Cycle 20 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 12814
Program Title: Signatures of turbulence in directly imaged protoplanetary disks

Principal Investigator: Philip Armitage
PI Institution: University of Colorado at Boulder

HST imaging of the edge-on protoplanetary disk in the HH 30 system has shown that substantial changes to the morphology of the disk occur on time scales much shorter than the local dynamical time. This may be due to time-variable obscuration of starlight by the turbulent inner disk. More recently, mid-infrared variability of protoplanetary disks has been attributed to a similar physical origin. We propose a theoretical investigation that will establish whether the optical and infrared variability is due to turbulent variations in the scale height of dust in the inner disk, and determine what observations of that variability can tell us of the nature of disk turbulence. We will use a new generation of global magnetohydrodynamic simulations to directly model the turbulence in an annulus of the inner disk, extending from the dust destruction radius out to the radius where turbulence is quenched by poor coupling of the gas to magnetic fields. We will use the output of the MHD simulations as input to Monte Carlo radiative transfer calculations of stellar irradiation of the outer disk. We will use these calculations to produce light curves that show how time variable shadowing from the inner disk affects the outer disk observables: scattered light images and the infrared spectral energy distribution.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12815
Program Title: Photometry of the Coldest Benchmark Brown Dwarf

Principal Investigator: Kevin Luhman
PI Institution: The Pennsylvania State University

In 2011, we used images from the Spitzer Space Telescope to discover the coldest directly imaged companion to a nearby star (300-345 K). In addition to breaking new ground in terms of temperature, this companion is one of a small number of benchmark brown dwarfs whose ages and distances are known via their primaries and thus can provide unusually stringent tests of theoretical models of substellar objects. However, few data are available for this companion for comparison to the models; we have measured photometry from two Spitzer bands, but it has not been detected at near-IR wavelengths with the largest ground-based telescopes (J>23.9). Therefore, we propose to use WFC3 to obtain deeper near-IR images of this object so that we can better test model atmospheres in a previously unexplored regime of temperature.

Proposal Category:	GO
Scientific Category:	QUASAR ABSORPTION LINES AND IGM
ID:	12816
Program Title:	Probing the Reionization Epoch of IGM Helium: A Detailed Follow-up Study of Three High-Quality He II Quasars
Principal Investigator:	David Syphers
PI Institution:	University of Colorado at Boulder

The full reionization of intergalactic helium likely occurred at redshifts between z=2.7 and 4, dramatically affecting the state of the IGM, including strong heating of the gas. Detailed UV spectral studies of He II Ly-alpha absorption toward a handful of quasars at 2.7<z<3.3 confirm the potential of such IGM probes, but the very small sample (3 sightlines) with detailed, high-S/N information limits the confidence in cosmological inferences. In recent cycles we have been very successful in identifying many new He II quasars at a wide range of redshifts. Here we follow up on the best of these, three uniquely bright He II quasars, including one at higher redshift. SDSSJ0915+4756, at z=3.34, is the brightest confirmed in the FUV at z>2.9, while HS1024+1849 and 4C57.27 are the brightest He II quasars without existing high-resolution and high-S/N observations. We propose a 25-orbit program that will study: (1) the currently ill-constrained evolution of He II reionization, from its end to well before completion; (2) the He II Ly-alpha forest; (3) the interaction of quasars and the IGM with the line-of-sight and transverse proximity effects; (4) high-redshift, high-opacity IGM He II using both Ly-alpha and Ly-beta Gunn-Peterson troughs.

Proposal Category:	GO
Scientific Category:	COSMOLOGY
ID:	12817
Program Title:	Longevity of dark matter substructure in Abell 3827
Principal Investigator:	Richard Massey
PI Institution:	University of Durham

We will investigate the interaction properties of dark matter, through the infall of substructure into a galaxy cluster

with a rare dynamical history. Abell 3827 appears to have grown rapidly through several simultaneous mergers, and currently hosts the stellar remnants of five massive elliptical galaxies within 15 kpc of the core. Only one other well-studied cluster (Abell 2261) contains a distribution of baryonic matter that is even comparably corrugated – and a strong lens threaded through the core of Abell 3827 provides a unique gravitational handle on its distribution of dark matter.
We will measure the late-stage dissipation of the dark matter halos that would have initially accompanied the infalling galaxies. The timescale for this dissipation is a key ingredient in models of structure formation. Most interestingly, our analysis of extant ground-based data also found dark matter offset from its stellar counterpart. This is predicted by numerical simulations if dark matter has (even a small) self-interaction cross section. If confirmed by a robust HST analysis, this result would achieve the same level of impact on fundamental physics as did HST confirmation of the Bullet Cluster offset between dark matter and gas. Constraints on both the tidal gravitational stripping and electroweak interactions of dark matter will be especially aided by the simultaneous measurement of multiple substructures within this single extended halo.
This project will require UV, optical and NIR imaging, plus a combined strong-lensing, weak-lensing and flexion analysis. We request six orbits with WFC3/UVIS, ACS/WFC and WFC3/IR, and will also exploit new Chandra data already in the archive.

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12818
Program Title: The Origin of the Intrinsic Scatter in the Correlation Between Black Hole Mass and Bulge Luminosity in Active Galaxies

Principal Investigator: Luis Ho
PI Institution: Carnegie Institution of Washington

The scaling relation between black hole (BH) mass and bulge luminosity is a fundamental tool to study the interplay between BH growth and galaxy formation. Recent studies suggest that the BH-bulge relation evolves rapidly with redshift. This potentially very important result critically depends on our knowledge of the local scaling relation for actively growing BHs (namely AGNs), which is still poorly known. In two prior archival programs, we have embarked on an extensive effort to characterize the zeropoint, slope, and scatter of the BH mass-bulge luminosity relation for a sample of 235 local ($z < 0.35$) broad-line AGNs (quasars and Seyfert 1s). This is the largest, most comprehensive sample to date, one that spans the widest range in luminosity, BH mass, and host morphology. This work serves as the definitive reference point for all investigations of the cosmic evolution of the BH-host relations. Our analysis employs a sophisticated new technique to decompose the 2-D structure of the host galaxies with unprecedented accuracy. We find that the scaling relation in the R band shows significant intrinsic scatter that depends systematically on Eddington ratio (accretion rate). AGNs with higher Eddington ratio tend to have either lower BH masses or more luminous bulges. The latter could be caused by enhanced ongoing or recent star formation linked to BH accretion. We propose to test this interesting possibility and to resolve this important ambiguity by studying the color and color gradients of the hosts using all available multi-filter data in the archives. Over 40% (101/235) of our parent sample contains usable WFPC2, ACS, and NICMOS images for this purpose.

Proposal Category: AR
Scientific Category: COSMOLOGY

ID: 12819

Program Title: Probing the Formation of Dust in the Early Universe

Principal Investigator: Steven Finkelstein

PI Institution: University of Texas at Austin

We request archival student funding to complete a study on the rest-frame ultraviolet (UV) colors of galaxies at z=8, using new Cycle 19 data in the Hubble Ultra Deep Field (HUDF). The addition of these new data quadruple the exposure time in the F105W band, allowing the compilation of much more robust samples of z=8 galaxies. In addition, this program obtains data in a new filter, F140W, which will allow robust colors of z=8 galaxies to be measured. The only color of z=8 galaxies measurable with the previous data in the HUDF is F125W-F160W, which is contaminated by both the Lyman break, and Lyman alpha emission.

Our previous work has examined in detail the evolution of the rest-frame UV colors of galaxies from $4 < z < 7$. We found that while typical galaxies at z~7 are dust free, those at $z < 6$ become progressively dustier. This is consistent with a scenario where the typical high redshift galaxy does not build up its dust reservoir until low-mass AGB stars begin producing dust, which will occur at $z < 7$ assuming galaxies form at $z \sim 15$-20. Any dust formed in supernovae is lost in the low-mass galaxies due to outflows, similar to the mass-metallicity relation at lower redshift.

Pushing these studies to z~8 will allow us to test this hypothesis. If z~7 galaxies are truly dust free, than z~8 galaxies should have similar colors. However, if we find z~8 galaxies to have significantly bluer colors, then it will signify that we have reached an era of very low metallicity star formation. Finally, if the massive galaxies at z~8 are also dusty, then it is further evidence that dust forms very early in the universe.

Proposal Category: AR

Scientific Category: HOT STARS

ID: 12820

Program Title: Multidimensional Simulations of Pair-Instability Supernovae and Circumstellar Interaction

Principal Investigator: J. Wheeler

PI Institution: University of Texas at Austin

The discovery of Super-Luminous Supernovae and other peculiar transient events imposed challenges to our understanding of the processes involved such as the energy input that powers their light curves and the environments in which their progenitors explode. Besides the high peak luminosity, the light curves of these events have a variety of shapes, rise-times and decline rates and a variety of spectral features that indicate of a variety of physical conditions that dominate their luminous output. Some of these events are thought to be associated with violent ejecta-circumstellar matter interaction causing the release of large amounts of shock-deposited energy. A few others are thought to be the manifestations of pair-instability supernovae producing massive amounts of nickel-56. Others may be powered by neutron star magnetic dipole radiation. So far only one-dimensional simulations of these various mechanisms have been presented. Multi-dimensional effects that will take into account mixing processes in the progenitor (convective and rotationally-induced)and the effects of rotation and hydrodynamic instabilities in the explosions are expected to alter the features observed in these events. We propose to perform multi-dimensional (2-D and 3-D) radiation hydrodynamics simulations for a variety of progenitor characteristics, explosion mechanisms, and circumstellar environments (including those deficient in H and He) in order to study those effects and ultimately better

constrain the nature of the progenitors, the explosion mechanisms, and the environments of these spectacular cosmic events.

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12821
Program Title: Probing the Lyman continuum in sub-M* galaxies at z~1

Principal Investigator: Claudia Scarlata
PI Institution: University of Minnesota - Twin Cities

Evidence increasingly indicates that star-forming galaxies reionized the universe at redshifts between 12 and 6, but at the current juncture our empirical understanding of the ionizing output of galaxies is unsatisfactory. Measurements and constraints on the ionizing output of galaxies are available between redshifts 0 and 3 (where the effect of the intervening IGM is minimum) for bright/massive galaxies, but almost non-existent for sub-M* objects.

This is a major observational deficiency, since most theoretical studies predict a high(er) escape fraction of ionizing radiation in galaxies at the low mass end.

Here we propose to combine the power of WFC3 IR grism spectroscopy with deep GALEX UV imaging to measure Lyman Continuum (LyC) leakage from galaxies at 0.95<z<1.5. The analysis will be performed in the CANDELS fields which are covered with the deepest data ever obtained with the GALEX satellite. We will identify a line flux-limited sample of ~ 3000 Halpha (Ha) emitters for which we will measure the absolute escape fraction of LyC photons. Most importantly, this sample will include ~700 sub-M* strong Ha emitters, that are thought to be the analogs of the sources that reionized the universe.

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12822
Program Title: Do Typical Galaxies in Adolescence Already Host Growing Black Holes?

Principal Investigator: Jonathan Trump
PI Institution: University of California - Santa Cruz

This archival grism proposal achieves a 100-fold gain in high-quality (5+sigma) information for discovering which properties of adolescent (0.7<z<2.4) galaxies of typical mass and SFR are linked to AGN activity. We propose to analyze 147 WFC3 G141 and 111 ACS 800L pointings of 2-orbit grism data in the CANDELS fields, for a sample of ~3000 galaxies reaching SFR~5 Msun/yr and stellar masses of log(M*/Msun)~9 at z~1.5. We will leverage spatially-

resolved line ratios to uniquely distinguish a nuclear AGN from extended low-metallicity or shocked gas. Compared to our 30-galaxy published sample that hints at AGNs in low-mass z~2 galaxies (Trump et al. 2011), this ~3000 galaxy sample enables a 100-fold gain in divisions by galaxy morphology, SFR, and stellar mass to discover which galaxy properties correlate most with rapid SMBH growth. We will stack the deep (0.8-4 Ms) Chandra data available in these fields as an independent check of the grism AGN/SF diagnostics. The unique ancillary data in these fields also include ACS+WFC3 imaging for morphologies, deep multiwavelength data for well-sampled SEDs and stellar masses, and previous optical (and future near-IR) spectroscopy to supplement the G141 coverage. Based on discussions with the GOODS-N and 3D-HST teams, our proposed AGN science does not overlap with their proposed or funded science goals. As a value-added product for the community we will release, via the public Rainbow-CANDELS database server, an atlas of spatial maps of emission lines and line ratios (and associated errors) for the entire sample of 3000 galaxies.

Proposal Category:	AR
Scientific Category:	EXTRA-SOLAR PLANETS
ID:	12823
Program Title:	Colliding Planetary and Stellar Winds: Charge Exchange and Metal Absorption in Hot Jupiter Exospheres
Principal Investigator:	Eugene Chiang
PI Institution:	University of California - Berkeley

Hot Jupiters unleash photoevaporative winds that are powered by ionizing radiation from their parent stars. Spectral signatures of such winds have been observed with HST STIS and COS in various UV absorption lines from H I, O I, C II, Mg II, and Si III. Interpretation of these absorption signatures is still debated, and the metal line observations have seen little modeling. Absorption by H I Lyman-alpha occurs at velocities of +/- 100 km/s; such large velocities are difficult to explain because thermal outflows from hot Jupiters have speeds < 30 km/s. Holmstrom et al. (2009) proposed that the anomalously energetic H I arises from charge exchange between planetary H I and protons from the incident stellar wind. If true, then basic quantities--e.g., the planetary mass loss rate, which we hope to infer from the HST data--would need re-calculation to account for the influence of the stellar wind. Charge exchange has not yet been integrated into models of photoevaporative winds. We propose to carry out hydrodynamic simulations of colliding planetary and stellar winds, including charge exchange, that would explain the HST Ly-a observations, thereby clarifying how the inferred planetary mass loss rate depends on stellar wind parameters. We also propose to incorporate photoionization heating by metals, and radiative line cooling by metals, both of which have not been simultaneously treated. The goal will be to reproduce the many HST line spectra of neutral and ionized metals and determine their import for the metallicity and mass loss rate of the planetary wind.

Proposal Category:	AR
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12824
Program Title:	Comprehensive Radiation-Hydrodynamic Models for Wolf-Rayet Galaxy Spectra

Principal Investigator: Claus Leitherer

PI Institution: Space Telescope Science Institute

We propose to compute a grid of radiation-hydrodynamic models of Wolf-Rayet star spectra for implementation in population synthesis models. Guided by stellar evolutionary tracks, we will calculate the wind density structure and iteratively solve the radiative transfer using a modified version of the CMFGEN code. The deliverables are stellar spectra at 0.5 A resolution covering 912 to 3000 A for super-solar to near-zero metallicity. The models will be tested by comparison with ultraviolet archival data. By virtue of their luminosities, strong mass loss and peculiar chemical abundances, Wolf-Rayet stars can make a significant - sometimes the dominant - contribution to the line spectra of star-forming galaxies, in particular in the ultraviolet. The new models will provide synthetic ultraviolet spectra of these stars, with parameters optimized for the population synthesis code Starburst99. The parameter range will cover that encountered in local Wolf-Rayet galaxies, in Lyman-break galaxies at redshift 3 - 5, and in primeval galaxies expected to be observed with JWST. Since Wolf-Rayet stars are related to the most massive stars, calibrating and understanding their tell-tale spectral features is a prerequsite for using them as population probes.Our suite of models will allow us and the astronomical community to tackle a diverse set of astrophysical issues: How do the final stages of massive-star evolution differ in different environments? How important are WR stars for the ionization of the ISM and the primordial IGM? Does the anomalous strength of He II 1640 indicate an IMF enriched in massive stars? Are galaxies with WR features preferred hosts of Type Ib SNe and long GRBs?

