Cycle 22 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 13633
Program Title: A Kuiper Belt Object for the New Horizons Mission

Principal Investigator: John Spencer

PI Institution: Southwest Research Institute

The Kuiper Belt is arguably the most important discovery in planetary science in decades. On behalf of the New Horizons (NH) mission, we propose to use WFC3 to identify KBO flyby targets for NH. This proposal will also significantly improve knowledge on two crucial scientific questions: the size-frequency distribution and the binary fraction of 30-50 km diameter KBOs, providing important constraints on disk accretion and fragmentation processes of interest to both solar system and extrasolar planet origins. STScI's Director has committed both 40 DD orbits and early implementation in summer 2014 to this GO effort. The 2002 Planetary Decadal Survey ranked Pluto-KBO exploration at the top of the NASA medium-scale mission queue and cited the KBO flyby as a fundamental mission objective. There is no prospect of a KBO flyby by any other mission than NH. Intensive ground-based searches for a flyby target since 2011 have been unsuccessful, and offer a <50% chance of success in 2014, likely leaving the KBO mission with no accessible targets. But owing to its small and stable PSF, and zero chance of weather loss of observing time, we estimate an ~94% chance of finding a targetable KBO with this proposed 2014 HST program. Hubble is the only high-probability means to rescue the exploration of the Kuiper Belt; no other NASA orbital asset can. A discovery in 2014 is required to achieve the needed one-year tracking arc for an 2015 spacecraft targeting maneuver; as described below, discovery delay to 2015 reduces the probability of detecting a KBO within the fuel budget of NH to <15% by groundbased techniques and <55% by HST

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13639
Program Title: Resolving Lyman-alpha Emission On Physical Scales < 270 pc at z > 4

Principal Investigator: Matthew Bayliss

PI Institution: Harvard University

We propose ACS-WFC Ramp narrowband imaging of six strongly lensed Lyman-alpha Emitters (LAEs) at z > 4 that will spatially resolve the Lyman-alpha line emitting regions on scales < 270 pc. The best available observations (HST, Spitzer, 10m ground based telescopes) are unable to provide robust measurements of the structure of these galaxies from blank field studies, but strong gravitational lensing provides a unique opportunity to peer into the heart of young star forming galaxies at high redshift and address outstanding questions regarding their morphology and evolution. Strong lensing magnifies each of our target LAEs, increasing the effective spatial resolution of ACS-WFC such that the point spread function will correspond to physical scales < 270 parsecs within all six z > 4 galaxies. Additionally, the boost in flux due to gravitational lensing makes our proposed targets the brightest sources of their kind at these redshifts, in spite of the fact that they are intrinsically ~L* LAEs. The proposed observations will probe the

signal-to-noise and spatial resolution comparable to studies of Lyman-alpha emitting galaxies in the z ~ 0.1 universe. The resulting data will bridge the gap between deep ground-based studies of blank field LAEs at high redshift, and detailed studies of low-redshift LAEs.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13640
Program Title: A direct probe of cloud holes at the L/T transition

Principal Investigator: Esther Buenzli
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

Understanding cloud formation, evolution and dispersal is one of the biggest challenges in the field of substellar atmospheres. At the transition from L to T type brown dwarfs, thick silicate and iron clouds disappear below the visible photosphere and the spectra are altered dramatically despite little change in effective temperature. Observed strengthening of the FeH band through the transition has indicated an opening of cloud holes rather than gradual sinking of the clouds. This view has been supported by the discovery of brown dwarfs with photometric variability attributed to patchy cloud cover. However, our recent spectral variability observations have complicated the picture because patchy cloud models with cloud holes currently cannot reproduce the color variations and spectral variability signatures. Whether this implies an absence of cloud holes (in contradiction to the interpretation of the observed strengthening of FeH) or is because models neglect other mechanisms that can affect the colors (eg temperature anomalies) remains unclear.

Here, we propose WFC3/G102 spectral variability observations of the very nearby L/T transition benchmark binary Luhman 16AB, the only known variable brown dwarfs in a binary system. These observations target the FeH band. As the FeH molecule contains the cloud forming atom Fe, it is a direct tracer of the cloud holes. By comparing the variability amplitude in the FeH band with the surrounding continuum, as well as between the L and T component at different stages of cloud evolution, we will obtain direct evidence whether the formation of cloud holes is indeed the driving mechanism behind cloud dispersal at the L/T transition.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13641
Program Title: A Detailed Dynamical And Morphological Study Of 5<z<6 Star, Dust, and Galaxy Formation With ALMA And HST

Principal Investigator: Peter Capak
PI Institution:

We propose WFC3-IR imaging for a unique sample of 10 ~L* "normal" 5<z<6 galaxies for which direct dust dust continuum emission and dynamical measurements from the CII 158um line obtained with ALMA. This is the first, and currently only sample of z~5-6 "normal" galaxies with direct and robust measurements of their dust content, star formation rates, and dynamics. These objects will provide a representative sample of galaxies in the primordial universe that will be used for a wide range of studies. Furthermore, the dense spectroscopic sampling at z>5 from Keck and VLT along with the wealth of multi-wavelength data in the proposed COSMOS field ensure the physical properties and local environment of these sources is known.

Immediate studies with the proposed WFC3-IR data include: 1) Measuring the rest-frame Ultraviolet (UV) spectral slopes to calibrate the infrared-excess - UV-slope (IRX-beta) relation which is an essential ingredient in estimating star formation rates at z>5 (e.g. Bouwens et al. 2012, Finkelstein et al. 2012), but is currently determined at z~0-2 and expected to strongly evolve at higher redshift (Meurer et al. 1999, Reddy et al. 2010,2012). 2) Compare quantitative morphologies with the ALMA dynamical measurements, constraining the formation mechanisms of these galaxies. 3) Significantly improve the spectra-energy distribution fits used to estimate stellar masses, which when combined with the dynamical mass estimates and atomic line data will test for biases in the mass estimates.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13642
Program Title:	The evolutionary link between low-mass X-ray binaries and millisecond radio pulsars

Principal Investigator:	Nathalie	Degenaar
PI Institution:	University of Michigan	

Low-mass X-ray binaries (LMXBs) and millisecond radio pulsars (MSRPs) are two different manifestations of neutron stars in binary systems. They are thought to be evolutionary linked, but many questions about their connection remain. Recent discoveries have opened up a new vista to investigate the LMXB/MSRP link. The neutron star XSS J12270-4859 was recently observed to switch between the two different manifestations. Here, we propose to exploit the unique UV capabilities of the HST to search for the presence of a quiescent accretion disk and to test if the neutron star is hot. This will give insight into its accretion history and the mechanism driving its metamorphosis, which will have direct implications for our understanding of the LMXB/MSRP evolutionary link.

Proposal Category: GO
Scientific Category: ISM and Circumstellar Matter
ID: 13643
Program Title: Imaging the tenuous dusty atmosphere of edge-on protoplanetary disks

Principal Investigator: Gaspard Duchene
PI Institution: University of California - Berkeley

In a successful Cycle 19 survey for edge-on protoplanetary disks, we have discovered that some, but not all, protoplanetary disks present a tenuous atmosphere detected in scattered light, thus containing dust grains, located well above the optically thick disk surface. This atmosphere could be direct evidence for the super-heated region above the disk surface due to direct illumination from the central star or for a disk wind that carries along the smallest dust grains from the disk surface. Here we propose to obtain the first F475W images of a sample of six edge-on protoplanetary disks, four of which were discovered in our Cycle 19 survey, in order to constrain the characteristic grain size in the disk atmosphere and establish whether the presence of this atmosphere correlates with other disk properties. With our carefully selected sample, we will correlate the properties of the disk atmosphere with other properties of the system, such as presence of a collimated jet, dust settling and grain growth, thus providing a first empirical analysis of the nature of this phenomenon.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13644
Program Title: CIII] Emission in z=5.7 Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

Principal Investigator: Xiaohui Fan
PI Institution: University of Arizona

The last few years has witnessed a rapid increase in the detections of galaxies at z>7, at the end of the reionization era. However, as a result of the increasing attenuation of Ly alpha emission by the partially neutral IGM at this redshift, it is becoming clear that the traditional means of redshift confirmation is bound for limited success; this presents a major challenge to galaxy spectroscopy as we probe deeper into the reionization era with JWST and ELTs. Through our survey of reionization-era analog galaxies at z~2, we find that low metallicity, low luminosity galaxies exhibit strong CIII] 1909 nebular emission lines. If, as is expected, CIII] remains strong at high redshift, the line can be used as a powerful alternative to Ly alpha in spectroscopy of reionization-era galaxies. To explore this possibility, we will carry out deep HST WFC3/IR F128N narrow-band imaging of a sample of 8 galaxies at z=5.7 in two fields. At this redshift, the CIII] line is fortuitously located within the F128N passband, allowing detection of CIII] in this sample of spectroscopically

confirmed galaxies, reaching a flux limit beyond what is possible with current ground-based observations. Combining the F128N narrow-band imaging with broad-band observations, we will reliably measure the CIII] flux for the brighter objects in our sample (J<~26), and measure or strongly constrain the stacked CIII] flux for fainter objects (J~27). This program will provide the first statistical sample of CIII] emission in galaxies close to the end of reionization. Success in this venture would usher in a new era of redshift confirmation at z>7, guiding the strategy of such programs on future major facilities.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13645
Program Title:	Galactic Environment of A Twenty-Billion Solar-Mass Black Hole at the End of Reionization
Principal Investigator:	Xiaohui Fan
PI Institution:	University of Arizona

When did the first supermassive black holes (SMBHs) appear in the universe? How do they co-evolve with and impact their galactic environment? We propose to carry out deep HST ACS and WFC/IR imaging of a newly discovered ultra-luminous quasar at z=6.30. At about 10 times brighter than an average SDSS z~6 quasar, this object is the most luminous quasar yet known at z>5.5 and is powered by a SMBH with an estimated mass of 20 billion M_sun, comparable to the most massive SMBHs found in the local universe. It is among the most massive systems in the observable early universe and likely resides in the densest and most biased environment at the end of cosmic reionization. Our WFC/IR J and H band observations will reveal the rest-frame UV emission in the quasar host galaxy, directly probing the coeval star formation in quasar host when the SMBH is accreting at the highest rate. Deep HST images will be used to rule out or confirm lensing magnification and to search for signatures of major merger activity. We will use the ACS i and z band imaging, combined with WFC/IR imaging, to select young star forming galaxies in the quasar environment and to study whether this ultra-luminous quasar lives in a significant galaxy overdensity, or whether early reionization has suppressed galaxy formation in the quasar environment. The HST observations will provide key insight into the formation and evolution of the earliest 10^10 M_sun BH systems in the universe.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13646
Program Title:	Understanding the Progenitor Systems, Explosion Mechanisms, and Cosmological Utility of Type Ia Supernovae
Principal Investigator:	Ryan Foley

Despite using Type Ia supernovae (SN Ia) to precisely measure cosmological parameters, we still do not know basic facts about the progenitor systems and explosions. Theory suggests that SN Ia progenitor metallicity is correlated with its peak luminosity, but not its light-curve shape. As a result, this effect should lead to an increased Hubble scatter, reducing the precision with which we measure distances. If the average progenitor metallicity changes with redshift, cosmological measurements could be biased. Models also indicate that changing the progenitor metallicity will have little effect on the appearance of optical SN data, but significantly change UV spectra. These data can only be obtained with HST.

We recently published the first detection of 2 SN Ia with different progenitor metallicities. These "twin" SN had nearly identical optical spectra and light-curve shapes, but different UV spectra and peak luminosities, consistent with the models. We now must increase the sample of SN Ia with UV spectral time series to investigate the impact of metallicity on SN properties. To do this, we plan to obtain UV spectral time series of 3 SN Ia, nearly doubling the sample. UV observations are critical to the understanding of SN Ia explosions and progenitors. This is our best opportunity to further our understanding of SN Ia while directly improving the utility of SN Ia for cosmology.

Using parallel observations, we will obtain Cepheid distances to a subset of the SN for free, providing precise SN luminosities and a better measurement of the Hubble constant. The UV Initiative is an excellent opportunity for HST to address significant questions in SN physics and cosmology.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13647
Program Title:	Testing the Standardizability of Type Ia Supernovae with the Cepheid Distance of a Twin Supernova
Principal Investigator:	Ryan Foley
PI Institution:	University of Illinois at Urbana - Champaign

Having nearly identical optical light-curve shapes, colors, and spectra, SN 2011by and 2011fe are "twin" Type Ia supernovae (SN Ia). As such, these "standardizable candles" should have identical luminosities. But using independent distance measurements to these SN, their peak luminosity differs by 0.6 mag --- significantly larger than the typical scatter amongst all SN Ia. Differences in their UV spectra indicate that the SN have different metallicities, which could account for the luminosity difference. On the other hand, the distance to SN 2011by, from a Tully-Fisher measurement, may be wrong. We propose to measure a Cepheid distance to SN 2011by to determine if metallicity or an imprecise measurement is causing this large difference.

The implications are far reaching for SN cosmology. If the current distance is correct, changing progenitor metallicity could cause large distance biases with redshift. If the distance is revised to bring SN 2011by in line with SN 2011fe, we will infer that metallicity differences are not a large bias for SN cosmology.

In the latter case, these data will also provide an additional SN with which we can measure the Hubble constant. Since the number of SN calibrators (only 8 published) limits the precision of our measurement of the Hubble constant, these observations can have a large impact on this measurement.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13648
Program Title: Uncovering the Putative B-Star Binary Companion of the SN 1993J Progenitor

Principal Investigator: Ori Fox
PI Institution: University of California - Berkeley

The stripped-envelope Type IIb supernova (SN IIb) is a unique subclass of core-collapse explosions that result when a massive star loses most, but not all, of its outer envelope. Theoretical models suggest progenitor systems consist of low-mass stars that lose their envelopes during mass transfer to a binary companion, which becomes UV bright in the process. Although four stripped-envelope supernovae have progenitor stars identified in pre-explosion images, not a single progenitor companion star has been directly detected to date. In other words, the Type IIb progenitor system remains observationally unconfirmed. The nearby Type IIb SN 1993J in M81, at a distance of only 3.6 Mpc, offers one of the best opportunities to detect the putative companion and test the progenitor model. Indeed, evidence has been mounting over the past decade for a hot companion, but the dominating SN flux and contamination from nearby stars has made a confirmation difficult. In 2012, our team obtained HST/COS spectra and detected a far-UV (FUV) excess flux consistent with a hot B-star. This spectrum, however, is limited by a low signal-to-noise ratio and poor spatial resolution. Now that the SN has sufficiently faded, we propose FUV and NUV imaging of SN 1993J and the surrounding stars to disentangle the source of the FUV excess flux once and for all. Coinciding with Cycle 22's UV initiative, we can shed light on the binary nature of Type IIb progenitors in just 3 orbits.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13649
Program Title: UV Spectroscopic Signatures from Type Ia Supernovae Strongly Interacting with a Circumstellar Medium

Principal Investigator: Ori Fox
PI Institution: University of California - Berkeley

Type Ia supernovae (SNe Ia) are well-known for their use as precise cosmological distance indicators due to a standardizable peak luminosity resulting from a thermonuclear explosion. A growing subset of SNe Ia, however, show evidence for interaction with a dense circumstellar medium during the first year post-explosion, and sometimes longer (SNe Ia-CSM). The origin of this dense CSM is unknown and suggests either a) the less typical single-degenerate progenitor scenario must be considered or b) the exploding star was not a thermonuclear explosion of a white dwarf at all (i.e., core-collapse). The ultraviolet (UV) offers a unique opportunity to determine the true nature of the SNe Ia-CSM subclass. Unlike optical wavelengths, which can be quite ambiguous, the UV has distinguishing features due to its sensitivity to the composition of the optically thin ejecta that are illuminated by X-rays generated by shock interaction. Yet not a single UV spectrum exists for this subclass. Here we propose a non-disruptive ToO with HST/STIS to obtain 3

epochs (5 orbits each) of UV spectra of a SN Ia-CSM within 100 Mpc. This program will not only distinguish between the SN explosion mechanisms, but also trace CSM interaction, constrain the progenitor mass loss history, and identify late-time heating mechanisms of warm dust. Coinciding with Cycle 22's UV Initiative, this program offers new insights regarding both the progenitor and explosion characteristics of the SN Ia-CSM subclass.

Proposal Category:	GO
Scientific Category:	Extra-Solar Planets
ID:	13650
Program Title:	The MUSCLES Treasury Survey: Measurements of the Ultraviolet Spectral Characteristics of Low-mass Exoplanetary Systems
Principal Investigator:	Kevin France
PI Institution:	University of Colorado at Boulder

It has recently been discovered that 10 - 50% of M dwarfs host Earth-size planets in their habitable zones. Furthermore, the nearest potentially habitable super-Earths orbit M dwarfs, meaning that these systems likely represent our best chance to discover habitable worlds in the coming decade. The ultraviolet (UV) spectrum incident upon Earth-like planets drives the dissociation of water and CO2, the production of O2 and ozone, and may determine their ultimate habitability. At present, we lack the observational and theoretical basis to predict the energetic radiation spectrum (X-ray through UV) of an M dwarf. UV variability of low-mass exoplanet host stars, in particular the possibly sterilizing effect of flare activity, is almost completely unexplored observationally. This proposal aims to acquire the critical UV observations of low-mass host stars now, providing a treasury database for studies of exemplary nearby exoplanetary systems and potentially habitable worlds not yet discovered. Building on our successful pilot program of spectrally and temporally resolved UV radiation fields, we propose the MUSCLES Treasury Survey: a UV survey of nearby low-mass exoplanetary host stars. Using HST-COS and STIS, we will observe the 1150 - 5700A fluxes, reconstruct the important Ly-alpha emission lines, and use these data to estimate the extreme-UV (200 - 912A) irradiances incident upon exoplanetary atmospheres. The UV data will be complemented with contemporaneous X-ray and ground-based observations as well as new M dwarf atmosphere models to constrain atmospheric heating rates and provide a baseline for long-term ground-based studies of these systems.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13651
Program Title:	Disentangling Signatures of Ultra-high-energy Cosmic Rays from a Unique Gamma-ray Blazar
Principal Investigator:	Amy Furniss
PI Institution:	

Blazars have been postulated as possible progenitors of ultra-high-energy cosmic rays (UHECRs; E>1 PeV) for decades. This is particularly compelling in the case of blazars observed as TeV gamma-ray sources, since acceleration of particles to extreme energies must take place there. Unfortunately, convincing evidence supporting this theory has yet to be collected, mainly due to lack of firm measurements of blazar distances. Leveraging a novel technique that we successfully used to robustly pin-down redshifts in four blazars via absorption spectroscopy, we propose HST/COS observations of B2 1215+30, a blazar with the unique potential to address the validity of blazars as acceleration sources of UHECRs. These observations will provide firm limits on the distance to B2 1215+30, which will be used in conjunction with archival observations in the very high energy (VHE; E>100 GeV) band to enable a detailed study of the interaction of UHECRs with the lower-energy extragalactic photon fields along the line of sight between B2 1215 +30 and the Earth.

Proposal Category:	SNAP
Scientific Category:	Extra-Solar Planets
ID:	13652
Program Title:	The frequency and chemical composition of rocky planetary debris around young white dwarfs: Plugging the last gaps
Principal Investigator:	Boris Gaensicke
PI Institution:	The University of Warwick

Many planetary systems will survive the post main-sequence evolution of their host stars into white dwarfs (WDs). In the solar system, Mars, the asteroid belt, and the outer planets will eventually orbit the WD remnant of the Sun, and many WDs are known to have remnants of planetary systems. Historically, planetary debris was detected in ~20% of WDs with cooling ages >0.5Gyr from Ca K detections. However, the Ca II ionisation balance makes the ground-based detection of planetary debris at younger, hotter WDs impossible.

We have carried out a very successful Cycle 18/19 COS snapshot survey of 100 WDs with cooling ages of 20-200Myr, and detect metal pollution in up to 50% of all targets via the strong Si resonance lines. This survey also showed that terrestrial material is common around A-stars, that rocky exo-planetary bodies display a similar variety in abundances as the meteorites in our solar system, and that water-rich Ceres-like asteroids still exist in evolved planetary systems.

We propose to close the last gaps in the statistics of evolved planetary systems: an extension of our snapshot survey to cooling ages of 5-25Myr and 100-300Myr. Our orbital integrations suggest that mass-loss during the AGB phase can stirr up instabilities leading to planet-planet collisions, which should be most frequent during the first 10Myr, and the proposed observations will unambiguously test these predictions. In addition, the extended sample will improve the statistics on the formation of planetary systems as a function of host star mass, and build up a deeper insight into the abundances of rocky exo-planetary material that will guide models of terrestrial planet formation

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Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13653
Program Title: Elementary Abundances of Planetary Systems

Principal Investigator: Caitlin Griffith

PI Institution: University of Arizona

Close-orbiting Hot Jupiter exoplanets were not predicted because the ices needed to build their large cores would have accreted in the outer stellar system where temperatures are cool enough for ices to condense. Their existence suggests more substantial planet migration than indicated in the Solar System, or perhaps different formation mechanisms. To probe the formation environment of Hot Jupiters, we propose measurements of the elemental abundances of oxygen and carbon, which derive from icy (H2O, C02 and CO) planetismals that condensed in different parts of the disk. To determine the water abundance at the precision needed to detect ice-derived material in Jupiter's atmosphere, we propose a coordinated ground-based and space-based study. We target the exoplanet XO-2b, which has an ideal reference star (the host star's binary companion of similar stellar type and brightness), allowing us to remove atmospheric effects from the ground-based measurements. We propose to measure XO-2b's water bands with HST/WFC3 1.1-1.7 micron spectra, which enables a retrieval of CO from the already measured Spitzer transit and eclipse photometry. Simultaneous Gemini optical measurements constrain XO-2b's 10-bar radius and the cloud coverage, which allow us to constrain the degenerate solution set and decrease uncertainties in retrieved water abundances from current values of a factor of 100 to our expected uncertainty of a factor of 3 in the derived abundance. The aim of this study is to derive strategies for measuring accurate exoplanetary compositions, as needed to pursue statistically significant studies.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13654
Program Title: Ultraviolet Spectroscopy of the Extended Lyman Alpha Reference Sample

Principal Investigator: Matthew Hayes

PI Institution: Stockholm University

The importance of the Lyman alpha (Lya) emission line for high-z galaxy studies cannot be overstated. Tens of thousands of galaxies have been found and confirmed through Lya, and in the next decade the samples will increase 100-fold. Yet Lya is a resonance line, and transfer effects may bias surveys in complicated and unknown ways if fundamental relations between Lya observables and physical properties are not established. This requires large samples and comprehensive multi-wavelength data sets. The Extended Lyman alpha Reference Sample is a sample of 28 star-forming galaxies, complete with 8-band HST imaging, 21 cm observations of HI gas, and a plethora of other data: it will provide the gold-standard study of Lya astrophysics in extragalactic laboratories. Currently eLARS includes no data from which to measure the Lya line profile or the covering/kinematics of the ISM - properties ranked among the most crucial for Lya transfer.

The proposed COS spectra will measure ~8 ISM absorption lines, Ly-alpha itself, and an array of stellar features. From this we will:
1. determine the covering and kinematics of the neutral and ionized ISM - the material through which Lya transfers
2. resolve the Lya emission/absorption and model the properties of the HI medium
3. quantify of mechanical feedback from massive stars and supernovae
4. enhance the accuracy and ensure maximal return from ACS Lya imaging

With large-scale galaxy surveys now beginning, eLARS spectroscopy will provide a vital interpretive dataset for the coming decades when no UV platforms are available. It adheres perfectly to the philosophy of the UV initiative.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13655
Program Title: How Lyman alpha bites/beats the dust

Principal Investigator: Matthew Hayes

PI Institution: Stockholm University

The bulk of high redshift star formation occurs in IR-bright objects. At similar epochs the de facto spectroscopic tracer of galaxies is the Lyman-alpha line, which is used almost ubiquitously with a diverse range of applications in galaxy evolution. Ly-alpha is also very sensitive to dust absorption, however, and a challenging emergent result of recent years is that an overwhelming fraction of IR-bright galaxies are also luminous Ly-alpha emitters. How is this possible given the mammoth dust contents? We will take advantage of the unique capabilities of HST and the Cycle 22 UV initiative to find out.

Ly-alpha observations are infamously difficult to interpret because of the resonant nature of the transition. This has motivated detailed studies of nearby galaxies with space-based platforms, that have aided in unleashing the power of Ly-alpha for high-z studies. Only HST provides the UV access and resolution to do this, and hundreds of orbits have been devoted to studying UV-selected galaxies. Yet the UV reveals a small fraction of high-z star formation and no study has ever imaged the IR-bright systems in Ly-alpha. The proposed ACS observations will do this in five Ultraluminous Infrared Galaxies (ULIRGs), sampling spatial scales of just 50 pc. We will test sophisticated new models of Ly-alpha escape, study morphologies in comparison to the stars and nebular gas, measure global Ly-alpha quantities for the first time, and probe the relevant structures in the ISM in minute detail. We will finally push nearby Ly-alpha studies to the highest possible bolometric luminosities.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13656
Program Title: Unveiling the Dark Baryons: The First Imaging of Circumgalactic OVI in Emission

Principal Investigator: Matthew Hayes

Hot gas outflows through the extended circumgalactic medium of galaxies are likely responsible for regulating star formation, shaping the galaxy luminosity function and mass-metallicity relation, and enriching the IGM. Over a wide temperature range of 10^5 K to 10^6 K, the cooling of this hot CGM flow is dominated by OVI (lambda=1032,1038 AA) emission. Thus OVI plays a vital role in driving, cooling, and generally probing galaxy outflows. The difficulty is that OVI gas is typically only observed in absorption against bright QSOs: consequently spatial information for a single galaxy has never been available, rendering it impossible to estimate the mass of (missing) baryons in this phase and its impact on braking galaxy superwinds/enriching the IGM.

We have devised a method of using ACS/SBC filters to observe and map emission lines in the far UV, which has been tried and tested many times with Lyman alpha. We will now turn the method to image OVI emission from a more redshifted (z=0.23) extreme starbursting galaxy. The observations will map OVI in emission for the first time. From this we will calculate the allowed ranges of gas density, temperature, and metallicity that can give rise to the observed emission and provide the first estimate the OVI mass from resolved information. New constraints on galactic wind models and input for cosmological simulations may be expected.

This work is exploratory, but the possible scientific return is extremely high. Results will be used to guide subsequent HST observations and the next generations of UV-capable satellites, and thus it is truly in the spirit of the UV initiative.

Proposal Category:	GO
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13657
Program Title:	Probing the Most Luminous Galaxies in the Universe at the Peak of Galaxy Assembly

Principal Investigator:	Jeyhan	Kartaltepe
PI Institution:	National Optical Astronomy Observatory, AURA	

What drives the most luminous galaxies in the universe at z~2, the peak of galaxy assembly? Is it the major merger of two gas rich disk systems as is the case in the local universe or can these extreme luminosities be driven by secular processes, such as the steady accretion of cold gas along filaments thought to play an important role in the early universe? Recent studies on the structure of high redshift luminous and ultraluminous infrared galaxies (LIRGs and ULIRGs, respectively) have stirred up this controversy but have found a range of results leading to a confused picture of star formation in the early universe. In order to solve this question, we will search for unambiguous merger signatures (i.e., pairs, double nuclei, and tidal features) among a large sample of the more rare, extremely luminous HyLIRGs (L_IR > 10^13 L_sun) and the highest luminosity ULIRGs with a wide range of properties and separate them from galaxies that are clearly not mergers (e.g., structured disks). For those objects that remain ambiguous, particularly irregular clumpy systems, we will obtain ground-based IFU follow up observations to add detailed velocity information to the observed morphologies. The large volume probed by the COSMOS field at these high redshifts is an excellent complement to the smaller area fields covered by the CANDELS survey. While CANDELS imaging is excellent for studying the properties of less luminous but more common LIRGs and ULIRGs, it completely misses the more rare, extreme sources. Combined, these data will allow the detailed study of IR galaxies across a range of luminosities spanning over two orders of magnitude.

Proposal Category: GO
Scientific Category: ISM and Circumstellar Matter
ID: 13658
Program Title: Farewell to the Voyagers: Measuring the Local ISM in the Immediate Path of the Two Voyager Spacecraft

Principal Investigator: Seth Redfield
PI Institution: Wesleyan University

Astronomical observations of the interstellar medium often struggle to measure fundamental physical properties of the gas on small scales because most observations are averaged along the line of sight, leading to difficulties in evaluating pressure equilibrium, turbulence, magnetic field structure, and volume density. The local ISM has helped in this regard by providing relatively simple ISM absorption profiles over short path lengths, with low column densities only detectable with strong transitions in the UV . On August 25, 2012, the first human-made object, the Voyager 1 spacecraft, crossed the heliosphere, effectively leaving the solar system and entering the galactic interstellar environment. Voyager 2 is expected to do the same in the coming years, and over the next decade both spacecraft will continue to make daily measurements of fundamental physical properties. We propose to make the first observations of nearby stars along the same line of sight as the current locations of the Voyager spacecraft in order to measure the same interstellar material. The proposed observations are of the very closest stars in these directions and will provide measurements of the kinematic structure, electron density, temperature and turbulence, elemental abundances and small scale structure by comparing two closely spaced sight lines. With both HST and the Voyager spacecraft approaching the end of long and fruitful missions, we have the opportunity to acquire a unique dataset which synthesizes the independent and complimentary in situ observations with the shortest possible line-of-sight observations, to provide an unprecedented study of the galactic ISM surrounding the Sun.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13659
Program Title: A New View of Dust at Low Metallicity: The First Maps of SMC Extinction Curves

Principal Investigator: Karin Sandstrom
PI Institution: University of Arizona

In order to constrain basic dust physics and anchor the interpretation of both UV/optical extinction and IR emission at low and high redshifts, we propose seven-filter photometry of a key region in the Small Magellanic Cloud (SMC). Via a cutting-edge technique demonstrated to work in M31 we will use these data to construct the first ever maps of the extinction curve shape (Rv), 2175 Angstrom bump strength, and dust column (Av) across a low metallicity environment. These maps will allow us to (1) measure the true distribution of extinction curves in the SMC, which is frequently used as a template for low metallicity extinction; (2) rigorously test whether PAHs are the carriers of the 2175 Angstrom extinction feature; and (3) place the estimation of dust masses from IR emission in low metallicity systems on a firm empirical and observational footing. Dust regulates the structure and evolution of interstellar medium (ISM) and shapes the optical and ultraviolet emission of galaxies. Its emission at infrared and mm wavelengths

represents a powerful tool to probe the ISM out to the highest redshifts. Understanding the physics and interpretation of dust absorption and emission as a function of metallicity is critical to a vast range of science and mapping key dust properties is a new application, uniquely possible with UV through NIR imaging from HST. As such, we expect this program to have wide ranging scientific impact.

Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13660
Program Title: Near-IR spectroscopy of the newly discovered benchmark hot Jupiter WASP-103b

Principal Investigator: Ming Zhao
PI Institution: The Pennsylvania State University

We propose to use the WFC3 IR-G141 grism to measure the near-IR emission spectrum of the newly discovered hot Jupiter WASP-103b at secondary eclipse. WASP-103b is one of the three best targets for thermal emission spectroscopy, but is the only one with no existing data of any kind. It receives relatively little far UV flux from its early-type host star as compared to other hot Jupiters, implying potentially different atmospheric chemistry. Because understanding the complex physics and chemistry of planetary atmospheres requires high significance, high fidelity measurements, WASP-103b provides an essential benchmark for testing planetary atmosphere models. The high quality WFC3 observations will definitively determine the presence or absence of a thermal inversion in the planet's upper atmosphere and constrain the efficiency of heat recirculation to its night side by probing the water bands between 1.1 -1.7 microns. When combined with complementary ground-based and Spitzer measurements at longer wavelengths these observations will also provide constraints to the C/O ratio of the atmosphere. They will therefore provide insight on whether or not some hot Jupiters have C/O ratios that deviate from those of their host stars. This study can only be done with HST because of the ultra-high precision requisite for meaningful model constraints, and the coverage of water bands that are critical for constraining elemental compositions but are inaccessible from the ground.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13661
Program Title: A SHARP View of the Structure and Evolution of Normal and Compact Early-type Galaxies

Principal Investigator: Matthew Auger
PI Institution:

We have recently discovered a new population of z ~ 0.6 strongly lensed 'red nuggets' -- massive, compact early-type galaxies (ETGs) -- that enable us to directly address two fundamental questions: how do red nuggets evolve into 'normal' ETGs, and how is dark matter distributed in ETGs? The lensing-magnified imaging of red nuggets at intermediate redshifts permits spectroscopic observations -- and therefore a characterization of the red nugget fundamental plane -- and yields the deepest constraints on low surface brightness features that are the hallmark of inside-out growth mechanisms. Furthermore, the background sources are extended, very bright objects that provide excellent signal-to-noise imaging of complex lensed features and therefore give an extremely precise measurement of the mass profile and amount of dark matter substructure. We have compiled a sample of fourteen of these systems, and we now require the deep, multi-band, high-resolution, and high-fidelity imaging that can only be achieved with HST in order to invert the lensing signal and unveil the luminous structure of red nuggets and the mass structure of normal ETGs.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13662
Program Title:	Measuring the Black Hole Mass in the Brightest Cluster Galaxy NGC 1275

Principal Investigator:	Aaron	Barth
PI Institution:	University of California - Irvine	

NGC 1275 is the brightest and most massive galaxy in the Perseus Cluster, and is an excellent laboratory in which to examine the processes of black hole fueling and feedback in a cluster core environment. Our goal is to carry out a direct measurement of the black hole mass in NGC 1275 using ionized gas dynamics, by resolving the H-alpha and [N II] kinematics within the black hole's dynamical sphere of influence. We request five orbits to carry out STIS G750M spectroscopy at five parallel positions of the 0.1 arcsec-wide slit, in order to map the ionized gas kinematics and measure the central mass using the same methods successfully used for other giant ellipticals such as M84 and M87. We will compare the ionized gas kinematics with our observations of the H_2 molecular kinematics recently measured at 0.02-arcsecond sampling with Keck adaptive optics data in order to better understand the interplay between the different components of the ISM in this complex environment. We also request one orbit for WFC3/IR imaging of NGC 1275 in order to measure its near-IR surface brightness profile with unprecedented depth and resolution and model the galaxy's stellar mass profile. The results of this work will provide the first accurate measurement of the black hole mass in this highly unusual brightest cluster galaxy. Together with new and planned Keck AO observations, these HST observations will provide a critical new test of black hole mass measurement techniques by direct comparison of ionized gas dynamics, molecular gas dynamics, and stellar dynamics, and NGC 1275 is a nearly unique example of a galaxy in which all three methods are feasible.

Proposal Category: GO
Scientific Category: Solar System
ID: 13663
Program Title: Precise Orbit Determination for a New Horizons KBO

Principal Investigator: Susan Benecchi
PI Institution: Planetary Science Institute

The New Horizons (NH) spacecraft will flyby the Pluto system next summer, after this the spacecraft will be retargeted to one or more Kuiper Belt Objects (KBOs) to learn about the remnant material from our outer solar system's formation. We are actively carrying out dedicated ground-based observations to identify a target for NH to flyby and continue to improve our analysis algorithms. To date, we have 52 discoveries including five objects that are long-range reconnaissance candidates, and two that current orbit predictions require about a factor of 2 more propellant than is available for the encounter maneuver. Our searches are continuing in to 2014 and we anticipate as many as 2 objects that will require high precision HST imaging. Unfortunately, NH's trajectory line of site is within the galactic center (Sagittarius) making stellar confusion a major problem in recovering these objects from the ground to obtain precise astrometry and high precision orbits. HST's sensitivity, resolution and PSF stability are crucial components for the success of the NH Kuiper belt mission component. We are requesting 4 TOO orbits to be triggered when a candidate object is found within the targetable region. These observations will provide the required high precision astrometry required for targeting, will evaluate if the NH candidate is binary (~30%) and will make a preliminary color determination to assist in long or short range encounter planning.

Proposal Category: GO
Scientific Category: Solar System
ID: 13664
Program Title: Origin and Composition of the Ultra-Red Kuiper Belt Objects

Principal Investigator: Susan Benecchi
PI Institution: Planetary Science Institute

The low inclination classical Kuiper belt has been found to contain many objects with a unique ultra-red color. These ultra-red objects are not found in any stable reservoir interior to Neptune. The ultra-red objects in the classical Kuiper belt, through HST observations, show a very high binary fraction. A recent color survey from the Magellan telescopes have identified Kuiper Belt objects in the 5:3 and 7:4 mean motion resonances with Neptune to have a large fraction of ultra-red objects. We propose to use HST to determine if these ultra-red resonant objects have a similar binary fraction as the low inclination classical Kuiper belt objects. This would suggest that the two populations originated together and allow us to constrain the migration of the giant planets and evolution of the Kuiper belt. In addition, we will determine if water ice is present on the ultra-red objects to help constrain the composition of this mysterious material.

Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13665
Program Title: Exploring the Diversity of Exoplanet Atmospheres in the Super-Earth Regime

Principal Investigator: Bjoern Benneke
PI Institution: California Institute of Technology

Super-Earths are the single most common type of extrasolar planet, and also one of the least well-understood. We expect these planets could form with a broad range of bulk compositions, including true "super-Earths" with primarily rocky interiors, "water worlds" with a supercritical interior surrounded by a steam atmosphere, and "mini-Neptunes" with a thick hydrogen and helium atmosphere surrounding a rocky or icy core. In this proposal we focus on five planets with masses ranging from that of Neptune down to that of the Earth, and use a combination of visible-light and near-IR transmission spectroscopy to constrain their atmopsheric compositions and resolve degeneracies in their corresponding interior compositions. Our observations will probe the poorly understood transition region between gas giant planets and terrestrial worlds and provide the first detailed look at the diversity (or lack thereof) of planets in this mass range. These same data will also enable the first detailed studies of cloud properties in these atmospheres, which can dramatically alter their atmospheric temperatures and corresponding compositions. The proposed studies will pave the way for future observations of this class of planets with JWST.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13666
Program Title: The power of the great observatories: Investigating stellar properties out to z~10 with HST and Spitzer

Principal Investigator: Marusa Bradac
PI Institution: University of California - Davis

In spite of recent progress, the role of distant galaxies in cosmic reionization has been difficult to pin down. A powerful way to make progress is to move beyond counting high redshift sources and study the stellar properties of the population instead. Accurate knowledge of the average star formation density and its recent history in the universe at this epoch is necessary to determine whether these galaxies emit enough hard photons to reionize the Universe. SURFS UP is a Spitzer Exploration Science program (PI Bradac) designed to measure stellar masses and ages of galaxies at z >~ 7 and identify the dominant sources of the bulk of ionizing photons necessary to drive reionization. The last observations were completed in March 2014. The program uses 10 galaxy clusters as cosmic telescopes to study galaxies at intrinsically lower luminosities than blank field surveys of the same exposure time. All clusters but one have both extremely deep HST and Spitzer data available. The last cluster (MACS2214) is lacking HST WFC3-IR data which are crucial to select galaxies at z >~ 7, to study their instantaneous star formation rate via rest-frame UV, and to study their evolved population via rest-frame optical. We request here 5 orbits of WFC3-IR data, which will be a crucial complement to the existing extremely deep Spitzer and HST-ACS data for MACS2214, as well as to the entire SURFS UP sample. The proposal will double the number of currently detected sub-L* galaxies at z>~7 that have been detected by Spitzer and for which we can measure stellar masses and ages. The request of 5 orbits will strongly increase the legacy value of SURFS UP and we waive any proprietary rights.

Proposal Category: GO

Scientific Category: Solar System

ID: 13667

Program Title: Observations of the Pluto System During the New Horizons Encounter Epoch

Principal Investigator: Marc Buie

PI Institution: Southwest Research Institute

We propose a comprehensive set of observations of the Pluto system that will leverage upon the contemporaneous New Horizons flyby to study the surfaces of all the bodies in the system, rotation states of the outer satellites, and provide improved masses. These observations comprise a tightly integrated set of WFC3 imaging and grism data that span from Feb 2015 to Oct 2015, critically providing a broader temporal context for most fully understanding the once-in-a-lifetime encounter snapshot. A small portion of the data collected will also be directly useful for cross-calibrating HST and ground-based data with the New Horizons data. Our science objectives address both the past formation and current evolution of the Pluto system, thereby setting this system into the larger context of the Kuiper Belt. For example, the rotation state measurements anchored with the New Horizons data represent a truly unique dataset that is unlikely to ever be achievable for any similar-sized satellites or Kuiper Belt objects for many decades to come. As such, this proposal will provide a legacy dataset for understanding the diverse members Pluto system and by extension, analogous members of the Kuiper Belt.

Proposal Category: GO

Scientific Category: Solar System

ID: 13668

Program Title: Deep Search for Small Satellites of Eris and Makemake

Principal Investigator: Marc Buie

PI Institution: Southwest Research Institute

Recent HST observations searching deeper than ever before have discovered a very distinct family of small, faint, circumbinary satellites around Pluto and Charon. Pluto has looked like the oddball of the Solar System many times in the past, with its inclined and eccentric transneptunian orbit, its enormous satellite Charon, and its volatile ice rich surface composition. But in each of these matters, subsequent discoveries revealed that Pluto was not unique, merely the first of an entirely new class of objects. This proposal aims to determine if Pluto's family of small faint satellites is also non-unique, through unprecedentedly deep imaging of Eris and Makemake, the two other most Pluto-like bodies in the Kuiper belt.

Proposal Category: GO

Scientific Category: Cosmology

ID: 13669

Program Title: The star-formation histories within clumpy disks at z ~ 2.2

Principal Investigator: Marcella Carollo

PI Institution: Eidgenossiche Technische Hochschule (ETH)

We propose to obtain WFC3 F438W images, sampling the rest-frame FUV (~1400A), of 10 clumpy disk galaxies at z~2.2. These 10<log M/Msun<11 galaxies comprise an ideal sample of rotationally-supported star forming disks at these early epochs, for which we have in hand (i) Adaptive Optics VLT/SINFONI maps of the Halpha fluxes and kinematics at 0.1 arcsec (~1 kpc) resolution, (ii) WFC3 F160W and F110W images that straddle the 4000A break, and (iii) for 7 targets, also ACS F814W images in the rest-NUV (2700A) - we request here also the missing F814W imaging on the 3 remaining galaxies.

These new data will allow us:

(1) to measure the slope of the UV continuum throughout the galaxies to yield, for each galaxy, a two-dimensional reddening map and an extinction-corrected UV-brightess map. The latter will test whether the overall correlation between Halpha and the UV continuum that is seen in the integrated light of these galaxies is maintained down to kpc scales; and

(2) to break the degeneracy between stellar population age (i.e. star-formation history) and dust extinction, and to obtain spatially-resolved information on the star formation rates in these galaxies on three different timescales: 10^7 yr (Halpha), 10^8 yr (dust-corrected UV) and 10^9 yr (rest-optical). We will therefore be able to determine the star formation histories of the individual clumps and the interclump regions on kpc scales, as a function of distance from the galaxy centers. Our high-level scientific goals are to measure the lifetime of the clumps, to understand the origin of the disk stars, and to test the idea that the in-spiral of clumps results in the formation of bulges and thick disks.