Proposal Category: AR

Scientific Category: AGN/QUASARS

ID: 12825

Program Title: An AGN Composite Spectrum in the Far-Ultraviolet and Lyman Continuum

Principal Investigator: J. Shull

PI Institution: University of Colorado at Boulder

Our group at Colorado has produced an AGN composite spectrum, using a pilot sample of 22 bright AGN observed by the Cosmic Origins Spectrograph (COS), probing the rest-frame FUV and EUV, for targets between z = 0.026 and z = 1.44. Of these 22 AGN, only 8 were at sufficient redshift to measure the rest-frame continuum below 912 A. We will now analyze archival spectra of 100-150 AGN covering the rest-frame EUV (600-900 A) and 10-40 AGN that cover even shorter wavelengths (300-600 A). The resulting composite spectrum will provide a dramatic improvement over our pilot study. We also expect this composite to identify and characterize key emission lines in the EUV, such as Ne VIII, O III, O IV, and O V, whose line strengths will provide new diagnostics of the broad emission-line regions of quasars.
Our full composite AGN spectrum will span 300-1800 A, using a significant number of COS spectra of AGN, with a variety of types and luminosities. These Lyman continuum photons are responsible for ionizing hydrogen, helium, and metal ions, and for the heating of the diffuse intergalactic medium. Characterizing the AGN spectrum in the far-UV and ionizing EUV is a crucial ingredient for studies of quasars and the IGM.

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12826
Program Title: Feeding active nuclei in gas-poor galaxies

Principal Investigator: Nadia Zakamska
PI Institution: The Johns Hopkins University

The fueling, growth and feedback of supermassive black holes in the centers of galaxies have become central topics in galaxy formation studies. But despite significant observational efforts, the drivers of nuclear activity remain elusive. We propose a comprehensive archival study of nuclear activity in elliptical galaxies, using a novel combination of data from HST and SDSS. We will compile a catalog of about 2000 extragalactic objects which have both SDSS spectroscopic data and high-quality HST imaging data -- a valuable community resource. Within this sample we expect approximately 100 galaxies with old stellar populations, but with activity in their nuclei, and we will select 100 inactive galaxies with the same distribution along the fundamental plane. These objects represent ideal laboratories for testing theoretical paradigms of black hole fueling: as old galaxies contain little gas, one might expect those that feature an active nucleus to have had to collect the gas from galaxy-wide scales through non-axisymmetries in their potentials. We will provide a definitive test of this hypothesis by conducting detailed analyses of HST images of active and inactive galaxies, and by testing for relations between the incidence and power of nuclear activity and the structure of the host galaxy. Our study, probing scales down to 100 pc over a wide range of nuclear activity, will illuminate a critical gap in our understanding of galaxy and black hole growth.

Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 12827
Program Title: Comprehensive Analysis of the Atmosphere of Uranus Using ~1000 HST Images

Principal Investigator: Erich Karkoschka
PI Institution: University of Arizona

I propose to use most of the HST images of Uranus to characterize its atmosphere as function of wavelength, latitude, longitude, and time. The HST data set of Uranus at CCD wavelengths is unique since no other data set of Uranus has a similar combination of spectral coverage, spatial resolution, and temporal coverage. Among 700+ planets, Uranus is the planet best observed by HST. This proposal follows program AR 11259, which analyzed 620 HST images of Neptune and revealed discoveries about Neptune's atmosphere and its interior detailed in two papers, suggesting the revolutionary idea that some features observed at visible wavelengths are connected to motions in the deep interior.

Data from each latitude in each image will create some 100,000 center-to-limb curves, orders of magnitude more than

all previous investigations combined, and information about ~100 discrete features. These data will be analyzed by statistical methods and the principal component analysis. Results will uncover the interconnection between latitudinal variations, temporal changes on various time scales, and Uranus' vertical structure from filters probing different altitudes. Nothing remotely similar has ever been done with the HST data set of Uranus.

The data set covers 18 years and includes the equinox of Uranus when fast changes occurred on Uranus. The extreme seasons of Uranus offer a unique case to study seasonal change on an ice giant. No other planet among hundreds of ice giants has a similar seasonal record. Results from this work will test our understanding of all ice giants. Acquiring 1000 images of Uranus was a major accomplishment of HST deserving a comprehensive study.

Proposal Category: AR

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12828

Program Title: Evolution of Early-Type Field Galaxies Since z~1: Insight into Physical Processes at Work

Principal Investigator: Susan Kassin

PI Institution: NASA Goddard Space Flight Center

We propose for archival funding to create the first large homogenous sample of sizes, structural parameters, velocity dispersions, and stellar masses of ~730 field early-type galaxies complete to R=24.1 (AB) over 0.2<z<1.0 in the AEGIS/DEEP and GOODS-N fields. We will use scaling relations created from this dataset to constrain our theoretical models (Porter, Somerville et al. 2012; Oser, Naab et al. 2012). It has recently been discovered that the population of early-types has grown significantly since z=1: galaxies at this epoch constitute only ~20-35% of the population today (e.g., Bundy et al. 2005, Abraham et al. 2007). A fundamental unknown in our picture of galaxy formation and evolution is the physics behind this transformation. There are a variety of phenomena likely at work: mergers of late-types, mergers of early-types, minor mergers, the role of dark matter, and mass loss from AGN/star-formation. Only now are theoretical models mature enough to make predictions for how early-types evolve, but they are unfortunately poorly constrained over 0.1<z<1.2. The most robust constraints on our models come from velocity dispersions, but only when coupled with size and stellar mass measurements. Hubble images are essential to (1) measure sizes, (2) measure structural parameters, and (3) remove red interacting and late-type galaxies from the sample. We already have in hand velocity dispersions measured from high-resolution Keck spectra for all galaxies, and stellar masses for 75% of the sample. Preliminary results for ~1/3 of the final sample indicate the need for winds/supernovae feedback and more minor merging than previously expected.

Proposal Category: AR

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12829

Program Title: Modeling the Blue Stragglers in Globular Clusters

Principal Investigator: Sourav Chatterjee

PI Institution: University of Florida

Blue stragglers (BS) have been extensively observed in Galactic globular clusters (GGC). primarily with HST. Many theoretical studies have identified BS formation channels and it is understood that dynamics in GCs modifies formation and distribution of the BSs. Despite the wealth of observational data, comprehensive theoretical models including all relevant physical processes in dynamically evolving GCs do not exist. Our dynamical cluster modeling code, developed over the past decade, includes all relevant physical processes in a GC including two-body relaxation, strong scattering, physical collisions, and stellar-evolution (single and binary). We can model GCs with realistic N and provide star-by-star models for GCs directly comparable with the observed data. This proposed study will create realistic GC models with initial conditions from a grid spanning a large range in the multidimensional parameter space including cluster mass, binary fraction, concentration, and Galactic position. Our numerical models combined with observational constraints from existing HST data will for the first time provide explanations for the observed trends in the BS populations in GGCs, the dominant formation channel for these BSs, typical dynamical ages of the BSs, and find detailed dynamical histories of the BSs in GGCs. These models will yield valuable insight on the correlations between the BS properties and a number of cluster dynamical properties (central density, binary fraction, and binary orbital properties) which will potentially help constrain a GC's past evolutionary history. As a bonus a large set of realistic theoretical GC models will be constructed.

Proposal Category: AR

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12830

Program Title: Dynamics of Binary Stars in Multiple Population Globular Clusters

Principal Investigator: Enrico Vesperini

PI Institution: Drexel University

Spectroscopic and photometric observations indicate that globular clusters (GCs) host multiple stellar populations. This discovery challenges the standard view of GC formation, in which GCs are `simple stellar populations' composed of stars of uniform age and chemical composition. This proposal is aimed at studying how the presence of multiple stellar generations and the substructure arising from the formation of second-generation stars can affect the evolution and disruption of binary stars. Binary interactions play a key role in determining GC dynamical evolution and the abundance of exotic stellar populations (e.g. low-mass X-ray binaries, blue stragglers, millisecond pulsars). Understanding binary dynamics in the context of the emerging paradigm of multiple-population GCs is an important step toward deciphering the dynamical history behind their current observed properties.

By means of an extensive survey of N-body simulations, we will follow the evolution of the fraction of binaries, their spatial distribution, and the evolution of the orbital properties of the survivors. Our simulations will allow us to investigate the differences between the properties of first- and second-generation binaries and explore how they arise from differences in the initial structural properties and subsequent dynamical evolution of first- and second-generation stars. Our study will shed light on how the observed properties of binariescan be used as a tool to gain a deeper understanding of the formation and dynamical history of multiple-population GCs.

Proposal Category: AR

Scientific Category: COSMOLOGY

ID: 12831

Program Title: Groups of Galaxies in the CDFS: Tracing the Evolution of Galaxies from z=1.6 to the Present Day

Principal Investigator: John Mulchaey

PI Institution: Carnegie Institution of Washington

Although groups are the most common environment experienced by galaxies, we still know surprisingly little about the mechanisms that drive galaxy evolution in these systems. While galaxy-galaxy encounters and mergers are thought to be common in groups, recent observations and simulations suggest encounters with the hot intragroup medium may also be important. To help distinguish between these possibilities, groups with and without a hot intragroup medium must be studied over a range of redshifts. Such studies have been limited because groups tend to be very faint in X-rays and difficult to detect at even moderate redshifts. Fortunately, the recently completed 4 Msec Chandra observation of the CDFS now allows the hot intragroup gas to be detected in ordinary groups out to z=1 and beyond. Here, we propose to use archival HST images from GEMS, GOODS and CANDELS to study the galaxy populations in a unique sample of 40 X-ray groups and approximately 100 non-X-ray groups in the CDFS in the redshift range z=0.5 to z=1.6. The ACS and WFC3 images will be used to search for signs of interactions and disturbances in these galaxies which will allow a detailed analysis of the effects of interactions as a function of group mass and redshift. Since the depth of the Chandra exposure in the CDFS is unlikely to be matched for any other fields, our group sample will be the only one with sufficient X-ray data to allow such a study for the forseeable future.

Proposal Category: AR

Scientific Category: STAR FORMATION

ID: 12832

Program Title: Climbing the Ladder of Star Formation Feedback

Principal Investigator: Adam Frank

PI Institution: University of Rochester

While much is understood about isolated star formation, the opposite is true for star formation in clusters of both low and high mass. In particular the mechanisms by which many coevally formed stars affect their parent cloud environment remains poorly characterized. Fundamental questions such as interplay between multiple outflows, ionization fronts and turbulence are just beginning to be fully articulated. Distinguishing between the nature of feedback in clusters of different mass is also critical. In high mass clusters O stars are expected to dominate energetics while in low mass clusters multiple collimated outflows may represent the dominant feedback mechanism. Thus the issue of feedback modalities in clusters of different masses represents one of the major challenges to the next generation of star formation studies.

In this proposal we seek to carry forward a focused theoretical study of feedback in both low and high-mass cluster environments with direct connections to observations. Using a state-of-the-art Adaptive Mesh Refinement MHD multi-

physics code (developed by our group) we propose two computational studies: (1) multiple, interacting outflows and their role in altering the properties of a parent low mass cluster (2) Poorly collimated outburst/outflows from massive star(s) and their effect on high mass cluster star forming environments. In both cases we will use initial conditions derived from high-resolution AMR MHD simulations of cloud/cluster formation. Synthetic observations derived from the simulations (in a variety of emission lines from ions to atoms to molecules) will allow for direct contact with HST and other star formation databases.

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12833
Program Title: The Master Lens Database and The Orphan Lenses Project

Principal Investigator: Leonidas Moustakas
PI Institution: Jet Propulsion Laboratory

Strong gravitational lenses are uniquely suited for the study of dark matter structure and substructure within massive halos of many scales, act as gravitational telescopes for distant faint objects, and can give powerful and competitive cosmological constraints. While hundreds of strong lenses are known to date, spanning five orders of magnitude in mass scale, thousands will be identified this decade. To fully exploit the power of these objects presently, and in the near future, we are creating the Master Lens Database. This is a clearinghouse of all known strong lens systems, with a sophisticated and modern database of uniformly measured and derived observational and lens-model derived quantities, using archival Hubble data across several instruments. This Database enables new science that can be done with a comprehensive sample of strong lenses.

The operational goal of this proposal is to develop the process and the code to semi-automatically stage Hubble data of each system, create appropriate masks of the lensing objects and lensing features, and derive gravitational lens models, to provide a uniform and fairly comprehensive information set that is ingested into the Database. The scientific goal for this team is to use the properties of the ensemble of lenses to make a new study of the internal structure of lensing galaxies, and to identify new objects that show evidence of strong substructure lensing, for follow-up study. All data, scripts, masks, model setup files, and derived parameters, will be public, and free. The Database will be accessible online and through a sophisticated smartphone application, which will also be free.

Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12834
Program Title: The Masses of Supernova Remnant Progenitors

Principal Investigator: Benjamin Williams
PI Institution: University of Washington

One of the key constraints on the production of supernovae (SNe) is the initial mass of the stars that eventually end in these cataclysmic events. Historically it has been very difficult to obtain estimates of the masses of SN progenitors

because there have only been a few dozen nearby events, only a handful of which have high-quality precursor imaging.

We propose dramatically increasing the number of SNe with progenitor mass estimates by applying an exciting new technique to HST archival data in M31 and M33. Through detailed modeling of the stellar populations surrounding the location of any known SNe, we can constrain the progenitor mass. Since supernova remnants (SNRs) mark the locations of SNe for the past ~20,000 years and M31 and M33 contain hundreds of these objects, detailed studies of the stellar populations at these locations will constrain the progenitor masses of potentially hundreds of events. After correlating archival HST imaging with the SNR positions, there is useful data for 137 SNRs. We have already measured the progenitor masses for 65 SNRs in M31 and plan to apply our method to 72 SNRs in M33. This proposal will fund the publication of our M31 measurements, analysis of the M33 SNRs, and public release of our photometry. Ultimately, our work will increase the existing sample of SN progenitor masses in the literature by a factor of 20.

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12835
Program Title: Thermal and Dynamical Models of Broad Line Regions in AGN - Testing Virial Estimators of Black Hole Masses.

Principal Investigator: Daniel Proga
PI Institution: University of Nevada - Las Vegas

Most important and useful methods of measuring masses of super-massive black holes use properties of AGN, in particular, properties of broad emission lines. Those methods assume that the regions where those lines are formed are virialized systems. We propose to study dynamics and kinematics of multi-phase flows in the vicinity of the central black hole in AGN. Our study will be based on numerical, time-dependent, fully three-dimensional hydrodynamical simulations taking into account black hole gravity, pressure due to gas and radiation, radiative heating and cooling, and gas rotation. Therefore, our simulations will follow gas that will be subject to thermal and hydrodynamical instabilities which will lead to formation and evolution of cold clouds and filaments surrounded by a hot gas. By measuring the kinematic properties of the simulated clouds, we will investigate what is required for the clouds to form a virialized system and whether the assumption of the virialized system holds for objects with low as well as high luminosities.

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12836

Program Title: Simulating the Local Group in Cosmological Context

Principal Investigator: Michael Boylan-Kolchin

PI Institution: University of California - Irvine

We propose to run ten very high resolution simulations of the Local Group in order to better understand the dynamics and formation histories of nearby galaxies. This is a field to which the HST has made unique and essential contributions, from proper motion measurements of dwarf galaxies in and around the Milky Way to star formation histories of a volume-limited sample of dwarf galaxies within 4 Mpc from the Galaxy.

Our simulations will be chosen to match observations of the Local Group, including the mass, present separation, and radial velocity of the Milky Way-M31 system and the overdensity of nearby galaxies on 4 and 8 Mpc scales. We will use the simulations to focus on three main areas: (1) are observed dynamics of galaxies in and around the Local Group typical of those from LCDM simulations of apparently similar systems? (2) what is the role of environment in establishing the morphologies and controlling the star formation histories of nearby dwarf galaxies? and (3) how many faint galaxies remain to be discovered (to specific luminosity limits) within 4 Mpc of the Local Group? These questions all address issues for which HST data has been and continues to be indispensable. Halo catalogs and merger trees from our simulations will be made publicly available; this will constitute an order of magnitude increase to the number of high resolution simulations of Milky Way-mass dark matter halos with public data products.

Proposal Category: AR

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12837

Program Title: The Age-Metallicity Relation of Galaxies in a LambdaCDM Universe

Principal Investigator: Jeremy Bailin

PI Institution: University of Michigan

Over the past decade, HST has obtained deep color-magnitude diagrams (CMDs) of a large number of nearby galaxies. These data have allowed the age-metallicity degeneracy to be broken and the age-metallicity relation (AMR) of stars within these galaxies to be empirically derived. However, the theoretical predictions of the AMR in a LambdaCDM universe have lagged behind: interpretation of the observations usually rests on simple untested expectations. Our pilot study of the AMR within a simulated galaxy generated in a full cosmological context has revealed a wealth of structure that is not anticipated by the simple models, including abundant substructure, a broad age-metallicity distribution, and non-monotonic evolution. It is now clear that interpretation of the HST observations requires a thorough theoretical analysis of the AMR in a large sample of galaxy formation simulations; this will be particularly critical for the large ACS Nearby Galaxy Survey Treasury (ANGST) and Panchromatic Hubble Andromeda Treasury (PHAT) programs that together invest over 1000 orbits to obtain spatially-resolved AMRs. We propose to perform such a study, using the 16 SPH simulations of galaxies from the McMaster Unbiased Galaxy Simulations (MUGS) and 19 adaptive mesh galaxy simulations from the Ramses Disk Environment Study (RaDES). This analysis will enable us to predict how the chemical enrichment histories of different galactic components and galaxies with different accretion and merger histories differ, how substructures in age-metallicity space relate to dynamical events in the history of the galaxy, and how well the AMR can be reconstructed from observed HST CMDs.

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12838
Program Title: Galaxy Star Formation Histories as a Function of Halo Mass and Environment across Cosmic Time

Principal Investigator: Risa Wechsler
PI Institution: Stanford University

Many recent surveys have probed the evolution of the stellar mass function and galaxy clustering as a function of stellar mass and star formation rate over the range z = 1 - 8. This theory proposal requests funding for a project to combine these new and ongoing observations with metallicity measurements in order to determine statistical variations in galaxy star formation histories and the buildup of stellar mass within dark matter halos from the epoch of reionization to the present day, including a detailed treatment of uncertainties. Our method would use merger trees from dark matter simulations as priors on the possible evolution paths of galaxies, resulting in new constraints on the star formation rate in galaxies as a function of halo mass, redshift, and galaxy environment, as well as mock catalogs of galaxies with full star formation histories which have statistically identical properties to observations. This project would thereby place a diversity of galaxy observations from HST as well as other space and ground-based telescopes into full cosmological context.

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12839
Program Title: The Geometry of Quasar Outflows

Principal Investigator: Rajib Ganguly
PI Institution: University of Michigan

Quasar outflows are important for understanding the accretion and growth processes of the central black hole, but also potentially play a role in feedback to the galaxy, halting star formation and infall of gas. A big uncertainty lies in the geometry and density of these outflows, especially as a function of ionization and velocity. We aim to tackle this using the archival COS M grating spectra of 266 quasars. We separate the geometry of outflows into two parts: the solid angle subtended around the black hole, and the distance of the outflow from the central engine. Large numbers of quasars with high resolution spectra are required for each aspect of this statistical investigation. First, we will

determine which/how many absorption-line systems are intrinsic through both partial covering methods and statistical assessments. Second, we will consider the incidence of intrinsic absorbers as a function of quasar property (e.g., radio-loudness, SED shape, black hole mass, bolometric luminosity). This will reveal what determines the solid angle. This can only be done at moderate redshifts where quasars with a larger range of properties are observable, and hence requires HST/COS. Third, we will use the wide range of diagnostic lines to constrain the physical conditions of the absorbers. We will target the CIII*1175 complex and apply photoionization models to constrain the densities and ionization parameters. This will provide the largest set yet of intrinsic absorbers with systematic distance constraints. In tandem with the solid angles, this work will inform models regarding the geometry of quasar outflows.

Proposal Category:	AR
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12840
Program Title:	The next generation of galaxy evolution models: A symbiosis of stellar populations and chemical abundances
Principal Investigator:	Ralf Kotulla
PI Institution:	University of Wisconsin - Milwaukee

Over its lifespan Hubble has invested significant effort into detailed observations of galaxies both in the local and distant universe. To extract the physical information from the observed (spectro-)photometry requires detailed and accurate models. Stellar population synthesis models are frequently used to obtain stellar masses, star formation rate, galaxy ages and star formation histories. Chemical evolution models offer another valuable and complementary approach to gain insight into many of the same aspects, yet these two methods have rarely been used in combination.
Our proposed next generation of galaxy evolution models will help us improve our understanding of how galaxies form and evolve. Building on GALEV evolutionary synthesis models we incorporate state-of-the-art input physics for stellar evolution of binaries and rotating stars as well as new spectral libraries well matched to the modern observational capabilities. Our improved chemical evolution model allows us to self-consistently trace abundances of individual elements, fully accounting for the increasing initial abundances of successive stellar generations. GALEV will support variable Initial Mass Functions (IMF), enabling us to test recent observational findings of a non-universal IMF by predicting chemical properties and integrated spectra in an integrated and consistent manner.
HST is the perfect instrument for testing this approach. Its wide wavelength coverage from UV to NIR enables precise SED fitting, and with its spatial resolution we can compare the inferred chemical evolution to studies of star clusters and resolved stellar populations in nearby galaxies.

Proposal Category:	AR
Scientific Category:	QUASAR ABSORPTION LINES AND IGM
ID:	12841
Program Title:	The Sensitive Side of Galaxy Formation: How sub-L* Galaxies Accrete, Form Stars, and Enrich the IGM

Principal Investigator: Benjamin Oppenheimer

PI Institution: Universiteit Leiden

We propose a series of cosmological zoom simulations specifically targeting the formation and evolution of dwarf and sub-L* galaxies living in halos of 10^11- 10^12 solar masses. The shallow potential wells and low-density environments of these halos provide uniquely sensitive laboratories to understand the physics of galactic feedback, as well as the thermal history of the intergalactic medium, from which these galaxies accrete. Given that 129 orbits of Cycle 18 COS data probing such halos is now being completed, combined with the insufficiency of current cosmological simulations to resolve these halos, the theory is lagging the data. We will remedy this by running zoom simulations of individual halos with 1000-10,000 times greater mass resolution than current cosmological simulations used for similar studies. We aim to resolve the sub-kpc scale of high-velocity cloud-like structures and <100 pc scales of the interstellar medium. We will simulate circumgalactic quasar absorption metal-line and H I statistics using our novel non-equilibrium ionization solver that follows individual ionic states. We will also investigate the delicate balance of accretion, star formation, and feedback required to reproduce the observed stellar properties of these small galaxies. In the spirit of transparency, we will make our simulation results available on a public website to encourage new projects and collaborations with observers and theorists understanding the physics regulating galaxy growth.

Proposal Category: AR

Scientific Category: QUASAR ABSORPTION LINES AND IGM

ID: 12842

Program Title: The evolution of intergalactic neutral hydrogen (HI) over cosmic time

Principal Investigator: Tae-Sun Kim

PI Institution: Dept. Astronomy, University of Wisconsin-Madison

We propose to study the evolution of intergalactic HI over the past 12 Gyrs, by combining our recent results from high quality ground-based observations covering the intergalactic gas at $1.5 < z < 4$ with highest quality archival HST observations from STIS ($1.0 < z < 1.3$) and COS ($0 < z < 0.48$). The HST archive data set includes 28 COS spectra with S/N > 25 and 2 STIS spectra with S/N ~ 15. The evolution of the HI in the intergalactic medium is governed by cosmic expansion which cools the gas, the gravitational assembly of matter which heats the gas, and the mechanical and radiative feedback from galaxies and AGNs. Our primary scientific goals are to measure 1) the evolution of the HI absorption line number density from z = 0 to 4 in order to constrain the evolution of the UV ionizing radiation field; 2) the evolution of the HI line width to constrain the change of physical and kinematical conditions in the intergalactic gas as the Universe evolves.

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12843
Program Title: Under Construction: the Next Generation Spectral Library

Principal Investigator: Michael Gregg

PI Institution: University of California - Davis

We propose to derive high level science products from the STIS snapshot program data which constitutes the Next Generation Spectral Library. The NGSL covers 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. Our main goal is to develop code to use the NGSL as a basis for interpolating spectra of arbitrary atmospheric parameters in Teff -- log(g) -- Z. A secondary goal is extension of the library spectra to the near-IR and to echelle resolution, mainly using data already obtained for this purpose. Both of these goals will increase the value of the NGSL database for use in modeling the integrated light of galaxies and clusters. We will make the results available to the community via MAST and a public website.

Proposal Category: AR
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12844
Program Title: Exoplanetary Spectroscopy with NICMOS Revisited

Principal Investigator: Drake Deming

PI Institution: University of Maryland

Transmission and secondary eclipse spectroscopy of giant hot exoplanets using NICMOS are iconic results in exoplanetary science. Recently, these results have been challenged as being due to inadequately corrected instrumental systematic error. We propose to re-analyze the NICMOS exoplanet transit and eclipse data, including some grism spectra that were never analyzed (over 5000 spectra in total), using a powerful new method developed for WFC3. We will compare our reanalyzed NICMOS spectra with new WFC3 exoplanet spectra in the region of overlap, and we will interpret our new NICMOS spectra in the total scientific context - including consistency with the WFC3 and extant Spitzer results.

Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12845
Program Title: Hunting for Intermediate-Mass Black Holes: Archival Proper-Motion Analysis of Globular Clusters

Principal Investigator: Andrea Bellini
PI Institution: Space Telescope Science Institute

The unambiguous detection of an intermediate mass black hole (IMBH) in a globular star cluster would be a major achievement for the Hubble Space Telescope. It is critical to know whether or not IMBHs exist in the centers of clusters in order to understand the dynamical evolution of dense stellar systems. Also, an IMBH detection would prove the existence of BHs in an entirely new mass range. Observationally, the search has been hampered by the low number of stars with known velocities in the central few arcseconds. This limits measurements of the stellar velocity dispersion in the region where the gravitational influence of any IMBH would be felt. Existing IMBH claims in the literature have all been called into question, and have all been based on line-of-sight velocities from spectroscopy. We propose to derive a homogeneus set of high-precision proper motions in the cores of 12 globular clusters for which there exist suitable multi-epoch ACS and WFC3 datasets in the archive, and either detect or place firm constraints on the presence of an IMBH in them. Seven of these clusters are known to harbor multiple populations of stars. For them, in addition, we will also be able to derive luminosity and mass functions for the different subpopulations and measure possible differences in their velocity distributions, as merging-formation theories suggest. Many other projects will benefit from our high-precision proper-motion measurements (bona-fide membership determination, detailed cluster modeling, etc.), so we will make our catalogs available to the astronomical community.

Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12846
Program Title: Mapping the Multiphase High Velocity Clouds in the Milky Way Halo

Principal Investigator: Jane Charlton
PI Institution: The Pennsylvania State University

The Milky Way halo is covered with gaseous structures observed through 21-cm emission, and through high,

intermediate and low ionization absorption lines. Detailed case studies of individual high velocity clouds have shown them to be multiphase structures, with low ionization metal lines falling through the hot halo and producing high ionization interface layers evident in OVI. Surveys of OVI from FUSE show large coherent structures covering large fractions of the sky, but the structures traced by the low ionization gas have not yet been systematically mapped. Our previous HST/STIS archival study found six low ionization HVCs along 26 sightlines. The HST/COS archive now facilitates an unprecidented study of ten times as many sightlines through the Milky Way halo, mapping a much wider variety of directions, and allowing constraints on transverse sizes. Coverage with the G130M and G160M gratings allows for simultaneous study of SiII 1260, OI 1302, CII 1335, SiIV 1394, and CIV 1548, which allow for a detailed study of the physical conditions of the low/intermediate ionization gas. High velocity clouds are not only important for our understanding of our own galaxy, but also trace the conditions of the gas around galaxies over cosmic time. The critical UV spectra obtained by HST/COS provide the benchmark by which galaxies of a variety of types, and over a wide range of redshifts, can be measured.

Proposal Category: AR

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12847

Program Title: Reconstructing the Lives of Massive Galaxies: From Large Clumpy Star-Forming to Compact Quiescent Galaxies?

Principal Investigator: Mariska Kriek

PI Institution: University of California - Berkeley

The massive galaxy population at z~2 appears to be quite diverse, ranging from large and clumpy star-forming galaxies to compact quiescent systems. However, the origin of compact quiescent galaxies and their relation to the larger star-forming galaxies are still poorly understood. In the proposed work we will make use of the exquisite CANDELS imaging data in combination with a novel approach to “spectroscopically” characterize the distant galaxy population to connect galaxies of different types and at different times. Using the high-quality photometry of the NEWFIRM Medium-Band Survey we have divided the galaxy sample at 0.5<z<2.0 in 32 different subsamples and constructed a composite SED for each subsample. The SEDs are of spectroscopic quality and exhibit various emission and absorption features. They span a wide range in evolutionary phases, and thus form a perfect basis to study the structural evolution of galaxies. We will use the 4-band CANDELS data in COSMOS to obtain stellar mass profiles and distributions of galaxies as a function of SED type, stellar mass, and redshift. This study will constrain the different scenarios proposed to explain a possible evolutionary connection between the large star-forming and compact quiescent galaxies. The composite SEDs in combination with the CANDELS data will also allow us to connect galaxies of the same type, but observed from different angles. We will use this method to constrain the dust attenuation law and 2175 Angstrom dust absorption feature in distant galaxies. Possible correlations between its strength and the spectral/morphological type of the galaxy may give crucial clues to the still unknown origin of this feature.