Proposal Category: GO
Scientific Category: Solar System
ID: 13670
Program Title: Giant impacts on giant planets

Principal Investigator: Imke de Pater
PI Institution: University of California - Berkeley

The 2009 impact and recent superbolides on Jupiter caught the world by surprise and cast doubt on impactor flux estimates for the outer solar system. Enhanced amateur planetary imaging techniques yield both high spatial resolution (enabling the 2009 impact debris field detection) and rapid frame rates (enabling the 2010/2012 impact flash detections and lightcurve measurements).

We propose a ToO program to image future impacts on Jupiter and Saturn. To remove the possibility of impact cloud non-detections, the program will be triggered only if an existing impact debris field is seen, an object on a collision course with Jupiter or Saturn is discovered, or an impact light curve is measured with an estimated total energy large enough to generate an impact cloud in a giant planet atmosphere (10^20 J).

HST provides the only way to image these events in the ultraviolet, providing information on aerosol altitudes and on smaller particles that are less visible to ground-based infrared observations. High-resolution imaging with proper timing (not achievable from the ground) is required to measure precisely both the velocity fields of impact sites and the optical spectrum of impact debris. HST observations of past impacts on Jupiter have also served both as cornerstones of science investigations at other wavelengths and as vehicles for effective public outreach.

Large outer solar system impacts are governed by the same physics as in the terrestrial events that dominate the impact threat to humans. Studying the behavior of impactors of various sizes and compositions, as they enter the atmosphere at varying angles and speeds, will better quantify terrestrial impact hazards.

Proposal Category: SNAP
Scientific Category: Cosmology
ID: 13671
Program Title: Beyond MACS: A Snapshot Survey of the Most Massive Clusters of Galaxies at z>0.5

Principal Investigator: Harald Ebeling
PI Institution: University of Hawaii

topics, and SNAPshot observations of these systems are ideally suited to identify the most promising cluster targets for further, in-depth study. The power of this approach was demonstrated impressively by
ACS/WFC3 SNAPshots of 81 MACS clusters at z>0.3 obtained by us in previous Cycles (28 of them in all of F606W, F814W, F110W, and F140W). Based on these data, the CLASH MCT program selected 16 out of 25 of their targets to be MACS clusters. The central role of X-ray luminous clusters in particular for gravitational-lensing work is further underlined by the fact that all but one of the six most powerful cluster lenses selected for in-depth study by the HST Frontier Fields initiative are MACS detections.

We here propose to extend our spectacularly successful SNAPshot survey of the most X-ray luminous distant clusters to a redshift-mass regime that is poorly sampled by any other project. Targeting only extremely massive clusters at z>0.5 from the X-ray selected eMACS sample, the proposed program will (a) identify the most powerful gravitational telescopes at yet higher redshift for the next generation of in-depth studies of the distant Universe with HST and JWST, (b) provide constraints on the mass distribution within these extreme systems, (c) help improve our understanding of the physical nature of galaxy-galaxy and galaxy-gas interactions in cluster cores, and (d) unveil Distant Red Galaxies as well as z>6 Ly-alpha emitters as F814W dropouts.

Acknowledging the broad community interest in our sample we waive our data rights for these observations.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13672
Program Title:	Explosions in Real-Time: Ultra-Rapid UV Flash Spectroscopy of Infant Core-Collapse Supernovae
Principal Investigator:	Avishay Gal-Yam
PI Institution:	Weizmann Institute of Science

Recent advances in transient survey hardware, computing and operations now allow real-time alerts and rapid follow-up spectroscopy of supernovae (SNe) within hours of explosion. The spectra at such early times are a new scientific territory; the first handful of exploratory cases show that optical spectra of massive star Type II SN explosions are dominated by high-ionization recombination lines from circumstellar material ionized by the SN shock-breakout flash ("flash spectroscopy"). UV spectroscopy of infant SN explosions at such early times offers compelling science: a unique insight into the first hours of the explosion, a way to determine the initial metallicity and surface composition of the exploding star (reflected in CSM abundances) as well as a probe of the final year of mass loss leading to the terminal SN event, tracing the final stages of pre-explosion stellar evolution. This is only possible with HST in ultra-rapid ToO mode. Here we propose to undertake such a study of a single, carefully selected SN in cycle 22. This proposal can lead to yet another signature achievement by Hubble.

Proposal Category: GO

Scientific Category: Resolved Stellar Populations

ID: 13673

Program Title: The Metallicity Dependence of the Initial Mass Function

Principal Investigator: Jason Kalirai

PI Institution: Space Telescope Science Institute

We propose to measure the metallicity dependence of the initial mass function (IMF), through a high-precision study of the stellar luminosity function in a remote halo field of the Small Magellanic Cloud (SMC). In a previous HST investigation of an [Fe/H] = -1.1 SMC halo field, we achieved one of the most accurate measurements of the stellar IMF to date. Based on resolved photometry of 10,000 stars, we demonstrated that the IMF over a mass of M = 0.37 to 0.93 Msun is a single power law with slope \alpha = -1.90 (dN/dM = M^\alpha; 3-sigma uncertainty of +0.15, -0.10). Comparing our measurement directly to high-precision local studies of the stellar IMF for stars with the same mass range but [Fe/H] = 0 provides firm new evidence that the IMF is flattening at low metallicities.

Using 6 orbits on HST, we propose to now compare our IMF from the Kalirai et al. (2013) study to a new SMC halo field with a very similar set of general properties (e.g., density, star formation history, distance, binary fraction), yet one that is 3 times more metal-poor at [Fe/H] = -1.6. This new field has been carefully chosen from a large ground-based imaging and VLT multiobject spectroscopic survey as the most metal-poor population that is well characterized in the Magellenic Clouds. Using both the ACS and WFC3 instruments simultaneously on HST, we will measure ~3000 stars along the unevolved main-sequence of this population from F606W = 23 - 28.1. Over a mass range of M = 0.40 to 0.90 Msun, these measurements will provide a controlled experiment to determine the power-law slope of the IMF to an accuracy of 0.20, and yield a sensitive characterization of its metallicity dependence.

Proposal Category: GO

Scientific Category: Cool Stars

ID: 13674

Program Title: A 1.05Msun Companion to PSR J2222-0137: The Coolest Known White Dwarf?

Principal Investigator: David Kaplan

PI Institution: University of Wisconsin - Milwaukee

The recycled pulsar PSR J2222-0137 is one of the closest known neutron stars, with a parallax distance of 267+/-1 pc. Using radio Shapiro delay measurements, we determine a companion mass (1.05+/-0.06 Msun) consistent with either a low-mass neutron star or a high-mass white dwarf (WD). However, the orbital eccentricity is too low to be the product of two supernovae and we are forced to conclude that the companion is a WD. And yet, despite deep optical and near-infrared searches with SOAR and the Keck telescopes we have not discovered the optical counterpart of the system and can limit its effective temperature to <3,000 K, a limit that is robust to distance, mass, and atmosphere uncertainties. This would make the companion to PSR J2222-0137 the coolest WD ever observed. For the implied age to be consistent with the age of the Milky Way requires the WD to have already crystallized and entered the faster Debye-cooling regime.

We wish to identify the companion of PSR J2222 and measure its spectral-energy distribution. Atmosphere models in

this regime are extremely poorly tested, with significant uncertainties in the equation-of-state. Cooling ages for these models are even less well-known, as the impacts of state changes, sedimentation, and chemical processes are not precisely known. Here we request 3 bands of imaging with HST (WFC3/UVIS for g, r, and ACS/WFC for i) designed to detect the companion under the most pessimistic scenario. This will measure the effective temperature and atmosphere, and constrain the radius. These models will then help calibrate the ages of the globular clusters, halo WDs, and millisecond pulsars.

Proposal Category: GO
Scientific Category: Solar System
ID: 13675
Program Title: Comet Siding Spring at Mars: Using MRO to Interpret HST Imaging of Comets

Principal Investigator: Jian-Yang Li
PI Institution: Planetary Science Institute

Comet C/Siding Spring is a dynamically new (DN) comet, and will approach Mars to within 135,000 km on October 19, 2014. This encounter presents the first ever opportunity for us to observe a DN comet from close distances. The planned observations from the Mars Reconnaissance Orbiter (MRO) can potentially resolve the nucleus to 140 m/pix, and trace the dust and gas activity to their sources on the nucleus. This "natural flyby" will allow us to directly compare a DN comet with previous comet flyby mission targets (all highly evolved comets), and generalize those mission results to more comets. We propose to observe C/Siding Spring with seven HST orbits during its Mars encounter. These observations will take advantage of this rare opportunity to study the evolution of C/Siding Spring, use the MRO observations to help us interpret HST observations of comets in general, and put the MRO observations into a broader context. We plan to image the dust coma with filters F689M and F845M, and the cyanogen coma with filter FQ387N. Comparisons with previous HST observations when the comet was far from the Sun, combined with MRO observations, will allow us to study the evolution of the coma of C/Siding Spring, and tie it to the sources on the nucleus. Putting MRO and HST observations together, we can reconstruct the 3-D structure in the inner coma, and study the possible chemical heterogeneity on the nucleus. HST is needed because of the unfavorable observing conditions from the ground, the specific timing of our observations, and its high resolution and high sensitivity. This proposal is part of a coordinated observing campaign of C/Siding Spring both from the ground and from space.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13676
Program Title: Solving the X-ray Origin Problem in Kiloparsec-Scale Relativistic Jets: Hubble Provides the Missing Key

Principal Investigator: Eileen Meyer
PI Institution: Space Telescope Science Institute

radio, X-ray, and gamma-ray observations. The proposed observations present a significant opportunity to advance our understanding of both the kinetic energy carried by jets, and the particle accleration mechanisms that produce high-energy emission seen hundreds of kiloparsecs from the black hole. All four of the kpc-scale jets have been shown with Chandra observations to have very hard X-ray spectra which has lead to the prevailing interpretation that the X-rays are due to inverse-Compton upscattering of CMB photons (IC/CMB) by a jet which is still relativistic on kpc scales. However, very recent work by our group has shown that the gamma-ray flux implied by this mechanism is not apparent in over 5 years of gamma-ray monitoring with the Fermi telescope for several sources, leading us to rule out the IC/CMB mechanism for the nearby source 3C 273 (Meyer et al., 2014). In order to positively rule out the IC/CMB model in the four proposed targets, we require an accurate measurement of the synchrotron spectrum of the jet, in order to exactly predict the gamma-ray spectrum expected and interpret the existing upper limits. As we have shown, the presence of relativistic, synchrotron-emitting electrons necessitates that high-energy IC/CMB emission should be present at a level which depends solely on the speed of the jet, assuming equipartition magnetic fields. Thus, with the HST imaging we propose, we will be able to settle over a decade of ambiguity about the emission mechanism of the X-rays, and place strong limits on the bulk speed of these large-scale jets.

Proposal Category: GO

Scientific Category: Cosmology

ID: 13677

Program Title: See Change: Testing time-varying dark energy with z>1 supernovae and their massive cluster hosts

Principal Investigator: Saul Perlmutter

PI Institution: University of California - Berkeley

HST is now uniquely capable of measuring the time variation of dark energy (DE) using supernovae (SNe) - and to address the recent surprising low DE density measured at very high redshift by BAO. The MCT survey has shown that field SN rates at z>1 are too low to accomplish this, but it can be done with a search for SNe in massive clusters. Based on the high SN rate found in our ACS-NICMOS SN cluster survey, we propose a cadenced two-cycle SN survey of 10 of the most massive known clusters at z = 1.1 to 1.75. We expect to accurately measure ~30 Type Ia SNe at these redshifts. The exquisite sensitivity of WFC3 ensures that each SN will have the high S/N color measurements necessary to provide the necessary control of the dominant astrophysical systematics so we can measure the density history of DE over the largest possible z range. With this calibration, our SN results at z>1 will be limited by statistical rather than systematic errors. This unique cluster data set will also be used for numerous key cosmology questions: Weak lensing (WL) cluster-masses derived from our imaging will allow the first calibration of the Sunyaev-Zeldovich (SZ)-mass relation at z > 1 at the level of precision required to make SZ derived masses competitive as strong measurements of DE. For the main science goal of this proposal, we can shrink the uncertainty on DE density at z>1 below +/- 0.6 - and be able distinguish the recent BAO low-density result from a cosmological constant at almost 3 sigma. We improve the uncertainty on DE equation of state w at redshifts z > 0.5 by a factor of three using SNe alone, and by combining the SN and WL results, double the DETF Figure of Merit to over 100.

Proposal Category: GO

Scientific Category: Cosmology

ID: 13678

Program Title: The Fifth and Final Epoch

Principal Investigator: Adam Riess

PI Institution: The Johns Hopkins University

A local measurement of the Hubble Constant with 1-2% precision can resolve recent hints of surprises in the cosmological model involving the nature of dark energy and the claimed presence of a new species of neutrino. Its leverage would be great, equal to nearly doubling the extent of near-term cosmological surveys like DES, BOSS and Pan-STARRS. We are building a new distance ladder to double the current precision of the Hubble constant to <2% by attacking the largest unaddressed obstacle to its determination, the lack of parallaxes of long period Milky Way Cepheids. We have developed a new technique to measure relative astrometry using spatial scanning with WFC3 to reach an unprecedented 30-microarcsecond precision scale for stars and measure parallaxes at 1-4 kiloparsecs. Our first completed measurement shows that a fifth epoch, included as a trial for our first measured parallax, is invaluable for 1) identifying astrometric binaries that can otherwise contaminate the derived Cepheid parallax, 2) fully removing the correlation in error between parallax and proper motion, and 3) improving the Cepheid parallax precision by 25%, equal to a 55% augmentation in the Cepheid sample size, much better than the naive (i.e., root n) expectation, a result of the longer temporal baseline and reduced covariance for proper motion. We propose to add this extra measure of robustness and precision to the 18 parallax measurements nearing completion. With Planck data, this new measurement of the Hubble constant will double the precision of the dark energy equation of state parameter, may reveal a new neutrino species, and would further HST's contribution to a task for which it was made.

Proposal Category: GO

Scientific Category: Solar System

ID: 13679

Program Title: Europa's Water Vapor Plumes: Systematically Constraining their Abundance and Variability

Principal Investigator: Lorenz Roth

PI Institution: Southwest Research Institute

The discovery of transient water vapor plumes near Europa's south pole (Roth et al. 2014) has important implications for the search for life in our Solar System. Europa's subsurface water ocean is thought to provide all the ingredients needed for a habitable environment. The plumes might enable direct sampling of Europa's subsurface constituents and provide insights into the chemistry, mobility, and extent of the liquid water environments. In STIS spectral images obtained in Dec. 2012, the intensity ratios of atomic H and O auroral emissions uniquely identify the source as electron impact excitation of water molecules. However, a confirmation of the initial detection has not yet been achieved, and non-detections from four out of five previous such visits suggest a complex and possibly episodic variation in plume activity. We have identified five potential variability sources for plume activity and detectability and propose a focused program to systematically constrain Europa's plumes and their variability pattern. Our constraints for the plume activity on Europa are vital inputs for key programmatic decisions regarding NASA's next large mission to Europa.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13680
Program Title: A 3D view of massive cluster formation in the SMC

Principal Investigator: Elena Sabbi
PI Institution: Space Telescope Science Institute

This is a 5-orbit astrometric proposal designed to measure for the first time the internal dynamics of NGC347, the super-OB-association in the Small Magellanic Cloud. Regions of massive-star formation are important to study because they are intricately related to the origin of the stellar-mass distribution and the formation, evolution and possible disruption of open and globular clusters. Despite its relevance, the process whereby stars form in massive star clusters is still poorly explored terrain within astrophysics. By combining our new observations with archival ACS/WFC data acquired in July 2004, we will be able to (1) measure the relative proper motions of NGC346 sub-clusters better than 3 km/s; (2) investigate the nature of the apparently isolated massive stars found around NGC346; (3) identify runaway OB stars with proper motion velocities >9 km/s and also establish their probable points of origin. Combined with radial velocities (RVs) from the "VLT-FLAMES Survey of Massive Stars", our observations will allow us to determine the 3D dynamics of NGC 346. This work will address significant open issues in: star formation, cluster dynamics, the origin of isolated Type II supernovae and GRBs, and the role of massive star feedback on the interstellar medium.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13681
Program Title: Fluctuation spectroscopy with the ACS ramp filters: a new way to measure the IMF in elliptical galaxies

Principal Investigator: Pieter van Dokkum
PI Institution: Yale University

Images of old stellar populations show pixel-to-pixel fluctuations due to Poisson variations in the number of giant stars.

These surface brightness fluctuations can be used to study the spectra of stars as a function of their luminosity, by obtaining differential spectroscopy of pixels with high and low fluctuations. If the average number of stars per pixel is sufficiently low, there will be individual pixels that have almost no light from luminous giants, providing sightlines that are dominated by main sequence stars. In this regime the observed spectral response is strongly dependent on the number of cool, low mass stars, and hence the stellar initial mass function (IMF). We propose to observe the nearest elliptical galaxy, Centaurus A, through four narrowband ACS ramp filters tuned to the 0.8 - 0.9 micron range. From the relation between ACS narrowband indices and the amplitude of the surface brightness fluctuation we will be able to obtain quantitative constraints on the IMF from 0.1-1 Solar masses, and distinguish between a Kroupa-like IMF or a bottom-heavy, Salpeter-like IMF, with ~5 sigma significance. We have demonstrated the feasibility of the technique used in this proposal in a Cycle 19 program, where we used the same observational strategy to measure the properties of luminous giants in the Virgo galaxy NGC 4472.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13682
Program Title:	Distances and stellar populations of seven low surface brightness galaxies in the field of M101
Principal Investigator:	Pieter van Dokkum
PI Institution:	Yale University

We have recently discovered seven large, extremely low surface brightness galaxies in the field of the nearby massive spiral galaxy M101. The galaxies were found with Dragonfly, a telescope that is optimized for the detection of low surface brightness emission. If the galaxies are associated with M101, their properties are similar to those of faint dwarf galaxies around the Milky Way and M31, and this would be the first time that a population of "typical", low luminosity dwarfs has been identified around a galaxy outside of the Local Group. Available CFHT imaging does not resolve the galaxies into stars, which makes it difficult to determine their distances and to characterize their stellar populations. Here we propose to obtain ACS imaging of these seven low surface brightness galaxies, with the aim of resolving them into individual stars. The primary goal is to determine their distances using the tip of the red giant branch, and the secondary goal is to constrain their star formation histories from the distribution of stars in the color-magntiude diagram.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations

ID: 13683

Program Title: The Stellar Origins of Supernovae

Principal Investigator: Schuyler Van Dyk

PI Institution: California Institute of Technology

Supernovae (SNe) have a profound effect on galaxies, and have been used as precise cosmological probes, resulting in the Nobel-distinguished discovery of the accelerating Universe. They are clearly very important events deserving of intense study. Yet, even with over 6300 IAU-designated SNe, we know relatively little about the stars which give rise to these powerful explosions. The main limitation has been the lack of spatial resolution in pre-SN imaging data. However, since 1999 our team has been at the vanguard of directly identifying SN progenitor stars in HST images. From this exciting line of study, the emerging trend from 9 detections for Type II-Plateau SNe is that their progenitors appear to be relatively low mass (8 to 20 Msun) red supergiants, although more cases are needed. Additionally, evidence is growing that the progenitors of Type II-narrow SNe may be related to luminous blue variables. However, the nature of the progenitors of Type Ib/c SNe, a subset of which are associated with the amazing gamma-ray bursts, remains ambiguous. Furthermore, we remain in the continually embarrassing situation that we still do not yet know which progenitor systems explode as Type Ia SNe, which are currently being used for precision cosmology. In Cycles 16, 17, and 20 we had great success with our approved ToO programs. As of this proposal deadline, we have had one trigger (SN 2014G) so far with our Cycle 21 program. We therefore propose to continue this project to determine the identities of the progenitors of 4 SNe within, generally, about 20 Mpc, which we expect to occur during Cycle 22, through ToO observations using WFC3/UVIS.

Proposal Category: GO

Scientific Category: Hot Stars

ID: 13684

Program Title: A Wolf-Rayet Progenitor for iPTF13bvn?

Principal Investigator: Schuyler Van Dyk

PI Institution: California Institute of Technology

Determining the nature of the progenitor stars responsible for core-collapse supernovae (SNe) is a vital problem for massive stellar evolution and, e.g., the chemical history of galaxies. Up to this point, the progenitor, or progenitor systems, responsible for the stripped-envelope Type Ib and Ic SNe are still not understood unambiguously. For the recent Type Ib SN iPTF13bvn in the spiral galaxy NGC 5806, a putative progenitor star was identified at the exact SN position in pre-SN, multi-band HST ACS images. The luminosity and colors for this object have been characterized as being consistent with a single, massive (M_initial > 31--35 Msun) Wolf-Rayet star. Notwithstanding uncertainties in the measurements of the object's brightness and also its host galaxy properties, such as distance and inclination, the progenitor of iPTF13bvn has been suggested by others, instead, to be much less massive and possibly in an interacting binary system. We propose here to deeply reimage the SN site in B and V with WFC3 to determine the status of the putative progenitor, when the SN itself has faded well below the brightness of the progenitor. We will be testing the Wolf-Rayet progenitor scenario and, at the same time, placing constraints on the interacting binary scenario. This can be done in Cycle 22 and only with HST.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13687
Program Title: Unveiling the mass-to-light distribution of high-redshift clusters

Principal Investigator: Alessandra Beifiori
PI Institution: Universitats-Sternwarte Munchen

We propose to investigate the formation of massive cluster galaxies in the redshift range (1 < z < 2). This is a critical epoch when galaxies in clusters are transitioning from actively star-forming to quiescent systems. We plan to perform deep near-infrared observations of two of the most distant galaxy clusters using HST WFC3, which will provide us with the highest resolution imaging possible of their stellar populations. These data will allow us to derive reliable, high resolution stellar mass maps and extract structural parameters such as size and morphology. By combining these measurements with our exceptionally deep VLT/KMOS data in the same cluster fields we can construct the fundamental plane of the most massive galaxies in the universe immediately after their initial assembly.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13688
Program Title: A clear patch in the dark age Universe? Looking for reionization sources around two bright Ly-alpha emitting galaxies at z=7

Principal Investigator: Marco Castellano
PI Institution: INAF, Osservatorio Astronomico di Roma

The last few years have seen a number of discoveries that provided the first glimpse of the Universe at z>7 using both space and ground-based telescopes. The spectroscopic determination of a significant decrease at z>6 of the Ly-alpha emitter fraction among Lyman break galaxies (LBGs) has been interpreted as evidence for a rapid increase of the

neutral HI in the inter-galactic medium (IGM). Among the different lines of sight explored so far, the BDF field stands out as a peculiar area since it contains two bright, high EW, Ly-alpha emitting galaxies at z=7.008 and z=7.109. However, their UV luminosity is not sufficient to generate an ionized region large enough to explain the observability of their Ly-alpha lines: the close physical distance between the two objects (4.4Mpc) thus suggests that they might be included in the same, large HII bubble which is ionized thanks to contribution of a yet undetected population of fainter sources. Indeed, theoretical models predict that a factor of 4-10 overdensity of z-dropout galaxies with respect to the available, robust determinations of the z~7 UV LF, should be detected by pushing the detection limits to Y=27.5 (M (UV)=-19.5).
A small investment of HST time will allow us to perform a direct test of these theoretical predictions by searching for additional ionizing sources through standard optical/near IR photometric criteria. With the proposed observations we will be able to confirm whether the BDF area is the first re-ionized "bubble" ever detected in the early Universe. This will help us to understand the earliest phases of galaxy formation and see the process of reionization caught in the act.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13689
Program Title: How Compact is the Stellar Mass in Eddington-Limited Starbursts?

Principal Investigator: Aleksandar Diamond-Stanic
PI Institution: University of Wisconsin - Madison

Theoretical models require strong ejective feedback to quench star formation in massive galaxies. To provide observational constraints on how this feedback process works, we have identified a sample of massive galaxies that have recently experienced a feedback-limited starburst and exhibit high-velocity, galactic-scale outflows. Our previous HST observations have shown that these galaxies are the remnants of gas-rich major mergers, and their incredibly compact optical morphologies (half-light radii ~ 100 pc) suggest that feedback from massive stars and supernovae was responsible for launching their spectacular gaseous outflows (v=500-2500 km/s). However, there is a crucial outstanding question regarding the outflow launching mechanism: how do the velocities compare to the escape velocity of the central stellar population? The current data at rest-frame V are sufficient to measure the size of the recent starburst, but we need to know how much mass is associated with this compact component in order to determine the escape velocity. Here we propose rest-frame U and rest-frame J observations for 12 extremely compact galaxies with high-velocity outflows and SFR surface densities that approach the Eddington limit. We will use spatially resolved U-V and V-J colors in tandem with the well-sampled, spatially integrated SED to determine the fraction of the stellar mass that is associated with the compact starburst. This will determine whether (1) the launching mechanism exceeds the escape velocity by a large factor or (2) the observed outflow velocity is comparable to the escape velocity, implying that these are the most compact galaxies ever observed by HST.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13690

Program Title: Tracking the Obscured Star Formation Along the Complete Evolutionary Merger Sequence of LIRGs

Principal Investigator: Tanio Diaz-Santos

PI Institution: California Institute of Technology

We propose to obtain WFC3 narrow-band Pa-beta imaging of a sample of 24 nearby luminous infrared (IR) galaxies (LIRGs) from the Great Observatories All-sky LIRG survey (GOALS) selected to be in advanced stages of interaction. LIRGs account for half of the obscured star formation of the Universe at z ~ 1-2, and they represent a key population in galaxy formation and evolution. We will use the Pa-beta images to trace the ionized gas in LIRGs and study its spatial distribution from scales of ~ 100 pc to up to several kpc, probing the youngest, massive stars formed in the most buried environments of LIRGs due to the interaction process. This will allow us to measure how the gas in the center of mergers is converted into stars, which eventually leads to the build-up of a nuclear stellar cusp and the "inside-out" growth of bulges. We will also create spatially-resolved Pa-beta equivalent width maps to search for age gradients across the galaxies and correlate the distribution of Pa-beta emission with that of un-obscured star clusters detected in the UV and optical with HST on the same spatial scales. Finally, we will combine our data with previous studies mainly focused on isolated and early-stage interacting LIRG systems to analyze the size and compactness of the starburst along the complete merger sequence of LIRGs. The requested data represent a critical missing piece of information that will allow us to understand both the physics of merger-induced star formation and the applicability of local LIRGs as templates for high-z interacting starburst galaxies.

Proposal Category: GO

Scientific Category: Cosmology

ID: 13691

Program Title: CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Principal Investigator: Wendy Freedman

PI Institution: Carnegie Institution of Washington

There has been great progress in the measurement of cosmological parameters in recent years, but controversy has arisen over the Planck/WMAP versus the direct measurement of the Hubble constant. The goal of our Carnegie Hubble Program (CHP) is to obtain a direct measure of Ho to 3%. In CHP I, we used Cepheid variables to calibrate the extragalactic distance scale. In the second phase, CHP II, we are establishing a completely independent route to Ho using RR Lyrae variables, the tip of the red giant branch (TRGB) and Type Ia supernovae (SNe Ia). Not only is the RR Lyrae route independent of the Cepheids, but its PL relation has a scatter that is a factor of 2 smaller. Unlike the Cepheids, the RR Lyrae / TRGB distance scale can be applied to both elliptical and spiral galaxies. This is a great systematic advantage, given the small number of galaxies (9 in total) close enough to have measured Cepheid calibrators within the SNIa hosts. By providing a new calibration using a Pop II distance scale, we will immediately double the number of SN Ia distances based on geometry, linking to over 200 SNe in the pure Hubble flow out to z = 0.7. Four calibrators containing both Cepheids and TRGB stars provide an important cross-check on systematics. Initially, the accuracy of our value of Ho will be set by four galactic RR Lyrae calibrators with HST/FGS parallaxes. With Gaia, both the RR Lyrae zero point and TRGB method will be independently calibrated with at least an order of magnitude more calibrators, each having precisions of 1% or better. This will allow the highest accuracy measurement of Ho to date

using the "Distance Ladder" method.

Proposal Category: GO
Scientific Category: Solar System
ID: 13692
Program Title: Orbits and Physical Properties of Four Binary Transneptunian Objects

Principal Investigator: William Grundy
PI Institution: Lowell Observatory

Intriguing patterns are evident in both the orbits of transneptunian objects and in their observable external characteristics (colors, spectral features, etc.). Bulk physical properties are needed to make sense of the observations and to exploit them to constrain conditions in the protoplanetary disk where these objects formed. The key to obtaining bulk properties of transneptunian objects is that a sizeable proportion of them are binaries. Binary mutual orbits provide dynamical masses that can in turn be used to compute bulk densities. A statistical sample of binary orbits offers powerful constraints on formation mechanisms as well as subsequent evolution. This proposal seeks to continue a multi-year campaign to obtain orbits for as large of a sample of binary transneptunian objects as possible. We seek to make efficient use of HST by targeting four systems where we can obtain a dramatic improvement in orbital knowledge from relatively few, strategically timed visits, and where the secondary is too faint for reliable detection with ground-based near-IR adaptive optics techniques.

Proposal Category: GO
Scientific Category: Solar System
ID: 13693
Program Title: The Ultraviolet Spectrum of Ceres

Principal Investigator: Amanda Hendrix
PI Institution: Planetary Science Institute

We propose a focused, four-orbit program to study Ceres, the largest -- yet most enigmatic -- asteroid, using ultraviolet spectroscopy. While Ceres will soon be visited by the Dawn spacecraft, Dawn does not have the capability to study Ceres in the UV, the spectral region of a mysterious surface absorption. The UV spectrum of Ceres may provide an important link with the most primitive materials in the solar system, and could reveal clues about the water activity

on Ceres -- and HST is our only opportunity to study this unique object.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13694
Program Title:	UV spectra of the icy Saturnian satellites: Understanding exogenic processes and NH3 in the system
Principal Investigator:	Amanda Hendrix
PI Institution:	Planetary Science Institute

Existing data from Cassini and HST inform us that the icy satellites of Saturn exhibit unidentified UV absorptions - an overall reddish slope in the ~200-400 nm range, with additional spectral features superimposed. We are unable to solve these mysteries surrounding the source(s) of these absorptions using Cassini datasets due to a gap in spectral coverage in the 190-350 nm range (broadband coverage is available to wavelengths as short as 260 nm). HST/STIS data are critical to understanding the spectra of these moons, and to resolving the sources and processes that cause the absorptions. We suspect that ammonia, with its distinctive and strong absorption near 200 nm, plays a role in the spectra of these moons, which has implications for geologic activity. These observations will provide the first-ever NUV observations of Mimas, improved coverage on Enceladus, and the first-ever STIS observations on Dione and Rhea. We base our observation strategy and estimated SNRs on existing high-quality STIS spectra of Tethys (from program 7316).

Proposal Category:	SNAP
Scientific Category:	ISM in External Galaxies
ID:	13695
Program Title:	STarlight Absorption Reduction through a Survey of Multiple Occulting Galaxies

(STARSMOG)

Principal Investigator: Benne Holwerda

PI Institution: Sterrewacht Leiden

Dust absorption remains the poorest constrained parameter in both Cosmological distances and multi-wavelength studies of galaxy populations. A galaxy's dust distribution can be measured to great accuracy in the case of an overlapping pair of galaxies, i.e., when a foreground spiral galaxy accidentally overlaps a more distant, preferably elliptical galaxy. We have identified over 300 bona-fide overlapping pairs --well separated in redshift but close on the sky-- in the GAMA spectroscopic survey, taking advantage of its high completeness (98%) on small scales.

We propose to map the fine-scale (~50pc) dust structure in these occulting galaxies, using HST/WFC3 SNAP observations. The resulting dust maps will (1) serve as an extinction probability for supernova lightcurve fits in similar type host galaxies, (2) strongly constrain the role of ISM structure in Spectral Energy Distribution models of spiral galaxies, and (3) map the level of ISM turbulence (through the spatial power-spectrum).

We ask for SNAP observations with a parent list of 355 targets to ensure a complete and comprehensive coverage of each foreground galaxy mass, radius and inclination. The resulting extinction maps will serve as a library for SNIa measurements, galaxy SED modelling and ISM turbulence measurements.

Proposal Category: GO

Scientific Category: Resolved Stellar Populations

ID: 13696

Program Title: The Anemic Stellar Halo of M101

Principal Investigator: Benne Holwerda

PI Institution: Sterrewacht Leiden

Models of galaxy formation in a cosmological context predict that massive disk galaxies should have richly-structured extended stellar halos, containing ~10% of a galaxy's stars, originating in large part from the tidal disruption of dwarf galaxies. Observations of a number of nearby disk galaxies have generally agreed with these expectations.

Recent new observations in integrated light with a novel array of low scattered-light telephoto lenses have failed to convincingly detect a stellar halo in the nearby massive face-on disk galaxy M101 (van Dokkum et al. 2014). They argue that any halo has to have <0.3% of the mass of the galaxy. This halo would be the least massive of any massive disk galaxy in the local Universe (by factors of several) -- such a halo is not predicted or naturally interpreted by the models, and would present a critical challenge to the picture of ubiquitous stellar halos formed from the debris of disrupting dwarf galaxies.

We propose to resolve the stellar populations of this uniquely anemic stellar halo for 6 orbits with HST (ACS and WFC3), allowing us to reach surface brightness limits sufficient to clearly detect and characterize M101's stellar halo if it carries more than 0.1% of M101's mass. With resolved stellar populations, we can use the gradient of stellar populations as a function of radius to separate stellar halo from disk, which is impossible using integrated light

observations. The resolved stellar populations will reveal the halo mass to much greater accuracy, measure the halo radial profile, constrain any halo lopsidedness, estimate the halo's stellar metallicity, and permit an analysis of outer disk stellar populations.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13697
Program Title: Does star formation proceed differently in metal-poor galaxies?

Principal Investigator: Vianney Lebouteiller
PI Institution: CEA/DSM/DAPNIA/Service d'Astrophysique

The importance of molecular gas in the star-formation process has been questioned by recent theoretical studies. When metals are scarce, star formation could proceed before the molecular fraction becomes significant, making cold atomic gas the key pre-requisite for star formation. The best case studies are blue compact dwarf galaxies (BCDs), with their prominent star-formation episode and yet with little or no evidence of molecular gas. Current observations do not provide strong constraints on the presence of dense atomic gas in BCDs nor on the fraction of molecular gas.

We propose to examine the HI region of 9 nearby BCDs selected from the Herschel Dwarf Galaxy Survey. Our program relies on the synergy of Hubble and Herschel, by calculating the gas cooling rate from the fine-structure level of ionized carbon, a parameter that can be determined both in the FUV with COS (probing the diffuse gas through the 1335.7A CII* absorption) and in the FIR with Herschel (probing the denser gas through the [CII] 157um emission). This comparison allows us to constrain the volume filling factor of dense vs. diffuse gas. The program we propose will allow us to examine how this fraction varies with metallicity, star-formation rate, and total gas mass. We will also be able to quantify the mass of molecular gas and evaluate its actual importance for star formation. Finally, a secondary objective is to characterize the main gas heating mechanisms in the HI region of BCDs and in particular the validity of the photoelectric effect paradigm in sources with a low dust-to-gas ratio, with potential implications for high-redshift galaxies.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13698
Program Title: The environments and progenitors of calcium-rich transients

Principal Investigator: Joe Lyman
PI Institution: The University of Warwick

Calcium-rich transients represent a new, peculiar class of extra-galactic explosion in which up to half the ejecta is calcium. Exhibiting peak luminosities in the gap between novae and supernovae, and fast evolving light curves, they present a challenge for both observation and theory. Their host galaxy locations prove a problem for most proposed progenitor systems as they are preferentially located at extreme offsets from their putative hosts, and no underlying stellar population has yet been detected in these cases.

In this proposal we will either detect for the first time, or conclusively rule out, underlying systems at the locations of a sample of these extreme-offset transients through very deep imaging provided by HST. Alongside this, we will characterise the underlying stellar population of examples of the class which appear, in projection, to be within the disks of their hosts. From these observations we will ascertain if Ca-rich transients are born in-situ or kicked from their birth sites at high velocity. Either scenario is of significant interest. If born in situ then there must be unusual chemical evolution properties in the exceptionally low mass systems in which they reside, which produce such unusual transients. In contrast if they are kicked then binary mergers (e.g. white dwarf -- neutron star) would become favoured systems, making these events powerful tools for constraining the evolution in creating tight binaries, and with important implications for gravitational wave searches.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13699
Program Title:	Fellowship of the Andromeda Dwarf Galaxies: A Census of their Extended Star Formation Histories
Principal Investigator:	Nicolas Martin
PI Institution:	Universite de Strasbourg I

We propose an efficient HST/ACS imaging survey of all 19 Andromeda satellite dwarf spheroidal galaxies that have not yet been observed with HST. The resulting color-magnitude diagrams will reach S/N=5-10 2 magnitude below the horizontal branch and will provide (a) precise distances to each of the galaxies and (b) well-constrained star formation histories (SFHs) for ages younger than ~8-10 Gyr ago. Neither of these goals can be achieved to the needed level of precision from ground based observations. Recent studies of the structural and age distributions of Andromeda's satellites hint at significant and systematic differences with properties of the Milky Way (MW) satellites, e.g., a co-rotating planar satellite structure and systematically larger intermediate age populations. But both suffer from uncertainties due the limitations of even the largest ground-based telescope (Subaru, LBT). Our proposed observations will provide an efficient way to test for these differences by tightly constraining intermediate age SFHs and improving distance determinations for all 19 systems. The discoveyr of systematic age differences with the MW group would have significant implications for our understanding of satellite systems, their relationship to a host galaxy, and cosmological modeling of low mass galaxies, all of which are exclusively based on observations of the MW companions.

Proposal Category:	GO
Scientific Category:	Extra-Solar Planets
ID:	13700
Program Title:	Confirming the most water-rich extrasolar rocky body

Principal Investigator: Carl Melis

PI Institution: University of California - San Diego

Most theories of exobiology require liquid water for a planet to be considered as habitable. Yet, very little is known about the prevalence of water for mature rocky objects in extrasolar planetary systems. A unique method of probing the existence, characteristics, and frequency of extrasolar water-bearing rocky bodies is through examining their bulk composition after they have been accreted by their host white dwarf star. Results to date show that water-rich extrasolar rocky bodies are rare. Evidence for oxygen in ground-based spectroscopy of SDSSJ104341.53+085558.2 suggests that it could be accreting the most water-rich extrasolar rocky object currently known. We propose COS ultraviolet spectroscopy to confirm the water-rich nature and characterize the mineralogy of the rocky body being accreted by this white dwarf star.

Proposal Category: GO

Scientific Category: Resolved Stellar Populations

ID: 13701

Program Title: Stellar Populations in the Outer Disk of M101

Principal Investigator: Christopher Mihos

PI Institution: Case Western Reserve University

The outskirts of disk galaxies hold a remarkable range of information on processes driving galaxy evolution. Correlations between outer disk structure and galaxy Hubble type argue for the interaction-driven growth of galaxy disks, but the specific mechanism by which this occurs remains unclear. Characterizing the age and metallicity of stars in the outskirts of disk galaxies can differentiate between models of disk building via induced star formation versus those involving stripping or migration of older stars outwards from the inner disk.

The nearby giant spiral M101 (NGC 5457) provides an ideal opportunity to study the outer disk populations of a giant Sc galaxy in great detail. Our deep ground-based imaging has mapped M101's stellar disk out to nearly 50 kpc (10 scale lengths), where we see signatures of diverse stellar populations tracing recent disk building. However, the constraints provided by integrated colors are limited; direct imaging of the stellar populations with HST will provide much stronger constraints on the evolutionary history of the outer disk.

We propose deep ACS imaging of the outskirts of M101's disk, to construct resolved stellar CMDs for the outer disk and use the relative distribution of stars in different evolutionary phases to constrain the ages and metallicities of the stellar populations. Our deep (I=28.7, V=29.9) imaging will extend far enough down the stellar luminosity function to probe a variety of stellar evolutionary tracers for both young and old stars. A parallel WFC3 pointing will image a nearby blank field, to allow for detection and separation of any M101 halo populations from those in the outer disk field.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13702
Program Title: Mapping the LyC-Emitting Regions of Local Galaxies

Principal Investigator: Sally Oey
PI Institution: University of Michigan

We propose to map the optically thin regions in the only two, known Lyman-continuum (LyC) emitting galaxies in the local universe, Haro 11 and Tol 1247-232. This will be done with the recently developed technique of ionization-parameter mapping (IPM), based on nebular emission-line imaging. We will use ACS/WFC and WFC3/UVIS to carry out narrow-band imaging in [O II] and [O III], as well as nearby continuum, where necessary. Together with existing data, our results will clarify the conditions for LyC emission and will yield more realistic estimates of the escape fraction of LyC radiation from these galaxies.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13703
Program Title: The donor star winds in High-Mass X-ray Binaries

Principal Investigator: Lida Oskinova
PI Institution: Universitat Potsdam

High-mass X-ray binaries (HMXBs) are essential astrophysical laboratories. These objects represent an advanced stage in the evolution of massive binary systems, after the initially more massive star has already collapsed in a supernova explosion, but its remnant, a neutron star or black hole, remains gravitationally bound. The stellar wind from the OB-type donor is partially accreted onto its compact companion powering its relatively high X-ray luminosity. Since HMXBs accrete from the stellar wind, parameters such as the donor's mass-loss rate, the velocity of the wind, and its clumpiness are of fundamental importance.

This proposal takes advantage of the unique capabilities of HST/STIS for UV spectroscopy. We focus on the most populous in the Galaxy class of those HMXBs where the stellar wind of the OB donor is directly accreted onto a neutron star. Recently, a new sub-class of HMXBs - "supergiant fast X-ray transients" - was discovered. It has been proposed that these enigmatic objects can be explained by the specific properties of their donor-star winds. The only way to validate or disprove this hypothesis is by a studying the wind diagnostics lines in the UV spectra of donor stars. The observations proposed here will, for the first time, provide the UV spectra of this important new type of accreting binaries. Our state-of-the art non-LTE expanding stellar atmospheres and 3-D stellar wind simulations allow thorough exploitation of the STIS spectra. As a result we will obtain the wind parameters for a representative sample of six Galactic HMXBs, thus heightening our knowledge thereof considerably.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13704
Program Title: Testing the single degenerate channel for supernova Ia

Principal Investigator: Steven Parsons

PI Institution: Universidad de Valparaiso

The progenitors of supernova Ia are close binaries containing white dwarfs. Of crucial importance to the evolution of these systems is how much material the white dwarf can stably accrete and hence grow in mass. This occurs during a short-lived intense phase of mass transfer known as the super soft source (SSS) phase. The short duration of this phase and large extinction to soft X-rays means that only a handful are known in our Galaxy. Far more can be learned from the underlying SSS progenitor population of close white dwarf plus FGK type binaries. Unfortunately, these systems are hard to find since the main-sequence stars completely outshine the white dwarfs at optical wavelengths. Because of this, there are currently no known close white dwarf binaries with F, G or early K type companions, making it impossible to determine the contribution of the single degenerate channel towards supernova Ia. Using the GALEX and RAVE surveys we have now identified the first large sample of FGK stars with UV excesses, a fraction of which are these illusive, close systems. Following an intense ground based spectroscopic investigation of these systems, we have identified 5 definite close binaries, with periods of less than a few days. Here we apply for COS spectroscopic observations to measure the mass and temperature of the white dwarfs in order to determine the future evolution of these systems. This will provide a crucial test for the single degenerate channel towards supernova Ia.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13705
Program Title: Brown dwarf Atmosphere Monitoring (BAM!): Characterizing the Coolest Atmosphere

Principal Investigator:

PI Institution: Arizona State University

Using the G141 WFC3/IR grism and the F098M filter, we propose a HST spectrophotometric monitoring study of the coolest variable brown dwarf (~650K) identified as part of our Brown dwarf Atmosphere Monitoring (BAM) program. The proposed observations will enable exploration of the dynamic atmospheric evolution of a benchmark T8.5 binary brown dwarf system, which we have discovered to exhibit the second-largest amplitude variation amongst all currently known brown dwarf variables. The close binarity of this system requires the exquisite stability of the HST point spread function to enable resolved monitoring of both components and to discriminate the source of the variability - the second component is a planetary mass object based on evolutionary models. This BAM follow-up study is designed to characterize both the longitudinal and vertical structure of the atmospheric properties of this system via multi-wavelength observations covering the entire spectral range of the WFC3/IR detector. Additionally, by monitoring the target over two separate epochs we will measure the evolution of atmospheric features giving rise to the flux variations. The proposed program will provide a comprehensive dataset serving as a benchmark comparison to directly imaged planets, intensely irradiated Hot Jupiters, and synthetic atmospheric models incorporating different physical processes.