Proposal Category: AR

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12848

Program Title: Cospatial [O III] emission with Herschel and Hubble to address the nebular abundance discrepancy problem

Principal Investigator: Robert Rubin

PI Institution: NASA Ames Research Center

There exist planetary nebulae (PNe) whose heavy element C, N, O, and Ne abundances as derived from optical recombination lines (ORLs) are a factor more than ~5 higher than those derived from the traditional method based on collisionally excited lines (CELs). This ratio is called the abundance discrepancy factor (adf). A promising proposition to explain this long-standing nebular abundance problem posits that these nebulae contain (at least) two distinct regions - one of "normal" electron temperature, Te (~10000 K) and chemical composition (~solar) and another of very low Te (< 1000) that is H-deficient, thus having high metal abundances relative to H. The latter component emits strong heavy element ORLs and IR fine-structure (FS) CELs, but essentially no optical/UV CELs. Efforts to directly detect these inclusions in PNe have been unsuccessful to date. However, there is mounting circumstantial evidence for their existence, such as presented in our recent paper that modeled the high-adf PN NGC 6153 using a 3-D photoionization code. The models that included the low Te, H-deficient knots fit most observations far better than did those models without the clumps. It has been shown that the adf varies with position in a PN and is highest close to the central star. The very low Te inclusions must be cooled predominantly by FS mid-IR lines. We propose to use HST archival images to derive [O III] 5007 A flux maps to compare with the [O III] 88 micron fluxes from our Herschel observations of four PNe - NGC 2392, NGC 2440, NGC 6720 and NGC 7009 - all on the largest adf list, to find if the IR line flux relative to the cospatial optical forbidden line flux peaks where the adf peaks.

Proposal Category: AR

Scientific Category: COOL STARS

ID: 12849

Program Title: Super-resolution detection of ultracool dwarfs in the HST/NIC1 archive

Principal Investigator: Frantz Martinache

PI Institution: Research Corporation of the University of Hawaii / Subaru Telescope Project

A recently invented data reduction technique called Kernel-phase offers the means to probe for faint companions around nearby stars and brown dwarfs, down to and even within the formal diffraction limit of HST, with milli-arcsecond astrometric precision: a regime refered to as super-resolution. We propose to revisit a uniform HST/NIC1 survey of ultracool dwarfs to probe for previously undetected companions at angular separations unaccessible to other techniques. In addition to potential new detections, this analysis provides improved relative astrometry of all known binaries and produces contrast detection limits that translate into strong constraints on the statistical properties of ultracool dwarf binaries: binary fraction, mass ratio and orbital separation distribution.

Proposal Category: AR
Scientific Category: HOT STARS
ID: 12850
Program Title: Young Stellar Populations Near the Sites of Stripped-Envelope Supernovae

Principal Investigator: Patrick Kelly
PI Institution: Stanford University

Core-collapse supernovae (SN) signal the deaths of massive stars, and their spectra, used to classify SN into types, reveal the state of the progenitor's outer envelope before the explosion. Using SDSS photometry, we have recently found strong, type-dependent patterns in the host galaxy's color and surface brightness near explosion sites. Exceptionally blue environments are typical of Type IIb SN, whose progenitors retain only a thin outer hydrogen shell. SN Ic, whose spectra are consistent with more complete loss of the progenitor's outer hydrogen and helium envelopes, explode in host regions with high u'-band surface brightness. We propose photometry of the resolved stellar populations near the sites of 35 stripped-envelope SN within ~25 Mpc. We will infer the age and mass distributions of the nearby young stellar population from isochrone modeling of the color magnitude diagram. The proposed analysis will reveal how pre-explosion mass loss depends on progenitor mass as well as the natal host environment.

Proposal Category: AR
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12851
Program Title: Light Echoes of Supernovae and other Transients in M31

Principal Investigator: Armin Rest
PI Institution: Space Telescope Science Institute

The PHAT legacy survey of M31 is a rich repository of data that has not yet been systematically mined for transients and variables. We propose to apply difference imaging to all suitable pairs of images in this extensive ongoing survey and to a smaller extent other previous observations of M31. Our main scientific goal is to discover light echoes of ancient SNe and other bright eruptive transients like LBVs in the subset of difference images for which the two epochs

were separated by 6 months. With the brightest of these echoes, we can do follow-up spectral classification of the source event, determine their ages, and determine properties of the scattering dust. However, our difference image data products will also greatly improve on the detection and characterization of variables and transients of all kinds using generic photometry in crowding-limited fields like M31. We will make these data available through the MAST archive so that they are easy to access and search by archival investigators and will cross-match with other internal or external catalogs from current M31 surveys like Pan-STARRS1 and PTF. This will add a new legacy aspect to these data by providing access to the time variable domain.

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12852
Program Title: The HST Milky Way Stellar Photometry Archive

Principal Investigator: David Radburn-Smith
PI Institution: University of Washington

The Hubble Legacy Archive has invested a significant effort into automatically generating photometry for point sources in all HST observations regardless of the target. We estimate that this archive contains up to 800,000 Milky Way (MW) stars, distributed across the whole sky, complete to some three magnitudes fainter than SDSS. Approximately half of these stars have color information, which is required for stellar population analysis. This considerable archive is thus in need of collation, analysis, and publication.

Here we propose to compile such a catalog for public access and to use it for two science goals: 1) A test of existing MW stellar models, where we will in particular constrain the fainter and more distant stellar populations; and 2) Probe the shape and structure of the MW stellar halo with a deeper star catalog than is currently available. These science cases will be used to fully define the catalog, in particular by assessing the different populations present in the observations, and by assessing the level of noise from contaminants and the completeness of the survey

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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12853
Program Title: Measuring the Ancient Star Formation Histories of the Magellanic Clouds

Principal Investigator: Daniel Weisz

PI Institution: University of Washington

We propose to uniformly derive the star formation histories (SFHs) of the LMC and SMC from 122 deep archival WFPC2 fields. The large number of extremely deep HST-based CMDs and our uniform approach to analysis will result in constraints the SFHs of both systems to ~ 10\% at all ages. From the HST archive, we have selected 97 fields in the LMC and 25 in the SMC were originally largely observed with other original science goals. Each CMD extends several magnitudes below the oldest main sequence turnoff, providing excellent leverage on the ages of older populations in both systems.

Current state of the art SFHs of the LMC and SMC are derived from spatially comprehensive, but unavoidably shallow ground based photometry that does not include main sequence stars older than 5 Gyr, severely compromising the accuracy of the SFHs older than this time. Conversely, existing HST-based SFHs are well-constrained at all ages, but limited to small sets of pointings, inhibiting galaxy wide generalizations. The lack of well-constrained SFHs of the SMC and LMC at all ages, significantly reduces their utility in discriminating between new dynamical models of the SMC and LMC. The results of our study will provide precise constraints on LMC and SMC formation and evolutionary scenarios over all cosmic time.

Proposal Category: AR

Scientific Category: QUASAR ABSORPTION LINES AND IGM

ID: 12854

Program Title: A COS Legacy Study of Circumgalactic Baryons

Principal Investigator: Nicolas Lehner

PI Institution: University of Notre Dame

Our modern understanding of galaxy evolution relies heavily on the exchange of matter between galaxies and the intergalactic medium (IGM) to explain a broad range of observable galaxy properties (color bimodality, mass-metallicity relationship, etc.). The competition between mass gain and loss plays out in the circumgalactic medium (CGM). QSO absorption lines can be selected to probe the CGM, and in a small pilot study of these absorbers we have disovered that our view of the metal content in the Universe at z<1 may have been biased toward the high end metallicity. We have discovered a population of very metal-poor absorbers (<2% solar) at z<1, >15 times smaller than the mean metallicity at these redshifts. These provide the best-yet observational evidence for cold accretion flows like those present in numerical simulations of galaxies. At the same time, we clearly see the signature of galaxy outflows in these absorbers. We propose a COS Legacy archival program to characterize the metallicity and physics of the diffuse matter around galaxies. We will use the high resolution z<1.5 QSO spectra in the HST/COS G130M/G160M archive to address the questions: What is the metallicity of the extended galaxy halos at z<1? What are the baryon and metal budgets of CGM gas at z<1? We will produce a public database of the 200 coadded QSO spectra with a line identification list for each QSO, which will provide the definitive database for studying the low-redshift IGM and the IGM-galaxy connection and undoubtedly leads to several major ancillary discoveries.

Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12855
Program Title: Herschel-Resolved Debris Disks: HST Constraints on Dust Albedo

Principal Investigator: Geoffrey Bryden
PI Institution: Jet Propulsion Laboratory

Debris disks are circumstellar dust clouds that trace extrasolar analogs of our solar system's Kuiper Belt. Over the years HST users have sought to image dozens of debris disks around stars selected to have far-infrared excess. While many notable imaging detections have been achieved, the vast majority of the targeted disks have gone undetected in scattered light. These non-detections are generally not interpreted or published by the original observing teams. A major opportunity to do science with these non-detections is now opening thanks to the Herschel Space Observatory, which has resolved the sizes of these disks for the first time. In a pilot study of HD 48682, a model fit to the resolved Herschel image and disk excess spectrum was used to make quantitative predictions of the brightness and radial location of scattered light from the star's debris disk. The HST archival image of the system is sufficiently sensitive to require the debris dust albedo to be <10%, which rules out an icy composition for the grains. We propose to perform a similar analysis on 24 additional debris disks resolved with Herschel and undetected in HST images. We will derive quantitative detection upper limits from the PSF-subtracted HST images and interpret them in the context of the Herschel and Spitzer data. Our project will more than double the number of debris disks with quantitative albedo constraints, and thus help to clarify the nature of dusty material in extrasolar planetary systems.

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12856
Program Title: An Astrostatistical Approach to Distant Galaxy Morphology

Principal Investigator: Jennifer Lotz
PI Institution: Space Telescope Science Institute

A galaxy's morphology is an important tracer of its recent assembly history and correlates strongly with other fundamental properties such as star-formation history, kinematics, and black hole mass. Our current approaches do not fully exploit the wealth of structural information available in the deep HST images, nor do they reliably classify rare but important populations such as galaxy mergers and unstable disks at $z > 1$. As a result, the connections between galaxy assembly, star formation, and morphological transformation via mergers, disk instabilities, and bulge formation remain unsolved problems.

Our primary goals for this Legacy Archival program are (1) to derive a rigorous statistical methodology for quantifying

and classifying distant galaxy structures; (2) to apply these new astrostatistical algorithms to galaxies at 0 < z < 2.5 in the major HST extragalactic legacy fields and measure the structural evolution; (3) to measure and classify mock HST images of hydrodynamical cosmological simulations of galaxies at 0 < z < 2.5, and test these against our measurements of the real universe.

This program will produce several much-needed Legacy products. With these algorithms, we will produce and publicly release high quality catalogs of optical/near-IR quantitative morphology and classifications for the HST extragalactic legacy fields. We will also provide similar catalogs for mock HST images of state-of-the-art cosmological simulations of galaxy assembly and structural evolution. Finally, we will publicly release the software for calculating our new morphology statistics and running the new galaxy classification algorithms to encourage broad use by the community.

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12857
Program Title: A homogeneous ACS dataset for realistic galaxy simulations

Principal Investigator: Rachel Mandelbaum
PI Institution: Carnegie Mellon University

Weak gravitational lensing (WL), the deflection of light from distant source galaxies due to the mass in intervening lenses, is a measurement technique that will be used to constrain dark matter and dark energy in several upcoming, wide-field imaging surveys. We propose to carry out HST archival research that will reduce a limiting systematic error in WL measurements, the estimation of galaxy shapes and therefore coherent WL distortions, in the presence of the larger (and coherent) distortions due to the point-spread function (PSF). In particular, we will produce and publicly release a training dataset covering ~380 square arcmin, consisting of homogeneously-analyzed galaxies observed in at least two orbits and typically two bands (F606W and F814W), each with a PSF estimate and a detailed understanding of the anisotropic, correlated noise in the images. This training data can be used as input for public simulation software that produces mock galaxy data to test the performance of WL analysis methods on realistic galaxies; it is complementary to a previous release of training data based on single-orbit F814W data from COSMOS.

The inclusion of a sufficiently large quantity of deep training data from HST is crucial for identifying biases in WL shape measurements due to deviations of galaxies from simple parametric models, such as have been used in the majority of WL simulations to date. This training data will help future lensing surveys to achieve their enormous potential, and will be a lasting legacy for the astronomical community due to its utility for many other scientific applications (e.g., galaxy morphologies).

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12858
Program Title: A Geometric Distance to the Small Magellanic Cloud using the Expanding Supernova Remnant 1E 0102-7219

Principal Investigator: Barry Madore

PI Institution: Carnegie Institution of Washington

1E 0102-7219 is a highly symmetric, rapidly expanding, supernova remnant in the the Small Magellanic Cloud. We propose to use 1E~0102 to independently derive a geometric distance to the SMC. Scaling the transverse proper motions to match the line-of-sight radial motions directly gives the distance. Previous studies have reported measuring stellar proper motions in the SMC of 1.1 +/- 0.2 mas/yr (a precision of about 17%) for transverse velocities of stars in the SMC of only 300 km/s within a time a baseline of only 2 years. Given that our expansion velocities (peak-to-peak) are around 6,000 km/s (a factor of 20 larger) and that we will have a time baseline between ACS observations of at least 9 years (another factor of 4 larger) we estimate that our SNR proper motions will be measured to better than 1% precision. At this point assumptions in the modeling will dominate the systematics. 1E 0102 is one of the nearest extragalactic test cases for this method and it will be the archetype and testbed for investigating systematics and assessing the potential of this method for determining distances to additional galaxies at larger distances. We are simply requesting a single-orbit ACS observation using the F475W filter for comparison with an identical image taken 9 years ago.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12859

Program Title: UV Imaging of LSB Galaxies

Principal Investigator: James Schombert

PI Institution: University of Oregon

This project is to obtain F336W, F555W and F814W (UVI) imaging of the last type of galaxy missing from the HST archives, low surface brightness (LSB) galaxies. LSB galaxies are unusual in having weak H-alpha emission with no signature of the ionizing stellar population in deep optical images nor in B-V color maps. We propose to obtain WFC3 imaging (with it's improved UV response) to resolve the star forming population in three nearby LSB galaxies (F415-3, F608-1 and F750-V1). This will allow us to resolve the young star clusters and map the top of the CMD in order to estimate the age and IMF of the underlying stellar population.

Proposal Category: GO

Scientific Category: QUASAR ABSORPTION LINES AND IGM

ID: 12860

Program Title: Detecting Sources of Early IGM Enrichment

Principal Investigator: Xiaohui Fan

PI Institution: University of Arizona

Intergalactic medium (IGM) metal absorption lines observed in z>5 quasar spectra offer the opportunity to probe early galaxy feedback process and the nature of enriching sources in the reionization and post-reionzation era. The question of whether galaxies drove cosmological reionization depends crucially on the strength of the feedback processes that regulated their growth. Theoretical models predict that outflows dominate galaxy growth and through it the ionizing luminosity function; at the same time, these superwind outflows would enrich their surrounding IGM, resulting in a strong IGM-galaxy correlation. We propose to test this idea directly by identifying and studying the host galaxies of four known IGM CIV absorbers along two quasar lines of sight at z=5-6. We will center the ACS ramp filters on the Ly alpha wavelengths corresponding to the CIV absorbers' as-yet-undiscovered host galaxies. With deep imaging, we will then detect Ly alpha emission from galaxies with star formation rates as low as ~1 M_sun/yr that lie within impact parameters of ~150 kpc (physical) from the quasars. We will use existing deep broad-band imaging to eliminate contaminants and constrain the properties of the absorbers' host galaxies. By combining our results with the single existing CIV galaxy detection at z>5, we will construct the first sample allowing direct statistical constraints on the nature of feedback near the end of the reionization epoch and providing tests to models of IGM enrichment and ionization.

Proposal Category: GO

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12861

Program Title: Morphologies of the Most UV luminous Lyman Break Galaxies at z~3

Principal Investigator: Xiaohui Fan

PI Institution: University of Arizona

We propose to carry out WFC3/F160W high spatial resolution imaging of a sample of eighteen extremely UV luminous Lyman Break Galaxies (LBGs) at z=2.2-3.2 to study their morphologies and to constrain models of the formation and evolution of the most massive and luminous galaxies at high-redshift. Studies of high-redshift LBGs in recent years have provided key insight into the history of galaxy assembly at the peak of cosmic star formation activity. However, most previous studies have been limited by small survey volume and could not select the rarest systems. We have carried out wide-field multicolor surveys of LBGs covering >300 deg^2, increasing the survey volume by ~2 orders of magnitude. Our initial observations have revealed eighteen extremely UV luminous galaxies with r~21-22.5, more than 2 magnitudes brighter than typical LBGs. At L > 6L*, they represent some of the rarest and most intensive star forming systems in the early Universe. With the proposed observations, we will look for signatures of major merger activities, measure the relative contribution of nuclear point source to the total luminosity, and carry out detailed quantitative morphological measurements. These analyses will help us understand the triggering mechanism of the

intense star formation in these galaxies, constrain their star formation and assembly histories, and reveal their evolutionary stage in the overall sequence of galaxy formation. Together with other observations, our study will place these newly discovered galaxies in the context of galaxy growth through merger and cold flow accretion at the peak era of cosmic star formation, and provide a unique laboratory for galaxy formation theory.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12862
Program Title: Towards Identifying Carbon Stars Beyond the Local Group

Principal Investigator: Martha Boyer

PI Institution: Space Telescope Science Institute

Recently, HST WFC3/IR broad-band imaging has proved effective at detecting AGB stars in galaxies beyond the Local Group, but it is impossible to distinguish between different AGB subtypes with only the available broad-band filters. We propose a 1-orbit pilot program to establish the ability of the WFC3/IR medium-band filters to separate carbon-rich and oxygen-rich AGB stars. Synthetic spectra of C and M stars indicate that the molecular features in the NIR will cause C-rich stars to appear much bluer than O-rich stars in medium-band colors. The ratio of C to M stars can have a dramatic impact on a galaxy's NIR flux and colors and studies of the C-rich stars in particular inform models of the processes of the third dredge up and dust production (which is dominated by C-rich sources in the Magellanic Clouds). Separating C-rich and O-rich AGB stars in galaxies outside of the Local Group will provide robust constraints on stellar evolution models, especially in the low and high metallicity realms, and act as a pathfinder for future mid-IR JWST observations.

We choose a well-studied field in M31 to calibrate the utility of using WFC3's medium-band filters to separate C and M stars. The metal-rich environment of M31 provides the added benefit of an opportunity to study C-rich stars at high metallicity.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12863
Program Title: Determining the Redshift of the Blazar 3C 66A for Studies of the Extragalactic Background Light

Principal Investigator: Amy Furniss

PI Institution: University of California Santa Cruz

The extragalactic background light (EBL) is the accumulated and reprocessed radiation of all the starlight produced over the life of the Universe. As such, measurements of the intensity and evolution of the EBL offer a critical test of

cosmology and structure formation. An accurate knowledge of this light density also plays an important role in the determination of the intergalactic magnetic field (IGMF) strength. The direct measurement of the EBL radiation field is hampered by the existence of foreground sources within our own solar system and Galaxy. This complication can be overcome by use of very high energy (VHE) emitting blazars. These sources produce gamma rays which interact with the EBL photons through pair production, altering the observed VHE spectrum in a distance-dependent manner. The most promising blazar for such studies is 3C 66A, which has a putative redshift of z=0.44, a measurement based on a single line observed in a 40 year old spectrum. If confirmed, the observed VHE spectrum would negate the validity of one of the most comprehensive EBL models to date. Recent efforts to confirm the redshift with 10m-class telescopes have proven unsuccessful. We propose far-UV spectroscopy with HST/COS for 3C 66A to search for the signature of the z~0 Lyman alpha forest, to thereby confirm or refute the putative redshift. With 3 orbits of G160M spectra, we will firmly establish it to have z>0.2 (or not) and if within z=0.2-0.45 establish its redshift to a precision of 0.05 (90% confidence limit). If the redshift of 3C 66A is found to be greater than 0.53, all EBL models produced thus far will be nullified.

Proposal Category:	GO
Scientific Category:	QUASAR ABSORPTION LINES AND IGM
ID:	12864
Program Title:	UV Spectroscopy of the H 2356-309 Sightline: Confirming the X-ray WHIM Absorber and Testing the Structure Formation Theory
Principal Investigator:	Taotao Fang
PI Institution:	University of California - Irvine

Most of the Warm-Hot Intergalactic Medium (WHIM) has yet to be found, posing a fundamental challenge to the current theory of cosmological structure formation. A key prediction is that the WHIM resides in the "cosmic web" structures that are traced by galaxy superstructures and served as "signposts" of baryons. Our detection of an OVII K-alpha absorption line located in the Sculptor Wall superstructure of galaxies (z ~ 0.03) in the X-ray spectrum of the blazar H 2356-309 is arguably to date the most promising X-ray detection of gas that could represent the typical WHIM. However, despite the solid statistical significance of our detection (4-sigma) and the consistency of the measurements with both good-quality Chandra and XMM data, further verification is warranted because of the scientific importance of the result and the history of controversial claimed detections in this field. We therefore propose a HST/COS observation of the blazar H 2356-309 sightline. The detection of an HI broad Ly alpha absorber (BLA) will offer an independent confirmation of the Sculptor Wall WHIM absorber at even higher significance than achieved with X-ray data. This sightline also passes through two other galaxy superstructures, therefore offering the best opportunity to perform a comprehensive, joint UV/X-ray study of the WHIM residing in the three galaxy superstructures, the signposts of the cosmic web.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	12865

Program Title: HD 188112 - a candidate Supernova Ia progenitor

Principal Investigator: Ulrich Heber

PI Institution: Universitat Erlangen-Nurnberg

Several different explosion channels have been proposed for Type Ia Supernovae (SNe Ia), and tested against observations through hydrodynamic explosion simulations and radiative-transfer calculations. A promising scenario is the double detonation of a sub-Chandrasekhar-mass C/O white dwarf (WD), where a surface detonation in freshly accreted He subsequently triggers a detonation in the C/O core. The companion and He donor would likely be a low-mass He WD. Potential progenitor systems (i.e., binaries of a sufficiently massive C/O WD with a low-mass He WD) have never been observed so far. However, HD~188112 might be part of such a system. HD~188112 is a nearby, bright, radial-velocity variable He WD of 0.24 M$_\odot$, whose unseen companion has been inferred to be another WD of at least 0.73 M$_\odot$. The exact mass of the companion depends on the unknown inclination of the system. Assuming tidally locked rotation, the inclination can be determined measuring the broadening of metal lines due to rotation. Since the metallicity of HD 188112 is extremely low (1/100 solar), this measurement can only be performed in the UV, making the use of HST mandatory. If the mass of the companion of HD 188112 is confirmed to be between 0.95 and 1.05 M$_\odot$, the first candidate double-detonation SN Ia progenitor system has been found.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12866

Program Title: A Morphological Study of ALMA Identified Sub-mm Galaxies with HST/WFC3

Principal Investigator: Mark Swinbank

PI Institution: University of Durham

For more than a decade sub-millimer bright galaxies (SMGs) have been known to host the most active sites of star formation at high redshift. However, given the course resolution (~20") of sub-millimeter cameras, all multi-wavelength studies to date were limited to a sub-set of SMGs at low redshift and were plagued by mis-identifications. This lead to a severely incomplete understanding of some of the most actively star forming galaxies in the universe. This field is now being transformed by ALMA: our early ALMA observations of >100 SMGs in the Extended Chandra Deep Field South (ECDFS) have resulted in extremely precise positions (<0.3") of an unbiased SMG sample. The requested WFC3/F160W observations of a carefully selected sub-sample are absolutely critical to investigate the triggering mechanisms for their immense starburst activity through the only collision-less tracer available to us: the morphology of the stellar distribution. Through its analysis we will be able to distinguish between low-mass merging starbursts, isolated or not-strongly interacting, gas-rich disk galaxies suffering secular bursts; and proto-spheroids undergoing classical top-hat collapse, thus putting tight constraints on the multitude of proposed models. HST is the only facility that offers the sensitivity and resolution needed to finally understand the nature of SMGs.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12867
Program Title: The Wind of Massive Stars in Low-Metallicity Galaxies

Principal Investigator: Thierry Lanz
PI Institution: Observatoire de la Cote d'Azur

The ultimate fate of massive stars rests on the mass and angular momentum that they loose during their evolution, hence depends on the properties of their winds. Because of the radiation-driven nature of these winds, we expect the mass loss rates to scale with stellar metallicity. Such a relation has been established theoretically and empirically with spectroscopic analyses of O stars in the Galaxy (Z/Zsun=1) and in the LMC and SMC (Z/Zsun = 1/2 and 1/5).

Tramper et al. (2011) derived mass loss rates of 6 O stars in galaxies with low metallicities (Z/Zsun ~ 1/7). Based on the Halpha line, they derived mass loss rates that are similar to those of LMC stars. This result, if upheld, would have far-reaching consequences beyond our understanding of radiatively-driven winds, and would imply for instance a lower number of collapsars and of SN Ib and Ic in low metallicity environments, hence in the high-z Universe.

We propose to coroborate or refute Tramper et al.'s result by obtaining FUV spectra of 3 O stars in the IC 1613 and WLM galaxies with HST/COS. Because of numerous iron lines and lines sensitive to wind properties, FUV spectroscopy is the adequate tool to fully address and resolve this outstanding issue of the dependence of hot, massive star mass loss rates with metallicity. A comparison of these spectra with extant STIS or COS spectra of LMC and SMC stars will provide a direct, model-independent check of the mass loss - metallicity relation. A quantitative analysis will be carried out using our state-of-the-art NLTE unified model atmospheres calculated with the CMFGEN code to establish robustly the wind properties of low-metallicity massive stars.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12868
Program Title: Unveiling the giant jet from Sanduleak's star in the Large Magellanic Cloud

Principal Investigator: Rodolfo Angeloni
PI Institution: Pontificia Universidad Catolica de Chile

An exceptionally large jet was recently discovered around the enigmatic LMC source known as Sanduleak's star (Angeloni et al. 2011 ApJ 743, L8). To our knowledge, with a physical extent of 14 parsecs, it represents the largest stellar jet ever discovered, and the first clearly resolved stellar jet beyond the Milky Way. Because of these exceptional properties, we expect that it will become a key target where to study the formation and evolution of astrophysical jets. While the ground based images have highlighted the exceptional nature of the source and its gross morphology, their limited resolution prevents a thorough discussion of the jet's properties, origin and expansion through the surrounding

environment. In order to largely improve our knowledge of the system, we propose here to obtain deep, narrow-band images in the Halpha (F656N), [NII] (F658N) and [SII] (F673N) emission lines by exploiting both the superb spatial resolution and large field of view of WFC3/UVIS.

With a reasonably short amount of telescope time, the HST observations would provide immediate scientific results, would help in the preparation of follow-up spectroscopic proposals, and would have a high PR value, considering both the outstanding properties of the jet of Sanduleak's star, and the likely spectacular outcome of the proposed imagery.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12869
Program Title: The chemical diversity of extra-solar planetary systems

Principal Investigator: Boris Gaensicke

PI Institution: The University of Warwick

Over the past few years, it has become increasingly clear that the most plausible scenario to explain the infrared excess observed at ~30 white dwarfs is accretion from rocky planetary material - suggesting that these white dwarfs may have had, or may still have terrestial planets as well. This hypothesis is corroborated through the detection of volatile-depleted abundance patterns in the photospheres of these white dwarfs. We are carrying out a large COS snapshot survey of 150 white dwarfs, with the aim to determine the fraction of remnants of planetary systems around young (20-200Myr) white dwarfs. At the time of writing, we have observed 94 white dwarfs, and find pollution by Si, one of the major constituents of the Earth, in ~25% of them. In about a dozen stars, we detect multiple (up to nine) different elements, and show that their abundance pattern is broadly consistent with that of bulk-Earth: extremely volatile depleted, in particular in C/Si. However, there are two exceptions: WD1013+256 and WD1647+375 show strong lines of both Si and C. We have ruled out accretion from the wind of a nearby low-mass companion, and the only explanation is accretion of planetary debris that is significantly richer in C than the bulk Earth. This discovery is of substantial significance within the current discussion on variations in the exo-planet chemistry. We propose to re-observe these two white dwarfs, doubling the signal-to-noise ratio with respect to our very short Snapshot spectra, to and to determine the abundances of additional elements, including Fe, O, and possibly Ni and N.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12870
Program Title: The mass and temperature distribution of accreting white dwarfs

Principal Investigator: Boris Gaensicke

PI Institution: The University of Warwick

2011 was an extraordinary year for astronomy, with the Nobel Prize for Physics being awarded for the discovery of dark enery. Yet, we are unable to explain the precise nature of type Ia supernovae, the very tool that led to that discovery. We propose an ambitious ultaviolet survey of a large sample of accreting white dwarfs that will improve by an order of magnitude our insight into the evolution of compact binaries and the effect that the accretion of mass and angular momentum has on the structure of the white dwarf. This COS survey will double the number of accreting white dwarfs with accurate effective temperatures, thereby measuring their mean secular accretion rates. We will investigate the spin rates of accreting white dwarfs, which have recently been subject of discussion in the context of super-Chandrasehkar SNIa. Measuring the abundances of the accretion flow onto the white dwarfs, we will precisely determine the frequency of systems that underwent thermal-time scale mass transfer, one of the canonical pathways thought to lead to type Ia explosions. Finally, using the synergy of GAIA parallaxes with the analysis of our COS data, we will quadruple the number of accreting white dwarfs with accurate mass measurements, and probe in exquisite detail the possibility that white dwarfs, in particular those that underwent thermal-time scale mass transfer, grow in mass. Confirming mass growth in these systems would provide an alternative channel for long-delay time SNIa, solving the discrepancy between the observed rates and the currently favored double-degenerate model.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12871