Proposal Category: GO

Scientific Category: ISM in External Galaxies

ID: 13706

Program Title: Galactic Accretion Unveiled: A Unique Opportunity with COS and M33

Principal Investigator: Joshua Peek

PI Institution: Columbia University in the City of New York

The flow of gas into and out of galactic disks is as crucial to the evolution of galaxies as it is difficult to observe. Observations of UV metal absorption lines towards a star at the center of M33 have already shown hints that this disk galaxy may be accreting through the cooling of hot gas at the center of its halo. We develop a suite of accretion models, which show how further UV absorption line observations to M33 disk stars will distinguish between different accretion scenarios. We propose to use COS to observe 7 more stars at high spectral resolution to determine the radial scale and velocity structure of this inflow and further study the mechanisms that drive galactic accretion and winds.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13707
Program Title: Mapping the Extreme Horizontal Branch instability strip in omega Centauri

Principal Investigator: Suzanna Randall

PI Institution: European Southern Observatory - Germany

We request far-UV spectroscopy for the hottest and the coolest members of the recently discovered class of rapid subdwarf O pulsators on the Extreme Horizontal Branch (EHB) in omega Centauri. Our main aim is to derive reliable temperature estimates and thus map the location of the omega Cen EHB instability strip in the Teff-log g plane. Current estimates based on optical spectroscopy suggest the pulsators to be clustered around 50,000 K, which is distinctly cooler than the red edge of the predicted instability strip. We suspect that this discrepancy is due, at least in part, to the known problem of the temperatures being significantly underestimated from optical spectroscopy (compared to the more realistic values from FUV spectroscopy) for very hot stars. Given the successful pulsational modeling of the cooler (~31,000 K) rapid subdwarf B pulsators found among the Galactic field population, the inability to reproduce the omega Cen pulsators would point towards fundamental differences between the two EHB populations. On the other hand, if we are able to reconcile the predicted and observed instability regions for the omega Cen pulsators, this will open them up to exploitation via asteroseismology. Asteroseismology has proven to be a very powerful tool for determining the internal stellar structure in the subdwarf B pulsators, providing valuable constraints on competing evolutionary scenarios. In light of the currently raging debate as to the origin of EHB stars particularly in Globular Clusters, the prospect of applying asteroseismology to EHB stars in a Globular Cluster for the first time is highly enticing.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13708
Program Title: Following the rapid evolution of the central star of the Stingray Nebula in real time

Principal Investigator: Nicole Reindl

PI Institution: IAAT, Eberhard Karls University, Tuebingen

SAO 244567 is an unusually fast evolving star. Within twenty years only, it has turned from a B-type supergiant into the central star of the Stingray nebula. Space and ground-based observations obtained over the last decades have revealed that its spectrum changes noticeably over just a few years, showing stellar evolution in real time. Previous analysis indicates it must be a low mass star and thus the observed fast evolution is in strong contradiction with canonical post-asymptotic giant branch (AGB) evolution. A late He-shell flash is able to account for the rapid evolution. This scenario would predict an evolution back to the AGB, e.g. a decrease of the effective temperature (which is already indicated by the FUSE observations in 2006) and an increase of luminosity. With COS spectroscopy we want to follow the evolution of the surface properties of SAO 244567 to verify this thesis. The very compact nebula of SAO

244567 makes it impossible to derive these parameters from optical spectra, because most of the photospheric lines are blended by nebular emission lines thus they are not suitable for a spectral analysis. The derived surface parameters will establish constraints for late thermal pulse evolutionary calculations. With these calculations we aim not only to explain the nature of SAO 244567, but they also will provide a deeper insight in the formation process of hydrogen deficient stars, which make up 25% of the post AGB-stars and white dwarfs.

Proposal Category:	GO
Scientific Category:	ISM and Circumstellar Matter
ID:	13709
Program Title:	Constraining the Cosmic-ray Acceleration and Gamma-ray Emission Processes in IC 443
Principal Investigator:	Adam Ritchey
PI Institution:	University of Washington

Supernova remnants are widely believed to be the sources responsible for the acceleration of Galactic cosmic rays. Over the last few years, observations made with the Fermi Gamma-ray Space Telescope have confirmed that cosmic-ray nuclei are indeed accelerated in some supernova remnants, including IC 443, which is a prototype for supernova remnants interacting with molecular clouds. Still, while cosmic-ray acceleration has been confirmed for IC 443, through the detection of the characteristic pion-decay signature, the acceleration processes are not fully understood, in part because the basic model parameters are not always well constrained. Here, we propose FUV observations of two stars probing diffuse molecular gas in IC 443. One star probes the interior region of the supernova remnant, while the other is located just outside the visible edge of IC 443. This arrangement will allow us to evaluate the physical conditions in pre-shock and post-shock gas through a comprehensive analysis of interstellar absorption lines. A major component of the analysis will involve the derivation of gas densities and kinetic temperatures from the relative populations of collisionally-excited fine-structure levels in C I and O I. A determination of the post-shock temperature will yield the shock velocity, which will constrain not only the age of IC 443, but also the cosmic-ray acceleration efficiency. The observed B/O ratio will also help to constrain the cosmic-ray content in the gas. These results will be of primary importance in accessing the role of supernova remnants as sources of Galactic cosmic rays.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13710
Program Title:	Constraining Models of Evolved UV-Bright Stars in the M31 Bulge
Principal Investigator:	Philip Rosenfield

PI Institution: Universita degli Studi di Padova

We aim to use HST observations of M31 to generate the definitive data set for modeling the population of the UV-bright stars that contribute to the UV flux in old stellar populations (i.e., the "UV excess" seen in some elliptical galaxies and spiral bulges).

We propose to place stringent observational constraints on the post-AGB (P-AGB) and post-early AGB (PE-AGB) phases of stellar evolution using a UV survey of M31's bulge. M31 is a critical laboratory for testing these models, as it hosts an old, metal-rich stellar population with high stellar densities such that even rare evolutionary phases are well-represented.

We will (1) assemble a catalog of UV-bright stars in the center of M31 in F336W and F225W, extending out to ~0.7 kpc, to sample stellar populations with different metallicities; and (2) image a smaller 0.9 sqr-arcmin strip with ACS/SBC in F140LP, to image the regions with the highest density of rapidly-evolving P-AGB stars. The FUV imaging will allow us to separate the P-AGB from the PE-AGB. These observations will include thousands of UV-bright stars, increasing the size of existing samples by orders of magnitude.

These new observations will drive revisions in models for post-HB evolution, which we will merge into new isochrone libraries and stellar population synthesis codes. The revisions will have important implications for AGB evolution, spectral evolution models of galaxies, and for mass loss on the RGB. The observations will also have a direct impact on interpreting (1) the UV flux from old stellar populations; (2) the emission line flux from M31's nuclear spiral; and (3)

Proposal Category: GO

Scientific Category: Cosmology

ID: 13711

Program Title: Establishing a Network of Next Generation SED standards with DA White Dwarfs

Principal Investigator: Abhijit Saha

PI Institution: National Optical Astronomy Observatory, AURA

Photometric calibration uncertainties are the dominant source of error in current type Ia supernova dark energy studies, and other forefront cosmology efforts, e.g., photo-redshifts for weak lensing mass tomography. Modern 'all-sky' surveys require a network of calibration stars with 1) known SEDs (to properly and unambiguously account for filter differences), and 2) that are on a common photometric zero-point scale. HST enables us to establish this essential network of faint spectrophotometric standards, by eliminating the time-variable Earth's atmosphere, and by exploiting the well-understood energy distributions of DA white dwarfs. We have selected a set of DA WD targets that will have SNR ~200 in the LSST (and PanSTARRS and Dark Energy Survey) survey images, while avoiding saturation. This means they will be included in the surveys, and will directly calibrate the data products. By using ground-based spectra of Balmer lines to obtain the two parameters (temperature and log(g)) that determine the SED, we can use broadband HST photometry to set the overall flux scale for each source, and determine any applicable reddening. Thus calibrated, these standards can then be used as flux standards at wavelengths well beyond the range of HST, and in any arbitrary, but defined passband. This precision photometric heritage from HST benefits essentially all existing and upcoming surveys, standardizes (spectro)photometry across observatories and facilities, and directly addresses one of the current barriers to understanding the nature of dark energy. In our Cycle 20 program we achieve sub-percent accuracy. Here we propose improvements in experimental design from lessons learned.

Proposal Category: GO
Scientific Category: Solar System
ID: 13712
Program Title: Target of Opportunity Observation of an Episodic Storm on Uranus

Principal Investigator: Kunio Sayanagi
PI Institution: Hampton University

We propose a TOO observation of Uranus to capture the formation process of a dark anticyclonic vortex during an episodic convective storm. The planet Uranus continues to exhibit increased atmospheric activity after the 2007 equinox, likely in response to extreme insolation change (Hammel et al. 2005, Icarus 175, 284, Sromovsky et al. 2009, Icarus 203, 265, Sromovsky et al. 2007, Icarus 192, 558, Sromovsky et al. 2012, Icarus 220, 6). We hypothesize that Uranian dark spots emerge from an episodic outburst, and predict that such a spot will form in the near future. The historical record makes references to such discrete structures (both bright and dark) on Uranus during previous equinoctial apparitions (Alexander 1965; the last equinox occurred in 1965). Furthermore, northern high-latitudes are now coming into view after 40+ years of winter darkness, exhibiting unusual activities (Sromovsky et al. 2012, Icarus 220, 694). Our TOO will be triggered by amateur observations; the best amateur facilities are now able to resolve the disk of Uranus and detect such activity if it is very large or has very high contrast. Amateurs also have access to a great many nights of telescope time. If a discrete cloud feature on Uranus is reported through these networked professional and amateur ground-based observations, we propose to obtain follow-up images with Hubble's WFC3. The proposed TOO images will permit determination of detailed structure of the feature at visible wavelengths, and provide vertical and horizontal constraints on the feature's scattering properties. Hubble is the only facility that can provide such information at visible wavelengths.

Proposal Category: GO
Scientific Category: Solar System
ID: 13713
Program Title: Observation of Chariklo's rings and the surroundings of Chiron

Principal Investigator: Bruno Sicardy
PI Institution: Observatoire de Paris and Paris 6 university

Dense and sharply confined rings have recently been discovered during a stellar occultation around the small Centaur object Chariklo (Braga-Ribas et al., 2014). This is the first body after the giant planets found to possess a ring system. We propose to use HST to (1) obtain direct images of the rings, confirming their existence and their orientation, (2) derive multi-wavelength photometry, thus constraining their composition (concerning in particular the presence of water ice), (3) perform for the first time a deep search of small satellites and (4) faint dusty rings around Chariklo, and (5) search for material around another Centaur similar to Chariklo, Chiron, which is known to be surrounded by cometary material and narrow jets. The presence (or absence) of satellites and dusty material around Chariklo will discriminate the various theoretical models that are invoked to explain the origin, evolution and stability of rings around this minor body. The motion of putative Chariklo satellites will also provide an estimation of the mass of the primary,

from which its density can be derived, which eventually tells us where the rings are relative to Chariklo's Roche limit.

Proposal Category: GO
Scientific Category: Resolved Star Formation
ID: 13714
Program Title: Tracing Hot Plasma in the RY Tau Jet

Principal Investigator: Stephen Skinner

PI Institution: University of Colorado at Boulder

The accreting T Tauri star RY Tau drives a spectacular bipolar jet whose blueshifted component is traced optically at separations of 1.3" - 30" from the star. Optical studies probe cool jet plasma (T ~ 1e4 K) but evidence for much hotter plasma (T ~ 1e5 - 1e6 K) is seen in UV spectral lines and Chandra X-ray images. We propose to obtain STIS UV spectra of RY Tau with the slit aligned along the jet. HST's high spatial resolution and UV spectral line diagnostics will determine the spatial extent and properties of the hot plasma in the inner jet and will test jet-heating models. Only HST provides the capabilities needed to study conditions in the hot dense plasma in the physically important inner jet where launching and collimation occur.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13715
Program Title: Imaging Spectroscopy of the Gamma-Ray Nova V959 Mon

Principal Investigator: Jennifer Sokoloski

The Fermi Gamma-Ray Space Telescope has recently revealed that most normal nova explosions probably emit gamma-rays. With energies of greater than 100 MeV, these unexpected gamma-rays do not emanate from radioactive nuclei. They must instead be the end product of particle acceleration in shocks. But what generates these pervasive shocks? To resolve this question, we propose a program of imaging spectroscopy of the northern gamma-ray nova V959 Mon. Our proposed HST observations will provide the 3-D morphology and kinematic structure of the ejecta, and thereby show which portion of the ejecta drove shocks into which other component of the ejecta. V959 Mon is the perfect target for this research because it is the only one of four classical novae with well-characterized gamma-ray emission to be near enough and large enough to be spatially resolved with HST. Radio images confirm that the ejecta from V959 Mon contain resolvable substructures that will enable us to distinguish between models for the formation of shocks in novae. Uncovering the origin of gamma-ray emission from novae will not only solve the most exciting new puzzle in the field of nova studies, but also answer the long-standing question of how the envelope on a white dwarf is expelled during a nova event. Because the remnant around V959 Mon is less than 1 arcsec in diameter, however, and because of the need to resolve substructure within the remnant to distinguish between different models for the generation of shocks, HST is required for this research. Moreover, since V959 Mon is fading quickly and few other promising gamma-ray novae exist, this work is extremely time critical.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13716
Program Title:	Constraining the history of the outer Solar System: Definitive proof with HST

Principal Investigator:	David	Trilling
PI Institution:	Northern Arizona University	

We propose to image five faint cold classical Kuiper Belt Objects (KBOs) to test hypotheses about the collisional evolution of the outer Solar System. There is an observed break in the size distribution of cold classical KBOs at around 40 km. If small cold classicals exhibit bluer colors and a smaller binary fraction than large cold classicals then the nature of the break is collisional. If the small cold classicals are as red as their larger counterparts and have a similar binary fraction, then the break is most likely primordial and a product of the environment in which these objects formed. Our data in-hand suggests the collisional model, using both binary statistics and color measurements, but the signal is not unequivocal. We propose to observe the five smallest available cold classical KBOs to search for binaries and measure colors. The five KBOs that we will observe here, combined with our existing data, will allow us to determine conclusively the physical process that drive the break in the size distribution and the evolution of the outer Solar System. This well-posed experiment will offer for the first time a direct observational test of the broad collisional history of the outer Solar System and is only possible with HST.

Proposal Category: GO
Scientific Category: ISM and Circumstellar Matter
ID: 13717
Program Title: Polarimetry of SN 2014J in M82 as a Probe of Its Dusty Environment

Principal Investigator: Lifan Wang
PI Institution: Texas A & M University

Late time polarimetry can effectively probe the circumstellar (CS) dust environment of SNe Ia. We propose to acquire imaging polarimetry of SN 2014J at three epochs between 200-400 days after the SN explosion. The delayed light from optical maximum may be scattered into the line of sight and reveal the scattering dust through polarization. Light echoes from interstellar dust at very large distances (> 10pc) from the SN will not be highly polarized in these observations due to the small scattering angle involved. Polarimetry at late time is thus an unambegeous probe of CS dust very close to the SN (at distances ~ 1 light year). Observations of the illusive CS matter is critical in constraining the progenitor systems of SNIa.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13718
Program Title: The nature and environment of the earliest dusty starburst galaxies

Principal Investigator: Julie Wardlow
PI Institution: Dark Cosmology Centre, Niels Bohr Institute

We propose HST ACS and WFC3 imaging of four of the brightest spectroscopically confirmed dusty starburst galaxies at z=4.2 to z=5.3. Theoretically the existence of dusty, massive startbursts at such early epochs is difficult to explain and thorough observational constraints on their properties provides a stringent test of galaxy formation models. Our targets were selected from the Herschel-HerMES survey and have a multitude of far-infrared follow-up data, including the CO spectroscopy that revealed their extreme redshifts. However, deep optical and near-IR observations are currently lacking and we require the resolution and sensitivity of HST at these wavelengths to completely reveal these rare galaxies. We will use the proposed data to measure the physical properties of four z>4 dusty starbursts, including their sizes, stellar masses, and the scale and mode of the star-formation. There is also evidence of gravitational lensing and the HST data are crucial for accurately measuring the lensing amplification and reconstructing the source plane.

The wider field data will be used to investigate the environments of these galaxies and determine whether they are protocluster members, as often expected of massive high-redshift galaxies and similarly to some other z>4 starbursts. We will be able to measure the dark matter halo mass scale and thereby consider the evolution and descendent of these galaxies, particularly in comparison with lower redshift dusty starbursts.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13719
Program Title: Accretion of planetary debris onto the unique white dwarf GD394

Principal Investigator: David Wilson

PI Institution: The University of Warwick

It is now undisputed that metal-pollution of the H or He atmospheres observed in a substantial fraction of white dwarfs is due to accretion of planetary debris. While significant progress has been made in establishing the frequency of such evolved planetary systems, and statistics on the abundances of the debris material are beginning to emerge, very little is known regarding the delivery mechanism of the debris. Given that the red giant progenitors of the metal-polluted white dwarfs evaporated all planetary material within >1 AU, the debris found at many white dwarfs must originate originally from a substantial distance of the star. The canonical model is that remaining planets perturb the orbits of astroids, sending them onto a white dwarf grazing course, where the extreme gravity will result in their tidal disruption. The debris then must undergo complex dynamical evolution, and eventually fall into the white dwarf atmosphere.

EUV light curves of GD394, an extremely metal-polluted white dwarf, suggest a strong variation of the metal abundances over the stellar surface. We propose to obtain spin-phase resolved high-resolution spectroscopy of GD394 over its 1.15d rotation period to resolve the abundance pattern on its surface from variations in the photospheric metal lines, and thereby probe the geometry of the circumstellar debris. Line profile variations can be used to reconstruct the surface distribution of the metals using Roche tomography. In addition, comparison to a single archive HST/GHRS observation from 1992 will place tight constraints on the long-term variation of the accretion rate, and the life time of the circumstellar debris.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13720
Program Title: Testing Models of the Black-Hole X-ray Source in the NGC4472 Globular Cluster RZ2109 with COS UV Spectroscopy

Principal Investigator: Stephen Zepf

PI Institution:

We propose to obtain COS ultraviolet spectroscopy of the black-hole X-ray source in the NGC 4472 globular cluster RZ2109. This object was the first unambiguous black hole X-ray source in a globular cluster. It is clearly identified as a black hole through its high X-ray luminosity and short-term variability. The optical spectrum of RZ2109 shows strong and extraordinarily broad [OIII]4959, 5007 emission, and our recent STIS spectrum demonstrates that this comes from an outflow extended across most of the globular cluster. The optical spectrum also remarkably shows no emission lines other than [OIII] to sensitive limits, indicating that the material is very hydrogen-poor. One way to account for these observations is if RZ2109 hosts a CO white dwarf accreting onto a stellar mass black hole. In this case, CIV 1549 emission is expected and no nitrogren lines will be seen. However, if nitrogen lines such as NIV 1486 and NV 1239, 1243 are observed, then a different source for the accreting material such as a nova shell or a horizontal branch star would be required, and a re-evaluation of all aspects of our understanding of the dynamics and accretion in RZ2109 would be needed. Determining which of these is the case is a major step for understanding how accreting black holes form and grow in dense stellar systems, whether they make intermediate mass black holes, and what accretion and feedback processes lead to strong outflows rich in elements such as oxygen.

Proposal Category:	GO
Scientific Category:	ISM and Circumstellar Matter
ID:	13721
Program Title:	The Windy Milky Way Galaxy

Principal Investigator:	Robert	Benjamin
PI Institution:	University of Wisconsin - Whitewater	

The Milky Way is the only galaxy in which we can directly measure the three dimensional density, kinematics, metallicity, and multi-phase structure of a Galactic wind. There are two major outflow regions suspected to exist in the Galaxy: a nuclear outflow associated with the Fermi Bubble and an annular wind associated with the star formation activity in the Molecular Ring/Scutum-Centaurus spiral arm. We request 14 hours to observe five UV-bright sources in globular clusters in front of and behind the Scutum-Centaurus spiral arm. The interstellar absorption data will provide unique constraints on the vertical outflow velocity and radial extent of this outflow. We will combine these results with archival data in order to develop the next generation of multiphase, rotating wind models and use this model to estimate the energetics, mass outflow, and angular momentum flux of this galactic outflow. We expect the insights gained here will be valuable in understanding the nature of local systems and the ubiquitous winds present in the universe at z=2. An analysis of the sources themselves will also provide valuable insights into the late stages of stellar evolution in low-metallicity populations.

Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13722
Program Title: Characterising the atmosphere of the super-Earth 55Cnc e

Principal Investigator: Ernst de Mooij

PI Institution: University of Toronto

So-called "super-Earth" planets could come in a variety of flavors, but to date we have few observational constraints on their diversity. In fact, atmospheres of only two members of the class have been measured in transmission so far. Here we propose to observe two transits of the third of that class that can be characterised, the super-Earth 55Cnc e, orbiting the brightest star in the sky known to harbor a transiting planet, using WFC3 in the near-infrared. This planet's low average density implies either a significant water fraction or a hydrogen-rich envelope. However, given the intensity of its stellar insolation, a hydrogen-rich envelope is expected to have evaporated. If, on the other hand, 55Cnc e contains a large water fraction, it is expected to have a small scale-height envelope dominated by water. Our proposed observations will not only investigate its atmospheric properties and constrain the scale-height, but also demonstrate HST's capabilities for characterizing small planets around nearby, bright stars, which will be prime targets for upcoming surveys such as the TESS mission.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13723
Program Title: Multiband Observations of a Local Tadpole Galaxy

Principal Investigator: Bruce Elmegreen

PI Institution: IBM T.J. Watson Research Center

We propose WFC3 broadband and Halpha observations of a local tadpole galaxy with a starburst and low metallicity in the head suggestive of ram pressure triggering from cosmological inflow. Such head-tail structure dominates local ultra-low metallicity Blue Compact Dwarfs and it represents 10% of resolved galaxies in the Hubble UDF. We will identify star clusters and measure their properties, including masses and ages, two-point correlations for position as a function of mass and age, and the cluster mass distribution as a function of age. We will also determine the star formation fraction in clusters. These measurements can suggest definite processes for star formation including the importance of turbulent fragmentation. The presence of a super star cluster, if found, will be a model for the formation of metal-poor globular clusters in high redshift dwarf galaxies, which could have formed in similar conditions. The Halpha observations will also show bright rims and nebular structures down to 10's of pc scales. Such structures can indicate pressure

sources and nebular flow directions that allow us to understand gas motions inside the starburst head, including pressurized outflows and cosmological inflows. The head is so bright in Halpha that even if only 25% of the ionizing radiation escapes, an inflowing halo stream as far away as 1' will be ionized sufficiently on the surface for our observations to detect it. Thus the proposed galaxy, Kiso 5639, is a prime laboratory to study processes that may be related to cosmic accretion, starburst conditions in primitive galaxies, and the formation of metal-poor globular clusters.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13724
Program Title: Pinpointing the Characteristics of Stars and Not Stars

Principal Investigator: Todd Henry

PI Institution: Georgia State University Research Foundation

We propose to observe 9 binaries with HST-WFC3 to measure the optical fluxes of individual red and brown dwarfs bordering the transition region between stellar and substellar objects. The optical fluxes will be combined with infrared adaptive optics measurements to provide spectral energy distributions covering 0.5-2.2 microns, which includes more than 90% of the total fluxes for these objects. The separations and position angles will be used to convert our ground-based astrometry of the photocentric orbits into relative orbits with critical mass ratios that will then yield unprecedented mass measurements for each component. The 18 carefully characterized objects will comprise a fundamental set of standards that will stress-test theoretical models of the smallest stars and brown dwarfs for years to come. The results will be combined with our previous mass-luminosity relation work for stars with masses 0.10-0.60 Msun to extend our understanding of masses down to 0.05 Msun. We will then have a map covering a factor of more than 10 in mass for the most common objects in the Galaxy.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13725
Program Title: Testing the correlation between low mass planets and debris disks

Principal Investigator: Paul Kalas

The number of dusty debris disks has increased across all spectral types through recent infrared surveys. This has provided greater overlap with stars known to host extrasolar planets via RV surveys. New studies have therefore investigated how the different properties of host stars, exoplanets, and debris disks may be correlated, with the objective of giving empirical support to competing theories of planet formation and evolution. One such emerging correlation is that stars with only low mass planets are more likely to host prominent debris disks than stars that have at least one giant planet. If true, then M dwarfs should have abundant debris disks given that they more frequently have low mass planetary systems. However, the information needed to critically test these ideas is lacking. For most systems, the presence of an outer planet with >30 Earth masses has not been observationally tested, nor are there many M dwarf debris disks available for detailed scrutiny. Here we propose to use STIS coronagraphy to image for the first time the debris disks around three nearby stars in optical scattered light. Searching for sharp dust belt structures indirectly tests for the existence of outer planets that are otherwise undetectable by RV or adaptive optics planet searches. Moreover, two of our target stars are the most recently discovered M dwarf debris disks, both closer to the Sun than AU Mic. The scattered light observations of these two targets would present a major advance in characterizing how M dwarf debris disks co-evolve with planets under different stellar environments.

Proposal Category:	GO
Scientific Category:	Debris Disks
ID:	13726
Program Title:	Scattered light imaging of Fomalhaut's ice line belt to understand dynamical upheavals in planetary systems
Principal Investigator:	Paul Kalas
PI Institution:	University of California - Berkeley

The dynamical history of the solar system in the first gigayear is thought to be complex and violent, with fossil evidence pointing to events such as the Late Heavy Bombardment and the formation of the Moon via a giant impact. The study of extrasolar planetary systems has also revealed tracers of vigorous dynamical evolution, such as the existence of hot Jupiters and cases of highly eccentric planet orbits. The closest planetary system with evidence of complex dynamics is Fomalhaut at 7.7 pc. Fomalhaut has two dusty debris belts - the cold belt at 140 AU imaged with HST and other facilities, and a warmer, ice-line belt at 8-12 AU which has not been resolved yet. Fomalhaut b has a highly eccentric orbit with periastron occurring a century ago at ~10 AU, and which is currently located at ~125 AU on its way to apastron at ~300 AU. Fomalhaut b may have been recently scattered outward by a more massive planet near the ice line belt, or inward by an outer planet close to the cold belt. If the dynamical upheaval occurred in the ~10 AU region, then the ice-line belt could have an asymmetric morphology. We propose a STIS imaging program optimized for detecting the ice line belt in scattered light for the first time. Concurrently, we will obtain deeper images with STIS to detect Fomalhaut b in 2015. This astrometric point is extremely valuable in constraining Fomalhaut b's orbital elements. In particular, its periastron distance and coplanarity with the belts are crucial elements in determining the likely location and mechanism for the system's dynamical upheaval.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13727
Program Title: Which Stars Go BOOM?

Principal Investigator: Jason Kalirai
PI Institution: Space Telescope Science Institute

Intermediate mass stars with M = 6 to 10 Msun will end their lives by either losing mass quiescently and forming massive white dwarfs or by exploding as core collapse type II supernovae. The critical mass separating these two stellar evolution channels is not only a fundamental threshold of stellar astrophysics, but is a crucial ingredient to generate reliable galaxy evolution simulations. Given the steepness of the stellar IMF, small changes in the critical mass directly affects chemical evolution scenarios, energetics, and feedback relations. Although most astronomers reference the critical mass at M = 8 Msun, there is a lack of robust theoretical or observational confirmation of this number.

We propose to measure the critical mass directly by verifying the end products of stellar evolution in four rich, young, co-eval stellar populations. With ages of 25 to 60 Myr and total stellar masses >10,000 Msun, the Magellanic Cloud globular clusters NGC 1818, NGC 330, NGC 1805, and NGC 2164 have present-day main-sequence turnoff masses of M = 6.2, 7.2, 8.5, and 9.8 Msun, respectively. Existing photometry verifies that each cluster has a rich upper main sequence of massive stars, and therefore would have formed dozen(s) of stars above the present day turnoff. If those stars did not explode as core collapse supernovae, they will populate a clear blue white dwarf cooling sequence. Our experiment uses the full power, wavelength coverage, and resolution of HST/WFC3 to detect these cooling sequences in high-precision, UV-sensitive color-magnitude diagrams.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13728
Program Title: Do QSO2s have Narrow Line Region Outflows? Implications for quasar-mode feedback

Principal Investigator: Steven Kraemer
PI Institution: Catholic University of America

The correlation between the masses of galaxy bulges and the super-massive black holes (BH) at their gravitational centers suggests that they co-evolve. The process thought to regulate bulge/BH growth is ``AGN feedback'', either in the form of radiation-driven (``quasar mode'') or mechanically driven (e.g., ``radio mode'') outflows. Studies of Seyfert galaxies have revealed massive gas flows through the Narrow Line Region (NLR), likely radiatively driven by the AGN. Although one might naively expect that the magnitude of these outflows would scale with luminosity, a recent ground-based study of the NLR of QSO2s suggests more chaotic kinematics, with little evidence for grand-scale outflows.

Are the outflows disrupted close to the AGN? If so, it casts doubt on the effectiveness of quasar-mode feedback. However, based on what is observed in Seyferts and scaling with luminosity, the outflow-dominated regions in QSO2s should be ~ 1 kpc, which cannot be resolved in ground-based optical spectra. Therefore, we propose to obtain HST/ACS images and STIS long-slit spectra of 11 radio-quiet QSO2s, selected from the Reyes et al. (2008) sample. With these data, we will measure and model the NLR kinematics, probe the dynamics of the gas, and, ultimately, determine whether AGN-driven outflows exist in QSO2s. These results will have profound implications towards our understanding of AGN feedback.

Proposal Category: SNAP

Scientific Category: AGN/Quasars

ID: 13729

Program Title: Slow-blue PanSTARRS transients : high amplification microlens events?

Principal Investigator: Andy Lawrence

PI Institution: University of Edinburgh, Institute for Astronomy

With PanSTARRS-1 we have discovered a new class of extreme, rare, extragalactic transients which we believe represent Seyfert-like AGN at z=1 amplified by factors of 4-100 by microlensing in foreground galaxies at z=0.25. The source should be partially resolved by the lens, leading to colour and spectroscopic trends during the decay and so providing a new and unique handle on the size and structure of the accretion disc and the broad line region. HST is the only facility capable of testing this hypothesis; we should see a typical AGN offset of a few tenths of an arcsecond from the centroid of the blue light, and signs of two galaxies of very different colour that dominate B-band and J-band respectively. An HST snapshot survey will test the hypothesis, measure the sizes and luminosities of foreground galaxies, set baseline AGN level to constrain lens models, and show us how to design future more detailed studies.

Proposal Category: GO

Scientific Category: ISM in External Galaxies

ID: 13730

Program Title: Maps of Recent Star Formation to Match ALMA Observations of the Nearest Nuclear Starburst

Principal Investigator: Adam Leroy

We propose narrow band WFC3 infrared imaging of the central part of NGC 253, the nearest nuclear starburst, with the goal of imaging the location of recent star formation traced by the Paschen β line. We will compare the distribution of Paβ emission to our understanding of the molecular ISM, built on a series of successful ALMA programs. These have revealed the location of star-forming clouds, shells carved by feedback, molecular outflows emerging from the disk, and a rich suite of interstellar molecules. Knowing exactly where (and how many) stars are forming is key to make the best use of these data. From the comparison of ALMA and HST Paβ data, we will be able to assess the efficiencies of feedback, test models of star formation, and help establish the interpretation of new molecular tracers. Our proposed observations target the off-line filter (F130N) and will be combined with archival on-line imaging (F128N). Right now, those on-line data are not useful for science because the broad band data are inadequate for a quality continuum subtraction.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13731
Program Title:	The Real Impact of Extragalactic Jets on Their Environments: Measuring the Advance Speed of Hotspots with HST
Principal Investigator:	Eileen Meyer
PI Institution:	Space Telescope Science Institute

We propose moderately deep imaging of two nearby radio galaxies, M87 and Pictor A, in which the terminal shock of the jet as it impacts the IGM (aka 'hotspot') has previously been imaged in the optical with HST. The primary goal of this program is to leverage the 20 year imaging baselines afforded by Hubble archival data and state-of-the-art precision astrometry in order to measure, for the first time, the proper motions of a terminal shock/hotspot. This is the most direct method of constraining the velocity of the working surface, and when combined with existing multi-wavelength data, yields an estimate of the momentum carried by the jet, an important, but difficult-to-measure physical characteristic necessary for understanding the impact of extragalactic jets on their hosts and environments. In addition, the proposed imaging will allow us to study the inner kpc-scale jets of M87 and Pictor A, as well as the counter-jet and counter-hotspot of Pictor A.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13732
Program Title: Detecting dark matter substructure with narrow line lensing

Principal Investigator: Anna Nierenberg

PI Institution: University of California - Santa Barbara

The abundance of low mass halos is one of the key predictions of LCDM and remains at apparent odds with observations of luminous structure. Strong gravitational lensing provides a straightforward means of testing this theory as it enables the detection of dark matter subhalos at cosmological distances, without requiring the structure to contain any baryons at all. The fluxes of strongly lensed, parsec scale sources in particular, are excellent probes as they are extremely sensitive to the presence of low mass subhalos, while still being extended enough to remain unaffected by microlensing by stars which is a dominant contaminant for smaller sources. Traditionally this field has been limited to the analysis of the small number of strongly lensed, radio-loud quasars. Quasar narrow-line emission offers an alternative to radio. It is also parsec scale and microlensing free, but has the benefit of detectable in a much larger sample of systems. This proposal will combine milliarcsecond astrometry, and percent level photometry attainable with WFC3 IR grism, in order to measure spatially resolved narrow line lensing in six new systems, which cannot be studied from the ground. We have demonstrated that data of this quality can be used to detect subhalos as small as a million solar masses. This proposal will double the sample of systems which can be used to detect dark, low mass substructure using flux ratio anomalies.

Proposal Category: GO
Scientific Category: Quasar Absorption Lines and IGM
ID: 13733
Program Title: The Stellar Continuum Light from Damped Lyman-alpha Absorber Galaxies Detected with Integral Field Spectroscopy

Principal Investigator: Celine Peroux

PI Institution: Laboratoire d'Astrophysique de Marseille

A new challenge in galaxy evolution studies is to understand how gas flows in and out of galaxies through their circumgalactic medium (CGM). The best way to tackle this is to bring together data on cold gas, metals and stellar content of the same galaxies. Galaxies selected via the absorption they produce in the spectra of background quasars are a powerful tool to study the cold gas play a crucial role in this respect, but characterising the stellar content of these absorbers has proved to be challenging until now. Our group has used 3D spectroscopy at near-infrared wavelengths made possible by the SINFONI instrument on VLT, aided with adaptive optics (AO), to successfully detect 5 galaxies responsible for DLAs/sub-DLAs. For this sample, we have retrieved and analyzed data from HST/STIS (for the neutral gas content), VLT/UVES, Keck/HIRES or Magellan/MIKE (for the metallicity and dust content of H I gas), VLT/SINFONI (for SFR and kinematics of H II gas) and VLT/X-Shooter (for metallicity of H II gas). However, none of the

data currently in hand can probe the faint optical continuum of these objects. Here we propose to observe these DLA/sub-DLA galaxies at z~1-2 using WFC3/UVIS and IR channels, to characterize the stellar content (extinction, stellar mass, age) and environment. The proposed observations will allow us to better probe the flow of gas around these galaxies, directly testing models of cold gas accretion from filaments and thus current theories of galaxy formation and evolution.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13734
Program Title:	Probing the extreme wind confinement of the most magnetic O star with COS spectroscopy
Principal Investigator:	Veronique Petit
PI Institution:	University of Delaware

We propose to obtain phase-resolved UV spectroscopy of the recently discovered magnetic O star NGC 1624-2, which has the strongest magnetic field ever detected in a O-star, by an order of magnitude. We will use the strength and variability of the UV resonance line profiles to diagnose the density, velocity, and ionization structure of NGC 1624-2?s enormous magnetosphere that results from entrapment of its stellar wind by its strong, nearly dipolar magnetic field. With this gigantic magnetosphere, NGC 1624-2 represents a new regime of extreme wind confinement that will constrain models of magnetized winds and their surface mass flux properties. A detailed understanding of such winds is necessary to study the rotational braking history of magnetic O-stars, which can shed new light on the fundamental origin of magnetism in massive, hot stars.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13735
Program Title:	A New Dwarf Galaxy Associated with an Ultra-Compact High Velocity Cloud
Principal Investigator:	David Sand
PI Institution:	

We request three filter HST imaging to study the properties of what may be the faintest gas-rich dwarf galaxy known (M_V ~ -5). This galaxy will provide crucial information on how the very lowest mass galaxies form in isolation, unaffected by local environment. It will provide a useful reference object for interpreting the ultrafaint dwarfs in the Local Group, and help to populate the poorly known luminosity function of faint galaxies in the Local Volume. The galaxy was found through deep ground based imaging of a ultracompact high velocity HI cloud, however with current data we can only constrain that it likely lies within the local volume at a distance of < 4.5 Mpc. We propose to combine optical and UV imaging to determine the galaxy's distance, extent, current metallicity, and star formation history.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13736
Program Title:	Contemporaneous Mid-UV Spectral Coverage of Pluto and Charon Coincident With the New Horizons Encounter
Principal Investigator:	Eric Schindhelm
PI Institution:	Southwest Research Institute

The New Horizons spacecraft will perform the first-ever, and the only planned flyby of the Pluto System, in July 2015. It will observe Pluto and its moons from Far-Ultraviolet (FUV) to radio wavelengths. However, between 1870 and 4200 Angstroms there is no spectral coverage aboard New Horizons. The Mid-Ultraviolet (MUV, 2000 - 3000 Angstroms), which cannot be observed from the ground, contains numerous useful indicators of surface and atmospheric composition that can provide additional constraints about Pluto. Since Pluto's MUV spectrum is known to change over time, it is scientifically important to capture such data at the unique New Horizons encounter epoch. We propose here a focused, 2-orbit STIS G230L observation of Pluto at the same sub-Earth longitude where New Horizons will obtain its best FUV spectra during its closest approach to Pluto. We note that only one UV spectrum of Pluto has been obtained at this longitude, and that was by IUE 25 years ago. We also note that these HST observations need not occur on the same day as the New Horizons encounter, only during the same observing season. In two orbits, STIS yields higher-SNR spectra of Pluto than have ever been obtained to date in the MUV. This will bridge the gap in New Horizons' spectral coverage, placing the FUV spectra in context with longer wavelength data and contributing new information to augment the New Horizons results with those from HST. Our main science objective is MUV spectroscopy of Pluto, however if scheduling allows for the correct roll angle to also capture Charon in the STIS 52"x0.2" slit, MUV surface reflectance spectra of Charon would also complement New Horizons FUV data.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13737
Program Title: Whimper of a Bang: Documenting the Final Days of the Nearby Type Ia Supernova 2011fe

Principal Investigator: Benjamin Shappee
PI Institution: The Ohio State University - Department of Astronomy

Even though SNe Ia are crucial to cosmological studies as distance indicators, the exact nature of these systems remains theoretically ambiguous and observationally elusive. However, there is a new hope. Due to nucleosynthetic effects during explosion, single and double degenerate SNe Ia models are predicted to produce vastly differing amounts 57Co and 55Fe. 57Co and 55Fe dominate the power of the very late time light curves of SNe Ia at ~1050 days and ~1500 after the initial explosion, respectively. Broad band observations of the bolometric luminosity at these epochs have the ability to measure the ratio of these two isotopes and thus discriminate between progenitor models. As the brightest SN Ia in nearly 40 years, SN 2011fe offers a prime opportunity to follow a SN Ia to such late epochs. Here we propose HST WFC3 optical and IR photometry of SN 2011fe to observe the transition from a 56Co powered lightcurve to a 57Co powered one. These observations will place unique constraints on progenitor systems of SNe Ia. SN 2011fe is likely to remain the best studied normal SN Ia of our generation and if these observations are not made this cycle, they will likely never be done with Hubble because this measurement will not be possible next cycle for SN 2011fe.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13738
Program Title: The Proper Motion of M31 Vast Plane Galaxy LGS3

Principal Investigator: Edward Shaya
PI Institution: University of Maryland

We propose to measure the proper motion of Local Group dwarf galaxy LGS-3 with a 10 year baseline provided by existing first epoch ACS imaging. An HST-determined proper motion can both constrain the mass of M31 to 20% and test whether LGS-3 is indeed a part of the recently discovered thin plane of M31 dwarf galaxies (Ibata et al., 2013). If it is, we will trace its orbit backwards in time to understand the origin of this plane; how it formed, how it persists, and why all of the blueshifted members are on one side of M31 and the redshifted members are on the other side.

The long HST baseline and the fact that the field is extra rich in background galaxies that can define an excellent reference frame will allow a second epoch of deep images in the ACS to reach a proper motion error of about 7 - 8 microas/yr in each angular component. At the distance of LGS-3, Gaia is unlikely to detect any stars, making this a

measurement that can only be made by HST.

There are two important reasons to learn the 3-d velocity of this particular galaxy. The distance of LGS-3 from M31 is known to 2% accuracy, and modeling indicates that LGS 3 is falling nearly radially toward M31 with proper motion amplitude of ~60 microas/yr (Shaya & Tully, 2014). Therefore, a proper motion that refines this value can constrain the mass of M31 to 20% and through the Local Group timing argument, will also constrain the mass of the MW to 30%. LGS 3 happens to be in a recently discovered thin plane of dwarf galaxies. It is important to get the 3-d velocity of at least one of these to discriminate between different theories about the origin of such planes of galaxies or else to point to new possibilities.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13739
Program Title: Is the First Epoch of Star Formation in Satellite Galaxies Universal? - Part II

Principal Investigator: Evan Skillman
PI Institution: University of Minnesota - Twin Cities

We propose to derive detailed star formation and chemical enrichment histories of a representative sample of M31 dwarf spheroidal (dSph) companions in order to compare directly the timing, duration, and strength of their first episodes of star formation to those of the Milky Way (MW) satellites. Compared to the MW companion dSphs, the M31 companion dSphs have significantly different horizontal branch morphologies and a different range in structural parameters. We hypothesize that these differences are connected to the evolutionary histories of their host galaxies. The proposed deep HST imaging is the only means to accurately measure the early star formation histories of the Andromeda companions and thus to test our hypothesis. Fundamentally, we will be testing the assumption that the early evolution of the Milky Way satellites was typical and therefore representative of dSphs in general. The M31 dSphs are our only option.