Program Title: When Giants Collide: Mapping the Mass in the Cluster Merger Abell 2146

Principal Investigator: Lindsay King

PI Institution: University of Texas at Dallas

Galaxy cluster mergers are critical for our understanding of dark matter, as shown with the Bullet Cluster (1E0657-56). These violent events result in a separation of the dark matter in these systems from the hot X-ray emitting plasma, the dominant baryonic component. Our proposed target, Abell 2146, is an extraordinary post-merger system, discovered using Chandra X-ray observations. It is a unique system, presenting two unambiguous shock fronts that allow us to estimate that the collision between the two clusters occured ~0.1-0.2 Gyr ago. We propose ACS/WFC observations of this system, from which we will obtain a high-resolution map of the total mass distribution, using gravitational lensing analysis of distant background galaxies. By comparing this mass map with our X-ray images, and with the locations of cluster galaxy populations, we will study dark matter and test gravity on cluster scales. We will map the detailed mass substructure in the clusters, essential to our understanding of their formation, facilitated by the exquisite resolution of HST. We will use the window that HST provides in conjunction with gravitational lensing, to reveal the dark matter haloes that harbour cluster members in this extreme environment, studying their characteristic mass and size, and the physical processes at play.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12872
Program Title: Characterizing the mass accretion rates in young low-mass stars at low metallicity

Principal Investigator: Nicola Da Rio
PI Institution: European Space Agency - ESTEC

Mass accretion from circumstellar disks onto young pre-main sequence (PMS) stars is a key aspect in the evolution of both the central star and the surrounding material. Over the past few years, new observational studies have improved dramatically our knowledge on these accretion processes, in particular thanks to the Hubble Space Telescope. A recent work in the Orion Nebula Cluster - the prototypical few Myr old Galactic star formaing region - allowed us to obtain very accurate measurements of mass accretion rates (Mdot) for ~700 PMS stars. This enabled the analysis of the dependence of Mdot with stellar mass and age with unprecedented accuracy.

Moreover, several recent works based on HST Halpha photometry have investigated accretion rates in metal-poor young regions of the Magellanic Clouds (MCs). These studies demonstrate a clear anti-correlation of Mdot with metallicity, but results are limited to intermediate mass stars (M~1Msun).

We aim at completing the parameter space of these studies, i.e., study Mdot for low mass stars (down to 0.3 Msun, the peak of the initial mass function) in the Magellanic Clouds. This can be achieved through deep Halpha imaging of a particular region of the LMC, LH 95, whose low-mass PMS population has been already well characterized by us down to 0.2Msun. The methods we will use to derive Mdot from the proposed observations, together with the data already in our hands, have been fully tested in other regions of the MCs. The proposed observations will enable us to probe the role of metallicity in low-mass star formation, in order to set additional constraints on PMS theory.

Proposal Category: SNAP
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12873
Program Title: Search for Planetary Mass Companions around the Coolest Brown Dwarfs

Principal Investigator: Beth Biller
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

In the last two years, discoveries of the very coolest brown dwarfs (T<800 K) have accelerated, due to results from WISE, UKIDSS, and other IR surveys. These objects close the gap in mass between brown dwarfs and planets -- indeed many of them have planetary masses. Any companions around such an object would certainly be among the lowest mass imaged to date. Here we propose to obtain HST WFC3 IR imaging of newly discovered >T8 dwarfs to search for planetary mass companions to these objects. Any companion discovered to these objects will be a key benchmark object for models and will eventually yield a dynamical mass. We will also be able to place the first constraints to date on the binary fraction for >T8 cool brown dwarfs. For our sample with typical estimated distances of 10-15 pc, WFC3's 0.13" IR platescale will allow us to probe equal magnitude binaries down to separations of 0.2", corresponding to physical separations of 2-3 AU. In order to clearly distinguish cool substellar/planetary mass companions from

background stars, we propose observations in the F127M and the F138M filters, since true cool companions should show deep water absorption features at 1.4 um. HST WFC3 is the only instrument in the world capable of observing reliably in both of these filters, since the bandpass of the F139M water filter is often unobservable from the ground due to telluric water absorption. Additionally, more than half of our sample is unobservable from the ground, due to the lack of suitable NGS AO guide stars or LGS AO tip-tilt stars.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12874
Program Title: Quasar accretion disks: is the standard model valid?

Principal Investigator: David Floyd
PI Institution: Monash University

Understanding quasar accretion is both at the frontier of new physics, and essential in understanding the driving force behind the great power of quasars and their energetic feedback onto their galactic environments. However, the accretion disks are at micro-to-nano arcsecond scales, unresolvable from Earth.
Gravitational microlensing of quasars (by stars in a foreground lensing galaxy) provides statistical information on the microarcsecond structure of the lensed quasar. By measuring the flux ratio in two of the lensed images and comparing to a lens models for the intervening galaxy, we can establish upper limits on the size of the emission region. The principle is now well-established, with variability (due to caustic-crossing events) and statistical modelling of the microlens population giving consistent results. Both techniques have shown tantalising evidence that the emission region does not fit the standard accretion disk model, being larger, and with flatter profiles (change of source size with wavelength), than expected.
However, existing studies have used ground-based data (in which separation of the quasar images from each other and from the host galaxy arc is difficult), and have been unable to probe the UV in detail. Existing multi-wavelength HST observations do not cover the UV and are split across multiple epochs, so it is impossible to eliminate variability as a cause of the observed changes in flux.
We propose contemporaneous medium-band WFC3/UVIS and broad-band WFC3/IR imaging of all known ``anomalous'' lensed quasars, in which the effects of variability are eliminated.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12875
Program Title: Resolving the Thermal Conduction Front in the Bubble S308

Principal Investigator: You-Hua Chu
PI Institution: University of Illinois at Urbana - Champaign

Heat conduction is one of the most fundamental processes in the interstellar and intergalactic media. Many astronomical systems contain cool (<10^4 K) gas in contact with hot (10^6 -10^8 K) gas; at the contact surfaces, heat conduction occurs and may play an essential role in the thermal structure and evolution of the system.

Observations of thermal conduction fronts have been extremely limited. Conventionally observations use absorption lines of collisionally ionized high ions as tracers of 1-3x10^5 K gas in the conduction front. Such observations allow the determination of column densities but not the relative locations of these tracer ions. Emission-line observations of a clear-cut, edge-on conduction front are needed to study the physical structure of a thermal conduction front.

We have identified a clean-cut, edge-on conduction front in the circumstellar bubble S308, using XMM-Newton X-ray observations and ground-based optical images and spectra. We request HST STIS spectroscopic observations of the NV and CVI emission lines in the transition region from the hot interior gas to the cool nebular shell, as well as WFC2 and ACS images to study mass-loading by nebular knots. These observations, combined with our complementary observations at optical and X-ray wavelength, allow us to determine the spatially-resolved temperature profile of a thermal conduction front. Comparisons with models further allow us to assess the efficiency of thermal conduction and mass-loading.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER
ID:	12876
Program Title:	Project WHIPS (Warm H2 In Protoplanetary Systems): Direct Measurement of Molecular Abundances in Circumstellar Disks
Principal Investigator:	Kevin France
PI Institution:	University of Colorado at Boulder

The composition and spatial distribution of molecular gas in the inner few AU of young (< 10 Myr) circumstellar disks are important components to our understanding of the formation and evolution of extrasolar planetary systems. Recent observations of these systems with HST-COS have vastly increased the number of disks with well-characterized ultraviolet H2 and CO spectra, and initial results suggest a CO/H2 ratio 3-to-4 orders of magnitude larger than expected from interstellar abundances. It is not clear from existing observations if this reflects the local CO/H2 abundance ratio or if these observations are sampling separate molecular populations. We propose Project WHIPS (Warm H2 in Protoplanetary Systems) to answer this question by using absorption line spectrosopy of H2 to directly probe a sightline through the warm molecular material in a sample of three disks with well-characterized CO absorption. This program takes advantage of the short-wavelength, medium-resolution capability of the newly commissioned COS G130M lam1222 mode to measure warm H2 absorption in circumstellar disks with Hubble for the first time.

Proposal Category:	GO
Scientific Category:	RESOLVED STELLAR POPULATIONS

ID: 12877

Program Title: Exposing the Maffei Group

Principal Investigator: Igor Karachentsev

PI Institution: Russian Academy of Sciences, Special Astrophysical Obs.

Accurate distances can be determined for nearby galaxies from the luminosities of stars at the Tip of the Red Giant Branch (TRGB). There is now detailed information on the distribution of galaxies within 4 Mpc at high Galactic latitudes. Radial velocities are known to a few km/s from HI observations and distance measurement with 6% accuracy permit the parsing of peculiar velocities from the cosmic expansion at the level of 15 km/s. Dynamic models of the region within 4 Mpc are becoming increasingly sophisticated with the result that our understanding of the distribution of matter is increasingly detailed. However there is a problem. The greatest tidal influence on the Local Group comes from the Maffei - IC342 complex at low Galactic latitudes and its members are heavily obscured. We need to know the distances and masses of the members of this complex in order to accurately reconstruct the orbital history and map the mass distribution of the Local Group. There has been limited success studying the Maffei region with observations shortward of 1 micron but accurate distances can be obtained with observations in the infrared. The TRGB is extremely bright in the infared and obscuration is not such a problem. Twelve candidates will be observed with WFC3/IR through the F110W and F160W filters, 3 important and heavily obscured objects requiring two orbits each and another 9 requiring only a single orbit per target. Parallel observations with ACS through the F814W and F606W filters will contribute to an accurate measurement of line-of-sight extinction. All the important members of the Maffei complex lacking accurate distances are included in the program.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12878

Program Title: The Near Edge of Infall into the Virgo Cluster

Principal Investigator: Igor Karachentsev

PI Institution: Russian Academy of Sciences, Special Astrophysical Obs.

Infall upon a gravitationally collapsed core displays a characteristic S-wave pattern in velocity as a function of distance to an external observer. Foreground galaxies have motions larger than Hubble flow as they fall away; background galaxies have motions smaller than Hubble flow as they fall forward. In the rest frame of the collapsed core there is a zero-velocity surface separating the domains of Hubble expansion and infall. The radius of this surface depends on the mass internal to the surface and on Omega_Lambda. The infall of galaxies into the Virgo Cluster can provide an interesting test: specifically, galaxies located near the line-of-sight to the cluster at the intersection with the foreground part of the zero-velocity surface. Here, the surface is anticipated to lie about 7 Mpc in front of the Virgo Cluster or about 10 Mpc away from us. Accurate distances can be determined to galaxies near this surface through observations of the Tip of the Red Giant Branch in the resolved stellar populations. An accurate mass can be determined for the region centered on the cluster interior to the targets. If there is an unexpectedly large amout of mass in an extended halo around the cluster then the zero velocity surface is expanded and the test galaxies will be closer to us than anticipated.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12879
Program Title: A 1% Measurement of the Distance Scale with Perpendicular Spatial Scanning

Principal Investigator: Adam Riess

PI Institution: Space Telescope Science Institute

We propose to measure the distance scale to 1% precision using a new capability of HST, thereby paving the way for a 1% measurement of the Hubble constant. Perpendicular spatial scanning with WFC3 can improve the precision of relative astrometry for parallax measurements by an order of magnitude over the previous best attained with point-and-stare imaging or by use of the Fine Guidance Sensor. We successfully demonstrated this capability with a Cycle 19 test program, measuring the position of bright Milky Way Cepheids to an unprecedented precision of 20 micro-arcseconds for optical sources. The leverage afforded by the technique can be used to extend the useful range of optical trigonometric parallax measurements to 1-3 kpc to collect a sample of long-period Cepheids, analogues of the Cepheids observable by HST in the nearest hosts of Type Ia supernovae. We propose to measure the distances to 11 Galactic Cepheids and obtain the photometry of these Cepheids on the same photometric system as distant Cepheids to eliminate zeropoint errors in the determination of H_0. Our program will establish a new technique to benefit a wide range of programs while advancing the investigation of unknowns in the present cosmological model by connecting the distance scale from the CMB to the present.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12880
Program Title: The Hubble Constant: Completing HST's Legacy with WFC3

Principal Investigator: Adam Riess

PI Institution: Space Telescope Science Institute

An independent measurement of the Hubble Constant with 1-2% precision offers enormous leverage for resolving outstanding cosmological investigations including the precise geometry of space, the properties of the elusive neutrinos, and the nature of dark energy. In past HST Cycles we constructed a refurbished distance ladder from high-quality light curves of Type Ia supernovae (SNe Ia), a geometric distance scale measured to 3% from masers in NGC

4258 and to 2.5% from HST FGS parallax measurements to 10 Milky Way Cepheids, and a uniform sample of Cepheids observed in the optical and infrared with WFC3 in NGC 4258 and in hosts of 8 recent SNe Ia. Our new ladder circumvents the dominant sources of past systematic error to measure the Hubble constant to 3.3% precision, tripling the prior precision. We now propose to measure the Hubble constant to 1.9% by attacking the largest unaddressed obstacle to its determination: the small number of high-quality SN~Ia hosts with HST Cepheid distances. We propose to observe Cepheids in a new sample of SN Ia hosts by using observing modes unique to WFC3, a white-light filter and wide IR field of view, to collect the data over 3 times faster than previous HST programs. We also will calibrate the Cepheid photometry observed in all SN hosts directly to those in the Milky Way whose parallax distances are being measured with GAIA or in our companion HST proposal. With Planck CMB data now in hand, this measurement will more than double the precision of the dark energy equation-of-state parameter, may reveal a new species of neutrino, and would complete HST's legacy in the measurement of the Hubble constant, a task for which it was built.

Proposal Category:	GO
Scientific Category:	EXTRA-SOLAR PLANETS
ID:	12881
Program Title:	Spanning the chasms: re-observing the transiting exoplanet HD 189733b

Principal Investigator:	Peter	McCullough
PI Institution:	Space Telescope Science Institute	

We propose to validate prior detections of molecular features in published spectra of the transiting hot gas giant HD 189733b. We will observe the planet in transit and in eclipse, with the G141 grism of WFC3, using the spatial scanning technique implemented by STScI and GSFC specifically for just this type of observation. Our proposed observations will resolve the controversy surrounding the chasm between the two leading interpretations of archival NICMOS data by spanning the chasms in existing NICMOS data and WFC3 data which had been intended to resolve that controversy.

Proposal Category:	GO
Scientific Category:	SOLAR SYSTEM
ID:	12882
Program Title:	Giant impacts on giant planets

Principal Investigator: Imke de Pater

PI Institution: University of California - Berkeley

The 2009 impact 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 impact flash detections and lightcurve measurements).