We have designed a representative sample of six galaxies which optimizes coverage in galaxy properties and observing efficiency. From cycle 20 observations of two of these galaxies (And II & XVI) we have discovered that - despite a factor of ~100 difference in mass - both galaxies show similar SFHs with star formation extending until intermediate ages and a synchronous termination in star formation ~5 Gyr ago. There are no MW satellite analogs to the lower luminosity M31 dSph And XVI. Here we propose observations of the rest of the sample, allowing direct inner/outer comparisons, comparison of SFHs as a function of luminosity and membership in substructures, and determination whether the synchronous truncation is observed in more of the M31 dSphs.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13740
Program Title: Clusters Around Radio-Loud AGN: Spectroscopy of Infrared-Selected Galaxy Clusters at z>1.4

Principal Investigator: Daniel Stern

Spitzer has revolutionized studies of distant galaxy clusters. Largely courtesy of IRAC's efficiency at detecting and isolating massive galaxies at high redshift, several dozen clusters have now been confirmed at z>1, including a few massive systems at z>1.5. These cluster samples have, for example, probed the star-formation and mass assembly history of massive galaxies, studied the evolutionary role of AGN in galaxy clusters, and provided a target-rich sample of distant, massive galaxies in which to identify cosmologically interesting Type- Ia supernovae. Most of the distant clusters identified to date come from field surveys, effectively limiting the redshift and mass range of identified structures. Complementary targeted searches for clusters and proto-clusters around radio galaxies have proven quite successful due to the known tendency for radio-loud AGN to reside in rich environments. Taking advantage of this as well as the efficiency with which Spitzer detects and isolates L* galaxies at high redshift, we have identified a large sample of mid-infrared-selected galaxy cluster candidates from the 420 powerful radio-loud AGN fields observed by our 408 hr Warm Spitzer program, `Clusters around Radio-Loud AGN' (CARLA). We propose here to spectroscopically follow-up our 20 richest fields (at 1.4<z<2.8) using the WFC3 G141 slitless grism. The proposed 40-orbit program will increase the number of massive clusters known at z>1.5 by approximately an order of magnitude. Clusters at these high redshifts are valuable both for studying the formation and evolution of massive, early-type galaxies as well as a probe of fundamental cosmological parameters.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13741
Program Title:	Constraining the structure of the Narrow-Line Region of nearby QSO2s

Principal Investigator:	Thaisa	Storchi-Bergmann
PI Institution:	Universidade Federal do Rio Grande do Sul	

The Narrow-Line Region (NLR) of Active Galactic Nuclei (AGN) is the only resolved region of AGN, observed via high excitation ionized gas emission that extends from hundred to kiloparsec scales in the host galaxies. In nearby AGN (z<0.03), the NLR is known to present an elongated or cone-like morphology seen in type 2 AGN, and circular morphology in type 1 AGN, supporting the Unified Model. Nevertheless, at somewhat higher z's (~ 0.5) recent ground-based studies have found mostly circular morphologies in observations of QSO2s (obscured QSOs). But at the corresponding distances of these objects, ground-based observations lack the necessary angular resolution to fully resolve the NLRs. It is not clear if the intrinsic NLR morphology changes for more luminous AGN or this is an effect of the atmospheric seeing. Only with HST we will be able to resolve the NLR morphology down to a few hundred parsec scales in the galaxy. We thus propose a "mini-survey" of the NLRs by obtaining narrow-band images in [OIII] and Halpha +[NII] of a sample of nearby QSO2s spanning the redshift range 0.05<z<0.5 in order to constrain the extent, morphology and excitation of the NLR. These data will complement an homogeneous database of HST narrow-band images of ~100 Seyfert galaxies at z<0.03, and will allow us to constrain the relation between the radius and luminosity of the NLR over a luminosity range 39<log(L[OIII])<43.5 (L in erg/s). The Halpha+[NII] images will be used to calculate the gas masses and constrain the nature of the emission, providing also a census of the presence of recent star formation in the host galaxies.

Proposal Category: GO
Scientific Category: Resolved Star Formation
ID: 13742
Program Title: Kinematics of a Massive Star Cluster in Formation

Principal Investigator: Jonathan Tan
PI Institution: University of Florida

We propose to measure the proper motion stellar kinematics of a massive (~10^4Msun), forming proto-star-cluster to test basic theoretical models of formation. This will be the first time such a measurement has been performed. It requires HST-WFC3/IR and is beyond the practical capabilities of ground-based adaptive optics (AO) observations. In contrast to previously-studied massive, young (<10 Myr-old), already-formed clusters, such as NGC3603, Westerlund 1 or the Arches, our target protocluster, G286.21+0.17 (hereafter G286), is still gas-dominated and undergoing active star formation. It has been carefully selected from a complete survey of ~300 dense molecular gas clumps in a 120 sq. deg. region of the Galactic plane. The cluster is also relatively nearby (~2.5 kpc), but not too close that it would span a prohibitively large angular area or suffer from significant saturation problems. Such massive systems are rare and indeed we are unaware of any equivalent, early-stage (i.e., gas dominated) cluster that is closer. Given the depth of its gravitational potential based on its mass and size, the expected proper motions of many independent sub-clusters of stars are detectable at the ~5 sigma level over a 2-year baseline and global contraction of the cluster can be seen if it is happening even at just ~10% of the free-fall rate.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13743
Program Title: The Controversial Nature of the Diffuse UV Emission in Galaxies: Exploring NGC300

Principal Investigator: David Thilker
PI Institution: The Johns Hopkins University

The wealth of data produced over the past decade by sensitive IR and wide-field UV space facilities has ushered a new era for studies of star formation in galaxies, both at the whole-galaxy and sub-galactic (<~kpc) scale. These data underscore the difficulty of using standard methods, including the dust-corrected UV light, to measure star formation within galaxies, owing to the local variations in stellar population and dust properties. The UV should be a direct tracer of young stellar populations and recent star formation, yet UV colors in the 'diffuse' interarm regions of spiral galaxies are unusually red relative to those of spiral arms, even after accounting for dust attenuation. This suggests a complex mix of moderately aged stars and dust, plus perhaps scattered light. We will unveil the origin of those UV colors with new ACS far-UV (FUV) and WFC3 near-UV (NUV) images of the nearby, prototypical spiral NGC300, which will be combined with B,V,I archival images. By exploiting the dust-insensitivity of the HST FUV-NUV color for resolved stars,

we will obtain a census of both O and B stars in order to: (1) uncover the nature of the UV-emitting interarm stellar populations, while estimate the true diffuse fraction; (2) constrain the extinction law in both interarm+arm regions; (3) place UV-based SFR indicators on a secure footing for use both at low and high redshift. The angular resolution and UV capabilities of HST are crucial for this project. By directly addressing the use and limitations of UV colors to trace young stellar populations and dust attenuation in galaxies, this project maximizes the return from the large investment of HST time devoted to high-z surveys.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13744
Program Title:	Green Peas and diagnostics for Lyman continuum leaking in star-forming dwarf galaxies
Principal Investigator:	Trinh Thuan
PI Institution:	The University of Virginia

One of the key questions in observational cosmology is the identification of the sources responsible for cosmic reionization. The general consensus is that a population of faint low-mass galaxies must be responsible for the bulk of the ionizing photons. However, attempts at identifying individual galaxies showing Lyman continuum (LyC) leakage have so far not been successful, both at high and low redshifts. We propose here to observe directly the LyC of five so-called "Green Pea" (GP) galaxies. GPs share many of the properties of the Lyman Break galaxies at high z (compactness, low mass, low metallicity, high specific star formation rate, gas-rich and clumpy morphology) and may constitute local examples of the long sought-after LyC leaking galaxies. The five GPs have been identified by searching the Sloan Data Release 10 spectral data base of 2 million spectra for non-AGN emission-line objects that meet the following criteria: high [OIII]5007/[OII]3727 ratios, large GALEX FUV fluxes, and redshifted enough (z~0.3) so that the LyC is shifted into the sensitive spectral range of COS. Our unique GP sample will allow us to combine for the first time four fundamental tests for LyC leaking in galaxies and validate their usefulness as LyC leaking indicators : 1) direct measurements of the LyC; 2) high [OIII]/[OII] ratios; 3) characteristics of the Lyman alpha line profile; and 4) residual intensities in the low-ionization ISM absorption UV lines.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13745
Program Title:	Resolving the Tip of the Red Giant Branch of Two New Candidate Local Group Dwarf Galaxies
Principal Investigator:	Erik Tollerud
PI Institution:	

We propose to use ACS/WFC to observe two faint dwarf galaxies recently discovered via their HI emission. Based on a blind HI search of 40 HI clumps from 7500 square degrees of the GALFA-HI survey, these two candidates are the only objects with optical counterparts. They show HI and Halpha emission consistent with nearby galaxies, and have blue stars that are barely resolved in ground-based optical imaging with good seeing . These resolved stars are consistent with the galaxies being at Local Group distances. If they are in the Local Group, these galaxies are both less luminous and more compact than the recently-discovered Leo P, also found first with HI observations. They may then also be the faintest known star-forming galaxies. The ground-based imaging leaves large distance uncertainty, however, because the tip of the red giant branch cannot be resolved. We propose one orbit per galaxy of ACS/WFC imaging in F606W and F814W to measure accurate TRGB distances and determine if they truly are Local Group galaxies. If so, these galaxies provide tests on both the efficacy of Lambda CDM in predicting the properties of dwarf galaxies in low density environments, and the lowest-luminosity data points on models of galaxy star formation.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13746
Program Title:	Is the Crater satellite the Milky Way's Smallest Dwarf Galaxy or its Largest Globular Cluster?
Principal Investigator:	Matthew Walker
PI Institution:	Carnegie Mellon University

We propose deep ACS/WFC3 photometry that will reveal the nature and origin of the Galactic satellite known as 'Crater'. Crater exhibits properties intermediate between dwarf galaxies and globular clusters. As a dwarf galaxy, Crater would be the smallest and least massive known in the Galactic halo. As a globular cluster, Crater would be the largest and most distant. Our photometric observations will tell the age, metallicity, limits on metallicity spread, mass function and dynamical state of Crater's stellar population(s). We will use this information to distinguish whether Crater is 1) a dwarf galaxy that formed in a dark matter potential, or 2) a globular cluster that has grown to its current size via internal dynamical evolution. In either case, we will learn what mechanisms are responsible for Crater's extreme properties.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13747
Program Title: Understanding the In-Situ Star Formation in a z=1.7 Cluster Core Galaxy

Principal Investigator: Tracy Webb
PI Institution: McGill University

We have discovered a rare beast of a central galaxy within a z=1.7 rich galaxy cluster (estimated ~4x10^14 Msun), forming stars at a prodigious rate of 1200 Msun/yr. This system is infrared bright and its SED and the detection of PAHs at the cluster redshift, implies the IR luminosity is dominated by star formation. Such an extreme system has to date, only been confirmed in the z=0.6 Phoenix cluster (McDonald et al. 2012, 2013, 2014), whereas this object is observed at a much earlier and more active epoch of galaxy and cluster evolution. Here we propose deep HST imaging with WFC3 F160W/F105W to investigate the morphology of the BCG galaxy and its nearest neighbours. Our main goal is to understand the physical processes fuelling the intense starburst, be it a major merger or infalling gas from a cooling flow. We will also characterize the morphological properties (with color information) of the central BCG. These data will be the first of their kind at this redshift and will relate overall formation and evolution of the central galaxy massive parent halo at a cosmological epoch where these processes may begin to dominate.

Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13748
Program Title: Astrometric search for Planets in the closest Brown Dwarf Binary system Luhman 16AB

Principal Investigator: Luigi Bedin
PI Institution: Osservatorio Astronomico di Padova

Located at 2.0 pc, the L8+T1 dwarfs system Luhman16AB is the third closest system known to Earth, making it a key benchmark for detailed investigation of brown dwarf atmospheric properties, thermal evolution, multiplicity and planet-hosting frequency. Indeed, a recent ground-based astrometric campaign suggested this system to host a 5-30 Jupiter masses exoplanet.

We propose to use HST in spatial-scanning mode to obtain the most accurate annual parallax of any brown dwarf to date, achieving an unprecedented accuracy of 1 part in 10000 (50 micro-arcsecond) for each of the two components of Luh16, and to constrain their absolute space motions with similar accuracy. Most importantly, we will be able to confirm the giant planet candidate and to search for faint companions co-moving with the targets, either resolved or

through astrometric perturbations of the A-B orbital motion, the latter probing down to few Earth-masses.

Present-day ground-based direct imaging and AO facilities have fundamental limitations (field of view, PSF stability, differential chromatic effects, visibility) which introduce systematic and seasonal errors that are hard to quantify, and which have already resulted many times in clamorous false alarm in the recent past. This is particularly true for faint and red objects.

Luhman 16A and B will be problematic for GAIA (faint, color, crowding, visibility), and the here proposed HST spatial-scanning mode observations will actually be an important complementary validation of the final GAIA catalog itself (expected 2020). Similarly, JWST is not expected to provide any better astrometry than HST because of its broader

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Proposal Category:	GO
Scientific Category:	Quasar Absorption Lines and IGM
ID:	13749
Program Title:	Baryon Structures Around Nearby Galaxies: Using an Edge-On Disk to Assess Inflow/Outflow Models
Principal Investigator:	David Bowen
PI Institution:	Princeton University

We propose observing 6 QSOs whose sightlines pass through the halo of the highly inclined galaxy NGC 3510 at impact parameters of 62-139 kpc. This galaxy has the highest available surface density of UV-bright QSOs behind high-inclination spirals in the nearby Universe. Our principal goal is to use the projected positions and kinematics of gas clouds seen in absorption towards the QSOs in conjunction with the high inclination of the galaxy to differentiate between gas flowing into the galaxy from intergalactic medium filaments ("cold-flow" accretion), and gas flowing out of the galaxy from galactic winds. We will search primarily for Lyman-alpha, SiIII, and SiIV absorption from gas in the galactic halo, as well as NV from hot gas, and any other lower ionization species. These data will answer the basic questions of how absorber column density, covering fraction, and temperature all decline with impact parameter. More importantly, the data will show whether gas is found preferentially along the major or minor axis of the galaxy, and whether absorption line velocities conform to those expected from inflow or outflow models. NGC 3510 is undergoing a recent burst of star formation, and is likely at a young stage of its evolution. Our observations will address whether the current paradigm that has QSO absorption line systems arising primarily from star-forming galaxies holds when a single galactic halo is probed along multiple sightlines.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13750
Program Title:	Fundamental Parameters of the SHIELD II Galaxies
Principal Investigator:	John Cannon

The "Survey of HI in Extremely Low-mass Dwarfs" ("SHIELD") is a multiwavelength, legacy-class observational campaign that is facilitating the study of both internal and global evolutionary processes in 12 low-mass dwarf galaxies discovered in early Arecibo Legacy Fast ALFA (ALFALFA) survey data products. Cycle 19 HST observations of the 12 SHIELD galaxies have allowed us to determine their TRGB distances, thus anchoring the physical scales on which our ongoing analysis is based. Since the inception of SHIELD, the ALFALFA survey has completed data acquisition, thereby populating the faint end of the HI mass function with dozens of SHIELD analogs. In this proposal we request ACS imaging of 18 of these "SHIELD II" galaxies that have already been imaged in the HI spectral line with the WSRT. These data will enable a holistic HST imaging study of the fundamental parameters and characteristics of a statistically robust sample of 30 extremely low-mass galaxies (including 12 SHIELD and 18 SHIELD II systems). The primary science goal is the derivation of TRGB distances; the distance dependence of many fundamental parameters makes HST observations critical for the success of SHIELD II. Additional science goals include an accurate census of the dark matter contents of these galaxies, a spatial and temporal study of star formation within them, and a characterization of the fundamental parameters that change as galaxy masses range from "mini-halo" to star-forming dwarf.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13751
Program Title:	Imaging the Crab nebula when it is flaring in gamma-rays

Principal Investigator:	Andrea	De Luca
PI Institution:	INAF - IASF Milano	

One of the most intriguing results of the gamma-ray instruments currently in orbit has been the detection of powerful flares from the Crab Nebula. Such events, with a recurrence time of about once per year, can be so dramatic to make the system the brightest source in the gamma-ray sky, as it occurred in April 2011. Such a discovery challenges our understanding of how pulsar wind nebulae work and defies current astrophysical models for particle acceleration. With the aim of locating the site(s) of the flares, an ad hoc HST strategy have been put in place to be prepared and react promptly in case of a new brightening in gamma rays. We ask here for a triggered TOO observation of the Crab Nebula with ACS/WFC in case a gamma-ray flare is announced by the Agile and/or the Fermi missions. This TOO is crucial part of a multiwavelength program that we have organized, based on lessons learnt from our follow-up observations of previous flares, including a regular (quarterly) monitoring of the source both in X-rays and optical through a joint Chandra-HST proposal.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13752
Program Title: An autopsy of dead planetary systems with COS

Principal Investigator: John Debes

PI Institution: Space Telescope Science Institute

We propose to use HST/COS to conduct autopsies of dead planetary systems around UV bright hydrogen-white dwarfs (WDs), which have dust disks found via their mid-IR emission in excess of that expected from the photosphere. As part of a WISE survey, and followed up with a combination of NASA Keck HIRES/Magellan MIKE optical spectroscopy, we have identified three new systems that are accreting dust. These WDs are bright in the mid-IR and UV, gold-standard targets for studies with HST/COS and later with JWST. The dusty material is debris resulting from the tidal disruption of exo-asteroids that accrete onto the WD surface. Many atomic elements from the accreted and dissociated dust particles are detectable with COS, enabling abundance determinations of exo-asteroidal material. Moreover, the photospheric abundances of this material can be directly compared with a determination of the dust mineralogy obtained with future JWST mid-IR spectroscopy-our proposed UV observations provide complementary constraints on mineralogical compositions of the accreting dust particles.

UV spectroscopy is crucial for cataloging elemental abundances for these exo-asteroids. For the majority of WDs, optical spectroscopy reveals only a couple of lines of Ca or Mg, while UV spectroscopy captures lines from Al, Fe, Si, C, Ni, O, S, Cr, P, and Ti. Obtaining the elemental abundances of exo-asteroids is comparable to the spectroscopic characterization of transiting exoplanets or protoplanetary disks-all of these techniques determine how the chemical diversity of planetary systems translate into planetary architectures and the probability of habitable planets around solar-type stars.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13753
Program Title: Pushing to 8 AU in the archetypal protoplanetary disk of TW Hya

Principal Investigator: John Debes

PI Institution: Space Telescope Science Institute

We propose to use eight orbits of HST/STIS coronagraphy with the new bent finger occulter (BAR5) to probe, for the first time in visible scattered light, the protoplanetary disk of TW Hya down to as close as 8-13 AU (0.15-0.24"; roughly Saturn's orbit). That distance is a factor of three improvement compared to previous STIS images of this disk taken in 2000. HST/STIS provides a unique window through visible wavelengths at inner working angles on Solar System scales and at a spatial resolution comparable to the highest resolution modes of ALMA in Cycle 2. Previous scattered light observations show that the surface brightness of the disk abruptly changes its character interior to 50 AU, which could be indicative of a gap opened by a forming planet, a large opacity change, or shadowing from the inner disk. We will probe the inner disk at high fidelity, with the goal of discriminating between these three possibilities. A secondary goal will be to look for brightness variations and Keplerian motion of structures in the outer disk during the

15 year baseline between images. These legacy observations of TW Hya's small dust grain population will provide an anchor for future JWST, ALMA, Gemini Planet Imager (GPI), SPHERE, and polarimetric observations of this disk.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13754
Program Title: The first mass and angular momentum loss measurements for a CV-like binary

Principal Investigator: Jeremy Drake

PI Institution: Smithsonian Institution Astrophysical Observatory

The period distribution of close binaries, cataclysmic variables, novae and single-degenerate SN1a progenitor candidates is largely controlled by magnetically-driven mass and angular momentum loss (AML) from the M dwarf secondary. The mass loss rates for these spun-up stars remain essentially unknown and impossible to observe directly, with likely values in the range 1e-12 to 1e-15 Msun/yr. AML presciptions for CVs differ by orders of magnitude. One way to measure the mass loss rate is to observe the dM wind accrete onto its WD companion in a pre-CV very close to Roche Lobe overflow but lacking the obscuring complications and emission from an accretion disk. The measurement can be combined with realistic MHD models to understand the accretion fraction, the mass that escapes, and the AML. The best-studied nearby pre-CV is QS Vir (48pc, P=3.6hr). However, its wind accretion rates measured from 1999 HST UV spectra of the WD metal absorption lines and 2006 XMM-Newton CCD spectroscopy differ by a factor of a thousand, pointing to either a dominant CME stochastic component, or a "magnetic switch" found in MHD simulations and driven by cyclic activity on the M dwarf. HST COS spectra combined with XMM-Newton monitoring on timescales from weeks to years will tease out CME vs cyclic accretion variations. UV and X-ray measurements will provide the first consistency check of both accretion rate measurement methods. MHD models tailored to the system will enable the first quasi-direct measurements of the mass loss and AML from a CV-like binary. Our project requires 6 HST/COS orbits in Cycles 22-24, and 60ksec on XMM in Cycle 22

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13755
Program Title: The Hosts of Megamaser Disk Galaxies (II)

Principal Investigator: Jenny Greene

PI Institution:

We propose to observe ten new megamaser disk galaxies. Much like in NGC 4258, the megamasers in our sample trace sub-pc, circumnuclear gas in Keplerian rotation around central supermassive black holes (BHs). From the maser disk, we derive the most precise BH masses (<10%) outside of our own Galactic Center, as well as a very precise orientation for the megamaser disk. These megamaser galaxies are the best available tool to study BH demographics in spiral galaxies, but HST resolution is required to disentangle the nuclear disks, star-forming rings, bars, and dust from any underlying bulge component. Using F336W, F438W, F814W, F110W, and F160W observations of these galaxies with WFC3, we will derive accurate bulge masses to study BH-galaxy scaling relations. We will then compare the orientation of the ~100 pc-scale structures we find with that of the accretion disk on sub-pc scales, to determine the mechanisms that connect the galactic ISM to accretion. The ten new megamaser disk systems proposed here not only double the entire megamaser sample with uniform HST imaging, but crucially add six new dynamical BH masses with M_BH<10^7 M_sun.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13756
Program Title:	Rings within Rings: High Resolution Imaging of a Spectacular Gravitational Lens
Principal Investigator:	Saurabh Jha
PI Institution:	Rutgers the State University of New Jersey

We propose WFC3 optical and infrared imaging of the largest, nearly-complete Einstein ring known. The ring has an extreme diameter, approximately 20 arcseconds, and is the result of gravitational lensing by a massive cluster elliptical galaxy at z = 0.36. This spectacular system shows two source galaxies (perhaps interacting), resulting in double arcs with striking differences in color. The proposed high resolution images will unveil detailed structure in the ring arcs (which exhibit a complex structure), allowing for the identification of multiply imaged regions in the source galaxies. Modelling the images over the full range of position angles around the rings will provide the best constraints on the lens mass distribution, and will connect observations and models from galaxy to cluster scales. These data will allow for the study of spatially resolved star-formation in the source galaxies, and enable additional followup through a more democratic window to the high-redshift Universe.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13757
Program Title: The Progenitor System of a Peculiar Thermonuclear White-Dwarf Supernova

Principal Investigator: Saurabh Jha
PI Institution: Rutgers the State University of New Jersey

Type Ia supernovae (SN Ia) have enormous importance to cosmology and astrophysics, but their progenitors and explosion mechanisms are not known in detail. Recently, observations and theoretical models have suggested that not all thermonuclear white-dwarf supernova explosions are normal SN Ia. In particular, type Iax supernovae (peculiar cousins to SN Ia), are also thought to be exploding white dwarfs. In deep and serendipitous HST pre-explosion data, we have discovered a luminous, blue progenitor system for the type Iax SN 2012Z in NGC 1309. The light in this system, called S1, could be dominated by: a companion star to the exploding white dwarf, accretion onto the exploding white dwarf, a massive star that exploded (suggesting SN Iax are not in fact white-dwarf supernovae), or if we were very unlucky, an unrelated star in a chance alignment. Here we propose HST Cycle 22 ACS/WFC optical imaging to see what, if anything, has happened to S1. These data will allow us to definitively confirm and characterize what may be the first progenitor system discovered for a thermonuclear white dwarf supernova.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13758
Program Title: The Age-Metallicity relationship of the Galactic Bulge via Stromgren Photometry

Principal Investigator: Andreas Koch
PI Institution: Landessternwarte Heidelberg

We propose to use the WFC3 Stromgren filter set to image the Galactic bulge in the well studied SWEEPS deep field. The main aim is an independent test of a putative intermediate age, metal rich, population seen in the microlensed dwarf population. Proper motion separation, combined with the application of the Stromgren photometric measurements, offers the potential of determining the age-metallicity relationship for the bulge, which no present ground-based facility can attempt. The age-metallicity relationship is a fundamental description of the formation history of the Galactic bulge, and the age/metallicity precision of the Stromgren calibration offers our best hope of constraining the age range in the bulge population. At present, there is strong evidence that the bulge is actually a bar that has buckled dynamically into its present form. However, the presence of an abundance gradient is at odds with purely dynamical secular evolution, unless the metal poor population is also signficantly older than the bulk of the more

metal rich stars. Our proposed observations can also separate out dwarfs with [Fe/H]<-2, that are rare in the bulge and may have unique kinematics if they are associated with a "first stars" generation of formation.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13759
Program Title: Extreme Variability in the M87 Jet

Principal Investigator: Juan Madrid

PI Institution: Swinburne University of Technology

The M87 jet is experiencing extreme optical/UV variability and very high energy emission that were never anticipated. HST-1, a knot along the M87 jet located at ~0.85" from the nucleus, has experienced unusual and repeated flaring at all wavelengths during the last decade: exceptional brightness variability for an individual component of an AGN jet. Hubble Space Telescope observations revealed that the NUV intensity of HST-1 increased by a factor of 100 between 1999 and 2005. Equivalent variability was recorded by Chandra, and the VLA. This is an unprecedented event that has only been observed in the M87 jet and has serious implications for models of jet variability and unified schemes of AGNs. Similarly, all three major Cherenkov observatories studying very high energy gamma-rays reported flaring of M87 in the very high energy regime in 2005, 2008, and 2010.

This proposal aims at obtaining a single orbit image of the M87 jet with STIS to determine the evolution of the rapidly changing M87 jet during Cycle 22. This new image will be an important addition to the dataset of HST observations of M87 in the optical and near ultraviolet spaning more than 20 years. A single observation of the M87 jet in 2015 will also make a substantial contribution to the interpretation of M87 observations built by Chandra.

With these observations we aim to: study the physical origin of the flare, find new and longer periodicities for this event, and measure the impact of such an energetic burst on the outflow of an AGN jet.
We will also follow the emergence of new knot along the M87 jet, unrelated to HST-1, and present during the last years of STIS observations.

Proposal Category: SNAP
Scientific Category: ISM and Circumstellar Matter
ID: 13760
Program Title: Filling the gap --near UV, optical and near IR extinction

Principal Investigator: Derck Massa

PI Institution:

We propose a SNAP program to obtain STIS low resolution near-UV, optical and near-IR (G430L and G750L) spectra for a set of O7-B7 class III-V stars in the Galaxy and Magellanic Clouds with available IUE or HST/STIS UV spectropotometry, optical photometry and 2MASS IR photometry. Together with the existing data, the new observations will provide complete photometric and spectrophotometric coverage from 1150 to 10000 A and enable us to produce complete extinction curves from the far-UV to the near-IR, with well-determined values of R(V). The proposed set of 150 program sight lines includes the full range of interstellar extinction curve types from both the Galaxy and the Magellanic Clouds. The new data will allow us to examine variability in the near-UV through near-IR spectral regions, including the UV-optical "knee", and the "Very Broad Structure" and to verify the applicability of the near IR extinction law recently derived by Fitzpatrick and Massa (2009). We will examine the response of these features to different interstellar environments and their relationship to other curve features. These are largely unexplored aspects of the extinction curves which will provide additional constraints on the properties of interstellar grains. The curves will be derived using model atmospheres for the program stars, eliminating the need for standard stars.

Proposal Category:	SNAP
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13761
Program Title:	High efficiency SNAP survey for Lyman alpha emitters at low redshift
Principal Investigator:	Stephan McCandliss
PI Institution:	The Johns Hopkins University

The goal of this proposal is to provide the first statistically significant survey of star-forming galaxies with Lyman alpha emission at redshifts $0.02 < z < 0.24$. It will provide an overall assessment of the evolution in Lyman alpha luminosity at the lowest redshifts and allowed detailed studies of the physical processes that shape the Lyman alpha profile and govern escape in multi-phase, kinematic media. It will also provide a serendipitous search for star-forming galaxies with high LyC escape fractions that are analogous to those commonly invoked as being responsible for initiating and sustaining the epoch of reionization. The SNAP survey proposed here employing the G140L mode of COS offers a highly efficient means to examine the Lyman alpha emission properties of our candidate emitters and to inform our choice of objects that could warrant deeper integrations in future observations. These data have high UV legacy value and will be of broad interest to the star-forming galaxy community, so we have elected to waive the proprietary period.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13762
Program Title: A powerful starburst at z=5.4 with strong Lyman alpha emission: resolved SED with HST

Principal Investigator: Ian McGreer
PI Institution: University of Arizona

We serendipitously discovered the brightest galaxy known at z>5 as part of a faint quasar survey. LAEJ1414+5446 has extremely strong Lyman alpha emission and a bright stellar continuum, consistent with an unobscured star formation rate of ~300 Msun/yr. This object is uniquely suited for detailed studies of a powerful starburst galaxy near the epoch of reionization. Archival HST snapshot imaging in a single band (blueward of Lyman alpha) shows that the galaxy resolves into multiple emission components on 0.4" scales. We propose multi-band imaging with ACS/WFC and WFC3/IR in order to fill out the spectral energy distribution (SED) at rest-frame UV wavelengths, while resolving the individual emission clumps. Combined with Spitzer observations, the UV SED will constrain the star formation activity, stellar population age, and dust extinction in an extremely luminous starburst at z>5. We will map the Lyman alpha emission in a narrow band and use SED modeling to estimate the escape fraction of ionizing photons. Constraints on the star formation activity and history of a potentially massive galaxy at z>5 will impact models of galaxy formation during the reionization epoch and provide clues to the star formation activity at higher redshift that is thought to drive reionization.

Proposal Category: GO
Scientific Category: Resolved Star Formation
ID: 13763
Program Title: WFC3 Spectroscopy of Faint Young Companions to Orion Young Stellar Objects

Principal Investigator: S. Megeath
PI Institution: University of Toledo

We propose G141 grism spectroscopy of faint young companions to young stellar objects (YSOs) in the Orion molecular cloud which were recently identified in a WFC3/HST 1.6 micron survey of 320 YSOs in Orion. We will target the ten faintest companions detected between 80-1000 AU which have F160W magnitudes between 19 and 22.6 mag; these are too faint to obtain spectra from ground-based telecopes. The faint magnitudes of these ten companions suggest that they have masses as small as 5 Mjupiter depending on their age and reddening. To determine spectral types and masses for these sources, we will use grism spectroscopy to detect broad water features in the photospheric spectrum. These observations are part of a coordinated spectroscopy campaign; the remaining 50 brighter companions will be observed using spectrographs on the IRTF and SUBARU. These data will constrain the companion mass function at projected separations of 80-1000 AU from Orion young stellar objects. Given their faint

magnitudes, as many as half of the 60 companions may be below the Hydrogen burning limit. With spectra, we can determine whether there is an excess of sub-stellar companions relative to the field IMF at these separations; the detection of such an excess would be evidence for the formation of sub-stellar objects in the outer regions of protostellar disks. Furthermore, the observed fraction of companions at these separations increases from 7.8 to 14.1% between low and high stellar density region in Orion; suggesting that the formation of multiple sytems is dependent on the birth environment. With spectra, we can explore the dependence of the companion mass function on the birth environment.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13764
Program Title: The Physics of the Jets of Powerful Radio Galaxies and Quasars

Principal Investigator: Eric Perlman

PI Institution: Florida Institute of Technology

We propose HST polarimetry of the jet of 3C 273. Polarization is a critical parameter for understanding jet flows, and only HST has the resolution and capability to perform this measurement. The data will confirm which mechanisms are operating to create its optical and X-ray emission, and will show locations where the magnetic fields are being structured by shocks and shears. This will greatly advance modeling efforts for this jet and nail down its kinetic power, a key unknown parameter for understanding quasars and their cosmological effects. Comparison with in-hand radio and ground-based near-IR (AO) optical polarimetry at matched resolution will measure the flow speed in the plasma as a function of particle energy, in the same way as in our analysis of our earlier HST polarimetry data on low-power jets.

This proposal builds on our observations of two other quasar jets, where we measured high polarization in the X-ray brightest knots, and so showed that their optical and X-ray emission is most likely due to the synchrotron model, since the alternative, IC/CMB model fails to match those objects' steep radio spectra and modest variability, and requires exceptionally fast flows (Gamma>30) at hundreds of kpc and super-Eddington kinetic power. The proposed observations will provide much stronger constraints because this iconic jet, because of its brightness, exceptional angular separation from the core and low redshift (z=0.158). Our modelling techniques will also provide much information on the jet's internal structure, including shocks and the sites of particle acceleration.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13765
Program Title: A Cepheid-Based Distance to the Benchmark AGN NGC 4151

Principal Investigator: Bradley Peterson

We propose to measure an accurate Cepheid-based distance to the archetypical Seyfert 1 galaxy NGC 4151, the brightest and arguably best-studied AGN in the sky. The current uncertainty in its distance is no less than 20% (the irreducible limit of the Tully-Fisher method, which in any case we argue systematically underestimates distances of AGNs), and consequently all luminosity and energetics measures are uncertain by more than 40%. The results of detailed studies of feedback, infall, and outflow and the interaction of gas, radiation, and winds in this galaxy have implications for our understanding of other galaxies because there are so few galaxies that can be observed in such great detail. Importantly, recent developments allow a direct high-precision comparison of black hole masses measured from gas and stellar dynamical modeling (distance dependent) and reverberation mapping (distance independent). With a precise distance measure, it is possible to address lingering doubts about the consistency of black hole mass measurement by these various methods. This program must be done at visible wavelengths and, on account of field crowding, can only be done with the high angular resolution obtainable with HST.

Proposal Category:	GO
Scientific Category:	Resolved Star Formation
ID:	13766
Program Title:	The nature of stationary components in jets from young stellar objects

Principal Investigator:	Peter	Schneider
PI Institution:	Universitat Hamburg, Hamburger Sternwarte	

There is increasing evidence that jets are essential for the star formation process. Our understanding of the jet launching process is, however, still fragmentary. In particular, new observations revealed (a) that jets from young stellar sources possess hot, stationary components close to the driving source that contrast the well-known moving parts of the jets further out and (b) possible evidence for plasma acceleration within a few 10 AU from the source.

We propose to follow-up these new results by providing the required diagnostics to uncover the controversial origin of the stationary component and to constrain the location where the outflowing plasma is accelerated. Specifically, we propose to observe the classical T Tauri star DG Tau with STIS and the slit oriented along the jet axis to measure the plasma density of the warm (1e4 K) and hot (1e5 K) parts of the jet to distinguish between proposed models for the stationary component, as well as to follow the plasma traveling through the jet collimation region to test current jet launching models.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13767
Program Title: Bright Galaxies at Hubble's Detection Frontier: The redshift z~9-10 BoRG pure-parallel survey

Principal Investigator: Michele Trenti
PI Institution: University of Cambridge

Hubble/WFC3 observations transformed our view of early galaxy formation by building reliable samples of galaxies out to redshift z~8, ~700 Myr after the Big Bang and hinting at a dramatic evolution in properties at yet earlier times. From z~8 to z~10 (~200Myr) the luminosity density seems to decrease by a factor ten, but bright galaxies may remain relatively common, based on the four z>9 objects detected so far with m_AB<27. To investigate this apparent conundrum, and study the formation of the most massive and luminous galaxies at ~500 Myr without being affected by cosmic variance, we propose a random-pointing survey to detect 20+/-5 galaxies at z ~ 9-10 as faint as m_AB=27.1 (5-sigma) at zero prime orbit cost. This request builds on our successful Cycle 17 & 19 Brightest of Reionizing Galaxies (BoRG) Survey, which found the largest sample of L>L* galaxies at z~8. BoRG[z8] demonstrated, by adding constraints from the Ultra Deep Field (UDF), that the luminosity function follows a Schechter form, as at lower z, but with a steeper faint-end slope, leading to a photon production sufficient to complete reionization. BoRG[z9-10] will similarly complement the UDF and Frontier Fields datasets by imaging ~550 arcmin^2 over 120 sightlines in five WFC3 bands (F350LP, F105W, F125W, F140W, F160W). Besides twenty new catches at z>9, we will double (from ~60 to ~120) the number of bright z~8 galaxies within reach of spectroscopy, to tighten constraints on Ly-alpha emission and reionization obtained by our BoRG@Keck follow-up. This new public dataset will reveal the connection between massive dark matter halos and formation of first galaxies, and create a legacy of rare targets for JWST

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13768
Program Title: Completing the Census of Isolated Dwarf Galaxy Star Formation Histories

Principal Investigator: Daniel Weisz
PI Institution: University of California - Santa Cruz

We propose to complete our census of the ancient star formation histories (SFHs) of isolated dwarf galaxies by obtaining deep ACS/WFC optical imaging of WLM and Pegasus Dwarf Irregular Galaxy (PegDIG). They are the only two systems without previous deep HST imaging that are isolated yet close enough to guarantee that their oldest main sequence turnoffs are accessible with HST, and do not have previous deep HST imaging. We will measure their lifetime SFHs with an age resolution of < 1 Gyr at all epochs to address questions about growth of stellar mass, the effects of reionization, radial population gradients, and variable star populations in WLM and PegDIG.

This program is a concerted effort between theorists and observers to obtain the best possible observational constraints on the the early epochs of isolated low mass galaxies, which are essential to the next generation of galaxy

simulations. With these new observations we will have completed our efforts to collect precise lifetime SFHs of all nearby isolated dwarfs that are accessible with HST. We will create a legacy sample of 5 isolated dwarfs (2 new, 3 archival) with identically derived SFHs, that will be serve as the baseline for the community's understanding of how low mass galaxies form and evolve over a Hubble time and in the absence of environmental effects of a massive host (e.g., tides, ram pressure). These are the only galaxies for which such measurements can be made, and only HST is capable of acquiring the necessary observations.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13769
Program Title: Trans-iron group elements in hot helium-rich white dwarfs

Principal Investigator: Klaus Werner
PI Institution: Eberhard Karls Universitat, Tubingen

Our recent detection of twelve trans-iron group elements (Z=30-56) in the hot helium-rich white dwarf (i.e. spectral type DO) RE0503-289 is a unique discovery. This phenomenon was never observed before in any white dwarf. Abundance analyses hitherto performed for five species (Zn, Ge, Kr, Xe, Ba) reveal values between 155 and 23000 times solar. There are reasons to believe that these extreme overabundances are connected to the evolutionary history of the DO white dwarfs. They are the outcome of a late helium-shell flash that consumes all hydrogen in the stellar envelope and at the same time dredges up helium-rich intershell matter that is enriched with s-process elements. These elements were synthesised in the preceding AGB phase of the evolution. We argue that if RE0503-289 is a typical representative of the DO white dwarfs, then all DOs with similar effective temperature should also show these extraordinary chemical diversity and overabundances. In order to prove this hypothesis, we want to obtain FUV spectra of two other hot DO white dwarfs plus a representative of the PG1159 stars, which are thought to be immediate progenitors of DO white dwarfs. If all three targets show the same heavy-metal abundance pattern, then these objects hold the promise that their metal abundances can be used to constrain AGB star nucleosynthesis. If otherwise RE0503 -289 remains a unique object, then an alternative evolutionary scenario (binary WD merger) is probably responsible for its extreme element abundances.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13773
Program Title: H-alpha LEGUS: Unveiling the Interplay Between Stars, Star Clusters, and Ionized Gas

Principal Investigator: Rupali Chandar
PI Institution:

We propose to obtain narrow-band, H-alpha observations for a significant subset of the star-forming, nearby galaxies recently targeted by the LEGUS treasury program (GO-13364). LEGUS is observing these galaxies in five broad-band filters: NUV, U, B, V, and I. The new H-alpha observations will reveal thousands of previously undetected HII regions, including those ionized by stellar clusters and single massive stars, allow us to measure their luminosities and sizes, and to separate discrete sources from diffuse ionized gas. We will use our narrow-band imaging survey to: (1) establish the connection between star and cluster formation, and determine the prevelance with which isolated massive stars form in different galaxies; (2) determine whether the initial cluster mass function is universal; (3) investigate the size evolution of ionized gas bubbles, and how this depends on cluster age and mass, as well as on local galactic conditions; and (4) place stringent limits on the leakage of ionizing photons from HII regions, and better understand how the interplay between properties of the ionizing source and the morphology of the HII region impacts leakage. The broad goal of this study is to better understand how feedback from massive stars affects the surrounding medium. Ultimately, the interplay between feedback and the ISM on these scales will enable a better understanding of galaxy-scale outflows in the early universe, a process critical to galaxy evolution. This program naturally lends itself to an improvement of the scientific output by involving the general public via an already established Citizen Science program.

Proposal Category:	GO
Scientific Category:	Quasar Absorption Lines and IGM
ID:	13774
Program Title:	Feeding and feeback: The impact of AGN on the circumgalactic medium.

Principal Investigator:	Sara	Ellison
PI Institution:	University of Victoria	

A galaxy's history is shaped by the fuelling and feedback of gas both from and into the circumgalactic medium (CGM). The importance of the CGM in low z galaxies has been unequivocally demonstrated in recent years, thanks to the availability of COS and a coupling with large galaxy surveys. These studies have traced the HI and metals out to several hundred kpc, revealing a rich and extended medium around star-forming galaxies. However, the impact of AGN on this CGM is almost completely unknown. We propose to observe the CGM probed by background QSOs at impact parameters up to 175 kpc around 10 moderately high luminosity AGN-dominated galaxies selected from the SDSS. By comparing with an archival sample of non-AGN in the same stellar mass, redshift and impact parameter regime we will investigate 1) the extent of the halo, its velocity structure and its metal enrichment and 2) the ionization structure and physical properties of the AGN galaxies' CGM. These objectives are both scientifically timely and yet only recently achievable, thanks to the combination of COS's high sensitivity, the compilation of large numbers of local AGN, and the development of sophisticated ionization models by our team.

Proposal Category: GO
Scientific Category: Resolved Star Formation
ID: 13775
Program Title: Testing EUV Photoevaporation Models in Young Disks

Principal Investigator: Catherine Espaillat
PI Institution: Boston University

The lifetime of gas in young disks places an upper limit on the timescale for giant planet formation. This lifetime is dictated by the rate at which gas is eroded by photoevaporative winds created by high-energy radiation from the central star. Observations suggest that EUV emission may play an important role in photoevaporation. However, EUV emission cannot be directly observed due to its high opacity. One way to indirectly trace the EUV is by simultaneously measuring X-ray and FUV/NUV emission to extrapolate the intervening EUV spectrum. Here we apply for 6 orbits with HST to observe 3 T Tauri stars with STIS, which traces the FUV/NUV wavelengths. We will observe these objects simultaneously with SWIFT, which traces the X-ray wavelengths, via our institutional access. When combined, these observations can characterize the EUV spectrum and thus the efficiency of photevaporation, providing constraints on the disk clearing timescale and the potential for planet formation in disks.

Proposal Category: SNAP
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13776
Program Title: Completing the Next Generation Spectral Library

Principal Investigator: Michael Gregg
PI Institution: University of California - Davis

We propose to complete our STIS UV+optical snapshot program, the Next Generation Spectral Library, which now stands at 380 targets. When complete the NGSL will comprise 600 stars, roughly equally divided among four metallicities, very low ([Fe/H] < -1.5), low (-1.5 < [Fe/H] < -0.5), near-solar (-0.3 < [Fe/H] < 0.1), and super-solar ([Fe/H] > 0.2), well-sampling the entire HR-diagram in each bin. The finished NGSL will be invaluable for modeling the integrated light of galaxies and clusters, as well as calibrating the stellar effective temperature scale to <1% precision. Included in the updated target list for Cycle 22 are select "touchstone" stars with precise radii measured with long baseline interferometry, which will be used in the absolute calibration of the stellar effective

temperature scale. Upon completion, the NGSL will surpass all extant spectral libraries because of its combination of UV spectral coverage and comprehensive metallicity range, with lasting archival value well into the JWST era and beyond. Because of the universal utility and community-broad nature of this venture, we waive the proprietary period. While snapshot proposals are ineligible for the UV initiative, the scientific returns from this program stem mainly from the HST/STIS UV capabilities.

Proposal Category:	GO
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13777
Program Title:	Morphological Transformation in the Coma Cluster
Principal Investigator:	Michael Gregg
PI Institution:	University of California - Davis

This proposal seeks to document the various stages of ram pressure stripping of bright spiral galaxies evolving in the rich Coma cluster environment. Based on two ram pressure stripping examples we have already found in Coma, we have selected an additional five targets which manifest signs of ICM-ISM interactions. These seven objects are distributed in a ring around the inner core of Coma, sampling different locations in the cluster and each can be expected to show a different phase of evolution of the stripping process. We propose WFC3 UVIS and IR imaging to reveal the details of the interactions. From these observations, we will be able to piece together a coherent picture of the processes which drive morphological transformation and evolution of disk galaxies in rich environments. The ionization and global star formation patterns, both spatial and temporal, will reveal and characterize the ISM-ICM interactions driving the evolution of galaxies in clusters and altering their morphologies.

Proposal Category:	GO
Scientific Category:	ISM in External Galaxies
ID:	13778
Program Title:	Using ISM abundances in the SMC to Correct for Element Depletions by Dust in QSO Absorption Line Systems
Principal Investigator:	Edward Jenkins

The availability of 10-m class telescopes with high resolution echelle spectrographs has enabled astronomers to measure accurately the gas-phase abundances of various elements in QSO absorption line systems at high redshifts. These systems offer insights on the chemical evolution of galaxies (and their nearby environments) in their early stages of development. However, in order to obtain total abundances the observations need to be corrected for the depletions caused by the formation of dust, and traditionally people have done so by using the depletion patterns seen in our own Galaxy. There is now evidence that indicates that such patterns in low-metallicity systems differ from those of our Galaxy and thus the corrections may be misleading. The aim of our proposed HST observations is to measure the gas-phase abundances toward stars in the Small Magellanic Cloud, which is a low-metallicity dwarf galaxy where there exist good measurements of stellar comparison abundances. We plan to record ISM absorption features from STIS medium-resolution echelle spectra for 14 stars in the SMC that are known to have varying levels of depletion, so that we can derive the gas-phase abundance patterns of the elements Ni, Fe, Cr, Mn, Si, Mg, Ge, Kr, Zn, and perhaps P.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13779
Program Title:	The Faint Infrared Grism Survey (FIGS)

Principal Investigator:	Sangeeta	Malhotra
PI Institution:	Arizona State University	

We propose uniquely deep near-infrared spectroscopy using the WFC3 IR grism down to a continuum limit of J=26.5, and line flux limit 4e-18 ergs/cm^2/s, yielding spectra of 6000 sources in 4 fields. Only Hubble can achieve such sensitivity, as we have demonstrated in our previous deep grism surveys with ACS.
With the deep spectra obtained in the FIGS survey we will:
(1) Probe the reionization epoch by spectroscopy of galaxies at z = 5.5-8.5, whether or not they show Lyman-alpha (LyA) line emission. Continuum breaks are hard to detect from the ground and LyA lines may be scarce at these redshifts. Spectroscopic redshifts will probe galaxy clustering and improve luminosity measurements, thereby improving estimates
of reionizing photons by at least 40%.
(2) Robustly measure the fraction of galaxies with high EW LyA, to measure the neutral fraction of the IGM. We will be sensitive to LyA lines in the central period of reionization where we expect to see a change in LyA fraction.
(3) Illuminate the formation processes of early type galaxies at 1<z<2, down to a few 10^9 solar masses.
(4) Study star-formation, dust extinction and metallicity evolution during the peak of star-formation at z=1-2, using hundreds of low-mass emission line galaxies.
The lasting legacy of this project will be spectra of over 6000 galaxies, without preselection, at an unprecedented depth not possible from the ground. These spectra can inform us about the nature of sources found at other wavelengths by ALMA, Herschel, Spitzer.
We waive all proprietary rights, and will make fully reduced data products public, adding to the legacy of HST by doing what only the WFC3-IR grism can do: truly deep spectroscopy.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13780
Program Title: The Nature of Newly Discovered Wolf-Rayet Stars in the LMC

Principal Investigator: Philip Massey
PI Institution: Lowell Observatory

We have recently discovered five Wolf-Rayet (WR) stars in the LMC which might be naively classified as "WN3+O3 V." However, such a pairing is unlikely for a number of reasons: (a) O3 V stars are very rare, as they are the hottest and most luminous of the dwarfs; (b) the absolute visual magnitudes of our stars are quite faint (Mv=-3) compared to even an O3 V star by itself (Mv=-5.5); (c) these stars do not exhibit radial velocity variations, although our data on this are admittedly limited; and (d) such a pairing would be hard to understand from a stellar evolution point of view, since a massive star will evolve out of the O3 V phase in about a million years, while it takes several million years to form a WN star. We are forced to conclude that we have discoverd a new class of WRs. We have excellent optical spectra with Magellan, and our modeling of these data suggest a very high effective temperature (70,000 K), strongly enhanced nitrogen, and a very low mass-loss rate. However, these physical parameters are poorly constrained by the optical data alone, and we now seek UV spectra that will contain lines that will better determine the temperatures, and the important resonance lines that provide crucial diagnostics of the stellar winds. The results of this modeling will allow us to understand the nature of these objects, and where they fit in the evolution of massive stars. If they are the products of single star evolution, they indicate we have some fundamental misconceptions. If they are the products of binary evolution, how do we explain the absence of any companions? We can only address these questions by having reliable stellar parameters and abundances.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13781
Program Title: WO-Type Wolf-Rayet Stars: the Last Hurrah of the Most Massive Stars?

Principal Investigator: Philip Massey
PI Institution: Lowell Observatory

WO-type Wolf-Rayet (WR) stars are considered the final evolutionary stage of the highest mass stars, immediate precursors to Type Ic (He-poor) core-collapse supernovae. These WO stars are rare, and until recently only 6 were known. Our knowledge about their physical properties is mostly based on a single object, Sand 2 in the LMC. It was the only non-binary WO star both bright and unreddened enough that its FUV and NUV spectra could be obtained by FUSE and HST/FOS. A non-LTE analysis showed that Sand 2 is very hot and its (C+O)/He abundance ratio is higher than that found in WC-type WRs, suggesting it is indeed highly evolved. However, the O VI resonance doublet in the FUV required a considerably cooler temperature (120,000 K) model than did the optical O VI lines (170,000 K). Further, the enhanced chemical abundances did not match the predictions of stellar evolutionary models. Another non-LTE study found a 3x higher (C+O)/He abundance ratio and a cooler temperature. We have recently discovered two other bright,

single, and lightly reddened WOs in the LMC, allowing us to take a fresh look at these important objects. Our newly found WOs span a range in excitation type, from WO1 (the highest) to WO4 (the lowest). Sand 2 is intermediate (WO3). We propose to use COS to obtain FUV and NUV data of all three stars for as comprehensive a study as is currently possible. These UV data will be combined with our optical Magellan spectra for a detailed analysis with CMFGEN with the latest atomic data. Knowing the degree of chemical evolution of these WO stars is crucial to determining their evolutionary status, and thus in understanding the final stages of the most massive stars.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13782
Program Title: The Double Supernova in NGC 6984

Principal Investigator: Dan Milisavljevic
PI Institution: Harvard University

In 2012 and 2013, two Type Ib/c supernovae -- SN2012im and SN2013ek -- were discovered at virtually the same location (< 0.4 arcsec) in NGC 6984 (D ~ 65 Mpc). A double supernova of this sort has never been observed before and it is possible that the two explosions are somehow physically linked. The uniqueness of the discovery prompted HST/WFC3 images of the region to be obtained in Cycle 21 via Director's Discretionary time led by our group. Those images revealed a weak source nearby to SN2013ek that could be late-time emission from SN2012im.

We propose a program of four orbits of Cycle 22 time to complete our original mission of determining the nature of this rare supernova coupling. A return visit with HST will conclusively verify whether the secondary source is indeed SN2012im. If the secondary source fades then this would mean a curious case of two neighboring but unrelated supernovae occurring within a year of each other. Alternatively, if the secondary source does not fade, then it is likely that the two events SN2012im/2013ek are connected -- a discovery that will have important ramifications in areas of high-mass binary star evolution and explosion mechanisms of core-collapse supernovae. The proposed UV and optical observations will enable us to perform a detailed investigation of the explosion site and model properties of the parent star cluster and its immediate environment.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13783
Program Title: Thermal evolution of old neutron stars

Principal Investigator: George Pavlov
PI Institution:

We propose the first observational study of the thermal evolution of old neutron stars (NSs) through far-UV observations of three nearby pulsars in the age range from 17 Myr to 6 Gyr. The cooling history of younger NSs is being mapped out in the X-rays, providing important information on the properties of the super-dense matter in the NS interiors. However, only one old NS, millisecond PSR J0437-4715, has so far revealed its thermal emission, which has been detected with HST in the far-UV. The observed high temperature of about 1.5 10^5 K unavoidably requires a heating mechanism to operate in the old NS interiors. Two possible heating mechanisms have been identified, but their relative importance and parameters, which depend on poorly understood properties of the NS matter, are currently unclear. The proposed program will discriminate between the competing heating models and help constrain the properties of matter under extreme physical conditions, such as neutron and proton superfluidity and frictional forces between the superfluid vortices and the crustal solid.

Observations of the far-UV surface emission of old NSs, undetectable from the ground, is the only way to establish their long-term thermal evolution (cooling curves) and so probe the cooling/heating mechanisms and the properties of matter at super-high densities. Therefore, the UV capabilities of the HST offer a unique opportunity to carry out such a study, which will be a long-lasting legacy of HST.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13784
Program Title:	The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

Principal Investigator:	Robert	Quimby
PI Institution:	Institute for Physics and Mathematics of the Universe	

There is a rare class of supernovae with peak luminosities ten times greater than a typical Type Ia supernovae in the optical and hundreds of times greater in the UV. Some of these "superluminous" supernovae (SLSNe) show evidence for hydrogen in their spectra, and some do not. There are now spectroscopically confirmed examples of these hydrogen poor SLSN-I out to redshift 1.6, but, surprisingly, there are no confirmed examples of any hydrogen-rich SLSN-II above redshift 0.4 even through SLSN-II can have peak luminosities comparable to or greater than SLSN-I. As a result, we have no rest-frame UV spectra of SLSN-II, the spectral range most critical for understanding the nature of these events and for verifying their utility as potential probes of the high redshift universe. Here we propose to obtain the first UV spectra of a SLSN-II. These data will serve as a guide to enable higher redshift SLSN-II to be identified and they will stand as a local reference to compare against these future, high-redshift discoveries against. HST is uniquely suited to these observations, which need to take place before our window into the UV universe closes.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13785
Program Title: Stellar Populations and Ionization States of Lyman Alpha Emitters During the Epoch of Peak Star Formation

Principal Investigator: Naveen Reddy
PI Institution: University of California - Riverside

Low luminosity galaxies contribute significantly to the mass and star-formation density of the early Universe. Ly-alpha emitting galaxies (LAEs) are powerful probes of the faint-end of the luminosity function and early mass assembly. LAE studies at z>2 have typically used stacked optical and/or Spitzer data to discern their median properties, but the actual distribution of stellar masses and ionization states of LAEs remain largely unconstrained. To advance our understanding of this important population, we have successfully identified large samples of LAEs (~900 in four 0.33 deg^2 fields) at z~1.9, and have spectroscopically confirmed our selection using Keck. Here we propose to leverage our existing deep HST near-IR and Spitzer/IRAC imaging with the WFC3 G141 grism to measure [OIII]+H-beta for 76 LAE candidates from our sample, 13 of which are already spectroscopically confirmed at z=1.9+/-0.1. Combined with [OII] measurements from the ground, we will: (1) correct the emission line contribution to the HST broadband photometry and thus more accurately measure stellar masses and ages of LAEs; (2) measure ionization states with [OIII]/[OII] to discern the physical conditions in the ISM of these faint, low-mass galaxies; and (3) use systemic velocities derived from [OIII]+Hb, combined with our rest-UV spectra of the Ly-alpha and interstellar absorption lines, to deduce the kinematics of the ISM and the prevalence of galaxy-scale outflows. An economical investment of 16 orbits will enable robust stellar population, ionization, and ISM structure measurements for LAEs, thus illuminating their significance at a time when galaxies were forming most of their stars.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13786
Program Title: Decoding Debris System Substructures: Imprints of Planets/Planetesimals and Signatures of Extrinsic Influences on Material in Ring-Like Disks

Principal Investigator: Glenn Schneider
PI Institution: University of Arizona

How do circumstellar (CS) disks evolve and form planetary systems? Is our solar system's two-component debris disk (DD) typical? Are planets implicated by evidence of dynamical stirring in disks? Are DD architectures correlated with stellar mass? To address these highly-compelling questions of fundamental astrophysical import, we propose follow-up STIS coronagraphy of five intermediate-inclination ring-like DDs. These images will provide unprecedented clarity, sensitivity, and photometric efficacy to: 1) Study the spatial distribution of dust as close as 0.2" from the host stars enabling us to infer the existence and properties of unseen co-orbiting planets, and to probe disk-planet interactions across stellar ages and spectral types; 2) Provide spatially resolved imaging within DD regions previously unsampled to significantly improve constraints on disk grain properties and radial segregation of grain populations as a function of stellocentric distance (and thus temperature); 3) Produce high-fidelity images of DD substructures for dynamical

beyond the primary, bright debris features to study small-grain populations that might be unbound from the system and affected by both extrinsic and intrinsic forces and may inform about the level of dynamical activity in the planetesimal belt; 5) Provide, through the HLA, the highest quality and most complete, value-added data products for a seminal legacy data set of spatially resolvable light-scattering DDs, thus enabling multi-wavelength investigations with new and future ground- and space-based facilities.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13787
Program Title:	Massive stars dying alone: Extremely remote environments of SN2009ip and SN2010jp
Principal Investigator:	Nathan Smith
PI Institution:	University of Arizona

We propose an imaging study of the astonishingly remote environments of two recent supernovae (SNe): SN2009ip and SN2010jp. Both were unusual Type IIn explosions that crashed into dense circumstellar material (CSM) ejected by the star shortly before explosion. The favored progenitors of these SNe are very massive luminous blue variable (LBV) stars. In fact, SN2009ip presents an extraordinay case where the LBV-like progenitor was actually detected directly in archival HST data, and where we obtained spectra and photometry for numerous pre-SN eruptions. No other SN has this treasure trove of detailed information about the progenitor (not even SN1987A). SN2010jp represents a possible collapsar-powered event, since it showed evidence of a fast bipolar jet in spectra and a low 56Ni mass; this would be an analog of the black-hole forming explosions that cause gamma ray bursts, but where the relativistic jet is damped by a residual H envelope on the star. In both cases, the only viable models for these SNe involve extremely massive (initial masses of 40-100 Msun) progenitor stars. This seems at odds with their extremely remote environments in the far outskirts of their host galaxies, with no detected evidence for an underlying massive star population in ground-based data (nor in the single shallow WFPC2/F606W image of SN2009ip). Here we propose deep UV HST images to search for any mid/late O-type stars nearby, deep red images to detect any red supergiants, and an H-alpha image to search for any evidence of ongoing star formation in the vicinity. These observations will place important and demanding constraints on the initial masses and ages of these progenitors.

Proposal Category:	GO
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13788
Program Title:	COS Views of Local Galaxies Approaching Primeval Conditions
Principal Investigator:	Aida Wofford
PI Institution:	

We propose to use the COS medium resolution gratings G160M and G185M for obtaining spectroscopic observations of a combination of the cosmologically important features C IV 1550, He II 1640, OIII] 1666, SiIII] 1888, and CIII] 1908, in the three most metal-poor star-forming dwarf galaxies known within 50 Mpc. These galaxies approach primeval insterstellar and stellar conditions. One of the galaxies has no existing spectroscopic observation in the ultraviolet (UV). Available spectroscopy of the most metal-poor galaxies in the local universe are scarce, inhomogeneous, mostly low spectral-resolution, and either noisy in main UV lines or lack their coverage. The proposed spectral resolution of about 20 km/s is an order of magnitude improvement over existing HST data and allows us to disentangle stellar, nebular, and/or shock components to the lines. The high-quality constraints obtained in the framework of this proposal will make it possible to assess the relative likelihood of new spectral models of star-forming galaxies from different groups, in the best possible way achievable with current instrumentation. This will ensure that the best possible studies of early chemical enrichment of the universe can be achieved. The proposed observations are necessary to minimize large existing systematic uncertainties in the determination of high-redshift galaxy properties that JWST was in large part designed to measure.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13792
Program Title:	A Complete Census of the Bright z~9-10 Galaxies in the CANDELS Data Set

Principal Investigator:	Rychard	Bouwens
PI Institution:	Universiteit Leiden	

At present, we have only limited information on the spectral properties, stellar masses, and luminosity function of galaxies at z~9-10. While the new Frontier Fields Initiative will significantly improve our knowledge of the prevalence of fainter sources at these epochs, no comparable HST programs exist to study the properties of the brighter z~9-10 galaxies. This is unfortunate given that the brighter z~9-10 candidates are more amenable to follow-up study with facilities such as Spitzer and ALMA and the existence of only 8 reasonably reliable bright candidates (only 3 visible to ALMA). Fortunately, we can rectify this situation by using the existing HST+Spitzer observations over the full CANDELS program to identify all plausible z~9-10 candidates in that data set, but which lack sufficiently deep 1-micron observations to be secure. Here we propose to follow up each of these candidates with WFC3/IR at 1-micron F105W to determine which are likely at z~9-10 and thereby almost certainly doubling the number of bright, reliable z~9-10 candidates known to ~17 galaxies. Our follow-up strategy is very efficient, e.g., >~10x more efficient as tiling the relevant CANDELS fields with 1-micron F105W data and ~40x more efficient as searches in fields with no pre-existing data. The large samples of bright z~9-10 galaxies we will select with our program will be used to solidify current conclusions about the evolution of the bright end of the UV luminosity function, to quantify evolution in the mean spectral properties and stellar masses of galaxies from z~10, and as targets for follow-up studies on dust emission from galaxies with ALMA.

Proposal Category: GO
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13793
Program Title: Unveiling the merger fraction, sizes and morphologies of the brightest z ~ 7 galaxies

Principal Investigator: Rebecca Bowler
PI Institution: Royal Observatory Edinburgh

The study of ultra-high-redshift galaxies has undoubtedly been led by HST, with surveys such as the UDF, CANDELS and BoRG leading to the discovery of hundreds of Lyman-break galaxies at z > 6. Furthermore, the unrivalled near-infrared sensitivity and resolution of WFC3 has enabled the first measurement of galaxy size and morphology at the highest redshifts, showing that the faintest galaxies are extremely compact and revealing disturbed morphologies for a subset of objects. The galaxies studied to-date however, are predominantly sub-L* due to the small cosmological volumes probed by the HST imaging used to select them. Our recent work has exploited the combined 1.7 square degrees of the UltraVISTA and UDS surveys (Bowler et al. 2014, 2012) to select the first robust sample of 20 extremely bright (-23.0 < M_UV < -21.5) Lyman-break galaxies at z ~ 7. However, the available ground-based imaging is insufficient to reliably unveil the sizes and morphologies of this unique galaxy sample. Therefore, we propose to obtain follow-up imaging of the sample with HST, to utilize the unrivalled high-resolution imaging capabilities of WFC3 in answering the following key questions: i) what is the merger fraction amongst the brightest z ~ 7 galaxies? ii) how does this impact on the (currently controversial) form of the luminosity function at the bright end? iii) is there a strong size-luminosity relation already in place at z ~ 7?

Proposal Category: GO
Scientific Category: Solar System
ID: 13794
Program Title: Seasonal Dependence of the Escape of Water from the Martian Atmosphere

Principal Investigator: John Clarke
PI Institution: Boston University

This proposal is to obtain ACS/SBC images and STIS spectra of the extended H Ly alpha and O 1304 emissions from H and O atoms in the atmosphere of Mars to study seasonal changes in the escape rate of H and O atoms, and thereby water. Prior HST observations have revealed a surprising rapid change in the H escape rate in late martian summer following a global dust storm, and have shown that STIS spectra can easily detect superthermal O atoms. The relative degree of influence of seasons and dust storms on the H density and escape flux are not known, and little is known about variations in the hot O density and escape rate. The timing of these observations is key to these scientific goals. Mars is now approaching the Sun, HST can observe Mars over a wide range of seasons from April - Nov 2014, and HST will not be able to observe Mars again until after the prime mission of MAVEN. The observations will also bracket in time the close approach of Comet Siding Spring on 19 Oct. 2014 and see any effects of the energy deposition in the

martian upper atmosphere. These observations will provide strong support for the NASA MAVEN mission, scheduled to arrive at Mars in Sept. 2014, and STScI has granted 3 orbits to establish the baseline conditions in the martin atmosphere in late spring 2014, when Mars is far from the Sun.

Proposal Category: GO
Scientific Category: Solar System
ID: 13795
Program Title: HST Observations of Comet-Induced Aurora on Mars during the Siding Spring Encounter

Principal Investigator: John Clarke
PI Institution: Boston University

The martian upper atmosphere is likely to be strongly perturbed by the near collision with Comet C/2013 A1 (Siding Spring) on 19 Oct. 2014. This is a unique event in the history of space science, it will be the first time that we have a chance to study the close encounter of an active comet with a terrestrial planet. Significant mass and energy will be deposited in the upper atmosphere of Mars if the comet coma is sufficiently dense. Present estimates have Comet Siding Spring at a moderate production rate when it passes by Mars, which is expected to result in the strong perturbations of the martian atmosphere. This proposal is to make HST observations of the atmosphere of Mars before and during the comet encounter to measure the energy input to the upper atmosphere through the auroral emissions that will be produced by the deposition of energy of incoming water-group molecules. The observation of auroral emissions will permit a direct estimate of the total energy input to the martian upper atmosphere, and it will provide us a unique chance to determine the response of the martian atmosphere to strong auroral processes. This will likely be the only opportunity to make this measurement in the lifetime of HST, and it will provide support for the NASA MAVEN mission, which will have recently arrived in orbit about Mars.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13796
Program Title: Understanding New Structures Ejected from Recurrent Nova T Pyx

Principal Investigator: Arlin Crotts

Recurrent nova T Pyxidis has recognized, major scientific significance but is a rapidly and surprisingly changing object, now fading quickly. Since its 2011 outburst (the first since 1966 but sixth since 1890), T Pyx has been the target of multispectral observation, including 60 HST orbits by several groups. Our group's HST observations of T Pyx not only have produced a reliable, geometrically determined distance to T Pyx and mapped the ejecta from pre-2011 outbursts, but have also revealed several new and unprecendented structures from the latest outburst, on scales of tenths of an arcsecond. With observations from GO program 13400, we parsimoniously determined the geometry and kinematics of these several new structures, but issues remain. A pair of jet-like spots frame the central ring-like disk structure, but based on simple assumptions have been ejected at an angle unaligned with the ring. We need another epoch of imaging to determine the proper motion of these spots to settle whether their kinematics are simple, or might instead suffer acceleration, deceleration or unaligned motion. More broadly, additional HST data are needed to determine the nature and origin the three morphological structures that are evident in our previous HST images, and to uncover their relationship to the distinct kinematic components of the ejecta inferred from ground-based monitoring. We request minimal visits of WFC3+STIS to establish a third epoch to rule out or verify competing hypotheses. The requested observations have implications for the ejection and shaping of remnants in nova explosions, binary stellar evolution, and the generation of shocks and gamma-rays in novae.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13797
Program Title:	Early-Time UV Spectroscopy of Stripped-Envelope Supernovae: A New Window

Principal Investigator:	Alex	Filippenko
PI Institution:	University of California - Berkeley	

We propose to continue our Cycle 19 and 20 Target-of-Opportunity (ToO) programs to obtain three early-time UV spectra of a stripped-envelope core-collapse supernova (SN Ib or SN Ic), starting well before maximum brightness. The underlying nature of these objects, from the mass-loss process stripping the envelope to the details of the explosion mechanism, remain mysterious. Connections to gamma-ray bursts and X-ray flashes further motivate this study. Many high-redshift SNe are being found in deep transient surveys, but the ability to distinguish between thermonuclear Type Ia SNe and stripped-envelope core-collapse SNe requires thorough knowledge of the latter at UV wavelengths. By comparing the evolution of the spectra as the photosphere recedes to deeper layers of the ejecta with our time series of spectral models, we will gain a better understanding of the explosion, and possibly of the progenitor star. Specifically, we may be able to determine the metal content of the progenitor through comparisons with our spectral models, and we should be able to probe the degree of mixing during the explosion. The heterogeneity seen in stripped-envelope SNe will allow us to choose objects with different characteristics than the ones observed in Cycles 19-20, gaining further insights into this unique class of cosmic explosion. We need to seize this opportunity now, while we still have access to the space UV, and indeed the UV is the Cycle 22 priority of HST.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13798
Program Title: A chemical inventory of Gas and Star-Grazing Exocomets in HD 172555

Principal Investigator: Carol Grady

PI Institution: Eureka Scientific Inc.

Planetary systems similar to our own harbor not only planets, but a range of minor bodies and their associated collisional debris. In the solar system, small bodies can be perturbed into sun-grazing orbits, where they sublimate, and their bulk composition can be inferred spectroscopically. Similar activity has been detected in UV spectra of rapidly rotating A stars, where circumstellar gas can be separated at high contrast from the stellar spectrum. Two components are seen in the edge-on disk of beta Pic, a stable gas component, potentially associated with the Kuiper Belt analog at 85 au, and transient features which may represent star-grazing bodies possibly originating from an asteroid belt at 4 au. The stable gas in the beta Pic system is unusually carbon-rich, but until recently, we have lacked data on other young systems to establish whether this is typical, or reflects the presence of parent bodies with no solar system analogs. In the past year, we have obtained STIS spectra of 49 Cet, demonstrating that both gas components are detectable even when the system is not inclined exactly edge-on to our line of sight, and similar gas features at optical wavelengths have been reported for another beta Pictoris Moving Group member: HD 172555. This system has conspicuous far-IR [O I] emission, and mid-IR spectra which have been interpreted as showing debris from a recent massive collision in the terrestrial planet zone. We propose obtaining COS and STIS UV spectra of HD 172555 to obtain an inventory of the stable gas in this system which can be compared with beta Pic and search for UV signatures of star-grazing transiting exocomets.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13799
Program Title: Constraining Type Ia Supernova Nucleosynthesis and Explosion Models Using Late-Time Photometry of SN2011fe and SN2012cg

Principal Investigator: Or Graur

PI Institution: The Johns Hopkins University

We propose to use WFC3 photometry from the near UV to the near IR to construct the bolometric light curves of the nearby Type Ia supernovae SN2011fe and SN2012cg at late times (>900 days after maximum light). These light curves will allow us to conduct a fundamental test of the theoretically predicted behavior of SN Ia light curves at late times. We will observationally determine, for the first time, whether the nuclear physics of SN Ia ejecta is solely determined by the radioactive decay of 56Co to 56Fe, or whether (and by how much) other nuclear heating mechanisms (such as the leptonic decays of 57Co and 55Fe) become discernible, as predicted. Due to the rarity of nearby SNe Ia such as SN2011fe, if this test is not performed during Cycle 22, it is highly unlikely that we would be able to perform it again during the remaining lifetime of HST.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13800
Program Title:	Heavy-metal, extreme chemistry and puzzling pulsation: ultraviolet clues to the formation of hot subdwarfs
Principal Investigator:	C. Jeffery
PI Institution:	Armagh Observatory

Subdwarf B stars are low-mass core-helium burning stars with a very thin hydrogen envelope; in most cases, surface helium and light elements are depleted, heavy elements are enhanced by a factor ten. It is argued that normal He-poor sdB stars evolve from giants which have been stripped almost to the core to reveal helium-enriched material. As the star ignites helium and contracts to the extreme horizontal branch, radiative processes re-stratify the internal chemistry of the atmosphere and the helium sinks. When does this happen, how long does it take, and what does it look like? A small number of sdB stars have intermediate helium abundances (He-sdB) and a few have extraordinary surface compositions. The pulsating "zirconium" star LS IV-14 116 shows a four dex overabundance of zirconium, yttrium and strontium. Two other He-sdBs show a four dex overabundace of lead. Such stars are almost completely unexplored in the space ultraviolet.

We will observe the ultraviolet spectrum of LS IV-14 116 and two other chemically peculiar hot subdwarfs in order to determine:
(a) the impact of extraordinary composition on their overall flux distribution and hence on measurements of their effective temperatures,
(b) the degree of stratification in the atmosphere (how thick is the enhanced layer?), and
(c) the abundances of species not observable in the visible.
(d) the ultraviolet lightcurve due to the principle pulsation modes of LS IV-14 116.
The observations will allow us to explore the processes that lead to heavily stratified atmospheres and to the transformation of red giants with helium-enriched surface into horizontal-branch stars with helium-poor surfaces.

Proposal Category:	GO
Scientific Category:	Quasar Absorption Lines and IGM
ID:	13801
Program Title:	Probing Structure in Cold Gas at z <~ 1 with Gravitationally Lensed Quasar Sightlines
Principal Investigator:	Varsha Kulkarni
PI Institution:	University of South Carolina Research Foundation

Absorption lines in quasar spectra offer a powerful tool to study distant galaxies and intergalactic matter (IGM). The strongest of these absorbers, the damped Lyman-alpha (DLA) and sub-DLA absorbers constitute a large fraction of the neutral gas in galaxies. Galaxies located in front of gravitationally lensed quasars (GLQs) are probed by multiple sightlines; so DLA/sub-DLAs in these sightlines can probe the internal structure of interstellar material (ISM) and/or the environment of these galaxies. From the lens galaxy images, impact parameters of the absorbing regions from the galaxy centers can be obtained accurately. Unfortunately, very little information exists on the neutral gas and metal content of DLA/sub-DLAs located in front of GLQs with confirmed lens galaxies. This is because at low redshift where lens galaxies are well-imaged, the H I and key metal lines lie in the UV. Here we propose to study 6 GLQs with known lens redshifts and a total of 14 closely separated double or quadruple images, that show candidate DLA/sub-DLAs along multiple sightlines. Our goal is to measure H I Lyman-alpha absorption in these sightlines. Many of these absorbers are at the lens redshift, with impact parameters 0.6-5.8 kpc. Our observations will therefore allow us to constrain gradients in H I column density and metallicity (combining H I with ground-based metal line measurements) within these galaxies. Our data will also help to constrain the sizes of DLA/sub-DLA absorbing regions by increasing the existing sample of DLA/sub-DLAs probed at < 10 kpc separations by a factor of ~3. HST is essential because of the need for both UV coverage and high spatial resolution.

Proposal Category: GO

Scientific Category: Cool Stars

ID: 13802

Program Title: Characterizing the Sun's 4th Closest Neighbor and the Coldest Known Brown Dwarf

Principal Investigator: Kevin Luhman

PI Institution: The Pennsylvania State University

I have conducted a search for high proper motion brown dwarfs using multi-epoch all-sky mid-infrared images from the WISE satellite. Through this work, I have discovered an object with a parallactic distance of 2.2 pc and a temperature of 250 K, making it the 4th closest neighbor of the Sun, and the coldest known brown dwarf. Because of its extreme proximity and temperature, it represents an unparallaled laboratory for studying planet-like atmospheres in an unexplored temperature regime. I propose to obtain deep near-IR images of this object in the single most sensitive band of WFC3 in order to 1) test the predicted near- to mid-IR colors of the coldest brown dwarfs, 2) assess the feasibility of more detailed observations through multi-band photometry and spectroscopy, 3) improve the accuracy of its parallax measurement, and 4) better constrain its multiplicity.

Proposal Category: GO

Scientific Category: Solar System

ID: 13803

Program Title: Europa's Composition as Revealed by its Atmosphere

Principal Investigator: Melissa McGrath

PI Institution: NASA Marshall Space Flight Center

The two main sources of Europa's tenuous atmosphere, surface sputtering and plumes, imply that Europa's surface and sub-surface composition are directly reflected by the composition of its atmosphere. Recent detection of water vapor plumes at Europa makes it more likely that the atmosphere contains important trace species that are diagnostic of the sub-surface ocean composition. We will perform a sensitive search for trace species via electron excited emissions in the far-ultraviolet with the Cosmic Origins Spectrograph, in order to constrain the composition of the ice-ocean-rock system and better understand the potential habitability of the satellite. HST spectroscopic measurement of trace species is one of the only techniques presently available to meaningfully constrain Europa's composition.

Proposal Category: GO

Scientific Category: Resolved Stellar Populations

ID: 13804

Program Title: Important Nearby Galaxies without Accurate Distances

Principal Investigator: Kristen McQuinn

PI Institution: University of Minnesota - Twin Cities

The Spitzer Infrared Nearby Galaxies Survey (SINGS) and its offspring programs (e.g., THINGS, HERACLES, KINGFISH) have resulted in a fundamental change in our view of star formation and the ISM in galaxies, and together they represent the most complete multi-wavelength data set yet assembled for a large sample of nearby galaxies. These great investments of observing time have been dedicated to the goal of understanding the interstellar medium, the star formation process, and, more generally, galactic evolution at the present epoch. Nearby galaxies provide the basis for which we interpret the distant universe, and the SINGS sample represents the best studied nearby galaxies.

Accurate distances are fundamental to interpreting observations of galaxies. Surprisingly, many of the SINGS spiral galaxies have numerous distance estimates resulting in confusion. We can rectify this situation for 8 of the SINGS spiral galaxies within 10 Mpc at a very low cost through measurements of the tip of the red giant branch. The proposed observations will provide an accuracy of better than 0.1 in distance modulus. Our sample includes such well known

galaxies as M51 (the Whirlpool), M63 (the Sunflower), M104 (the Sombrero), and M74 (the archetypal grand design spiral).

We are also proposing coordinated parallel WFC3 UV observations of the central regions of the galaxies, rich with high-mass UV-bright stars. As a secondary science goal we will compare the resolved UV stellar populations with integrated UV emission measurements used in calibrating star formation rates. Our observations will complement the growing HST UV atlas of high resolution images of nearby galaxies.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13805
Program Title:	Io's Atmosphere Silhouetted in Transit by Jupiter Lyman-alpha
Principal Investigator:	Kurt Retherford
PI Institution:	Southwest Research Institute

Io's active volcanos both directly establish local gas plumes and indirectly establish a more global sublimation atmosphere, through plume deposited sulfur dioxide frost patches. Despite decades of study and recent observational advances the very basic question about the relative role of each of these sources is unresolved. The correlation between volcanic activity variability and Io's dramatic influence on numerous time-variable phenomenon in the Jupiter system cannot be causally linked until this answer is in hand. Our experienced team has developed a novel approach to use STIS in a new way to obtain global radial profiles of SO2 scale height distributions above both plume and sublimation dominated regions. We exploit the bright Lyman-alpha dayglow of Jupiter as a background illumination source together with the strongly absorptive nature of SO2 at 121.6 nm to image Io's atmosphere in silhouette with unprecedented detail during transit events. Our program provides the following key information for SO2: 1) First high-altitude (>400 km) radial measurements of tangential column densities and scale heights; 2) First clear measurement of sublimation densities at polar locations; 3) Volcanic densities for large and mid-sized plumes (possibly new ones); 4) Globally distributed limb profiles allowing strong distinctions between plume and sublimation dominated locations; 5) Repeated imaging on a few day and a few week timescales for improved plume variability constraints; and 6) Lyman-alpha reflectance imaging at Io central lon. ~180 deg, filling a gap in previous coverage. These new information are critical to breaking through an impasse in our understanding of Io's atmosphere.

Proposal Category:	GO
Scientific Category:	Hot Stars
ID:	13806
Program Title:	UV spectroscopy of the most massive overcontact binary known to date: on the verge of coalescence ?
Principal Investigator:	Hugues Sana
PI Institution:	Space Telescope Science Institute - ESA

a quarter of all massive stars are thought to merge with their companion. The short-lived contact phase preceding coalescence is poorly understood due to the lack of observational constraints: only two overcontact O-type binaries are known so far. Yet, these systems provide crucial observational testbeds to understand the elusive formation and evolution of the most massive stars, the complex physics of stellar mergers and the role that the coalescence products play as progenitors of supernovae and gamma-ray bursts. We recently discovered VFTS 352, the most massive, earliest spectral type and shortest period (P = 1.12 d) overcontact O-type binary known to date. With an estimated combined mass of 130 Msun, this truly unique system is expected to merge into a rapidly rotating, very massive, single star. Initial estimates of the physical parameters were derived from high-quality ground-based optical spectra and photometry. Yet, optical analyses of overcontact systems can overestimate the radial-velocity amplitudes, hence the masses, by up to 40% because optical lines are susceptible to irradiation effects. Here we propose a limited 8-epochs COS monitoring of VFTS 352. The G130M and G160M spectra will allow us to side step the uncertainties affecting optical determination of the masses and to constrain the mass loss rate and CNO surface abundances. These constraints are crucial to identify the complex mixing processes, to reveal signs of mass exchange and mass loss from the system, and to enable a comparison with massive binary evolution models.

Proposal Category: GO

Scientific Category: Hot Stars

ID: 13807

Program Title: Unprecedented Tracking of the Unique Dwarf Nova GW Lib from Largest Amplitude Outburst to Quiescent Pulsations

Principal Investigator: Paula Szkody

PI Institution: University of Washington

The unique dwarf nova GW Lib, the prototype of cataclysmic variables containing white dwarfs that exhibit non-radial pulsations at quiescence, underwent the largest known amplitude outburst from an accretion disk instability (9 mag) in 2007. This huge outburst provided an unprecedented opportunity to probe how the
interior white dwarf structure reacts to the accretion of mass and angular momentum by using its pulsation
spectrum. As the outer envelope cools, the pulsation spectrum evolves, and we obtain the first opportunity to track how a white dwarf evolves through the instability strip on a timescale of just years.We have monitored GW Lib since its outburst with ground and COS observations. For the first 4 years after outburst, GW Lib followed a normal cooling pattern, with a different pulsation period than at quiescence becoming visible by year 3. However, rather than continuing to cool to its quiescent temperature, our latest 2013 COS observation showed a hotter temperature than in 2011, as well as a variable flux, temperature and pulsation amplitude during the HST orbits. As no previous dwarf nova has been followed for more than 3 years after outburst, and it is now obvious that the white dwarf in GW Lib does not cool monotonically, we propose to continue the cooling curve with a COS measurement in 2015. The cooling can only be constrained by an UV spectrum with HST (the optical spectrum is too contaminated by the accretion disk to determine a valid temperature) and the ratio of the UV to optical pulsation amplitude is needed to provide the mode index, essential for modeling the structure of the underlying white dwarf.

Proposal Category: GO

Scientific Category: AGN/Quasars

ID: 13816

Program Title: High-Resolution Imaging of Active Galaxies with Direct Black Hole Mass Measurements

Principal Investigator: Misty Bentz

PI Institution: Georgia State University Research Foundation

We propose to obtain WFC3 optical images of the host galaxies of 14 AGNs that have broad-line region radius measurements from ground-based monitoring campaigns and direct black hole mass determinations from reverberation mapping. The proposed images are essential for correcting the host-galaxy starlight contributions to the spectroscopically-measured luminosites of these AGNs and will allow us to place them on the radius-luminosity relationship. Furthermore, the high-resolution and stable PSFs of these images will allow us to accurately measure the (pseudo)bulge luminosities of the galaxies and include them in the black hole mass-bulge luminosity relationship.

The radius-luminosity relationship is the basis for all estimates of black hole mass in active galaxies at cosmological distances, and so informs our knowledge of the growth and evolution of black holes and their host galaxies throughout cosmic time. And the black hole mass-bulge luminosity relationship is an important alternative to the widely-used M-sigma relationship, especially given the recent intense scrutiny of the M-sigma relationship and its possible biases relating to galaxy morphology, and because of upcoming photometric surveys like LSST. These 14 AGNs represent an increase of 50% to the existing AGN sample at the low ends of these black hole scaling relationships, in the critical L* and sub-L* regimes that include the majority of galaxies in the universe. As such, these 14 objects are crucial additions that will increase our ability to accurately determine the slope and scatter of the relationships at the low-luminosity ends where the signatures of black hole seeds are expected to be found.