We propose a Target of Opportunity 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.

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: GO

Scientific Category: SOLAR SYSTEM

ID: 12883

Program Title: Unraveling electron acceleration mechanisms in Ganymede's space environment through N-S conjugate imagery of Jupiter's aurora

Principal Investigator: Denis Grodent

PI Institution: Universite de Liege

There is strong scientific interest in Ganymede (Jupiter’s third Galilean moon) and its surrounding environment, which stems from the likely presence of a liquid water ocean underneath its icy crust and from its internally driven magnetic field. The interaction of the latter with Jupiter’s magnetospheric plasma and its magnetic field gives rise to a unique situation in our solar system implying a mini-magnetosphere embedded within a giant-magnetosphere. This interaction generates Ganymede’s ultraviolet auroral footprint in Jupiter’s atmosphere. We propose to investigate the strong auroral connection between Jupiter and Ganymede and the variable characteristics of Ganymede’s magnetosphere with an innovative approach, taking advantage of the large scale north-south asymmetries of Jupiter’s magnetic field. The results obtained for Ganymede will be compared with the case of small injected hot plasma bubbles observed by the Galileo spacecraft and whose size and location are similar to those of Ganymede’s magnetosphere. HST is currently the sole instrument capable of obtaining this information which pins down the proposed mechanisms linking the source and sink regions of auroral particles in the giant planets’ magnetospheres.

Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 12884
Program Title: A Snapshot Survey of The Most Massive Clusters of Galaxies

Principal Investigator: Harald Ebeling
PI Institution: University of Hawaii

We propose the continuation of our highly successful ACS+WFC3 SNAPshot survey of a sample of 125 very X-ray luminous clusters in the redshift range 0.3-0.7, detected and compiled by the MACS cluster survey. As demonstrated by ACS/WFC3 SNAPshots of 63 MACS clusters obtained by us in previous Cycles (14 of them in all of F606W, F814W, F110W, and F140W), dedicated HST observations of the 12 most distant MACS clusters (GO-09722), and the CLASH MCT programme, these systems are highly efficient gravitational lenses as well as ideal targets for studies of galaxy evolution in dense environments.
Our primary science goals are a) the discovery of additional bright, giant arcs for resolved, in-depth, spectroscopic study with 8-10m telescopes, b) the selection of Distant Red Galaxies as well as z>6 galaxies as F814W dropouts, and c) the identification of extremely luminous but optically faint submm galaxies at z=2-5 detected in our Herschel/SPIRE observations of this sample. In addition, the proposed observations will d) provide important constraints on the mass distributions in these extreme systems, and e) improve our understanding of the physical nature of galaxy-galaxy and galaxy-gas interactions in cluster cores.
In recognition of the particular value of WFC3 images for our primary science goals (so far, only 21 WFC3/SNAPs have been executed), we stagger the proposed visits such that SNAPshots in the WFC3/F110W and F140W passbands will be executed first, followed by ACS observations in the F606W and F814W filters. The images thus obtained will build a dataset of legacy value for a wide range of extragalactic research topics. Acknowledging the broad community interest in this sample (16 of the 25 targets of the CLASH MCT cluster programme are MACS discoveries) we waive our data rights for these observations.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12885
Program Title: Kepler's SNR: A Type Ia Supernova from a Single Degenerate System?

Principal Investigator: Ravi Sankrit
PI Institution: Universities Space Research Association

Kepler's supernova remnant (SN1604) is now known to be the result of a Type Ia supernova explosion. The SN occurred in a region modified by the circumstellar material from the progenitor system, thus implying a likely single degenerate precursor. We request second epoch HST images of the remnant with WFC3 (first epoch was in 2003 with ACS) in order to (i) carry out a careful and accurate assessment of the proper motion of the primary blast wave and, with improved modeling of the primary shock velocity, constrain the distance to this important object, and (ii) perform a sensitive search for any possible surviving companion star to the SN progenitor that should still be present near the center of the remnant. Resolving the distance uncertainty is key to understanding the dynamics of the system and establishing an accurate explosion energy for the SN, thus putting Kepler in the context of other Type Ia SNe.

Constraining the precursor system by finding or placing stringent limits on a companion star could help answer one of the key outstanding questions about Type Ia SNe: how are they produced? Our second epoch observations will also allow us to measure the kinematics and brightness changes of the radiative knots and filaments, which arise from interactions between the blast wave and the densest portions of the circumstellar medium, and hence are tied to the evolution of the progenitor system. These changes can be seen to occur at ground-based resolution on a ~10 year timescale, but our first epoch data have shown that HST angular resolution is necessary to resolve the knot structures and complexes and accurately characterize these changes.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12886
Program Title:	Direct Detection of Escaping Lyman Continuum Emission from Local Lyman-Break Analog Galaxy
Principal Investigator:	Sanchayeeta Borthakur
PI Institution:	The Johns Hopkins University

Lyman continuum photons leaking out of massive star forming systems are believed to be the source of ionizing photons that led to reionization of the universe at z>6. However, our understanding of how these photons leaked from their parent galaxies is limited at best. Part of the problem is that the high-redshift galaxies are hard to study. Therefore, we have complied a sample of local galaxies that mimic star-forming Lyman-Break galaxies in every measurable way. We found that a class of these galaxies with Dominant Central Object (DCO) has much higher star-formation rates per unit volume and much faster outflows that can blow away and ionize interstellar medium, thus allowing a significant fraction of their Lyman continuum to escape. We request 9 orbits of HST to observe one such extremely rare galaxy with estimated escape fraction as high as 0.3. This value was estimated from three independent but indirect lines of evidence. These observations will provide the first direct evidence of leaking Lyman continuum emission in these systems. This will be a major step forward in understanding massive star forming systems and how ionizing radiation might have escaped at the epoch of reionization.

Proposal Category:	GO
Scientific Category:	SOLAR SYSTEM
ID:	12887
Program Title:	Precise Orbit Determination for New Horizons Candidate KBOs
Principal Investigator:	Susan Benecchi

PI Institution: Carnegie Institution of Washington

The New Horizons (NH) spacecraft is on its way to study the Pluto system during a flyby after which the spacecraft will be retargeted to one or more Kuiper Belt Objects (KBOs) to learn about small KBOs and the Kuiper Belt population. We are actively carrying out dedicated ground-based observations to identify a target for NH to flyby and continue to improve our analysis algorithms. So far we have identified a few candidate objects, but none have proven to be within an accessible distance for NH, our searches will continue in 2012 and 2013. Unfortunately, NH's trajectory line of site is within the galactic plane (Sagittarius) making stellar confusion a major problem in obtaining precise astrometry and high precision orbits for these objects from the ground. HST's sensitivity, resolution and PSF stability are crucial components for determining precise orbits for these candidates. We are requesting 6 TOO orbits to observe up to 3 KBOs (2 orbits per KBO) to be triggered in the event that candidate objects are found within the targetable region. The observations we propose will also determine if the NH candidate is binary (~30% probability per candidate) and will make a preliminary color determination to assist in target selection.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12888

Program Title: 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 recently as precise cosmological probes, resulting in the Nobel-recognized discovery of the accelerating Universe. They are clearly very important events deserving of intense study. Yet, even with over 5900 known 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 7 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, we have identified the possibly yellow supergiant progenitors of two likely Type II-Linear SNe. Also, one case indicates 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 and 17 we had great success with our approved ToO programs. We therefore propose to build on that success by determining the identities of the progenitors of 4 SNe within, generally, about 20 Mpc, which we expect to occur during Cycle 20, through ToO observations using WFC3/UVIS.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12889

Program Title: Accurate Cosmology from Gravitational Lens Time Delays

Principal Investigator: Sherry Suyu

PI Institution: University of California - Santa Barbara

Measuring cosmological parameters with a realistic account of the systematic errors is currently one of the principal challenges of physical cosmology. We have shown that a detailed analysis of the gravitational lens B1608+656, including systematic errors, measures the time-delay distance to 5% precision, corresponding to the Hubble constant (H0) to 7%. Combined with WMAP this yields flatness to 2% and the dark energy parameter w to 18%, comparable to BAO measurements. The results are made possible by deep HST/ACS images, showing the Einstein ring with high signal-to-noise ratio that allowed us to determine accurately the mass distribution of the deflector. We propose to extend our work to 4 additional lenses (1 archival) with exquisite time-delay measurements from the Cosmograil collaboration. New, deep WFC3/IR F160W images are needed for 3 systems to characterize fully their Einstein rings. With 5 systems in total, we will measure H0 to 3.8%, i.e., similar in precision to current distance-ladder results (3.3%). Combining these two independent measurements with upcoming Planck data yields 2.5% precision on H0, 0.5% on flatness and 13% on w. Furthermore, studying more lenses is the only way to test if unknown systematic errors are present in our approach. We will do this by performing blind analysis of each system and comparing the measurement scatter with estimated errors. With dozens of accurate time delays currently being measured by Cosmograil, the method has the potential to reach within 3 years 2% on H0 fully independent of the local ladder (and <0.3% on flatness). Eventually, PS1, DES, and LSST will discover hundreds of lenses, making 1% on H0 attainable.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12890

Program Title: The Unique Recurrent Nova T Pyxidis: The Decline and Transition to Quiescence

Principal Investigator: Edward Sion

PI Institution: Villanova University

The surprising April, 2011 explosion of the recurrent nova T Pyxidis, a potential Type Ia supernova progenitor, offers a unique opportunity to catch T Pyx on the decline and into quiescence where we expect to see the FUV continuum fade, emission lines weaken and the heated, bloated white dwarf (WD) continue to cool. Our three earlier STIS observations of T Pyx were centered on the outburst maximum, followed by a just awarded DDT proposal to obtain a single STIS and COS spectrum to cover the decline, until this standard Cycle 20 GO proposal. This will culminate in a complete and unprecedented cooling curve of the heated, bloated WD in the FUV, for the first time down to the Lyman Limit at high resolution, all the way from outburst into quiescence. Our hydrodynamic and synthetic spectral modeling of this unique spectroscopic dataset will enable us to measure the cooling rate, discriminate between the cooling of a massive (near Chandrasekhar mass) post-nova WD versus the cooling of a less massive WD, detail the accretion environment including if, and when, the accretion disk is re-formed, discover how much the WD was heated by the outburst, constrain the accretion rate, and possibly help explain why its latest nova outburst was delayed by 44 years. Virtually nothing is

known about the cooling behavior of the white dwarf in recurrent novae and classical novae so soon after outburst in the FUV with the necessary resolution.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12891
Program Title: Search For Binaries Among Ultra-Slow Rotating Trojans, Hildas, and Outer Main Belt Asteroids

Principal Investigator: Keith Noll
PI Institution: NASA Goddard Space Flight Center

Various models of giant planet migration predict that the small bodies currently in the Kuiper Belt, the Trojans and the Outer Main Asteroid Belt may have had a common origin in the protoplanetary disk between and beyond the forming giant planets. If so, they should share common physical characteristics including low density. Binaries offer the only practical way to determine density and we therefore propose a search for more, focusing on a search for equal-mass binaries that are the most common kind of binary found in the Kuiper Belt. We propose to search all of the known ultra-slow rotators in the Outer Main Belt and Trojan population with the expectation that some of these may be tidally locked binaries like the already known binary Trojan 617 Patroclus. The identification of more of this variety of binary would provide additional linkages between small body populations. The lack of any new binaries would require and constrain other evlutionary processes such as collisions.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12892
Program Title: Imaging the Host Galaxies of Low-Redshift Quasars with Associated Absorbers

Principal Investigator: Yue Shen
PI Institution: Smithsonian Institution Astrophysical Observatory

A few percent of quasars show strong narrow MgII associated absorption lines (AALs) lying close to the rest frame of the quasar. Recent results show that quasars with AALs (AALQSOs) have distinct host galaxy properties, with higher

star formation rate and more dust reddening than classical quasars, but less dust reddening than heavily dust-reddened quasars. These results suggest that the bulk of AALs are intrinsic to the quasar and its host galaxy, and AALQSOs may be the transitional population from dust-enshrouded to classical quasars in the Sanders & Mirabel picture of quasar evolution. This scenario predicts that AALQSO hosts should have a larger fraction of young bulges, disturbed morphologies and interactions compared with classical quasars. We propose to image a sample of 11 z~0.6 AALQSOs with WFC3 IR and UVIS to characterize their host galaxy properties and to test this evolutionary scenario. The host information will also help us constrain the nature of these associated absorbers. Confirming that AALQSOs represent a transitional population would be an important discovery, revealing the missing link between dust-enshrouded quasars and classical quasars, and justifying detailed studies of these associated absorbers to understand the physical conditions and formation processes of quasars and massive host galaxies.

Proposal Category: SNAP
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12893
Program Title: Study of Small and Cool Kepler Planet Candidates with High Resolution Imaging

Principal Investigator: Ronald Gilliland
PI Institution: The Pennsylvania State University

The Kepler Mission was launched three years ago. Well over 2000 planet candidates have now been published. Many of these have small radii, even sub-Earth. Many of the candidates have orbits sufficiently large to place the candidates in the Habitable Zone (HZ) where liquid water could exist. These two aspects together, small and cool, are still rare, but rapidly improving.The prime mission of Kepler is to detect true Earth analogs, i.e. Earth-size planets in year-long orbits of solar-like stars. Although we have not yet observed long enough to detect Earth analogs, there are now candidates orbiting K-M spectral type host stars that are nominally in the HZ. Current radial velocity precision does not come close to allowing the direct confirmation of Earth analogs, thus we must turn to other approaches to validate these Kepler discoveries. This program provides critical supporting information on the best (small planets, long periods, multiplicity of transiting objects) candidates that have already passed all of the validation steps available from the Kepler data, and for which HST imaging is demonstrably superior to ground-based AO. Imaging also enables reliable planet sizes by providing knowledge of diluting objects in the field. In particular these high resolution imaging observations directly address the difficult problem of thoroughly eliminating, or clearly identifying, false positives due to a blended background eclipsing binary along the line-of-sight as the source of apparent transits. These observations will allow us to validate many 10s of SuperEarth-sized and smaller planets, vastly increasing the number of confirmed small planets.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12894

Program Title: Methane migration on a Uranus-class planet: symmetric or seasonal?

Principal Investigator: Lawrence Sromovsky

PI Institution: University of Wisconsin - Madison

We propose 3 STIS orbits and one WFC3 orbit to obtain spatially resolved 300-1000 nm spectra of the ice giant Uranus, which will be used to determine (1) whether its northern high latitudes have the same methane depletion that has been inferred at high southern latitudes from similar 2002 observations, or whether it has a different depletion indicating seasonal forcing, (2) cloud and haze structure changes since 2002 (5 years before equinox), and (3) the current cloud structure at high northern latitudes that will be accessible during Cycle 20 (5 years after equinox). The complete lack of discrete cloud features pole-ward of 45 S correlates with the inferred local depletion of methane gas and raises questions about methane depletion at high northern latitudes where discrete cloud features have been recently observed. We propose to answer this question firmly by use of spectral differences in methane and hydrogen absorption near 825 nm. This will constrain the methane distribution over the latitude range from 25 S to 70 N, over which the cloud and haze distribution will also be tightly constrained by spectral limb darkening observations. The three STIS orbits will orient the spectral slit along Uranus' polar axis and step from the edge to the center of the disk, taking advantage of the zonal symmetry of Uranus to reduce total observing time by half. The orbit of WFC3 imaging over a broad range of wavelengths provides key information in support of complex corrections needed to produce well calibrated spectra. These results will be relevant to extra-solar science, as Uranus represents a size class that is the most abundant among Kepler extra-solar planet candidates.