Proposal Category: GO

Scientific Category: Resolved Stellar Populations

ID: 13817

Program Title: A Direct Distance to an Ancient Metal-Poor Star Cluster

Principal Investigator: Thomas Brown

PI Institution: Space Telescope Science Institute

We propose spatial-scanning observations of NGC 6397, an ancient metal-poor globular cluster, in order to obtain a high-precision measurement of its annual trigonometric parallax. Using comprehensive preparations and simulations, we have found that the uncertainty on this direct distance measurement will be approximately 2%. Although dozens of open clusters within 1 kpc have measured parallaxes, to date there has been no measured parallax for a globular cluster. All globular clusters lie further than 1 kpc, and so there are no stellar population anchors at old ages (> 10 Gyr) and low metallicities ([Fe/H] < -1) with direct high-precision distances. Our program will provide the first anchor in this ancient metal-poor regime, with implications for a wide variety of stellar population studies, particularly in the realm of star formation histories.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13818
Program Title: Probing Quasar Host Galaxy of a Quasar at z=2.1 with Damped Lyman Alpha System as Coronagraph

Principal Investigator: Zheng Cai
PI Institution: University of Arizona

Fully resolving high-redshift quasar host galaxies is crucial for understanding how massive galaxies and their central black holes form and evolve. However, studies of high-redshift quasar host galaxies are hindered by difficulties in isolating the hosts and accurately subtracting the strong emission from quasar nuclei. From the SDSS-III quasar spectra library, we have discovered a number of rare occurrences where strong damped Lyman alpha absorbers (DLAs) completely block the nuclear emission from the quasar; they act as a natural coronagraph and reveal narrow Ly-alpha emission from the quasar host galaxies. We propose to carry out HST/WFC3 narrow-band imaging of one such system, J1154-0215, at z=2.1. At this redshift, the WFC3/UVIS narrow-band filter FQ387N lies perfectly within the DLA dark trough, thereby enabling us to image the quasar host galaxy without the need for PSF subtraction. The FWHM and luminosity of the narrow Ly-alpha emission detected in this DLA trough are consistent with that of Lyman break galaxies. Our ground-based deep 2-D spectrum indicates that the Ly-alpha emission is marginally resolved under the seeing of 0.6", suggesting that it is most likely powered by star formation from the quasar host galaxies. High resolution HST imaging, for the first time, will enable us to fully measure the morphology and physical properties of a type-1 quasar host down to the inner 1 kpc scale at z>2, free of PSF subtraction systematics. It will also probe florescent Ly-alpha emission from cool gas associated with the DLA, and study the gas inflows/outflows in the quasar environment to test models of feedback in quasar host galaxies and massive galaxy formation.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13819
Program Title: Dynamical Masses for Free-Floating Planetary-Mass Binaries

Principal Investigator: Trent Dupuy
PI Institution: University of Texas at Austin

We propose a 3-year orbit monitoring program to measure the first dynamical masses in the planetary-mass regime (5

-15 Mjup) for free-floating objects, including the first known Y dwarf binary. With projected separations of only 0.7-1.4 AU, our targets are among the tightest substellar visual binaries ever found and are amenable to orbit determinations within only a few years. When combined with our parallax determination, these data will yield dynamical masses with <10% uncertainties. Two of our targets are late-T/Y dwarf field binaries (ages ~ 1-5 Gyr) and will provide the first empirical calibration in the poorly understood temperature regime of ~350-500 K, relevant both to free-floating objects and radial-velocity exoplanets. Such extreme conditions are the frontier of current theory, e.g. model uncertainties in non-equilibrium chemistry, metallicity, and clouds yield mass estimates that currently span an order of magnitude. Our third target is a young field L dwarf (age ~ 10-100 Myr), one of the rare field objects that that serve as analogs for young directly imaged exoplanets. Our dynamical mass combined with evolutionary models will yield the first precise age and temperature estimates for such an object, thereby testing our ability to derive physical parameters from current models. Our targets have been discovered at the limits of existing facilities and thus promise to be the only viable objects in the planetary-mass regime for direct mass measurements until next-generation facilities like JWST come online.

Proposal Category: GO
Scientific Category: Extra-Solar Planets
ID: 13820
Program Title: Search for an evaporating ocean on the super-Earth HD 97658b

Principal Investigator: David Ehrenreich
PI Institution: Observatoire de Geneve

The HD 97658b super-Earth was recently detected in transit across one of the brightest star (V=7.7) known to host a transiting planet. The density of the planet suggests it must contain a large mass fraction of water. Although the water vapor has not been detected in the lower atmosphere by HST/WFC3 due to the small atmospheric scale height, the moderate orbital distance of this warm (700-1000 K) planet favors the atmospheric escape of this water, which should be promptly dissociated at high altitude and become observable as hydrogen flowing within and beyond the Roche lobe. The parent star properties are similar to those of HD 189733 (K dwarf, V=7.8, d=20 pc) and numerical simulations show that the halo of atomic hydrogen resulting from the dissociation of water is observable with HST/STIS at Lyman-alpha (121 nm). The detection of this atomic hydrogen will be the first signature of an evolved evaporating ocean on an extrasolar planet, as well as the first validation of internal structure models of exoplanets in this mass regime. A non-detection of escaping hydrogen, as in the case of 55 Cnc e, would also bring useful constraints on the nature of the planetary atmosphere (CO2-rich vs. H2O-rich?), the fate of super-Earths, and the progenitors of the rocky evaporation remnants detected by CoRoT and Kepler.

Proposal Category: GO
Scientific Category: ISM in External Galaxies

ID: 13821

Program Title: H-alpha Filaments and Feedback in NGC4696 at the centre of the Centaurus cluster

Principal Investigator: Andrew Fabian

PI Institution: University of Cambridge

One third of Brightest Cluster Galaxies (BCG) have strong optical emission lines originating in an extensive filamentary nebula. The prototype is the spectacular nebula around NGC1275 in the Perseus cluster which we are have imaged in H-alpha and [NII] with HST, spatially resolving the filamentary structure. Here we propose deep observations of the nebula in NGC4696, the BCG in the Centaurus cluster. NGC4696, at approximately half the distance of NGC1275 is the nearest BCG nebula with molecular filaments, thus affording the highest linear spatial resolution in this type of source.

These observations will test the magnetic support model for the filaments by resolving and measuring the width of the filaments, and test the particle heating model for the excitation of the filaments through measurement of their surface brightness distribution and morphology.

The relation of the filaments to the dust lanes, and the complex Faraday Rotation maps of this source will provide further diagnostics not available in NGC1275. The results will have a wide relevance to similar

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Proposal Category: GO

Scientific Category: Hot Stars

ID: 13822

Program Title: iPTF 13bvn: First identification of the progenitor of a Type Ib supernova

Principal Investigator: Gaston Folatelli

PI Institution: Institute for Physics and Mathematics of the Universe

iPTF 13bvn may provide the first conclusive answer to the long-standing question of the nature of hydrogen-deficient supernova (SN) progenitors. The detection of a pre-explosion object in archival images at the SN site led at first to the proposal of a Wolf-Rayet progenitor. However, our hydrodynamical modeling of the SN light curves indicated a much lower progenitor mass, and we proposed an interacting binary system as the progenitor. The proposed HST observations will allow us to verify the disappearance of the pre-explosion object and, most importantly, they will test the binary progenitor scenario through the detection in the UV of a hot companion star. If confirmed, this will be the first firm identification of the progenitor of a hydrogen-deficient SN.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13823
Program Title:	A complete census of galaxy activity in a massive z>1.5 cluster: probing the SF-density relation down to the low M* regime
Principal Investigator:	Raphael Gobat
PI Institution:	CEA/DSM/DAPNIA/Service d'Astrophysique

We propose deep WFC3 spectroscopic observations of the z=1.58 X-ray luminous galaxy cluster XDCP J0044.3-2033. This is a remarkable structure, one of a handful of galaxy clusters secured at z>1.5 and one of the even fewer confirmed to be virialized thanks to high-quality X-ray data. Yet, despite its degree of structural maturity and high mass, optical and infrared observations indicate that its central galaxy population is undergoing significant morphological transformation and experiencing a high degree of star formation as well. This raises interesting questions on the actual degree of environmental forcing and the true diversity of galaxy populations in high mass, high redshift environments. This project thus aims at quantifying star-formation in cluster galaxies down to 5 Msun/yr. In a single HST visit, the proposed observations will allow us to probe the SF-density relation at z~1.6 down to the largely unexplored 5e9 Msun galaxy mass regime.

Proposal Category:	GO
Scientific Category:	Resolved Stellar Populations
ID:	13824
Program Title:	SN 2011fe - tackling the Type Ia progenitor puzzle through extremely late time photometry
Principal Investigator:	Wolfgang Kerzendorf
PI Institution:	University of Toronto

We propose to obtain extremely late-time photometry for the nearby SN Ia 2011fe. Located nearby in M101 and along a line of sight with negligible extincition, SN 2011fe provides us with the once-in-a-lifetime chance to probe SN Ia physics by measuring the very late time luminosity decline. Such extremely late photometric measurements are only

accessible to HST. Despite the importance of SNe Ia in astrophysics and cosmology, and a large concerted effort to understand these objects, it is still unclear whether SNe Ia result from the explosion of an accreting white dwarf (single-degenerate scenario) or from the merger-explosion of two white dwarfs (double-degenerate scenario). However, theoretical models predict clear differences in the very late time light-curves of the two scenarios. The UBVRI photometry which we propose to obtain will extend a current Gemini imaging campaign enabling us to test whether SN 2011fe originated from a single-degenerate or from a double-degenerate progenitor. As SN 2011fe is a typical SN Ia, the result - together with the results from complementary tests - will have a significant impact on the interpretation of SNe Ia and on future developments in SN Ia theory.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13825
Program Title: Stellar Forensics VI: A post-explosion view of the progenitor of SN 2012aw

Principal Investigator: Justyn Maund
PI Institution: The Queen's University of Belfast

Recent studies have used high spatial resolution HST observations of supernova (SN) sites to directly identify the progenitors of core-collapse SNe in pre-explosion images. These studies have set constraints about the nature of massive stars and their evolution just prior to explosion. Now, at late-times when the SNe have faded sufficiently, it is possible to return to the sites of these core-collapse SNe to search for clues about the nature of their progenitors.
We request time to conduct deep, late-time, high-resolution imaging with ACS/WFC of the site of the core-collapse SN 2012aw. We aim to: 1) Confirm our original identification, made in pre-explosion images, by confirming that the progenitor is now missing; 2) Apply image subtraction techniques for this late-time imaging with our pre-explosion images to determine accurate photometry of the progenitor to constrain the temperature and luminosity. HST provides the unique combination of high-resolution optical imaging at very faint
magnitudes that will facilitate this study.

Proposal Category: GO
Scientific Category: Resolved Star Formation
ID: 13826

Program Title: The Orion Nebula Cluster as a Paradigm of Star Formation

Principal Investigator: Massimo Robberto

PI Institution: Space Telescope Science Institute

We propose a 52-orbit Treasury Program to investigate two fundamental questions of star formation: a) the low-mass tail of the IMF, down to a few Jupiter masses; b) the dynamical evolution of clusters, as revealed by stellar proper motions. We target the Orion Nebula Cluster (ONC) using WFC3 and ACS in coordinated parallel mode to perform a synoptic survey in the 1.345micron H2O feature and Ic broad-band. Our main objectives are:

1) to discover and classify ~500 brown dwarfs and planetary-mass objects in the field, extending the IMF down to lowest masses formed by gravitational collapse. Using the latest generation of high contrast image processing we will also search for faint companions, reaching down to sub-arcsecond separations and 1E-4 flux ratios.
2) to derive high precision (~0.2km/s) relative proper motions of low-mass stars and substellar objects (about 1000 sources total), leveraging on first epoch data obtained by our previous HST Treasury Program about 10 years ago. These data will unveil the cluster dynamics: velocity dispersion vs. mass, substructures, and the fraction of escaping sources.

Only HST can access the IR H2O absorption feature sensitive to the effective temperature of substellar objects, while providing the exceptionally stable PSF needed for the detection of faint companions, and the identical ACS platform for our second epoch proper-motion survey. This program will provide the definitive HST legacy dataset on the ONC. Our High-Level Science Products will be mined by the community, both statistically to constrain competing theories of star formation, and to study in depth the multitude of exotic sources harboured by the cluster.

Proposal Category: GO

Scientific Category: Cool Stars

ID: 13827

Program Title: A New Opportunity to Detect Iron in the Most Iron-Poor Star Known

Principal Investigator: Ian Roederer

PI Institution: University of Michigan

At present, there are three stars known in the Milky Way with Fe/H ratios less than 1/100,000 times the Solar Fe/H ratio. These stars were almost certainly formed during the earliest epochs of star formation in the Milky Way, and their metals were formed from the yields of just one zero-metallicity Population III supernova. High-quality optical spectroscopy reveals the presence of C, Mg, Ca, Fe, and other metals in two of these stars. In the most iron-poor star, SMSS J031300-670839, only Li, C, Mg, and Ca are detected. Not a single iron line can be detected in the optical spectral range. The Fe/H ratio of this star is currently estimated to be less than 1/13,000,000 times the Solar Fe/H ratio.

I propose to obtain a high-resolution COS spectrum of this star to attempt to detect Fe II lines in the NUV near 2400 Angstroms. These Fe II lines are the strongest of any iron-group element, and they present the best opportunity to detect iron in this star. My proposed observations would tighten the constraint on the Fe/H ratio by a factor of 50, and a detection would be possible if the Fe/H ratio in this star is 1/1,000,000,000 times the Solar Fe/H ratio or greater. NUV observations with COS provide the only opportunity to perform this study.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13828
Program Title: Late nebular stage high resolution UV spectroscopy of classical Galactic novae: a benchmark panchromatic archive for nova evolution

Principal Investigator: Steve Shore
PI Institution: Universita di Pisa

The major obstacle to understanding the classical nova phenomenon is the lack of systematic observations, primarily spectroscopic, through the various stages of the ejecta and white dwarf evolution. Progress is only possible if long term, coordinated multi-wavelength spectroscopic data at high spectral resolution and high signal to noise are available. Our objective is to use HST/STIS spectra, along with coordinated space- and ground-based observations, to fully characterize three bright recent Galactic classical novae within a panchromatic framework. This proposed data set will be a benchmark sample for any future modeling efforts. All three, V959 Mon (ONe type), V339 Del (CO-type), and V1369 Cen (CO-type), were detected in gamma-rays by Fermi/LAT and well observed in the first months after outburst. We propose to use these data to address fundamental unsolved problems, such as: the origin of the large-scale bipolar structure, the origin and time development of the fragmentation detected in the ejecta, the uniformity of the abundances among the emission knots, and the determination of filling factors and masses for the ejecta. All are essential for understanding the thermonuclear explosion on the white dwarf and its related hydrodynamic events.

Proposal Category: GO
Scientific Category: Solar System
ID: 13829
Program Title: The ice plumes of Europa

Principal Investigator: William Sparks
PI Institution: Space Telescope Science Institute

It is of extreme interest to NASA and the scientific community that evidence has been found for plumes of water ice venting from the polar regions of Europa (Roth et al 2014) - spectroscopic detection of off-limb line emission from the dissociation products of water. We were awarded Cycle 21 time to seek direct images of the Europa exosphere, including Enceladus-like plumes if present, basing our study on FUV images of Europa as it transits the smooth face of

Jupiter. We also obtained a necessary FUV image of Europa out of transit. These observations provide additional evidence for the presence of ice plumes on Europa. Here, we propose to augment our previous imaging work and to seek an initial, efficient characterization of off-limb emission as Europa orbits Jupiter. Such images provide sensitive flux and column density limits, with exceptional spatial resolution. In transit, our strategy can place firm limits on, or measurements of, absorbing columns, their distribution with altitude above the surface of Europa, and constrain their wavelength dependence and hence composition. Out of transit, geometrical and surface brightness considerations can help us distinguish between continuum FUV emission from forward- or back-scattering, from line emission, or, though we might prefer otherwise, from more subtle instrumental artifacts than hitherto understood. If the ice fountains of Europa arise from the deep ocean, we have gained access to probably the most astrobiologically interesting location in the Solar System.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13830
Program Title: r-process kilonova emission accompanying short-duration GRBs

Principal Investigator: Nial Tanvir
PI Institution: University of Leicester

Our recent HST observations of the short-duration GRB130603B showed an infrared excess, about ten days after the burst, consistent with expectations from models of an emerging `kilonova' driven by the radioactive decay of newly-synthesised r-process elements. This directly supports the compact object merger hypothesis for short-duration GRBs, in which ejected neutron star material powers a radioactive transient. The discovery also provides a new, quasi-isotropic, electromagnetic localisation signature of the most promising class of gravitational wave (GW) sources for detection with the next generation of detectors, and suggests that kilonovae of this sort are likely sites of substantial (perhaps dominant) production of r-process elements in the universe. However, the ubiquity and range of behaviour of these events is entirely unknown. We need to establish their properties to inform searches of GW error boxes and quantify their contribution to the heavy element nucleosynthesis budget. Here we propose ToO observations a low-redshift (z<~0.35) SGRB localised during cycle 22 to search for and characterise more fully any similar kilonova signal.

Proposal Category: GO
Scientific Category: Cosmology
ID: 13831
Program Title: GRB hosts and the search for missing star formation at high redshift

Principal Investigator: Nial Tanvir

PI Institution: University of Leicester

Measuring the star formation rate (SFR) at high redshift is crucial for understanding cosmic reionization and the formation of galaxies at early times. Two common, complementary approaches are Lyman-Break-Galaxy (LBG) surveys, providing large samples, and Gamma-Ray-Bursts (GRBs) which can sign-post star formation even in the smallest galaxies. Recent results of both methods have found evidence for a dominant population of very faint star-forming galaxies at z>5, representing a continuation of the steepening of the galaxy luminosity function with redshift. However, LBG surveys are affected by possible incompleteness and contamination, while the magnitude limit means very large correction factors must be applied to account for these unseen galaxies. On the other hand GRBs suffer small number statistics and have their own selection biases. We propose to construct a new sample of six 6<z<8.2 GRB hosts with deep imaging in order to assess the proportion of star formation in very faint galaxies during at this key epoch. This is a critical issue, since only if faint galaxies dominate global star formation can UV light from stars sustain reionization. We will carry out WFC3/IR (F140W) imaging to a limit approaching that of the current HUDF observations (M(AB)~-18) in all cases. Prior knowledge of the exact locations and redshifts of the targets means that this can be achieved relatively economically, since we can accept a lower level of significance and single filter. This method depends only on GRBs and SF tracing UV light (both likely at high-z), and in turn will constrain the completeness correction to be applied to LBG surveys in order to derive the ionizing photon budget.

Proposal Category: GO

Scientific Category: Quasar Absorption Lines and IGM

ID: 13832

Program Title: Absorption in the Cosmic Web: Characterizing the Intergalactic Medium in Cosmological Filaments

Principal Investigator: Nicolas Tejos

PI Institution: University of California - Santa Cruz

We propose to observe and characterize the IGM associated with cosmological filaments in a statistical manner up to redshift ~0.4. For this purpose, we have used a published cluster catalog (Hao et al. 2010) to identify massive nodes in the cosmic web. We used cluster-pairs separated by < 20 Mpc (transverse) and < 2000 km/s (along the LOS) to identify zones where filaments should reside with high probabilities. We have selected a single QSO whose sightline passess through a total of 9 independent cluster-pairs (8 of which having spectroscopic redshifts) at impact parameters <10 Mpc (7 of which at < 5 Mpc). We propose to observe the QSO with HST/COS using the G130M and G160M gratings to cover the full FUV spectral range at medium resolution (R~20000). We require observations at S/N>10 to ensure a full characterization of HI and OVI lines at column densities N~10^13 cm^-2. This setup will allow us to detect broad and shallow HI and OVI lines (if any) at the redshifts of these filaments, believed to trace portions of the warm-hot intergalactic medium (WHIM). Combining these new observations with those from our pilot study carried out in cycle 20 (ID 12958, PI Tejos), we aim to provide a firm detection of the WHIM in cosmological filaments, at the 95% confidence level. Our findings will test our understanding of galaxy formation and the role of AGN/supernova feedback by comparing them with state-of-the-art hydrodynamical simulations. We will also test the the hypothesis which states that the majority of OVI absorbers at low-z are confined within <300 kpc from galaxies (i.e. circumgalactic medium) thus not related to the WHIM (Prochaska et al. 2011; Tumlinson et al. 2011).

Proposal Category: GO
Scientific Category: Quasar Absorption Lines and IGM
ID: 13833
Program Title: Characterizing the cool and warm-hot intergalactic medium in clusters at z < 0.4

Principal Investigator: Nicolas Tejos
PI Institution: University of California - Santa Cruz

Dedicated surveys with HST/COS and previous UV spectrometers have revealed that present-day galaxies of essentially all mass and spectral-type harbor a substantial reservoir of cool (T~10^4K) and warm (T~10^5-10^6 K) gas in their halos, defining a circumgalactic medium (CGM) around galaxies. At much higher halo mass scales, groups and clusters exhibit a hot (T~10^6-10^7K) tenuous plasma designated the intragroup or intracluster medium (IGrM, ICM). Although these massive structures hosts up to hundreds of individual galaxies, it is unknown whether the IGrM/ICM also contains cool or warm phases. Numerical simulations offer some guidance, predicting that the outer environment is warm (T<10^6K) and recent work on Virgo reveals a cool phase close to its virial radius. Here we venture into this unexplored territory, and propose to use HST/COS spectroscopy of 6 background QSOs to search for the cool (narrow HI Lya) and the warm/highly-ionized gas (broad HI Lya and OVI) at impact parameters of ~0.2 - 3 R_200 from 11 clusters lying in the foreground. We will use both G130M and G160M gratings to cover the full FUV spectral range to simultaneosly survey HI Lya and OVI at the redshifts of the intervening structures. This first systematic study of cool and warm gas in massive, low-z halos will enable us to: (1) quantify the contribution of the warm-hot intergalactic medium (WHIM) within or near massive groups and clusters; (2) explore the signatures of tidal and ram-pressure stripping of group/cluster members; (3) search for evidence of expulsion of baryons via feedback processes; and (4) search for evidence of cold/hot accretion modes in these massive halos.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13834
Program Title: The Proper Motion Field along the Magellanic Bridge: a New Probe of the LMC-SMC interaction

Principal Investigator: Roeland van der Marel
PI Institution: Space Telescope Science Institute

Our HST proper motion (PM) measurements of the LMC and SMC have revolutionized our understanding of the Magellanic System, and have spurred new research on its use as a cosmological probe of galaxy formation. The PMs imply that the Magellanic Clouds are likely on their first infall towards the Milky Way (MW). The disturbed nature of the Magellanic System is therefore likely due to the LMC-SMC interaction, and not to the MW influence. This has emphasized the importance of dwarf galaxy interactions for galaxy evolution. The Clouds are connected by a complex of gas and stars called the Magellanic Bridge. We propose to map the stellar PM field of the Bridge, similar to our prior HST

mapping of the LMC PM rotation field. Our state-of-the-art N-body simulations show that the PM field will tightly constrain the impact parameter of LMC-SMC orbit at its last pericenter 100-300 Myr ago, which is the main uncertainty in our understanding of the LMC/SMC interaction history. This will test whether the tidal debris between the galaxies is due to a recent direct-hit collision. It will also test models in which the tidal debris is responsible for the observed microlensing events. We will observe once 3 fields for which first-epoch archival data already exists, and observe twice 5 other fields over a 2-cycle time baseline. With the established data reduction techniques of our successful HSTPROMO collaboration, this will yield PM accuracies of 10-25 km/s per field, well below the 130 km/s velocity difference between the Clouds. This will yield the best constraints to date on the LMC/SMC interaction, and will further test the importance of dwarf-dwarf interactions for galaxy evolution.

Proposal Category:	GO
Scientific Category:	ISM and Circumstellar Matter
ID:	13838
Program Title:	UV Mapping of the Shocks in the Extremely Collimated Outflows of the Proto-Planetary Nebula Hen 3-1475
Principal Investigator:	Xuan Fang
PI Institution:	Instituto de Astrofisica de Andalucia (IAA)

In astrophysical environments, shocks are one of the key mechanisms to generate ionized material. These shocks arise mainly from the interaction between high velocity outflows/jets and the surrounding medium. Collimated outflows have been observed in a vast variety of objects including planetary nebulae (PNe) and their precursors, proto-planetary nebulae (PPNe), which are thought to be a crucial stage for PN structure formation. Hen 3-1475 is a PPN with extremely collimated, high-velocity outflows and an S-shaped string of point-symmetric knots. X-ray emission has been detected in the innermost knots, and HST STIS high-spatial resolution optical spectroscopy has shown that the knots are shock-excited. A time-dependent ejection velocity model has been invoked to explain the observed kinematics and morphology. We propose to obtain HST STIS slitless UV spectroscopy of Hen 3-1475 using the G140L and G230L gratings. This program will for the first time enable morphological studies of Hen 3-1475 in UV lines. The STIS UV spectrum will be analyzed in conjunction with archival STIS optical and Chandra X-ray data. Detailed hydro-dynamical simulations will be developed based on the multi-wavelength observations to investigate the formation and excitation of knots in fast outflows. Through this program, we will gain a deep understanding of the morphology, kinematics and excitation mechanisms in Hen 3-1475 and set up a benchmark for the morphological study of PPNe.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13839
Program Title:	The Lyman Alpha Extended Halo of a Quasar at z>6

Principal Investigator: Emanuele Farina

PI Institution: Max Planck Institute for Astronomy

The formation of quasars at z>6, when the Universe is less than 1Gyr old, require enormous reservoirs of gas to feed the black hole growth on such a short time scale. The only effective way to map the presence of this key ingredient of the galaxy formation at high-z is through the detection of the extended and diffuse Ly-Alpha emission that is powered by the star-formation and by the UV emission of the quasar. We here propose to observe the extended Ly-Alpha emission associated to the most powerful radio-loud high-redshift quasar known so far (J1429+5447, z=6.18). Radio-loud quasars are expected to be extremely biased tracers of the most massive dark matter halos and to be the precursor of the massive elliptical galaxies observed at z=0. The grism spectroscopy mode of the WFC3/IR camera provides the unique opportunity to directly investigate the properties of the Ly-Alpha ionized gas associated to the first quasars, putting strong constraints on the processes involved in the formation of the first galaxies at the end of the Cosmic reionization.

Proposal Category: GO

Scientific Category: ISM and Circumstellar Matter

ID: 13840

Program Title: The Smith Cloud: Galactic or Extragalactic?

Principal Investigator: Andrew Fox

PI Institution: Space Telescope Science Institute - ESA

The Milky Way is surrounded by a population of gaseous high-velocity clouds (HVCs), which play an important role in bringing fresh fuel for star formation into the disk. The Smith Cloud is an HVC in an advanced state of accretion, only ~30 Myr away from impacting the Galactic plane. It is unique among HVCs in having a known distance (12.4 kpc) and a well-constrained 3D velocity (300 km/s), but we do not yet know its metallicity, which would distinguish between Galactic (metal-enriched) and extragalactic (metal-poor) origins. Here we propose a program to measure the Smith Cloud's metallicity using HST/COS spectra of three AGN lying behind the Cloud and its wake. Combining the UV metal-line (O I and S II) column densities with existing H I column densities will lead to precise abundance measurements for the Smith Cloud, directly constraining its origin. In addition, the relative strength of depleted (Fe II, Si II) to undepleted (S II) UV absorption lines will be used to infer its dust content. Finally, we will search for variation in the ionization level and kinematics between the three sight lines, which would indicate a disruptive encounter with the hot Galactic corona.

Proposal Category: GO
Scientific Category: Hot Stars
ID: 13841
Program Title: Accurate masses and distances of the binary Cepheids S Mus and SU Cyg

Principal Investigator: Alexandre Gallenne
PI Institution: Universidad de Concepcion

We propose to study the main-sequence companion of the classical Cepheids S Mus and SU Cyg. Binary Cepheids lead to a better understanding of their age and evolution. Our primary goal with this proposal is to measure the radial velocity (RV) of the blue companions at several orbital epochs during two years. Most of the companions are B main-sequence stars, hidden by the brightness of the Cepheids for wavelengths longer than 0.5 microns. That is why all Galactic binary Cepheids are single-line spectroscopic binaries, so far. In UV, the spectrum of the companions dominate over the Cepheids, making UV spectroscopy clearly the best way to obtain the RV of the companions. We will then combine the RVs of both components with our accurate astrometric measurements obtained from our complementary interferometric program on binary Cepheids. The unique combination of interferometry and spectroscopy for this kind of stars will provide a independent estimate of the mass and the distance of these standard candles. This is particularly important to constrain Cepheid models and make progress on the Cepheid mass-discrepancy problem. Independent distance measurements are also necessary to the calibration of fundamental Cepheid relations (period-luminosity, period-mass, ...), and check the future GAIA parallax estimates.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13842
Program Title: Testing the Youth and Transition Object Status of FeLoBAL Quasars

Principal Investigator: Frederick Hamann
PI Institution: University of Florida

A popular paradigm for massive galaxy evolution has emerged in which mergers of gas-rich galaxies trigger both intense bursts of star formation and the growth of a central super-massive black hole. The transition from dusty starburst (e. g., ULIRG) to visibly luminous quasar is marked by a blowout of gas and dust that shuts down the star formation and unveils the central quasar. FeLoBAL quasars (with extreme low-ionization Broad Absorption Line outflows) are candidate young objects in the transition phase based on their dust reddened colors, large infrared luminosities (indicating ULIRG-like star formation rates), and exceptionally powerful outflows that appear strong enough to a drive galaxy-wide blowout.

We propose to test the youth and transition object status of FeLoBAL quasars by comparing their host galaxy morphologies and merger signatures to matched samples of 1) normal blue non-BAL quasars (that "should" be older), and 2) non-AGN galaxies at the same redshift and stellar mass. We will specifically obtain WFC3/IR F160W images of 10 FeLoBALs at redshift z ~ 0.8, supplemented by equivalent imaging data for normal blue quasars in our own cycle 21 program (PI Villforth) and for non-AGN galaxies from archival HST programs such as CANDELS. This will be the first HST imaging survey of FeLoBAL quasars and the first HST study of any transition object candidates to use matched control samples. Our results will uniquely test i) the alleged youth of FeLoBALs compared to normal quasars and non-AGN galaxies based on their merger status, and ii) the significance of mergers/interactions for quasar triggering based on comparisons to an equivalent non-AGN galaxy sample.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13843
Program Title:	A Candidate Recoiling Black Hole in a Nearby Dwarf Galaxy
Principal Investigator:	Michael Koss
PI Institution:	Eidgenossiche Technische Hochschule (ETH)

We have discovered a BH recoil candidate offset by 800 pc from a nearby dwarf galaxy. The object, SDSS1133, shows offset broad lines and strong variability. While originally classified as a supernova because of its non-detection in 2005, we detect it in recent and past observations over 63 years. Using high-resolution adaptive optics observations, we constrain the source emission region to be <12 pc. Overall these properties are consistent with theoretical predictions for a runaway BH ejected from its host by gravitational-wave recoil following a merger. We propose a small, 4 orbit HST observation using the COS spectrograph in the FUV, to test for broad C IV emission and other high ionization emission lines which would decisively favor the recoiling BH interpretation. The unique UV spectroscopic capability of HST is critical to decide whether this is a recoiling black hole or an unprecedented 50 year outbursting LBV star (e.g. Eta Carina) followed by a unique long duration SN IIn with rebrightening. Either discovery would be extremely exciting. Finally, SDSS1133 has recently undergone a 1.3 mag rebrightening in PanSTARRS imaging suggesting that the coming year is a critical time to observe the source at maximum.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13844
Program Title:	Unveiling the Black Hole Growth Mechanisms in the Protocluster Environment at z ~ 3
Principal Investigator:	Bret Lehmer

PI Institution: The Johns Hopkins University

We are studying the conditions leading to the enhanced growth of black holes (BHs) and galaxies observed in the z = 3.1 SSA22 protocluster, a progenitor of a rich galaxy cluster (Coma-like). With WFC3 near-IR imaging, we will measure the rest-frame optical properties (sizes, morphologies, and stellar masses) of 8 protocluster AGN host galaxies and a sample of 40 protocluster star-forming galaxies. We will compare these properties with those of > 100 AGN and > 1000 non-AGN host galaxies at z ~ 3 in field environments (via CANDELS), and clarify the role that environment plays in driving BH and galaxy growth at high redshift.

Proposal Category: GO

Scientific Category: Unresolved Star Formation

ID: 13845

Program Title: Resolved H-alpha Maps of Star-forming Galaxies in Distant Clusters: Towards a Physical Model of Satellite Galaxy Quenching

Principal Investigator: Adam Muzzin

PI Institution: Sterrewacht Leiden

It has been known for decades that satellite galaxies are always less star forming than central galaxies of similar mass. New, sophisticated modeling of satellites at both z = 0 and z = 1 has shown that the quenching of star formation in satellites must be a rapid process, occurring on a timescale of only ~ 0.5 Gyr. Despite good constraints on the quenching timescale, the detailed physics of how satellites actually shut down their star formation is still heavily debated. What is now desperately needed are high-quality observations of satellite galaxies directly in the process of quenching. In particular, resolved H-alpha maps would be extremely informative because H-alpha is a near instantaneous measure of the current SFR, showing where and when star formation is quenched. Thus far, these maps are only available locally for satellite galaxies in the Virgo cluster; however, they are fascinating. In H-alpha emission Virgo satellites are completely different than central galaxies, with >50% having highly truncated and disturbed disks, suggesting an outside-in truncation of star formation. We propose to obtain the first resolved H-alpha maps of star-forming satellite galaxies in massive clusters at z ~ 1. This high-redshift data will be critical to determine how satellite quenching evolves over time, as satellites have much higher gas fractions and star formation rates at z ~ 1. We will compare the H-alpha luminosities, sizes and profiles of the satellites to central galaxies in the 3D-HST survey and quantify how quenching affects star-forming disks at z ~ 1. This information will be key input for the next generation of physical models of satellite quenching.

Proposal Category: GO
Scientific Category: Quasar Absorption Lines and IGM
ID: 13846
Program Title: The COS Absorption Survey of Baryon Harbors (CASBaH): Probing the Circumgalactic Media of Galaxies from z = 0 to z = 1.5

Principal Investigator: Todd Tripp
PI Institution: University of Massachusetts - Amherst

In Cycle 17, we obtained high S/N, far-ultraviolet COS spectra of nine QSOs at 0.92 < z(QSO) < 1.47 to study the elusive warm-hot gas (log T = 5 - 6) and multiphase gaseous halos. Program highlights include (a) evidence of massive, multiphase galactic outflows with large spatial extent, (b) detection of pristine and cold gas, possibly in cold-accretion flows, and (c) discovery of a bimodal metallicity distribution in Lyman-limit absorbers. These rich data will be mined for some time, but ultimately the usefulness of the database is limited by the FUV wavelength range of the original observations. To fully exploit these unique HST observations to study the circumgalactic medium during the golden age of star formation (0.5 < z < 1.5), we propose high-resolution near-UV (>1800 A) spectroscopy of the same QSOs with STIS and COS to fully cover the H I Lya and Lyman series from z = 0 out to z = z(QSO) and significantly improve the statistics of far-UV lines and diagnostics. With these data we will (1) obtain precise metallicities of the cool CGM with added coverage of H I Lya and Lyman series lines (often not covered in current data at z > 0.5), (2) constrain the metallicity and mass of the warm-hot gas from, e.g, OVI/NeVIII + broad Lya constraints, (3) measure relative abundances (instead of assuming them) using banks of ions accessible only in the far-UV, (4) study absorber redshift evolution with the expanded samples at 0.5 < z < 1.5, (5) obtain more complete and accurate identification of weak lines, which is difficult without constraints on Lya at 0.5 < z < z(QSO), and (6) investigate statistical absorber-galaxy relationships in the epoch of peak star formation.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13851
Program Title: The Origin of Intermediate-Luminosity Red Transients

Principal Investigator: Howard Bond
PI Institution: The Pennsylvania State University

Intermediate-luminosity red transients (ILRTs) are a new class of optical transients. They have maximum luminosities between novae and SNe, and outbursts lasting several months, becoming cool, dusty, and extremely red as the eruptions proceed. A prototype is V838 Mon, which illuminated a spectacular light echo. Their outbursts may be due to catastrophic stellar collisions and mergers. This is demonstrably true for V1309 Sco, which was a contact binary before its eruption and is now a single star. However, it is not yet clear whether all ILRTs are due to mergers.
I propose WFC3 imaging of 3 ILRTs: (1) V4332 Sgr, which erupted in the Galactic bulge in 1994, is now a 19th-mag, very red remnant. Based on a high degree of linear polarization in ground-based measurements, it has been proposed that it is surrounded and obscured by a dusty, edge-on envelope, ejected during a stellar merger. If so, V4332 Sgr ought to display a dark lane at HST imaging resolution. (2) M31 RV is an ILRT that occurred in the bulge of M31 in

1988. HST images of the site taken between 1999 and 2010 failed to reveal a credible remnant of this event. However, models of expanding dusty envelopes predict that eventually, as the optical depth diminishes, the remnant should brighten. The passage of 5 years since the last HST observation of the field justifies another attempt to identify the putative merged binary. (3) CK Vul, the bright "nova" of 1670, is a candidate ILRT because of its red color and an outburst light curve resembling that of V838 Mon. A faint bipolar nebula lies at the site of CK Vul, but no credible remnant star has been found in ground-based images. HST resolution may reveal it.

Proposal Category:	GO
Scientific Category:	Quasar Absorption Lines and IGM
ID:	13852
Program Title:	How Galaxy Mergers Affect Their Environment: Mapping the Multiphase Circumgalactic Medium of Close Kinematic Pairs
Principal Investigator:	Rongmon Bordoloi
PI Institution:	Space Telescope Science Institute

Galaxy mergers are an important route through which galaxy transformations take place. The interplay of gas between the merging galaxies and their circumgalactic medium (CGM) likely plays a crucial part in this process. Despite its importance, no systematic study has been carried out to study the physical properties of this CGM gas and how it is affected by the merger process. We propose a carefully controlled absorption-line experiment to study the CGM around spectroscopically-identified close kinematic pairs. We plan to obtain COS observations of the CGM around a sample of 11 close kinematic pairs using 8 new QSO sight lines and three archival ones, all within 150 kpc of the interacting galaxy pairs. We will probe the multiphase CGM, using the C IV line to probe the warm gas and H I and other lower ionization metal species, C II Si II/III, to probe the cooler, more dense gas. We will combine these new observations with the complementary COS-Halos and COS-Dwarfs programs, which primarily probe the CGM around isolated galaxies. Using the isolated galaxies as a control sample will allow us to study the effects of the merging process on the CGM gas. Moreover, armed with spectroscopic and morphological information on the kinematic pairs, we will investigate how merger activities such as tidal interactions, affect the CGM of these galaxies. SDSS and COS provide the only means of probing the CGM of a controlled sample of mergers in the local Universe.

Proposal Category:	GO
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13853
Program Title:	UV Spectroscopy of Newly Discovered Tidal Disruption Flares
Principal Investigator:	Stephen Cenko

When a star passes within the sphere of disruption of a massive black hole, tidal forces will overcome self-gravity and unbind the star. While approximately half of the stellar debris is ejected at high velocities, the remaining material remains bound to the black hole and accretes, resulting in a luminous, long-lived transient known as a tidal disruption flare (TDF). Aside from serving as a unique laboratory for accretion physics, TDFs offer the hope of measuring black hole masses in galaxies much too distant for resolved kinematic studies. In the simplest analytic models, the black hole mass should scale as dt^2, where dt is the time delay between the disruption and the start of the flare.

Two primary factors have so far limited precise black hole mass estimates from current TDF searches: 1) The difficulty of distinguishing a bona fide TDF from the many other transients that can occur in galactic nuclei; 2) Determing the nature of the disrupted star from the observed electromagnetic signal (in particular the presence or absence of H in optical spectra). Here we request non-disruptive ToO spectra of two nearby TDF candidates in the UV with STIS. Our objectives are to search for unique "smoking gun" signatures of the tidal disruption process, and to constrain the geometry and composition of the newly formed accretion disk (and hence the disrupted star). Much like type Ia supernovae, these observations will furthermore serve as a cornerstone for future high-redshift TDF discoveries by LSST, where the rest-frame UV emission is redshifted into the optical bandpass.

Proposal Category:	GO
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13854
Program Title:	Characterizing New Fast Optical Transients with HST: Astrometry, Geometry, and Host Galaxies
Principal Investigator:	Stephen Cenko
PI Institution:	NASA Goddard Space Flight Center

The Palomar Transient Factory (PTF) is a wide-field, high-cadence optical survey designed with two primary objectives: (1) to perform a systematic study of known classes of transient and/or variable sources (e.g., Type Ia supernovae, RR Lyrae stars, etc.); and (2) to enable the discovery of new classes of transient phenomena by exploring new regimes of sensitivity and variability. PTF recently transitioned to a new observing strategy (dubbed "iPTF"), in large part due to a desire to investigate even shorter time scales (tau < 1 day). The systematic exploration of this new phase should enable the discovery of new astrophysical phenomenon, including both those predicted but not yet observationally confirmed (e.g., orphan gamma-ray burst afterglows) and those entirely unknown.

Here we request HST ToO observations of a newly discovered "fast" optical transient, typified by our previous discovery of PTF11agg. We argue that PTF11agg may represent a new class of distant, relativistic outbursts lacking in high-energy emission altogether (i.e., "dirty" fireballs), and that these sources may be at least as common as normal, on-axis gamma-ray bursts. Our transient detection pipeline now enables us to identify and confirm these sources in real-time, as demonstrated by our recent discovery of iPTF14yb (the first gamma-ray burst identified via its long-wavelength afterglow emission). HST can provide three vital diagnostics that cannot be achieved with any other facility: (1) resolved host imaging; (2) sub-galactic localizations; and (3) sensitive late-time photometry when the transient emission is comparable to or fainter than the underlying host.

Proposal Category: GO
Scientific Category: Debris Disks
ID: 13855
Program Title: STIS Coronagraphy of a Debris Disk Newly Discovered Around a Young M Dwarf

Principal Investigator: Elodie Choquet
PI Institution: Space Telescope Science Institute

We propose STIS coronagraphic observations of a new debris disk recently discovered around an M dwarf in our reanalysis of NICMOS coronagraphic archive as part of the ALICE program (Archival Legacy Investigations of Circumstellar Environments, AR-12652). Our target is a young (30 Myr) M dwarf. Only two disks have been imaged so far around M dwarfs, with only one in scattered light (AU Mic). STIS coronagraphy will dramatically surpass the NICMOS discovery, with 2x better angular resolution and much improved contrast and sensitivity. These observations will allow us to measure in detail the disk geometry, determining whether parent bodies are constrained in "birth rings" analogous to the Kuiper Belt, and to search for the signatures of unseen planets gravitationally stirring the disk. Only HST/STIS is capable of obtaining, at optical wavelengths, the necessary high angular resolution, sub-arcsecond high contrast, and image fidelity that are essential for tracing the faint extended components of this disk.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13856
Program Title: Resolving the faint end of the satellite luminosity function for the nearest elliptical Centaurus A

Principal Investigator: Denija Crnojevic
PI Institution: Texas Tech University

We request HST/ACS imaging to follow up 15 new faint candidate dwarfs around the nearest elliptical Centaurus A (3.8 Mpc). The dwarfs were found via a systematic ground-based (Magellan/Megacam) survey out to ~150 kpc, designed to directly confront the "missing satellites" problem in a wholly new environment. Current Cold Dark Matter models for structure formation fail to reproduce the shallow slope of the satellite luminosity function in spiral-dominated groups for which dwarfs fainter than M_V<-14 have been surveyed (the Local Group and the nearby, interacting M81 group). Clusters of galaxies show a better agreement with cosmological predictions, suggesting an environmental dependence of the (poorly-understood) physical processes acting on the evolution of low mass galaxies (e.g., reionization). However, the luminosity function completeness for these rich environments quickly drops due to the faintness of the satellites and to the difficult cluster membership determination. We target a yet unexplored "intermediate"

environment, a nearby group dominated by an elliptical galaxy, ideal due to its proximity: accurate (10%) distance determinations for its members can be derived from resolved stellar populations. The proposed observations of the candidate dwarfs will confirm their nature, group membership, and constrain their luminosities, metallicities, and star formation histories. We will obtain the first complete census of dwarf satellites of an elliptical down to an unprecedented M_V<-9. Our results will crucially constrain cosmological predictions for the faint end of the satellite luminosity function to achieve a more complete picture of the galaxy formation process.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13857
Program Title: Emission Line Stars in Andromeda

Principal Investigator: Julianne Dalcanton
PI Institution: University of Washington

Elucidating the physics that drives production of emission lines in a wide variety of stellar sources is hampered by the relatively small, heterogeneous available samples. We propose to construct a large, deep, homogeneous sample of more than 10,000 emission line stars in M31, by adding H-alpha imaging to existing data from the Panchromatic Hubble Andromeda Treasury (PHAT), in regions targeted to contain large numbers of massive young stellar clusters. This program will deliver the statistics needed to determine the prevalence of Be disk systems as a function of age and the rate of dramatic disk-loss/disk-renewal episodes. The survey will also provide a key opportunity to identify Symbiotic stars from a well characterized dataset, and diagnose why the current rate of observed symbiotic stars is several orders of magnitude less than that predicted by theory. Our program will also serve as a critical, deep legacy product for the broader community interested in other emission line stars such as Wolf-Rayet stars, PNe, and luminous M(e) stars.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13858
Program Title: The environment of the rarest and most energetic supernovae: do pair-instability explosions exist in the nearby Universe?

Principal Investigator: Annalisa De Cia
PI Institution:

We propose imaging of the host galaxies of super-luminous supernovae (SLSNe) of the rarest class, SLSN-R. These SNe are several magnitudes brighter than typical core-collapse SNe and their late-time light curves follow the 56Co radioactive decay. The physical process that leads to their explosion is under debate. Observationally, the more likely possibility is that SLSN-R are the product of stars with cores more massive than several tens of solar masses, that explode due to pair-production instability. However, such pair instability supernovae (PISNe) are theoretically easier to form from zero-metallicity population III stars at high redshifts, that could develop the massive cores required. Local pockets of low-metallicity gas or highly dense stellar clusters may allow PISNe to form at low redshift, but this has not been observationally confirmed. Our pilot HST program targeting a single SLSN-R (PTF10nmn) surprisingly showed it occurred well away from the host's most intense star formation, in a lower-metallicity region, up to 10 times lower than would have been measured using ground-based data alone. Here, we propose to target 4 additional SLSNe-R (out of a total of 6 events), all nearby candidate PISNe homogeneously selected from the Palomar Transient Factory wide-field survey, among thousands of classified SNe. The accurate location of these SNe with respect to their host galaxies and star-forming regions can provide invaluable information on the (typical?) environment of these events. This is crucial to both address the question of the existence of PISNe in the nearby Universe and to investigate the physical nature of these rare, extreme and debated explosions.

Proposal Category:	GO
Scientific Category:	Extra-Solar Planets
ID:	13859
Program Title:	Unveiling the circumstellar environment of the most extreme hot-Jupiters

Principal Investigator:	Luca	Fossati
PI Institution:	Universitat Bonn, Argelander Institute for Astronomy	

Ultraviolet HST observations have shown that atmospheric evaporation is a common feature of hot-Jupiters: highly irradiated (short-period) Jupiter-like planets. Models show that hot-Jupiters lose only a small fraction of their mass to evaporation but this may not be the case for extreme hot-Jupiters such as WASP-12b, which orbit very close to their host stars. Our Cycle 17 observations of WASP-12b showed that the planet atmosphere is evaporating and that gas escaping from the heavily irradiated planet may form a stable and thick circumstellar disk, causing an anomalously low stellar activity index. This anomaly does not allow us to correctly estimate the stellar UV flux, which drives the evaporation, from the available observational material. We request 6 HST orbits to obtain far-UV spectra of WASP-18 and WASP-13. Both stars host extreme hot-Jupiters, show an anomalously low activity index, and are much brighter than WASP-12, allowing one to obtain the necessary high quality far-UV spectra; WASP-12 is too faint at far-UV wavelengths to be measured by the instruments on-board HST. The data will allow us to improve the mass loss rates estimated for the most extreme hot-Jupiters as well as to resolve the ambiguity about the activity of the host stars in these systems. These data are necessary to correctly interpret the Cycle 17 HST observations, as well as observations of WASP-12b which have recently been obtained in Cycle-21.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13860
Program Title: Investigating the low-mass slope and possible turnover in the LMC IMF

Principal Investigator: Mario Gennaro
PI Institution: Space Telescope Science Institute

We propose to derive the Initial Mass Function (IMF) of the field population of the Large Magellanic Cloud (LMC) down to 0.2 solar masses, probing the mass regime where the characteristic IMF turnover is observed in our Galaxy. The power of the HST, using the WFC3 IR channel, is necessary to obtain photometric mass estimates for the faint, cool, dwarf stars with masses below the expected IMF turnover point. Only by probing the IMF down to such masses, it will be possible to clearly distinguish between a bottom-heavy or bottom-light IMF in the LMC. Recent studies, using the deepest available observations for the Small Magellanic Cloud, cannot find clear evidence of a turnover in the IMF for this galaxy, suggesting a bottom-heavy IMF in contrast to the Milky Way. A similar study of the LMC is needed to confirm a possible dependence of the low-mass IMF with galactic environment. Studies of giant ellipticals have recently challenged the picture of a universal IMF, and suggest an enviromental dependence of the IMF, with the most massive galaxies having a larger fraction of low mass stars and no IMF turnover. A study of possible IMF variations from resolved stellar populations in nearby galaxies is of great importance in sheding light on this issue. Our simple approach, using direct evidence from basic star counts, is much less prone to systematic errors with respect to studies of more distant objects which have to rely on the observations of integrated properties.

Proposal Category: GO
Scientific Category: Cool Stars
ID: 13861
Program Title: HST/COS FUV Spectrophotometry of the Key Binary Solar Twins 16 Cyg A&B: Astrophysical Laboratories for the Future Sun and Older Solar Analogs

Principal Investigator: Edward Guinan
PI Institution: Villanova University

The fortuitous location of the wide G1.5V/G2.5V binary 16 Cyg A&B as the brightest stars in the Kepler Field is a "game changer," permitting the determination of the stars' fundamental properties from asteroseismolgy analyses. Recent studies returned precise determinations of the stars' basic properties including masses and age (6.8+/-0.4 Gyr), along with the rotation periods. Thus, 16 Cyg A&B are now the oldest solar-mass analogs with reliable ages and physical properties. Only the Sun has better determined physical properties. 16 Cyg A&B now serve as old-age anchors for Rotation-Age-Activity-Irradiance relations (and Gyrochronology studies) for solar-type stars. Extensive Ca II HK spectrophotometry reveals low levels of chromospheric emission are below the lowest values for our Sun. These stars serve as critical test beds for studying solar/stellar dynamos for stars less active than the Sun. These advances have catapulted 16 Cyg A&B into a prominent place in solar/stellar astrophysics for studying the evolution, internal

has been observed from X-ray - IR, there are no observations in the FUV region where most of the crucial diagnostic chromospheric & transition region emissions occur. We request COS FUV medium resolution (G130M, G160M) spectra (six orbits/star). This permits the important FUV (1150-1750A) line emission strengths, profiles and Doppler shifts to be analyzed and compared with the Sun and other solar-analogs. This program is complemented by Ca II HK, high precision uvby observations, and by proposed Chandra X-ray coronal observations.

Proposal Category: GO
Scientific Category: ISM in External Galaxies
ID: 13862
Program Title: Measuring the Impact of Starbursts on the Circum-Galactic Medium

Principal Investigator: Timothy Heckman
PI Institution: The Johns Hopkins University

We request 49 orbits with COS to measure the impact of starburst-driven outflows on the surrounding Circum-Galactic Medium (CGM) using absorption-line spectroscopy of background QSOs . In a small pilot program with COS we were able to establish that the CGM surrounding starbursts is characterized by unusually strong CIV1549,1551 absorption lines out to an impact parameter of at least 200 kpc, most likely caused by the shock-ionization of CGM clouds by the starburst-driven wind. The new data we request will increase our sample with CIV measurements from 5 to 17 low redshift starbursts. These span a range in starburst age from < 100 Myr to > 600 Myr. With 17 total sightlines we will be able to study the time-evolution of the wind-CGM interaction. We will also be able to probe the size and geometrical structure of the wind-CGM interaction by looking for trends with the impact parameter and orientation (with respect to the galaxy minor axis) of the sightline, and to clarify the dependence of the wind-CGM interaction on the starburst strength and galaxy mass. In addition, we will obtain data on the OVI1032,1038 line for seven starbursts for which efficient COS observations can be made. This will extend our probe of the wind-CGM interaction to significantly hotter gas, and will also allow us to compare OVI in starbursts to the ordinary star-forming galaxies in the COS-Halos project. These new data will significantly improve our understanding of how galactic winds impact the evolution of galaxies and the inter-galactic medium

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Proposal Category: GO
Scientific Category: Solar System
ID: 13863
Program Title: Imaging Polarimetry of the 67P/Churyumov-Gerasimenko with ACS: Supporting the Rosetta Mission

Principal Investigator: Dean Hines
PI Institution:

We propose ACS/WFC imaging polarimetry of Comet 67P/Churyumov-Gerasimenko (hereafter 67P), in support of the Rosetta mission, to place stringent constraints on dust particles in the coma. Our observations bracket the period when Rosetta operates closest to 67P, and will deploy the Philae lander. Fortunately, this occurs when the comet phase angle is well centered in the negative-polarization branch (12-15 degrees), enabling the different materials within the coma to be mapped using their polarization response, providing information on comet heterogeneity, and on the size, shape/structure, composition, or orientation of the particles. Our results will compare directly with in-situ measurements from Rosetta, placing strong constraints on material on small scales near and at the nucleus, and on larger scales within the coma. During the encounter, 67P will subtend only about 4-5", so ground-based observations would only provide one or two "polarimetric resolution elements" across the coma, at most. Laser AO systems can provide higher spatial resolution, but do not have visible wavelength polarimetry modes. In addition to our high spatial resolution requirement, this exciting period in the Rosetta mission coincides with the end of the visibility window from Earth, with 67P only visible for around 45 minutes between the end of astronomical twilight and reaching 2 airmasses in mid-November for ground-based telescopes. The necessary S/N could not be achieved by polarimeters on even the largest ground-based telescopes during this window. HST/ACS is the only asset capable of achieving our objectives during this once-in-a-lifetime opportunity.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13864
Program Title:	Hubble Imaging of a Newly Discovered Active Asteroid

Principal Investigator:	David	Jewitt
PI Institution:	University of California - Los Angeles	

Active asteroids (aka Main-Belt comets or MBCs) have the orbital characteristics of asteroids but also show transient, comet-like activity caused by mass-loss. Examples of mass-loss likely caused by sublimation, impact, and rotational effects have been established, while numerous additional processes are capable of launching material from asteroids. We propose two orbits of non-disruptive, target-of-opportunity observations of the next discovered active asteroid in order to help determine the process driving mass loss.

Proposal Category: GO
Scientific Category: Solar System
ID: 13865
Program Title: Determining the Nature and Origin of Mass Loss from Active Asteroid P/2013 R3

Principal Investigator: David Jewitt

PI Institution: University of California - Los Angeles

We propose a program of WFC3 images of the active asteroid P/2013 R3 in order to determine the nature and origin of mass loss from this object. R3 has a unique, multiple nucleus structure in which the components are measured to separate at sub-meter per second velocities. It is best explained as a rotational breakup (presumably resulting from the YORP torque). We will obtain images over a wide time base in Cycle 22 in order to determine the orbits of the fragments and we will obtain time-series, high resolution photometry in order to measure their rotations. Rotational breakup and rotational mass-shedding are suspected to be the main mechanisms of destruction for sub-kilometer asteroids. Neither has been observed before but, between P/2013 R3 and P/2013 P5 (subject of another proposal) we have the first, potentially ground-breaking opportunities to observe both.

Proposal Category: GO
Scientific Category: Solar System
ID: 13866
Program Title: Determining the Nature and Origin of Mass Loss from Active Asteroid P/2013 P5

Principal Investigator: David Jewitt

PI Institution: University of California - Los Angeles

We propose a program of WFC3 images of active asteroid P/2013 P5 in order to determine the nature and origin of mass loss from this object. P5 ejects dust episodically, creating a multi-tailed appearance unlike that of any other known asteroid or comet. The ejection is thought to result from surface rotational instabilities (a process called "mass-shedding" by modelers). We will test the role of rotation by measuring the lightcurve of the nucleus and we will study the evolution of continued mass loss through Cycle 22. Rotational breakup and rotational mass-shedding are suspected to be the main mechanisms of destruction for sub-kilometer asteroids. Neither has been observed before but, between P/2013 P5 and P/2013 R3 (subject of another proposal) we have the first, potentially ground-breaking opportunities to observe both.

Proposal Category: GO
Scientific Category: Resolved Stellar Populations
ID: 13867
Program Title: Testing a Globular Cluster Origin for Elusive Calcium-rich Gap Transients

Principal Investigator: Mansi Kasliwal
PI Institution: Carnegie Institution of Washington

The advent of wide-field synoptic surveys has re-invigorated time domain astronomy. The six magnitude luminosity gap between novae and supernovae is now bridged with multiple classes of explosions that are rarer, fainter and faster than supernovae. Here, we discuss an emerging class of transients with the unique property of a small amount of ejecta dominated by Calcium. The members of this class are located in the middle of nowhere in intra-group/intra-cluster environments, offset by tens of kiloparsec from their putative host galaxy. No single model can yet explain all the observables of "Calcium-rich Gap" transients. The location distribution is inconsistent with stellar mass and yet, strikingly consistent with globular clusters. It has been speculated that the high stellar density in globulars leads to peculiar transients. Thus, we propose to use 4 HST orbits to test a globular cluster origin for these elusive Calcium-rich transients.

Proposal Category: GO
Scientific Category: AGN/Quasars
ID: 13868
Program Title: Are Compton-Thick AGN the Missing Link Between Mergers and Black Hole Growth?

Principal Investigator: Dale Kocevski
PI Institution: University of Kentucky

Galaxy mergers have long been proposed as a possible triggering mechanism for AGN activity, but surveys of AGN out to z~2 have consistently failed to find morphological signatures of recent merger activity. A major caveat to these results is that past studies have not been sensitive to heavily obscured, Compton-thick AGN. Hydrodynamical merger simulations predict that this obscured phase should coincide with the most morphologically disturbed phase of a galaxy interaction. To address this potential bias, we propose WFC3 F160W observations of 25 Compton-thick AGN at z~2. The majority of these AGN are newly discovered and have been found by their reflection dominated X-ray spectra and Fe Kalpha emission. We will use the F160W imaging to examine the rest-frame optical morphologies of their host galaxies to determine if obscured SMBH growth is preferentially associated with merger activity at z~2. The F160W imaging is vital as it provides high-resolution imaging beyond the 4000A break at z~2, revealing bulges, disks, and even interaction signatures for the first time. Our proposed observations will increase by a factor of three our current sample of Compton-thick AGN with rest-frame optical imaging at z>1.5. X-ray spectroscopy is arguably the most reliable technique for identifying Compton-thick AGN and our current sample is the largest ever compiled with this method at z~2. As such, the observations requested here will enable the first large-scale study of the host morphologies of bona fide Compton-thick AGN at this redshift and will help reveal if the long predicted AGN-merger connection has been missed in the past due to the effects of obscuration.

Proposal Category:	GO
Scientific Category:	AGN/Quasars
ID:	13869
Program Title:	Pinpointing the location and host of the candidate tidal disruption Swift J1112.3 -8238
Principal Investigator:	Andrew Levan
PI Institution:	The University of Warwick

Multiwavelength observations over the past few years have revealed a new class of high energy transient. These systems persist as bright gamma-ray sources for days, with luminosities in excess of the Eddington limit for a 10^10 solar mass black hole. They are accompanied by bright, long-lived (months to years) X-ray emission, and rather fainter, but still clearly detectable optical and IR counterparts. They are suggested to arise from the tidal disruption of stars in the nuclei of their host galaxies, which create a powerful relativistic outflow. In the first case (Swift J1644+57) astrometry ties the transient to nucleus of its host galaxy, while in a second (Swift J2058.4+0516) the host is exceptionally faint making (H~26.5) such tests challenging . However, other models have been postulated, such as the collapse of a giant star, where the outer envelope forms a disc that powers the observed transients, akin to a scaled-up gamma-ray burst. A key distinguishing feature between the two progenitors is their expected locations. Tidal disruptions are nuclear, while GRB-like events are consistent with the nuclei of their hosts only 1/6 of the time. Here we propose observations of an event recently uncovered in an archival search. These will resolve its host galaxy and provide a precise location on the host. An IR visit will also provide a colors, and an estimate of the stellar and (through the bulge mass -- black hole mass relation) black hole mass. These data will provide the key astrometric and photometric evidence to disentagle competing models for these events, and will greatly aid the development of a definitive understanding of this new class of transient.

Proposal Category: GO

Scientific Category: Hot Stars

ID: 13870

Program Title: The progenitors of the longest duration high-energy transients

Principal Investigator: Andrew Levan

PI Institution: The University of Warwick

Recent observations have highlighted a hitherto unexpected diversity in the properties of the high-energy transient sky via the discovery of populations of transient with durations of hours to days (comapred to seconds to minutes for the previously recognised classes of gamma-ray burst). The origin of these events remains uncertain with the prime models being either the collapse of a giant star, or relativistic variants of tidal disruption events. We propose a comprehensive campaign of observations to i) search for evidence of hot black-body components assocaited with tidal flares, ii) provide sensitive constraints on supernovae of any type, iii) map the X-ray to optical light curves and spectral energy distributions for comparison to model expectations and iv) precisely position the transients on their host galaxies, relative to the expected locations of supermassive black holes. These observations have the capability to unambigously determine the nature of these enigmatic transient systems, and pave the way for their use as probes of extreme physics and cosmology.

Proposal Category: GO

Scientific Category: Cosmology

ID: 13871

Program Title: A Spectroscopic Redshift for the Most Luminous Galaxy Candidate at z~10

Principal Investigator: Pascal Oesch

PI Institution: Yale University

We recently discovered an unexpectedly bright and hence very luminous z~10 galaxy candidate in the GOODS-North field (GN-z10-1; Oesch et al. 2014). This source is the brightest and highest-redshift z>9 candidate in the complete 900-orbit CANDELS dataset. It is also the only z>8 candidate that is robustly detected in both Spitzer 3.6 and 4.5 micron channels, allowing for an unprecedented sampling of the rest-frame UV to optical spectral energy distribution for such an early galaxy. The existence of such a luminous and massive source at z~10, just 500 Myr after the Big Bang, raises significant questions about our understanding of early galaxy formation: it would imply that massive galaxies built up their masses faster than hitherto thought. Our comprehensive photometric tests indicate that this galaxy lies at z>9. However, without a spectroscopic redshift, we can not exclude other possibilities, such as a low redshift galaxy with very unusual continuum and emission line properties. The unusual brightness of this candidate together with the unique continuum sensitivity of the WFC3/IR grism G141 opens up the possibility for spectroscopic confirmation with HST. Because of its high redshift, this source cannot be observed from the ground due to very low

atmospheric transparency at the wavelengths of its redshifted Lyman break. Before JWST, HST with the WFC3/IR G141 grism is uniquely capable amongst all existing telescopes of establishing a breakthrough in high-redshift galaxy spectroscopy by enabling a spectroscopic *continuum* detection at z~10.

Proposal Category:	GO
Scientific Category:	Cosmology
ID:	13872
Program Title:	The GOODS UV Legacy Fields: A Full Census of Faint Star-Forming Galaxies at z~0.5 -2
Principal Investigator:	Pascal Oesch
PI Institution:	Yale University

Deep HST imaging has shown that the overall star formation density and UV light density at z>3 is dominated by faint, blue galaxies. Remarkably, very little is known about the equivalent galaxy population at lower redshifts. Understanding how these galaxies evolve across the epoch of peak cosmic star-formation is key to a complete picture of galaxy evolution. While we and others have been making every effort to use existing UV imaging data, a large fraction of the prior data were taken without post-flash and are not photometric. We now propose to obtain a robust legacy dataset for a complete census of faint star-forming galaxies at z~0.5-2, akin to what is achieved at z>3, using the unique capabilities of the WFC3/UVIS camera to obtain very deep UV imaging to 27.5-28.0 mag over the CANDELS Deep fields in GOODS North and South. We directly sample the FUV at z>~0.5 and we make these prime legacy fields for JWST with unique and essential UV/blue HST coverage. Together with the exquisite ancillary multi-wavelength data at high spatial resolution from ACS and WFC3/IR our program will result in accurate photometric redshifts for very faint sources and will enable a wealth of research by the community. This includes tracing the evolution of the FUV luminosity function over the peak of the star formation rate density from z~3 down to z~0.5, measuring the physical properties of sub-L* galaxies, and characterizing resolved stellar populations to decipher the build-up of the Hubble sequence from sub-galactic clumps. The lack of a future UV space telescope makes the acquisition of such legacy data imperative for the JWST era and beyond.

Proposal Category:	GO
Scientific Category:	Solar System
ID:	13873
Program Title:	The Intriguing Formation of Haumea's Satellites
Principal Investigator:	Darin Ragozzine
PI Institution:	Florida Institute of Technology

satellites, Haumea is also the progenitor of the only collisional family in the Kuiper belt and provides unique insights on the physics of KBO collisions, tides, surfaces, and interiors. A self-consistent theory for Haumea's formation remains elusive, but is clearly connected to unanswered questions about the outer solar system. Precise physical and orbital characteristics of Haumea's satellites can distinguish between several proposed histories. When 2010 HST data was added to the initial orbital solution from Ragozzine & Brown 2009 (RB09), degeneracies between the non-Keplerian effects from satellite masses and from Haumea's non-spherical gravity began to break (Cuk, Ragozzine, Nesvorny 2013). By obtaining three single-orbit visits in Cycle 22, HST will double its observational baseline, which provides very significant improvement in inference of the most interesting system properties. This small investment benefits multiple sicence goals: robust satellite mass and Haumea J2 measurements to distinguish between formation models; crucial support for Haumea-inner-satellite mutual events through 2020; tying down the unusually rapid rotation of outer satellite; and providing context for New Horizons' visit to Pluto. Observations from the ground cannot reasonably provide the same scientific benefit since close-in (~0.25") resolved astrometry and photometry are required. This proposal provides low-risk, high-return scientific insight into the formation of this intriguing object with implications for understanding the outer solar system.

Proposal Category: GO

Scientific Category: Solar System

ID: 13874

Program Title: Using Hubble to Measure Volatile Abundances and the D/H Ratio in a Bright ToO Comet

Principal Investigator: Harold Weaver

PI Institution: The Johns Hopkins University Applied Physics Laboratory

We propose a 10-orbit program to observe any newly discovered bright comet as a non-disruptive Target of Opportunity during cycle 22. For a comet whose water production rate meets our basic ToO selection criterion, Hubble observations can be used to measure abundances of three highly volatile species (CO, CO2, and S2), providing critical information on the origin and evolution of the comet's nucleus. If the comet additionally has geocentric and heliocentric radial velocities in a favorable range, our Hubble observations will measure atomic deuterium emission, from which we can derive the D/H ratio for comparison to the values measured in other comets and Earth's water. The D/H ratio in cometary water is a key indicator of the role played by comets in the delivery of volatiles to the terrestrial planets. This is a non-disruptive ToO program because we anticipate that execution of the proposed observations need not be scheduled until at least 1 month after the triggering event. We have already identified four potential targets (C/2013 V5 (Oukaimeden), C/2012 K1 (PanSTARRS), C/2013 A1 (Siding Spring), C/2014 E2 (Jacques)), but it is still too early to tell if any of these will meet our ToO selection criteria.

Proposal Category: GO

Scientific Category: Quasar Absorption Lines and IGM

ID: 13875

Program Title: A Potential Paradigm Shift in our Understanding of Helium Reionization

Principal Investigator: Gabor Worseck

PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

The advent of GALEX and COS have revolutionized studies of HeII reionization. Observations of the FUV-brightest QSOs have resulted in a order-of-magnitude increase in science-grade HeII Lya absorption spectra in the HST archive. The clear picture emerging is that COS has successfully pinpointed the end of HeII reionization at z~2.7. Based on this, and our team's state-of-the-art radiative transfer simulations, one expects complete Gunn-Peterson absorption at higher redshifts. However, surprisingly, our analysis of the three existing sightlines at z>3.5 reveals high-transmission regions consistent with expectations for a reionized IGM, in striking conflict with the models. Explaining these measurements may require invoking other exotic sources of hard photons at high-z, which would amount to a paradigm shift in our understanding of HeII reionization, with concomitant implications for HI reionization. The unequivocal path forward is COS spectra of more QSOs at z>3.5, deep into the reionization era, to put this tentative result on firm statistical footing. We request 24 orbits to obtain science-grade COS far-UV spectra of the 3 brightest HeII QSOs at z>3.5, which will double the HeII pathlength at high-z and test tantalizing indications that HeII reionization began at z>4 and lasted over 1 Gyr. These spectra are complemented by ancillary data from 8m telescopes, including echelle spectra of the coeval HI Lya forest, and our dedicated survey for QSOs in the foreground of each HeII sightline. Our targets are the only viable sources probing z>3.5 in a reasonable orbit request, and it is critical to HST's legacy to solve this riddle before the mission ends.

Proposal Category: AR

Scientific Category: Unresolved Stellar Populations and Galaxy

ID: 13877

Program Title: Project ALCATRAZ: Archival Lyman-Continuum and Theoretical Reionization Analysis vs. z: Where, When, How & How Much does LyC Escape?

Principal Investigator: Rogier Windhorst

PI Institution: Arizona State University

We propose a systematic Archival study of the best available UV images: the WFC3 Early Release Science (ERS) data and, as a check, also the HUDF. Each was imaged in 3 WFC3 UV filters + 7-9 ACS and WFC3/IR filters. SED fits provide photo-z, luminosity, stellar mass, age, SFR, and extinction estimates. Stacking the 2-45 orbit native depth for 100's of objects will reach UV-depths of 100's-1000's of orbits, paying careful attention to systematics. Our main goal is to outline where, when, how and how much Lyman continuum (LyC) escapes from both galaxies and AGN in the epoch z=2 to z=7-11. Detailed science goals are:
1. Where does LyC escape, and for which classes of objects? We will study escaping LyC vs. galaxy luminosity, mass, age, SFR, and extinction, and for (weak) AGN.
2. When did LyC escape, and how did this vary with epoch? Available spectroscopic redshifts and the 10-12-filter photo-z probability distribution will be used to maximize each subsample, masking out all foreground interlopers.
3. How does LyC escape? Is it mostly via direct unobscured lines of sight? Or can it escape dusty star-forming galaxies

and/or dusty AGN with outflows, but be scattered in our direction off electron and/or dust clouds?
4. How much escaping LyC can we measure reliably? Preliminary WFC3 ERS results suggest a LyC flux for galaxies (and also some AGN) at z=2.45-4.2 of 28.4-29.5 mag/arcsec^2 (5.0-2.0-sigma), in line with our scattering predictions. Does any hard LyC escape below restframe 200-300 A from z=7-11 candidates along a few lucky unobscured lines-of-sight?

ALCATRAZ can and must be done now to constrain the processes that started and maintained cosmic reionization.

Proposal Category: AR
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13878
Program Title: Unearthing a Treasure Trove of Ultraviolet Galaxy Spectra

Principal Investigator: Claus Leitherer
PI Institution: Space Telescope Science Institute

We propose an archival study of a set of COS M-mode spectra of star-forming galaxies whose quality vastly supsersedes that of previously obtained data with FOS, GHRS, and STIS. The originally proposed science focused on the interstellar lines, requiring high S/N and spectral resolution. Our project addresses the stellar population as observed in the UV lines of, e.g., N V, Si IV, and C IV. The data set enables new discovery space by allowing us to study the behavior of weak stellar features at low metallicity and the bias introduced by the blending of interstellar and stellar-wind lines. We will create a set of galaxy templates for comparison with star-forming galaxies at low and high redshift. Comparison with population synthesis models will provide constraints on ages, IMF and metallicities and a first calibration of new stellar evolution models accounting for the rotation of massive stars.

Proposal Category: AR
Scientific Category: Cool Stars
ID: 13879
Program Title: The s-process contribution to rare, heavy elements

Principal Investigator: Ian Roederer
PI Institution: University of Michigan

capture reactions in an s-process environment. Lines of Cd I and II, Lu II, Os I, Pt I, Hg II, and Pb I are present in existing NUV spectra of the low-metallicity subgiant HD 94028, and many other species have been derived previously from optical spectra. We will use these data to compare against predictions of s-process nucleosynthesis operating in low-metallicity stars in the AGB phase of evolution. No such study has been conducted previously, and these results will provide the first observational constraints on the s-process nucleosynthesis reaction networks for Ge, As, Se, Cd, Lu, Os, Pt, and Hg.

Proposal Category: AR

Scientific Category: AGN/Quasars

ID: 13880

Program Title: The First Direct Measurement of the 2-3 Rydberg Quasar Continuum for a Statistical Sample

Principal Investigator: David Syphers

PI Institution: University of Colorado at Boulder

Quasars are responsible for the majority of photoionization of the intergalactic medium over most of the history of the Universe, dominating especially at the higher energies that produce many astrophysically important ions. However, direct observations of their intrinsic ionizing spectra have thus far been largely limited to energies less than ~1.5 Ryd. We propose to directly measure the 2-3 Ryd spectral indices of about 40 z ~ 3 quasars (originally observed to study helium reionization), carefully accounting for all Galactic and intergalactic modifications of the spectrum, in order to construct for the first time an accurate picture of this large portion of the ionizing spectrum of quasars. Such a fully corrected measurement of the ionizing continuum at these energies has not been made before, and the available sample allows a robust determination.

Proposal Category: AR

Scientific Category: Unresolved Star Formation

ID: 13881

Program Title: The formation of Lyman alpha fluorescent H2 lines in protoplanetary disks surrounding young solar mass stars

Principal Investigator: Nuria Calvet

PI Institution: University of Michigan

We propose to carry out a theoretical study of the formation of the H2 UV lines created by Lyman alpha fluorescence in protoplanetary disks around solar mass stars. We will use irradiated accretion disks models in which the dust and gas temperatures, as well as the hydrostatic density structure and corresponding chemistry is solved self-consistently, using as input realistic high energy fields, and observed ranges of accretion luminosities. We will include gas opacities in addition to dust to calculate the transfer of high energy radiation, which will enable us to model the gas disk inside the dust destruction radius where a substantial contribution to the flux of the H2 lines arises. The models will also include effects of dust settling by varying the vertical and radial distribution of the dust, which will have a direct effect on the the penetration of high energy radiation with implications for the gas temperature structure, the chemistry, and the strength of the H2 fluorescent lines. We will create a dedicated website with predicted H2 fluorescent line luminosities for a set of models covering ranges of stellar and accretion parameters typical of accreting solar mass stars and different degrees of dust settling. Our study will support efforts of the Ultraviolet Initiative of Cycle 22 by providing the community with the best means to interpret the FUV COS and STIS H2 spectra of young accreting stars.

Proposal Category: AR

Scientific Category: Resolved Stellar Populations

ID: 13882

Program Title: The Masses of M31 Supernova Remnant Progenitors

Principal Investigator: Benjamin Williams

PI Institution: University of Washington

We propose to expand our previous successful archival program to constrain the progenitor masses of supernova remnants (SNRs) in M31. Our previous program has resulted in 2 papers that each significantly improve our knowledge of the mass distribution of stars that produce supernovae. However, a new and significantly improved SNR catalog has been released this year, which is more comprehensive and reliable that anything available at the time of our previous program. The amount of high-quality HST imaging has also increased. This new catalog provides 106 SNRs with HST coverage, 67 of which were not measured by our previous archival program. Furthermore, our technique for measuring uncertainties in our mass estimates has become more reliable. This expanded and updated program will increase the number of measurements SNRs by a factor of 2, while also producing a much cleaner, more homogeneous sample.

Proposal Category: AR
Scientific Category: Solar System
ID: 13883
Program Title: Probing sub-km-sized Kuiper Belt Objects with Stellar Occultations

Principal Investigator: Hilke Schlichting
PI Institution: Massachusetts Institute of Technology

The study of the size distribution of small, sub-km-sized Kuiper belt objects (KBOs) provides fundamental constraints on their formation, their effective strength and their collisional evolution. Sub-km-sized Kuiper belt objects elude direct detection, but the signature of their occultations of background stars is detectable. The first two sub-km-sized KBOs have been reported by Schlichting et al. (2009, 2012), who analyzed a total of 90,000 star hours (containing 31,500 star hours of low ecliptic latitude, |b| < 20 deg., observations) of archival data taken by the Fine Guidance Sensors (FGS) on board the Hubble Space Telescope (HST). These works provide the first measurement of the abundance of hectometer-sized KBOs. This new archival proposal builds on our previous work and expands it to include: 1) The analysis of an additional ~40,000 star hours of FGS observations obtained between January 2010 to mid 2014, which will increase the number of star hours by more than 40% and holds the promise for additional detections of KBO occultations. This work will allow us to constrain the power-law index of the small KBO size distribution to an unprecedented accuracy, which in turn provides valuable insights into the initial planetesimal size distribution, the collisional processes of sub-km-sized KBOs and their material properties. 2) Statistically probing the underlying population of smaller KBOs by examining the noise properties as function of observing geometry and ecliptic latitude, which will allow us to measure, for the first time, the small KBO inclination distribution.

Proposal Category: AR
Scientific Category: Cool Stars
ID: 13884
Program Title: The Origins of Germanium and the Transition to Neutron-Capture Nucleosynthesis

Principal Investigator: Ian Roederer
PI Institution: University of Michigan

We propose to study the element germanium (Ge, Z=32) in cool stars. Ge has a mass that puts it in a transition region

from nucleosynthesis occurring in nuclear statistical equilibrium to charged-particle and neutron-capture reactions. Observational constraints on predictions of the nucleosynthesis of Ge are limited, since Ge has only be detected in cool stars with the UV sensitivity of HST. We propose a new ARCHIVE project that will double the number of cool stars with Ge detections. We will use these data to characterize the different Ge production mechanisms over the history of the Galaxy and understand the chemical evolution of this transition element. This will provide a better understanding of the many nucleosynthesis channels that have produced Ge since the earliest epochs of metal production in stars.

Proposal Category: AR
Scientific Category: Hot Stars
ID: 13885
Program Title: Comparative Precise Parameters for OB Stars in Three Galaxies

Principal Investigator: Nolan Walborn
PI Institution: Space Telescope Science Institute

The chemical abundances, wind terminal velocities, and mass-loss rates of OB stars in the Small and Large Magellanic Clouds will be determined homogeneously from high-resolution spectroscopic data in the Mikulski Archive; and they will be further compared with analogous determinations in the Solar Neighborhood. As is well known, the three systems offer a metallicity sequence with values in solar units generally given as 0.2, 0.5, and 1, respectively, which should have corresponding effects on the metallic-line-driven winds. However, the quantitative basis for that general result can and should be improved for various reasons. For instance, it is based on heterogeneous analyses, some dated, of data with varying quality. Moreover, there is not a single metallicity but different relative values for different elements, seldom available for individual stars, with CNO significantly affected by internal evolutionary processes. We propose advances with state-of-the-art analyses of the best data, primarily from STIS and COS in the UV, but also incorporating FUSE observations of the same stars, and IUE high-resolution of a few. We shall also analyze correlative groundbased optical data. J-CB and collaborators have already published recent results for Galactic supergiants and SMC dwarfs, while work on the SMC giants/supergiants is in progress. We shall build upon that work with further Galactic and SMC data, and especially with the still relatively small but significant LMC UV sample, with detailed spectral-type matching insofar as possible. We shall also produce an atlas of all spectra analyzed, to be placed in the Archive as a high-level product to guide future work.

Proposal Category: AR
Scientific Category: Cosmology

ID: 13886

Program Title: Behind the Mask: Are First-Light Galaxies or Intrahalo-Light Stars Dominating the Unresolved IR background Fluctuations?

Principal Investigator: Asantha Cooray

PI Institution: University of California - Irvine

Observations of the near-infrared (near-IR) background are extremely important for investigating the formation and evolution of first galaxies. The unresolved IR fluctuations in Spitzer/IRAC maps have been interpreted as due to faint galaxies present during reionization at z > 6. These galaxies have flux densities that fall below the point source detection threshold in even deeper IRAC maps. A new measurement of the fluctuation power spectrum with IRAC was shown by us to be more consistent with a model involving the intrahalo light (IHL) or the integrated emission from diffuse halo stars stripped during mergers and satellite accretion at z of 1 to 3. A multi-wavelength study can separate the two and place reliable limits on the surface density of z > 6 galaxies based on the Lyman drop-out nature of fluctuations from high redshifts at optical wavelengths relative to near-IR fluctuations. As part of CANDELS we have carried out such a study in GOODS fields using ACS/F814W and WFC3/F125W and F160W. We have obtained first limits on the UV luminosity density of the universe from faint galaxies with intensity fluctuations. The proposed archival analysis is aimed at extending the current study to wide area CANDELS fierlds (UDS, COSMOS, EGS), to improve statistical errors and reduce cosmic variance. We will also carry out a cross-correlation of intensity fluctuations against a map of the dark matter with weak lensing in the COSMOS. Such a cross-correlation is needed to improve halo model for IHL and to better separate the high-redshift signal in the intensity fluctuations.

Proposal Category: AR

Scientific Category: Unresolved Stellar Populations and Galaxy

ID: 13887

Program Title: Observing the Origins of Galaxy Structure in the Illustris Simulation

Principal Investigator: Greg Snyder

PI Institution: Space Telescope Science Institute

Many processes affect the appearance of galaxies, and it has recently become possible to predict how these processes set internal galaxy structure in significant populations. Such calculations are poised to clarify the physics of star formation quenching, the cosmological formation of bulges and disks, and the observability of galaxy mergers. To advance these goals, we propose to build and analyze a very large set of mock HST images based on the Illustris Project. This accurate continuous-volume hydrodynamical simulation formed thousands of structurally diverse Milky Way-mass galaxies in (106.5 Mpc)^3 with detail comparable to the resolution of HST at many cosmic times. We will mock-observe 41,000 model galaxies at 0 < z < 5 in broadband filters used by ACS, WFC3, and JWST/NIRCAM, and measure automated morphology diagnostics from each image. This will constitute a timely and effective tool to advance two key goals of observational cosmology with HST: linking the building blocks of galaxies across cosmic time, and understanding the implications of galaxy morphology and structure. It will allow us to study the emergence of the Hubble Sequence, estimate merger rates and consequences, and interpret star formation patterns in distant galaxies. Therefore this model dataset is ideally suited to enhance results from HST Treasury and Archival Legacy surveys, the

Ultra Deep Fields, and Frontier Fields. To increase the science return, we will publicly release our model images and morphology catalogs, providing a tool that can directly link physical mechanisms to high redshift galaxy data.

Proposal Category:	AR
Scientific Category:	Resolved Stellar Populations
ID:	13888
Program Title:	Star Formation Histories of Dwarf Galaxies: Keys to Galaxy Formation and Dark Matter Structure
Principal Investigator:	Michael Boylan-Kolchin
PI Institution:	University of Maryland

We propose to perform a suite of hydrodynamical simulations in order to understand the connection between dwarf galaxy star formation histories, stellar content, and central dark matter densities. This will leverage one of HST's unique and enduring scientific contributions, deep and uniform photometry of nearby dwarf galaxies that enables reconstructions of their ancient (z~6-10) star formation histories, to shed light on some of the main problems in galaxy formation and cosmology.

Analysis of HST observations has definitively shown that dwarfs exhibit a surprising variety of star formation histories: some dwarfs host nearly purely ancient populations, while others have formed 90% of their stars after redshift 1. This diversity is unexpected in current theoretical models, which predict primarily old stellar populations in low-mass objects. The topic of star formation histories of dwarfs has also received significant attention recently in the context of possible small-scale problems of the LCDM model: if episodic bursts of star formation inject energy into dwarfs' dark matter halos, it may provide a natural explanation of the observed low densities of dwarf galaxies within LCDM.

Our simulations will adopt physically-motivated, explicit feedback prescriptions that are fixed by our knowledge of stellar evolution. We will choose halos having diverse mass assembly histories within a narrow range of mass and compare their star formation histories to HST observations of nearby isolated dwarf galaxies, thereby testing fundamental aspects of galaxy formation modeling and dark matter astrophysics. Data from our simulations will be publicly released via a dedicated website.

Proposal Category:	AR
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13889
Program Title:	Galaxy Mergers, AGN, and Quenching in z > 1 Proto-Clusters
Principal Investigator:	Jennifer Lotz
PI Institution:	Space Telescope Science Institute

We propose to use the densest known environments at 1 < z < 2 as laboratories to understand the importance of galaxy mergers in the formation and quenching of massive bulge-dominated galaxies. High redshift proto-clusters are

the progenitors of today's massive clusters; yet at z > 1, they are less dense, with lower velocity dispersions, active star-formation, and are often recently assembled unrelaxed systems. Direct and indirect evidence points to rapid rates of galaxy assembly via mergers in these environments as compared to the field (e.g. Lotz et al. 2013). Therefore, they are ideal places for studying the connection between galaxy mergers, bulge formation, AGN activity, and quenching at this critical time in formation of early-type galaxies. We propose to use HST archival imaging and grism data of 18 z > 1 proto-clusters to identify galaxy mergers, emission-line AGN, and quenching spheroids. By comparing stellar mass controlled samples from proto-clusters to those drawn from CANDELS/3D-HST field samples, we will determine if bulge formation, AGN triggering, and quenching in massive galaxies at z > 1 are driven by galaxy mergers.

Proposal Category: AR
Scientific Category: AGN/Quasars
ID: 13890
Program Title: Quantifying the Bias in the Masses of Supermassive Black Holes in Barred Galaxies

Principal Investigator: Monica Valluri
PI Institution: University of Michigan

Recent studies of simulations of barred galaxies with supermassive black holes (BH) show that a bar can cause an increase in the central line-of-sight velocity dispersion (sigma) of about 7-12% - an increase that is consistent with the average offset observed for barred galaxies relative to unbarred ones. A more serious consequence of the presence of a bar is that its unique orbital structure (the combination of the radially biased bar orbits and the high bar pattern speed), results in a high central velocity dispersion but negative 4th Gauss-Hermite parameters, even in the vicinity of the BH. This unique combination of kinematical parameters can result in a systematic over-estimate of the BH mass - if the bar is modelled as axisymmetric. Although nearly 60% of spiral/S0 galaxies with existing stellar dynamically BH masses are in barred galaxies, their masses have been derived using axisymmetric models! An overestimate of BH mass in barred disks would erase morphological differences between the BH scaling relations of disks and ellipticals, which could be crucial to understanding the co-evolution of BHs and their host galaxies. In this theory proposal we will use N-body simulations to generate mock kinematic datasets (STIS, FOS and ground based IFU) for barred disk galaxies, model them with an axisymmetric orbit superposition code, and thereby quantify the magnitude of the bias in existing BH mass measurements. This analysis will provide crucial input for developing new and accurate methods for determining BH masses in galaxies of different morphological types, thereby revealing the true extent of intrinsic differences in the supermassive BH scaling relationships.

Proposal Category: AR
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13891

Program Title: Mining the Treasuries: Dwarf Galaxies at 0.5 < z < 1 as Lynchpins for Galaxy Formation and Feedback

Principal Investigator: Yicheng Guo

PI Institution: University of California - Santa Cruz

Distant dwarf galaxies (DGs), with stellar masses 100--1000 times less than that of our Milky Way, are lynchpins for understanding galaxy formation and feedback. Like gems, they are small, hard-to-find, but precious by being the most sensitive probes of both the macro-physics of dark matter halos and the micro-physics of the feedback and regulation of star formation. We propose to undertake a comprehensive study of dwarf galaxies at 0.5<z<1 in the CANDELS fields, by mining the archived HST broad-band photometry and grism spectroscopy, mainly from two Treasury Programs (CANDELS and 3D-HST). Our study will yield (1) reliable stellar mass function of DGs via high-quality photometric and grism redshifts and stellar masses of ~15,000 DGs, (2) gas-phase metallicities for ~1,700 DGs (over 50x current samples) from grism data, and (3) distributions of and correlations with stellar sizes, profiles, and shapes for ~15,000 DGs. We compare these measurements to predictions from the most advanced galaxy formation models to trace the stellar mass--halo mass relation, test viable feedback mechanisms, and track star formation and assembly histories of DGs.

Proposal Category: AR

Scientific Category: Resolved Star Formation

ID: 13892

Program Title: The Reel Deal In 3D: The Spatio-Temporal Evolution of YSO Jets

Principal Investigator: Adam Frank

PI Institution: University of Rochester

Jets are a ubiquitous phenomena in astrophysics, though in most cases their central engines are unresolvable. Thus the structure of the jets often acts as a proxy for understanding the objects creating them. Jets are also of interest in their own right, serving as critical examples of rapidly evolving astrophysical magnetized plasma systems. And while millions of CPU hours (at least) have been spent simulating the kinds of astrophysical plasma dynamics that occur routinely in jets, we rarely have had the chance to study their real-time evolution.

In this proposal we seek to use a unique multi-epoch HST dataset of protostellar jets to carry forward an innovative theoretical, numerical and laboratory-based study of magnetized outflows and the plasma processes which determine their evolution. Our work will make direct and detailed contact with these HST data sets and will articulate newly-observed features of jet dynamics that have not been possible to explore before. Using numerical simulations and laboratory plasma studies we seek to articulate the full 3-D nature of new behaviors seen in the HST data. Our collaboration includes the use of scaled laboratory plasma experiments with hypersonic magnetized radiative jets. The MHD experiments have explored how jets break up into clumps via kink-mode instabilities. Therefore such experiments are directly relevant to the initial conditions in our models.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13893
Program Title: The spectral shape of the ionizing extragalactic background radiation at z ~ 0

Principal Investigator: Bart Wakker
PI Institution: University of Wisconsin - Madison

The intensity and spectral shape of the cosmic ionizing UV background radiation is important for understanding the structure, formation, evolution and physical state of the low-density intergalactic medium (IGM). The UV background radiation is produced by the integrated radiation from QSOs and galaxies, which is then reprocessed by the clumpy IGM. Despite its importance, the UV background is still poorly known both observationally and theoretically, especially at low redshifts. We propose to constrain the spectral shape of the ionizing UV background radiation at z ~ 0 in the energy range 1 < E < 6 ryd using 16 optically thin metal absorbers which are in photoionization equilibrium with the extragalactic UV background. The selected absorbers have C III and C IV detections often accompanied by Si II, Si III and Si IV, which are clearly associated with each other and with H I at the same redshift. Comparing observations to metal column density predictions based on the photoionization code CLOUDY, we propose the first study of the spectral shape, fluctuation and dominant ionizing source of the UV background radiation at z ~ 0.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13894
Program Title: A Deep Survey of Low-Redshift Absorbers and Their Connections with Galaxies: Probing the Roles of Dwarfs, Satellites, and Large-Scale Environment

Principal Investigator: Joseph Burchett
PI Institution: University of Massachusetts - Amherst

In the not-too-distant past, the study of galaxy evolution neglected the vast interface between the stars in a galaxy and intergalactic space except for the dynamical effects of dark matter. Thanks to QSO absorption line spectroscopy and the Cosmic Origins Spectrograph (COS), the circumgalactic medium (CGM) has come into sharp focus as a rich ecosystem playing a vital role in the evolution of the host galaxy. However, attributing the gas detected in absorption

with host dwarf galaxies detected in optical surveys around the sightline becomes very difficult very quickly with increasing redshift. In addition, both targeted UV spectroscopy and ground-based galaxy surveys are resource intensive, which complicates compiling large, statistically robust samples of very-low-redshift absorber/galaxy pairs. We propose a CGM study of unprecedented statistical power by exploiting the vast number of sightlines in the HST/COS archive located within the Sloan Digital Sky Survey (SDSS) footprint to compile an estimated sample of 586 absorbers at z<0.015. This very-low-redshift criterion enables spectroscopic completeness down to L<0.01 L* galaxies in publicly available optical imaging and spectroscopy.

Our survey is uniquely poised to address the following questions: (1) What is the role of dwarf galaxies that would be undetectable at higher redshift in giving rise to the gas detected in QSO spectroscopy? (2) How does galaxy environment and large-scale structure affect the CGM and what are the implications for environmental quenching of star formation? (3) How efficiently do feedback mechanisms expel metal-enriched gas to great distances into the galaxy halo and into the IGM?

Proposal Category: AR
Scientific Category: Cosmology
ID: 13895
Program Title: Revealing the Properties of the Frontier Fields Galaxies

Principal Investigator: John Wise

PI Institution: Georgia Institute of Technology

The HST campaign Frontier Fields will discover an even larger sample of galaxies at redshifts greater than 6. We propose to make observational predictions for this high-redshift population, using a suite of high-resolution cosmological simulations, that will enable the correlation between key observables and the physical properties of the first galaxies in the universe. These simulations will have finished before Cycle 22, and this proposal focuses on the analysis of the simulated galaxies. The primary goal of this proposal is to constrain the following properties: (1) star formation histories and stellar populations, (2) nebular emission and dust extinction, (3) the faint end of the luminosity function, (4) cosmic variance, and (5) galaxy morphology and structure. We will make all of the analysis data products publicly available. We will also provide a Markov Chain Monte Carlo tool to the public that will calculate the most likely galaxy properties, such as stellar mass, metallicity, and ages, given a redshift, half-light radius, and magnitudes/spectra.

Proposal Category: AR
Scientific Category: Cosmology
ID: 13896
Program Title: Going out with a bang or a whimper? Star formation and quenching in the Local

Group's satellite galaxies

Principal Investigator: Andrew Benson

PI Institution: Carnegie Institution of Washington

HST observations of the Milky Way and M31's satellite galaxies show that those galaxies have an incredible diversity of star-formation histories, yet with the exception of the Magellanic Clouds, NGC205, and NGC185, none have active star formation or cold gas at the present. What accounts for the variation in star-formation histories, and what turns off star formation? We propose to use the publicly available Galacticus semi-analytic modeling code to explore the mechanisms for star formation and quenching of Local Group dwarf galaxies, comparing the satellite galaxies of the Milky Way and M31 with the star-forming "field" galaxies of the Local Group. We will create new modules for Galacticus to incorporate physical processes necessary to follow star formation and quenching (e.g., ram- pressure and tidal stripping and compression of gas), and perform a Markov Chain Monte Carlo analysis of the HST-derived star-formation histories to determine the best-fit physical model and degeneracies of parameters for star formation in the Local Group. These new modules and the Markov chains will be publicly released via the Galacticus web server. With this study, we can determine to what extent the star-formation histories and quenching of Local Group dwarfs are governed by physical processes that depend on properties of the Milky Way and M31's dark and gas halos versus other "external" (e.g., reionization-induced photoionization) or "internal" (e.g., supernova feedback) processes. This study will be a window into the broader question of star formation in dwarf galaxies.

Proposal Category: AR

Scientific Category: Cosmology

ID: 13897

Program Title: Clusters of Galaxies in the last 5 Billion Years: from the Brightest Cluster Galaxy to the Intra-Cluster Light

Principal Investigator: Annalisa Pillepich

PI Institution: Harvard University

Understanding the physical processes which shape the galaxy population in the high density environment of galaxy clusters as a function of cosmic time is a central open question in galaxy evolution studies. With the Frontier Field Initiative, HST will provide an ultra-deep view and an unprecedented multi-wavelength dataset to study the galaxy population in and around galaxy clusters at intermediate redshift. With our study, we aim at providing the first self-consistent theoretical framework based on cosmological hydrodynamical simulations to understand the evolution of cluster galaxies: our analysis is designed to complement and aid the interpretation of the wealth of observational data within the LCDM Cosmology. In particular, we plan an in-depth analysis of a sample of 15 haloes with masses between 7x10^13 and 2x10^15 Msun at z=0, simulated with the gravity+hydrodynamics code Arepo. The numerical scheme and the galaxy formation model adopted in this study have already been successfully tested against a series of global measurements: they will allow us to follow the fate, within each cluster, of hundreds of well-resolved galaxies with stellar masses above 5x10^9 Msun. Our analysis will include the assembly properties of the central brightest galaxies as well as the demographics of the satellite populations and their cluster-centric gradients of colors, morphologies and star formation rates. Our setup is suitable to quantify the effects of environment on star formation, stripping, and quenching across an unprecedented range of galaxy masses, cluster masses and spatial scales, in addition to providing valuable clues about the diffuse intra-cluster light.

Proposal Category: AR
Scientific Category: Extra-Solar Planets
ID: 13898
Program Title: The Influence of Stellar Companions on Fomalhaut's Planetary System

Principal Investigator: Nathan Kaib
PI Institution: Northwestern University/CIERA

The Fomalhaut star system has been targeted by at least 11 HST observing programs, resulting in nearly 150 orbits of observations that have uncovered an eccentric dust ring and a directly imaged exoplanet candidate on an extreme orbit. Despite extensive observational and theoretical study, a self-consistent explanation for this system's structure has yet to be found. However, the Fomalhuat system also contains two distant stellar companions orbiting at 57000 AU and 158000 AU whose dynamics are largely unexplored. We have recently shown that the influence of such distant stellar companions on the structure and evolution of planetary systems can often be (counterintuitively) quite dramatic. Based on preliminary work, we believe Fomalhaut's stellar companions (in particular the closer star) may account for the dust ring's eccentricity and possibly the imaged planet's orbit. We propose to use numerical simulations to thoroughly characterize the orbital evolution of Fomalhaut's stellar companions and assess the probability that they can produce the observed ring's eccentricity. These simulations will also provide mass constraints on the total ring material as well as mass and orbital architecture constraints on any undetected planets orbiting interior to Fomalhaut's ring. Understanding the potential role of Fomalhaut's stellar companions will offer new insights into HST's perplexing observations of this system.

Proposal Category: AR
Scientific Category: ISM and Circumstellar Matter
ID: 13899
Program Title: An H2/HD Collisional Excitation Database from High-Dimensional Quantum Dynamics Calculations: Benchmarking Interstellar STIS/COS observations

Principal Investigator: Phillip Stancil
PI Institution: University of Georgia Research Foundation, Inc.

The detailed understanding of the formation, destruction, and excitation of molecular hydrogen, H2, and its singly-deuterated isotopologue, HD, is crucial for astrophysical models of the postrecombination era, of local and extragalactic interstellar clouds, of circumstellar shells and protoplanetary disks, e.g. nearly every environment where molecular gas is exposed to UV irradiation resulting in a photodissociation region (PDR). However, the dominant impactors for exciting H2 and HD are para-H2 and ortho-H2. Rate coefficients for these colliders are limited to vibrational levels v<4 for H2

and v=0 for HD. Further, they are based on approximate calculations which treated the colliding H2 as a pseudo-atom. Here we propose to extend our full-dimensional 6D quantum calculations for H2-H2 with v=0-2 up to v=14 and to perform for the first time initial rovibrational calculations for HD-H2. The availability of the proposed rate coefficients will allow for advanced PDR models along site lines observed with STIS and motivate future COS observations. In a number of cases, a large number of absorption features (up to 300) have been observed allowing for detailed model refinement and potentially new PDR physics. The rate coefficients will be distributed to the astrophysical modeling community via standard database formats (e.g., LAMDA, BASECOL, Cloudy).

Proposal Category:	AR
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13900
Program Title:	Stellar Evolutionary Isochrones for Galaxy Evolution
Principal Investigator:	Guy Worthey
PI Institution:	Washington State University

We will combine new ab initio stellar evolution calculations with onging stellar flux and photometric improvements to provide HST and other missions with greatly improved stellar evolutionary isochrones and accompanying integrated light models for unraveling galaxy evolution using spacebourne and groundbased filter sets.

We propose to add the following capabilities currently unavailable: (1) carbon star populations, (2) nearly arbitrary chemical mixture, (3) stars with M < 0.6 Mo, down to 0.08 Mo, (4) realistic metallicity spreads in populations, (5) immediate and full transformations to space-based photometric systems including HST and also quantities as a function of redshift, and (6) where possible, empirical adjustments to colors and certain evolutionary phases.

Furthermore, we will provide web calculator pages yielding a broad array of color-calibration and isochrone-author choices, all of which are interchangeable. We currently give color-magnitude diagrams in graphical and plottable text form for 6 isochrone author choices and about 200 photometric filters. What would be added if this proposal is granted funding is (1) new evolution and improved color choices, (2) integrated light output for a variety of IMF choices and metallicity distribution functions, and (3) optional extra output of integrated quantites as a function of redshift.

Proposal Category:	AR
Scientific Category:	Resolved Stellar Populations
ID:	13901
Program Title:	A Legacy Magellanic Clouds Star Clusters Sample for the Calibration of Stellar Evolution Models

Principal Investigator: Morgan Fouesneau

PI Institution: University of Washington

Stellar evolution models are fundamental to all studies in astrophysics. These models are the foundations of the interpretation of colors and luminosities of stars necessary to address problems ranging from galaxy formation to determining the habitable zone of planets and interstellar medium properties. For decades the standard calibration of these models relied on a handful of star clusters. However, large uncertainties remain in the fundamental parameters underlying stellar evolution models.

The project we propose is two-fold. First we propose to generate a new high quality reference dataset of the resolved stars in 121 Magellanic Cloud clusters, selected from 18 past programs to efficiently sample a large grid of stellar evolution models. Our team will measure the photometry of individual stars in those clusters and characterize individual completeness and photometric uncertainties. Second, we will migrate the calibration of the stellar evolution into a fully probabilistic framework, that will not only reflect the state-of-the-art, but will also be published with fully characterized uncertainties, based on the entire reference data set, rather than a few select clusters.

We have entered an era dominated by large surveys (e.g. SDSS, PanSTARRS, Gaia, LSST) where the variations between families of stellar models are greater than the nominal precision of the instruments. Our proposed program will provide a library needed for a convergence in the stellar models and our understanding of stellar evolution.

Proposal Category: AR

Scientific Category: Quasar Absorption Lines and IGM

ID: 13903

Program Title: quasar lifetimes and helium reionization from HeII proximity zones

Principal Investigator: Matthew McQuinn

PI Institution: University of Washington

The Cosmic Origins Spectrograph (COS) has gathered science grade HeII Lyman-alpha forest spectra towards 22 quasars. The vast majority of these show an enhancement in the ionization of helium at the redshift of the background quasar (the line-of-sight proximity zone) and most also show additional enhancements along the line-of-sight owing to adjacent quasars (transverse proximity zones). These zones can be used to constrain the lifetimes of a statistically representative set of quasars on the extremely interesting timescale of 1-100 Myr and, at the higher redshifts probed by HST/COS, also the reionization of the second electron of helium. However, to extract this information requires radiative transfer calculations. We outline a regimen of such calculations that should lay the groundwork to be able to interpret HST/COS HeII Lyman-alpha forest observations.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13904
Program Title: SIMULATING THE CIRCUMGALACTIC MEDIUM AND THE CYCLE OF BARYONS IN AND OUT OF GALAXIES

Principal Investigator: Piero Madau
PI Institution: University of California - Santa Cruz

Studies of the ionization, chemical, thermodynamic, and kinematic state of gaseous material in the circumgalactic medium (CGM) hold clues to understanding the exchange of mass, metals, and energy between galaxies and their surroundings. We propose here a detailed comparison of HST-COS data at low redshifts with results from our suite of extreme-resolution cosmological hydrodynamic "zoom-in" simulations of the CGM of massive spiral and sub-L* galaxies. Our state-of-the-art simulations adopt a feedback prescription that produces hundreds of kpc-scale galactic outflows, metal-dependent radiative cooling, and a model for the diffusion of metals and thermal energy. They have been recently shown to generate interstellar absorption line strengths of Lya, CII, CIV, SiII, and SiIV as a function of impact parameter that are in agreement with those observed in the CGM of star-forming massive galaxies, and to reproduce the observed stellar mass and cold gas content, resolved star formation histories, and metallicities of field dwarfs in the Local Volume. During the duration of this program we will: 1) analyze these simulations and trace the formation of the CGM to z=0; 2) add, in post processing, radiative transfer effects using an updated version of the ray-tracing RADAMESH code developed by one of the co-Is; 3) generate synthetic spectra by drawing sightlines through the simulated CGM, and compare the resulting column densities and equivalent widths of key metal ions as a function of impact parameter with data from the Hubble; 4) make the simulated data available online to the community to enhance the value of past, present, and future observational programs with the HST-COS.

Proposal Category: AR
Scientific Category: Unresolved Star Formation
ID: 13905
Program Title: Quantifying Bursty Star Formation and Dust Extinction in Dwarf Galaxies at 0.75 < z < 1.5

Principal Investigator: Brian Siana
PI Institution: University of California - Riverside

Using the magnification provided by gravitational lensing, our team has recently uncovered an important population of star-forming dwarf galaxies at 1<z<3.5. Both the star formation histories and the dust extinction properties in these galaxies are claimed to be significantly different from their more massive counterparts, but uncertainties remain. First, the star formation rates of these dwarf galaxies are expected to vary by an order of magnitude on short, 10-30 Myr, time scales unlike the more massive galaxies. Second, the dust extinction is claimed to be very low, but these claims have not considered that the intrinsic colors of these galaxies are likely very different than more massive galaxies.

In cycle 21, we were awarded 48 orbits of near-UV imaging of the three best Frontier Field cluster lenses to measure the ultraviolet properties of a large number of star-forming dwarf galaxies. Also in cycle 21, the GLASS survey was allocated 140 orbits of WFC3/IR grism spectroscopy of 10 lensing clusters, including 42 orbits of spectroscopy in the Frontier Fields for which we have near-UV imaging.

We propose for archival funding to incorporate the WFC3/IR grism spectroscopy of a sample of ~70 dwarf galaxies at 0.75<z<1.5 in the three Frontier Fields with deep near-UV imaging. Together, the UV and H-alpha luminosities will determine star formation rates on very different timescales, allowing us to quantify the "burstiness" in these dwarf galaxies.

Furthermore, both the UV spectral slope and the Balmer decrement (Halpha/Hbeta ratio) will allow independent measures of dust extinction, to better quantify the intrinsic star formation rates in these galaxies.

Proposal Category:	AR
Scientific Category:	Unresolved Star Formation
ID:	13906
Program Title:	Cold Galaxies on FIRE: Modeling the Most Luminous Starbursts in the Universe with Cosmological Zoom Simulations
Principal Investigator:	Desika Narayanan
PI Institution:	Haverford College

As the most luminous, heavily star-forming galaxies in the Universe, Submillimeter Galaxies at z~2-4 are key players in galaxy evolution. Since their discovery, SMGs have received significant attention from HST in characterizing their physical morphology, stellar masses, and star formation histories. Unfortunately, these physical constraints have been difficult for theorists to reconcile with galaxy formation simulations. Previous generations of simulations have all either (a) neglected baryons; (b) neglected radiative transfer (and connecting to observations); or (c) neglected cosmological conditions. Here, we propose to conduct the first ever cosmological hydrodynamic simulations of Submillimeter Galaxy formation that couple with bona fide 3D dust radiative transfer calculations. These ultra-high resolution simulations (parsec-scale) will be the first to resolve the sites of dust obscuration, the cosmic growth history of SMGs, and their evolutionary destiny. Our proposal has two principle goals: (1) Develop the first ever model for SMG formation from cosmological simulations that include both baryons and dust radiative transfer; (2) Capitalize on our parsec-scale resolution to understand the connection between the physical properties of star-forming regions in high-z starbursts, and recent IMF constraints from present-epoch massive galaxies.

Proposal Category:	AR
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13907
Program Title:	Maximizing the Impact of CANDELS: Rest-frame Optical Spectroscopy of 2000 Galaxies at 1.4<z<3.8
Principal Investigator:	Mariska

PI Institution: University of California - Berkeley

A key goal of the CANDELS Multi-Cycle Treasury Program is to study galaxy evolution during at 1.5~<z~<3.5, the peak of both star formation and black hole accretion activity in the universe. However, CANDELS alone is not sufficient to fully characterize the galaxy population during this epoch. We are executing the MOSFIRE Deep Evolution Field (MOSDEF) survey over 47 nights with the Keck/MOSFIRE spectrograph. With MOSDEF, we will obtain rest-optical spectra of ~2000 CANDELS galaxies at 1.4<z<3.8. The unique combination of CANDELS and MOSDEF will enable the measurements of the stellar, gaseous, chemical and dust content of galaxies spanning a wider dynamic range in physical properties than has ever been accessed at these redshifts. We propose to conduct the following unique projects: (I) Using accurate sizes and profiles from CANDELS and stellar absorption and emission line kinematics from MOSDEF, we will derive dynamical masses and constrain the physical processes responsible for the structural evolution and growth of quiescent and star-forming galaxies. (II) Using spatially-resolved dust maps and spectral energy distributions from CANDELS in combination with Balmer decrements from MOSDEF, we will obtain the first complete census of the dust geometry and variation in the dust attenuation law in galaxies at z>2. (III) Using rest-frame UV sizes from CANDELS and Halpha star formation rates and outflow signatures from MOSDEF, we will constrain stellar feedback processes and the star formation efficiency in distant galaxies. Finally, we will release all combined CANDELS and MOSDEF data products to the scientific community, which will greatly enhance the legacy value of CANDELS.

Proposal Category: AR

Scientific Category: Resolved Stellar Populations

ID: 13908

Program Title: A Clumpy Model for Self-Enrichment in Globular Clusters

Principal Investigator: Jeremy Bailin

PI Institution: University of Alabama

Hubble observations have demonstrated that globular clusters (GCs) are not the simple stellar populations once believed, but have internal subpopulations with slightly different ages, metallicities, and detailed abundances. High-mass GCs also exhibit a mass-metallicity relation that indicates that they are at least partly self-enriched by heavy elements produced by their own massive stars. We propose to extend our previous model for GC self-enrichment, which has proven very effective at understanding the mass-metallicity relation but which assumes no internal subpopulations, to include the effects of clumpiness in the protocluster cloud. This will allow us to predict how internal variation in a GC depends on other GC properties, and determine how much of the internal variation is due to internal processes rather than inhomogeneities in the protocluster cloud.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13909
Program Title: Predictive Simulations of Metals Ejected from Galaxies in Galactic Winds

Principal Investigator: John Forbes
PI Institution: University California, Santa Cruz

Observations indicate that galactic winds are ubiquitous, and must carry substantial fractions of the total metals produced by star formation into the circumgalactic medium and perhaps beyond. UV spectroscopy with HST is now beginning to provide an accounting for these metals in local galaxies, but theoretical models for how metal-bearing winds are launched are primitive at best. The primary limitation of simulations at present is resolution: the process of entrainment and mixing between hot, metal-rich supernova ejecta and cool, metal-poor interstellar medium is simply too small-scale to be resolved in cosmological simulations. We propose to clarify the picture by running very high resolution simulations of isolated dwarf galaxies that resolve supernova bubbles and the adiabatic-radaitive transitions they undergo, thereby avoiding the resolution problem and the numerous ad-hoc tricks simulators have used to get around it. Our simulations will make direct, a priori predictions for the absorption spectra produced by various ions in the circumgalactic media of dwarf galaxies, which can be tested against and used to help interpret the forthcoming COS dwarfs survey. We will make our simulation and analysis code public, along with a library of synthetic spectra.

Proposal Category: AR
Scientific Category: Resolved Stellar Populations
ID: 13910
Program Title: Modeling the Origins of Sub-subgiant Stars

Principal Investigator: Aaron Geller
PI Institution: Northwestern University

We propose a study to determine the formation pathways of a new class of stars: the "sub-subgiants" (a.k.a "red stragglers"), identified in star clusters as stars that are redder than the main sequence but fainter than the giant branch in an optical color-magnitude diagram. First discovered about 15 years ago in the open cluster M67, today there are 47 sub-subgiants known in both open and globular clusters, most discovered using a combination of HST and Chandra data. Yet their origins remain a mystery. We propose a rigorous theoretical investigation into the origins of sub-subgiants, exploring all likely formation channels -- through detailed modeling of stellar and binary evolution and stellar mergers -- and specifically targeting the ability of each formation channel to explain the observed HST optical and UV magnitudes.

Proposal Category: AR
Scientific Category: Cool Stars
ID: 13911
Program Title: Modeling the Extreme Ultraviolet Radiation from M dwarfs

Principal Investigator: Travis Barman

PI Institution: University of Arizona

The possibility of finding habitable planets around M dwarfs has refueled interest in the astrophysical properties of these stars. The extreme ultraviolet (EUV) is a key portion of the spectrum for assessing habitability, yet this wavelength range is out of reach for all current telescopes and instruments. Observations at longer wavelengths (from Lyman-alpha and into the near-UV) are available from previously approved HST programs and these data (in addition to data from GALEX and elsewhere) can be used to calibrate M dwarf upper-atmosphere models (of the chromosphere, transition region and corona) to yield semi-empirical models capable of predicting the EUV. The synthetic M dwarf spectra that extend into the EUV are extremely valuable for studies of planetary atmosphere and the habitable zone. This modest program will provide physically and observationally motivated synthetic spectra for M dwarfs for a broad range of masses, ages and activity states.

Proposal Category: AR
Scientific Category: Cosmology
ID: 13912
Program Title: Identifiying the Progenitors of Massive Early-type Galaxies: A Complete Census of the Properties of S2CLS Submillimeter Selected Galaxies

Principal Investigator: David Wake

PI Institution: University of Wisconsin - Madison

Understanding the formation of massive early-type galaxies remains a long standing problem in astrophysics. Observational evidence suggests that these galaxies formed the bulk of their stars in a massive dissipative burst of star formation at z > 1. The discovery of high redshift dusty star-bursting galaxies in the late 90s via their submillimeter (submm) emission seemed to provide the ideal candidates for the progenitors of local massive early-type galaxies. However, despite much effort the importance of these submm galaxies remains uncertain mainly as a result of the difficulty in identifying and studying their typically faint counterparts at shorter wavelengths.

The combination of two of the latest world leading galaxy surveys, the HST WFC3 CANDELS and SCUBA-2 Cosmology Legacy Survey (S2CLS) finally provides the opportunity to resolve this issue once and for all. We propose to combine the deep, wide-field, high resolution near-IR (and associated multi-wavelength ancillary data) of CANDELS with the deep, high resolution SCUBA-2 submm imaging of the S2CLS to study with both unprecedented fidelity and statistics a sample of >400 z > 1 submm selected dusty starbursts. We will measure the redshift distribution, stellar mass, SFRs, dust masses, sizes and light profile shapes, morphology, merger fraction, and clustering amplitude and hence dark matter halo mass for a sample of submm-selected galaxies a factor of 10 larger than any studied to date. These measurements will finally allow us to determine if these submm galaxies are the crucial phase in the formation of massive early-type galaxies.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13913
Program Title: The Search for Diffuse Intergalactic and Circumgalactic Emission with the Cosmic Origins Spectrograph

Principal Investigator: Steven Penton
PI Institution: Space Telescope Science Institute

We propose to measure the emission from the gas associated with known extragalactic UV absorbers to constrain the physical conditions and physical size of the gas. This will be accomplished through the co-addition of numerous (>75) COS QSO lines of sight, shifted in wavelength so the absorbers are coincident. The COS aperture admits light from the surrounding sky that can be separated from the point source signal to measure diffuse emission. No single observation has the sensitivity to detect these signals, but large coadditions can, unless the gas is extremely low density. We have custom extraction procedures for this project, and our intimate understanding of CalCOS, the optical performance of COS, and FUV detector systematics (scattered light, dark rate, gain sag, detector walk, etc.), are essential to its success. Our team consists of COS IDT members, the COS PI and optical designer of COS, STScI COS calibration team members, and IGM/CGM experts. We will look for emission from HI Lya 1216A and OVI 1032A. Emission and absorption measures on a unique line of sight would normally allow for a determination of the volume density and physical size. However, since this study will produce a net emission measure from many co-added lines of sight, it will provide an average, but unique, physical insight into the nature of the gas, and in particular, indicate what fraction of this previously undetected gas is circumgalactic versus truly intergalactic in nature. We will also search for extended diffuse emission from gas not associated with absorption systems. We will also assist in testing and enabling many cutting edge additions to CalCOS which will benefit future COS users.

Proposal Category: AR
Scientific Category: AGN/Quasars
ID: 13914
Program Title: What AGN revergeration maps tell us: plasma simulations of dense accreting gas

Principal Investigator: Gary Ferland
PI Institution: University of Kentucky

The Cycle 21 large program, "Mapping the AGN Broad-line region by reverberation", will produce the definitive line-continuum reverberation dataset. These HST observations should "clarify the nature of the broad-line region, its role in the apparently complicated accretion/outflow process, and determine definitively the veracity and accuracy of the AGN reverberation-based black hole masses". This proposal aims to improve Cloudy simulations of the dense gas emitting the spectrum so that photoionization theory can meet the challenge posed by these new observations. Two specific advances, implementing physical processes now expected to be important, are proposed. The first involves electron scattering enhancement of H I lines. The lines will be broadened and enhanced by scattering off warm (8 000 K) electrons in the extended neutral gas deep within the cloud or disk, affecting both the line profile and intensity. The second involves collisional suppression of dielectronic recombination, the dominant process responsible for

access to a large body of atomic rates within OpenADAS, and will impact predictions of essentially the entire Broad-line region spectrum. Both advances will become part of Cloudy, a publically available and widely used plasma simulation code.

Proposal Category: AR
Scientific Category: Cosmology
ID: 13915
Program Title: Simulating HST observations of strong lensing clusters

Principal Investigator: Massimo Meneghetti
PI Institution: Jet Propulsion Laboratory

The Frontier Fields (FF) are using galaxy cluster gravitational lensing to boost the powers of Hubble and Spitzer to reveal the faintest galaxies yet observed. Accurate gravitational lensing models with uncertainty estimates are required to study some of the physical parameters of the lensed galaxies. Simulated HST observations of lensing clusters with known mass distributions are ideal to determine the accuracies of these modeling methods. Our team has begun performing these tests, demonstrating that integrated quantities such as lensed number counts are accurately recovered, enabling luminosity functions to be constrained. We have also begun to quantify magnification uncertainties for individual galaxies, but additional tests are needed. Here we propose to create a set of simulated osbervations of clusters selected to be analogs of the CLASH and FF clusters. They will include lensing effects and they will be delivered to the Mikulski Archive for Space Telescopes as a legacy product for others to analyze. They will be usable to extend our tests for robustly determine the accuracies in model magnification and mass measurements. Mass uncertainties will be a key ingredient in efforts to use galaxy clusters to constrain cosmology and theories of structure formation. Results from this program will also be useful to improve lens modeling methods toward more optimal use of the large numbers of lensing constraints available in deep FF imaging. This program will help astronomers realize the full potential of the large investments of Hubble, Spitzer, Chandra, and ground-based observing time in the FF, CLASH, and other past and future cluster lensing observations.

Proposal Category: AR
Scientific Category: Resolved Star Formation
ID: 13916
Program Title: Triggered Star Formation From Shock to Disk

Principal Investigator: Eric Blackman
PI Institution:

Triggered star formation (TSF) occurs when supersonic flows generated by distant supernova blast waves, stellar winds (wind blown bubbles) or ionization fronts (D-type fronts in HII regions) sweep over a stable cloud. TSF may play a role in massive regions of star formation where winds, HII regions and, eventually, blast-waves sweep through dense, heterogeneous molecular material. In addition TSF has played an important role in discussions of the formation of our own solar system because it offers a natural way of injecting short lived radioactive isotopes (SLRI's) like 26^Al into material which will then form planetary bodies.

The purpose of this proposal is to use advanced numerical tools to explore the physics of TSF in greater detail than has been attempted before. Previous studies have not been able to follow triggering past the early stages before a star forms. Our 3-D Adaptive Mesh Refinement (AMR) MHD code contains well tested physics modules which will allow us to track the influence of self-gravity, radiation-transport, cooling by molecules/neutrals/atoms and, finally, the collapse of gas into stars (i.e.condensed gravitating point-like objects or "sink-particles"). With this tool we will follow triggering well past the formation of the star to explore the creation of accretion disks and their properties. In addition the microphysics routines in the code allow us to make detailed contact with HST observations such as the pillars in the Carina nebula via synthetic observations of line profiles, proper motions, Position-Velocity diagrams and statistics.

Proposal Category:	AR
Scientific Category:	Quasar Absorption Lines and IGM
ID:	13917
Program Title:	The COS Cold Absorber Puzzle: Understanding the Metallicity and Phase of the Circumgalactic Medium
Principal Investigator:	Cameron Hummels
PI Institution:	University of Arizona

Grasping the way gas gets in and out of galaxies is fundamental to our understanding of galaxy formation and evolution, and COS observations are slowly providing a better picture of these gas flows. Recent COS observations of the circumgalactic medium (CGM) have revealed two puzzles: the bimodal metallicity distribution of Lyman Limit Systems (LLSs) proximate to galaxies (Lehner et al. 2013) and the low volume density for cold absorbers in the CGM (Werk et al. 2014). We propose to address both of these issues through the execution and analysis of grid-based cosmological hydrodynamics simulations of unprecedented resolution. By modeling galaxies at very high resolution using a physically-motivated, momentum-based feedback method, we will perform the first grid-based studies of the CGM at this scale, allowing us to identify analogs to the observed cold absorber population responsible for these puzzles. We will trace the simulated cold absorbers through time to understand their origins, producing a full picture of how they acquire and expel their gas.

Proposal Category: AR
Scientific Category: Cool Stars
ID: 13918
Program Title: A New Approach to Understanding Brown Dwarf Weather

Principal Investigator: Caroline Morley
PI Institution: University of California - Santa Cruz

Over 130 HST orbits and 3000 Spitzer hours have been dedicated to observing variability in the emission of brown dwarfs, but we do not yet understand the physical processes that cause brown dwarf weather. The aim of the proposed work is to build the modeling tools to turn brown dwarf light curves into constraints on their atmospheric physics. Light curves of variable brown dwarfs are not simple sinusoids, but show spectral dependence in both amplitude and phase. Many objects exhibit evolution in the amplitude or shape of the light curve from one observation to another, indicating evolution of weather patterns. These complexities mean that while the two likely causes of variability--patchy clouds and temperature perturbations--should have distinct spectral signatures, the data are proving challenging to explain with simple prescriptions. Our tool to understand this extrasolar weather is to use a retrieval technique to extract the physical parameters that cause brown dwarf variability, directly from brown dwarf spectra. Using this tool with the information-rich HST data, we probe the temperature and cloud structure in multiple spatial dimensions as well as the time-evolution of these structures. These constraints provide crucial information for the development of atmospheric dynamical models, currently in their infancy for brown dwarfs. The retrieval technique we propose will allow us to leave the confines of pre-calculated grid models and measure the causes of brown dwarf weather directly from spectra. This tool will provide the information necessary to understand the atmospheric physics underlying warm substellar weather, decades before we can study weather on exoplanets.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13919
Program Title: MAST Interface to Synthetic Telescopes with yt (MISTY): Observing Simulations of the Intergalactic Medium

Principal Investigator: Molly Peeples
PI Institution: Space Telescope Science Institute

The COS instrument has shed new light on the metal-rich, massive, multi-phase reservoirs of gas surrounding galaxies. Numerical modeling has greatly enhanced the scientific understanding of the large body of of circumgalactic medium (CGM) and intergalactic medium (IGM) observations taken with COS. These numerical models produce synthetic spectra for direct comparison against COS outputs, a useful data resource for both simulators and observers alike, yet different groups apply different methods and formats, and there is no public archive of this scientific resource. We propose to construct a uniform and public simulation-to-archive pipeline for generating, analyzing, and providing to the community such synthetic spectra. By enabling rigorous and consistent comparisons between COS data and simulations, this project will advance our detailed knowledge of the physical and chemical conditions in CGM/IGM absorbers (density, temperature, metallicity ionization, ionization process), and of the connection between observed

velocity structure and galactic inflows and outflows. The results of our pipeline will be searchable via a MAST interface allowing users to specify subsets of synthetic spectra they wish to download and analyze.

Proposal Category:	AR
Scientific Category:	Cosmology
ID:	13920
Program Title:	Testing Feedback Models of Galaxy Formation Using COS-Halos Survey Data
Principal Investigator:	Yu Lu
PI Institution:	Stanford University

The COS-Halos Survey, undertaken by the Cosmic Origins Spectrograph (COS) aboard the HST, has opened a new window for galaxy formation studies as it provides an unique observational constraint on the baryonic content in the circum-galactic region. We propose to further develop an existing semi-analytic model (SAM) of galaxy formation that implements self-consistent treatments for the halo gas configuration, radiative cooling, cold gas assembly, star formation and feedback to make robust predictions for not only galaxy properties but also the properties of circum-galactic medium around galaxies. We propose to compare the model predictions with observational data of the COS-Halos survey to constrain feedback processes of galaxies. Using Bayesian model inference, we will rigorously assess models with different assumptions of galaxy formation feedback processes. The proposed study will determine the observables that can best discriminate between different ejective feedback and preventative feedback models.

Proposal Category:	AR
Scientific Category:	Unresolved Stellar Populations and Galaxy
ID:	13921
Program Title:	Simulating the Impact of a Recent Merger on M31's Disk
Principal Investigator:	Mark Fardal

We propose to conduct N-body and hydrodynamic simulations of the impact of M31's Giant Southern Stream (GSS) progenitor on M31's disk. The GSS is believed to represent a merger of a LMC-sized galaxy within the last Gyr, and the orbital parameters of the merger have been well constrained by a combination of positional, kinematic, and distance measurements. Because of the wealth of HST and ground-based data on M31's disk, the M31-GSS system represents one of the best laboratories for understanding the effect of minor mergers on the disk morphology and star formation properties of spiral galaxies. We will adopt a range of progenitor stellar and total masses, orbital parameters, and M31 virial masses, as provided by a recent Bayesian study of this system. Using N-body runs, we will focus on the tidal tails, warping, disk heating, and other dynamical features of M31's disk. Then using full hydrodynamic runs, we will focus on the spatially resolved star formation history in M31's disk. We will make our simulations publicly available for comparison with observational surveys such as the large PHAT survey of M31's disk.

Proposal Category:	AR
Scientific Category:	AGN/Quasars
ID:	13922
Program Title:	Do Supermassive Black Holes really reside at the centers of their host galaxies?

Principal Investigator:	Andrew	Robinson
PI Institution:	Rochester Institute of Technology	

It is generally assumed in studies of active galactic nuclei (AGN) and galactic dynamics that supermassive black holes (SMBH) reside at rest at the dynamical centers of their host galaxies. However, SMBH can be significantly displaced by gravitational recoil kicks generated during the coalescence of an SMBH binary which itself formed in the aftermath of a galaxy merger. Such events have profound implications for gravitational wave astronomy and galaxy evolution and therefore determining the frequency with which they occur is of great interest. Gravitational recoils are capable of producing persistent (oscillating) displacements ~ 10 pc to ~ 100 pc or more and are likely to operate most commonly in early type galaxies, which are partly assembled via mergers. Here we propose to build on a recently completed pilot study and undertake a systematic search for SMBH displacements in a large sample of active early type galaxies, by measuring the position of the AGN (as a proxy for the SMBH) relative to the photocenter of its host galaxy. Our pilot study demonstrates that offsets ~0.05" are recoverable with high significance from HST data, allowing detection of projected displacements of ~10 - 100 pc, for the redshift range ($z<0.3$) covered by our sample. Theoretical models for both the distribution of recoil velocities and the subsequent dynamical evolution of the kicked SMBH in the host galaxy potential are sufficiently well developed that predictions can be tested statistically by measuring displacements (or upper limits) in a large sample.

Proposal Category: AR
Scientific Category: Unresolved Stellar Populations and Galaxy
ID: 13923
Program Title: Use of Wide-Field ACS Mosaics to Determine Total Properties of Globular Cluster Systems

Principal Investigator: Stephen Zepf
PI Institution: Michigan State University

As the result of a variety of HST programs, there are now mosaics of ACS images of eight nearby elliptical and S0 galaxies available in the archive. We propose to use these wide area HST mosaics to systematically study the globular cluster systems of early-type galaxies out to large radii. These will allow us to significantly improve the determination of key characteristics of these globular cluster systems, including: the total number of globular clusters around these galaxies, the ratio of red to blue clusters in the total population, the color gradients in these systems, the ellipticity and any spatial asymmetry in the cluster population, and the dependence of the half-light radii on position in the galaxy. The determination of these properties is a key step in understanding how globular clusters and their host galaxies form and evolve.

Proposal Category: AR
Scientific Category: Quasar Absorption Lines and IGM
ID: 13924
Program Title: The intergalactic medium in the cosmic web

Principal Investigator: Nicolas Tejos
PI Institution: University of California - Santa Cruz

We request funding to perform a dedicated survey and analysis of the HST archive of COS-G130M quasar spectra to construct an absorption-line catalog tuned to study the environment (i.e. large-scale structure, LSS) of the intergalactic medium (IGM). Specifically, we will characterize the HI Lyman series absorption at z<0.1 and associate metals for all absorbers along 100 quasar sightlines penetrating the SDSS footprint. Using standard line-profile fitting techniques, we will recover HI column densities and Doppler parameters. These will be publicly released in a database that

includes spectral masks identifying spurious spectral features, regions biased by previously known systems, etc. This catalog will be analyzed in conjunction with the suite of LSS catalogs generated from the SDSS footprint (e.g. clusters, groups), with emphasis on new algorithms designed to identify and characterize galaxy voids. Through this analysis, we will test the predictions from our cosmological paradigm that the IGM traces a so-called cosmic web of LSS.

Proposal Category:	AR
Scientific Category:	Resolved Stellar Populations
ID:	13925
Program Title:	Interpreting Resolved Stellar Populations in Local Group Dwarfs: Results from Cosmological Simulations
Principal Investigator:	Maureen Teyssier
PI Institution:	Rutgers the State University of New Jersey

Resolved stellar populations in Local Group galaxies are the best place to study the earliest epochs of star formation. Isolated Local Group Dwarfs are also ideal places to test the physics of star formation and the role of stellar/supernova feedback in moderating star formation. For the first time, high resolution, fully cosmological simulations of isolated dwarf galaxies have not only overcome long-standing modeling problems like the "cusp/core" problem and the "exponential disk" dilemma, but also successfully match observational trends such as metallicities and effective yields, colors, cold gas fractions, and cumulative SFHs. Therefore, for the first time, we are in a position to interpret observations of resolved stellar populations in Local Group dwarfs, and make predictions to test the models. In fact, exploratory work shows that the same physics that overcomes the problems with dwarf galaxy formation in CDM may also explain why observations seem to suggest outside-in growth, instead of the inside-out growth predicted by theory. The redistribution of stars in dwarfs has dramatic implications for interpreting observations of resolved stellar populations. We will produce results that are directly comparable to observations by creating artificial CMDs at varying radii, quantifying the observed age and metallicity gradients of dwarfs as well as quantifying the role that dark matter core creation and new radial migration schemes play.