Proposal Category: GO

Scientific Category: AGN/QUASARS

ID: 12895

Program Title: The Massive Black Hole in the MS0735 Brightest Cluster Galaxy

Principal Investigator: Brian McNamara

PI Institution: Smithsonian Institution Astrophysical Observatory

We propose to obtain STIS spectroscopy of the brightest cluster galaxy (BCG) in the MS0735.6+7421 cluster to measure the mass of its nuclear black hole. Recent studies have shown that nuclear black holes in BCGs may be more massive than expected based on the stellar velocity dispersion of the host galaxy. With the largest stellar core radius (3.8 kpc) and the most energetic (1E62 erg) AGN outburst known, the BCG in MS0735 is a strong candidate for harboring nuclear black hole mass exceeding 10 billion solar masses. The proposed spectra will be sensitive to black hole masses above ~7E9 solar masses, which is only 40% larger than scaling relations between black hole mass and bulge luminosity predict for MS0735. Our mass measurement will be sensitive to any significant upward departure from the mean scaling relations, and thus will place, at minimum, a significant constraint on the upper mass limit of black holes. Our program will likely yield the first dynamical evidence for an ultramassive black hole.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12896
Program Title: At the Turn of the Tide: WFC3/IR Imaging and Spectroscopy of Two Galaxy Clusters at z~2

Principal Investigator: Kim-Vy Tran
PI Institution: Texas A & M Research Foundation

We propose WFC3/IR imaging and grism spectroscopy of two newly discovered galaxy clusters at z~2, both of which are independently identified using Spitzer/IRAC colors and accurate photometric redshifts from medium-band near-infrared filters. Only with WFC/IR can we obtain the ~hundreds of spectra needed to separate both active and quiescent cluster galaxies from the field. We will combine the grism spectroscopy with our multi-wavelength data to measure redshifts for ~30 massive members and push down the luminosity function to L~0.3L* with an accuracy of sigma(z)/(1+z)=0.0034. The spectra also provide D4000 to measure stellar ages and oxygen emission to track star formation. The WFC3/IR imaging provides resolution of ~2 kpc to measure the physical properties of individual members and classify fainter members and their companions to H(160)~25.5. We will combine these WFC3/IR observations with public CANDELS and 3D-HST datasets of field galaxies to: (1) Compare the morphologies, sizes, stellar masses, luminosities, color maps, and star formation histories of cluster galaxies at z~2 to well-studied relations at lower redshift to determine how cluster galaxies evolve; (2) Compare to the field at z~2 to test for accelerated evolution in the clusters; (3) Measure the minor/major merger fraction to determine if cluster galaxies grow by accretion or in-situ star formation; and (4) Determine why cluster galaxies stop forming stars, i.e. via "mass-quenching" or "environment-quenching". We will effectively double our cluster sample at this pivotal epoch when members are transitioning from intensely star-forming systems to the passive galaxies that dominate local clusters.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12897
Program Title: Pluto System Orbits in Support of New Horizons

Principal Investigator: Marc Buie
PI Institution: Southwest Research Institute

We propose a sequence of observations that will significantly improve the orbit of P/2011 P1 and provide useful improvements to the orbits of other satellites in the Pluto system. The orbit determination work for the newest satellite discovery is critically needed so that New Horizons can know where to point its instruments at close approach. These data will also be useful for improved mass constraints on the outer satellites as well as refining our knowledge of the photometric properties of all objects in the Pluto system. In particular, lightcurve and color evolution will be monitored by these observations for use in constraining models of seasonal evolution on Pluto.

Proposal Category:	GO
Scientific Category:	COSMOLOGY
ID:	12898
Program Title:	Discovering the Dark Side of CDM Substructure
Principal Investigator:	Leon Koopmans
PI Institution:	Kapteyn Astronomical Institute

The existence of mass substructure is an inevitable consequence of the LCDM paradigm. Depite this clear theoretical prediction, a glaring discrepancy with the number of luminous satellites around the Milky Way (MW) has been identified, i.e. the "missing satellite problem". Notwithstanding great progress to address this problem, it remains unsolved. Moreover, the MW could be a biased environment, not representative of the typical universe.
Surface brightness aberrations of gravitationally lensed images provide a complementary channel to detect substructure beyond the local Universe in mostly massive early-type galaxies. Simulations suggest a substructure mass fraction of f_sub<=1% inside the inner projected 5-10 kpc or around 5-10% inside the virial radius. Although the observed (flux-ratio/brightness) anomalies/aberrations in lenses can be explained by the presence of this mass substructure, its high rate requires a larger inferred fraction of 2-3%.
To resolve these open issues convincingly, we propose to observe highly magnified Einstein rings/arcs in the ultra-violet, where the source is highly structured, to maximize sensitivity to dark substructures through surface brightness aberrations (i.e. the equivalent of the well-known flux-ratio anomalies).
Our simulations, modeling and statistical analyses show that our selected sample of 10 SLACS lens systems can pinpoint dark substructures down to 3x10^8 solar masses (~10^-4 of the ETG virial mass) and, for the first time, determine their mass fraction to down to f_sub~1%, at >99% CL.
We request 30 orbits with HST WFC3-F390W to accomplish this goal.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	12899
Program Title:	Emission line imaging of the bipolar shell in the Helium Nova V445 Puppis
Principal Investigator:	Danny Steeghs

PI Institution: The University of Warwick

Explosive detonations on the surfaces of accreting white dwarfs play a key role in establishing viable progenitor pathways towards Type Ia supernova explosions. If the white dwarf is accreting hydrogen deficient material, helium shell-flash driven eruptions can occur on its surface. Thus far only one such helium nova event has been observed in Nova Puppis 2000 = V445 Pup. We have discovered an expanding bipolar shell involving fast moving ejecta of He-rich material surrounding this binary. This used state of art ground-based AO imaging and IFU spectroscopy. However, we have now reached the limit of what can be done from the ground and therefore request high spatial resolution HST imaging of the ejecta in V445 Pup. We request 2 orbits in Cycle 20 split between three narrow band filters, followed by a repeat epoch two observing cycles later. These narrow band images will allow us to map the expanding ejecta in the [OII], [OIII] and HeI lines, to be directly compared with kinematical measurements based on the same lines. This will allow us to determine a robust distance using the expansion parallax method and study the ionisation structure of the shells and knots we have seen in our broadband AO images. Splitting the observations over two cycles is necessary in order to provide sufficient baseline to accurately measure the on-sky expansion which is estimated to proceed at an angular speed of 0.3"/year.

Proposal Category: GO

Scientific Category: SOLAR SYSTEM

ID: 12900

Program Title: Mapping the Methane and Aerosol Distributions within Titan's Troposphere: Complementing The Cassini/VIMS T90 Flyby of Titan

Principal Investigator: Eliot Young

PI Institution: Southwest Research Institute

Titan's atmosphere is mainly nitrogen gas with several trace constituents, including methane at the few percent level. The presence of methane has been a puzzle for decades, since the CH4 in Titan's atmosphere is expected to be destroyed by UV photolysis in ten million years or so. The source of Titan's atmospheric methane continues to be a major question.

We propose a set of three STIS image cubes with the G750M grating at 0.62, 0.72 and 0.89 μm methane bands. These bands probe altitudes from the surface to 70 km; unlike CH4 bands at 1.6 or 2.3 μm, these cubes will provide a 3-D picture of Titan's troposphere (below 40 km). The Cassini/VIMS visible channel has not been useful for this purpose for two reasons: its spectral resolution (about R=100) is coarse and its inconsistent background subtraction scheme that can lead to "stripes." HST/STIS resolves Titan's 1" disk into over 80 spatially resolved spectra, each with a spectral resolution greater than R=5000. STIS is a unique tool for mapping the 3-D distributions of CH4 and aerosols in Titan's troposphere.

We request observations within a day of the Cassini flyby of Titan on April 5, 2013 around 21:40 UT in order to combine Cassini/VIMS and STIS mage cubes. Together, the visible (STIS) and IR (VIMS) image cubes will probe altitudes from the surface to the stratosphere (several hundred km). The proposed STIS image cubes will provide the best tropospheric map of CH4 to date, relevant to surface/atmospheric coupling of CH4, latitudinal inhomogeneity of CH4 or aerosols, or the presence of condensates at low altitudes.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12901
Program Title: An Inventory of Gas in a Debris Disk: Far-UV Spectroscopy of 49 Ceti

Principal Investigator: Aki Roberge
PI Institution: NASA Goddard Space Flight Center

Debris disks stand between gas-rich protoplanetary disks and mature planetary systems, shedding light on the late stages of planetary system formation. Their dust component has been extensively studied, yet has provided little information about disk chemical composition. More information can be provided by their gas content, but astonishingly little is known about it. Only one debris disk has a fairly complete inventory of its gas, which is surprisingly carbon-rich (Beta Pictoris; Roberge et al. 2006). Basic questions remain unanswered. What are the typical gas-to-dust mass ratios in debris disks? What is the chemical composition of debris gas and its parent material? The answers to these questions have profound implications for terrestrial planet assembly and the origins of planetary atmospheres.

Most detections of debris gas were achieved with line-of-sight UV/optical absorption spectroscopy of edge-on disks, using the central star as the background source. This technique is far more sensitive to small amounts of gas than current emission line studies. The far-UV bandpass is particularly important, since strong transitions of abundant atomic, ionic, and molecular species lie there. We propose extending our intriguing studies of the Beta Pic gas with STIS far-UV spectroscopy of a highly promising debris disk system, 49 Ceti. This well-known disk is edge-on and contains CO gas (e.g. Hughes et al. 2008). We plan to measure column densities of the most important gas species (CI, CII, OI, CO, SiII, and FeII), find the relative elemental gas abundances, and determine the total gas mass using a powerful gas disk modeling code (ProDiMo; Woitke, Kamp, & Thi 2009).

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12902
Program Title: WFC3 Infrared Spectroscopic Parallel Survey WISP: A Survey of Star Formation Across Cosmic Time

Principal Investigator: Matthew Malkan
PI Institution: University of California - Los Angeles

Our WFC3 Infrared Spectroscopic Parallels (WISPs) have shown the power of slitless spectroscopy to probe galaxy evolution from 0.5<z<2. WISP is particularly sensitive to low-mass, metal-poor, galaxies with extreme star formation rates. These are missed by conventional continuum-selected surveys. The broad, continuous, spectral coverage of the G102 and G141 grisms (0.8--1.7 um) provides the best measurement of the de-reddened star formation rate, and the mass-metallicity relation, throughout this epoch, over which ground-based searches are severely limited.

We propose to extend this cost-effective WFC3 Survey by using 260 pure parallel orbits for grism spectroscopy in 30 deep (4-5 orbit) and 65 shallow (2 orbit) fields. This will complete a sample of 4000 galaxies with [OII], [OIII], Ha, Hb, or [SII] in the redshift desert. Our primary science goals are: (1) Derive the extinction-corrected Ha luminosity function, and the resulting cosmic history of star formation across 0.5<z<2. (2) Measure the mass-metallicity relation at z>1 to

low masses, with the support of our ongoing ground-based follow-up. (3) Examine the role of metal-poor dwarf galaxies in galaxy assembly. (4) Use the Balmer break and D4000 diagnostics to find and determine the ages of absorption-line galaxies down to J=25. (5) Search for rare objects such as Lya emitters at z>5.5, reddened AGN, close physical pairs of galaxies, and L- and T-dwarf stars (of which we have already found three).

The WISP value-added public data release is likely to be Hubble's principal legacy of 0.8--1.7 um spectroscopy.

Proposal Category: SNAP
Scientific Category: AGN/QUASARS
ID: 12903
Program Title: The Evolutionary Link Between Type 2 and Type 1 Quasars

Principal Investigator: Luis Ho

PI Institution: Carnegie Institution of Washington

The coevolution of central black holes and their host galaxies appears to be driven by starburst and AGN activity, and their respective energy feedback. Most models invoke gas-rich major mergers as the triggering mechanism for this process. Depending on the evolutionary state of the system, the AGN can be heavily obscured by dust and appear as a type 2 QSO, eventually evolving into an unobscured type 1 QSO that blows away the gas and dust. In an effort to test this popular scenario, we have been awarded a significant amount of Herschel time to measure the ISM (dust) content and star formation rates of two well-studied samples of low-redshift, luminous AGNs: the complete sample of 87 z < 0.5 Palomar-Green type 1 QSOs and a carefully matched sample of 88 type 2 QSOs selected from SDSS. Here we propose to conduct a WFC3 snapshot survey to provide the crucially missing data on the stellar properties of the host galaxies. We will obtain rest-frame images in the B and I bands to probe the young and old stars, respectively, with the observed filter combination carefully chosen to minimize contamination by strong nebular emission lines. We will apply 2-D fitting (with GALFIT) to rigorously characterize the morphologies, bulge properties, bulge-to-disk ratios, and integrated colors and color gradients of the hosts. We will quantify the frequency and strength of tidal interactions to constrain the merger hypothesis. Together with the Herschel data, the HST data will provide a fundamental dataset for testing the evolutionary link between type 1 and type 2 QSOs, and the broader relationship between black hole growth and galaxy formation.

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12904
Program Title: The Galactic Fountain Meets The Accreting Halo

Principal Investigator: Joel Bregman

PI Institution: University of Michigan

Galaxies grow by accretion of gas in addition to mergers, but the current accretion rate onto a typical spiral is uncertain

by at least an order of magnitude. Gas can accrete hot and we observe X-ray emitting gas extending several kpc above the plane around spirals. This may be a hot accretion mode, a galactic fountain, or a combination. These phenomena are best studied around edge-on galaxies, where there is unambiguous height information. A unique set of conditions exist around the nearby edge-on galaxy NGC 891, which not only has an HI map and X-ray halo extending 10 kpc from the disk, it has a bright background AGN projected 5 kpc above the disk. Metal halo absorption lines of Fe II and Mg II are seen against the AGN continuum, offering the promise of using metallicities to differentiate between fountain gas, with near-solar metallicities, and accreted gas with 0.1-0.3 solar metallicities. We cannot achieve those goals with these low resolution NUV STIS spectra, but the proposed COS observation will permit us to determine metallicities as a function of velocity through the rotating halo. Depletions onto grains will be inferred from elemental column density ratios. These observations will determine the relative importance of fountain vs accretion and will provide the most complete picture for the properties of a gaseous halo around a normal spiral galaxy.

Proposal Category:	GO
Scientific Category:	COSMOLOGY
ID:	12905
Program Title:	Unveiling the structure of the farthest galaxy protocluster: WFC3 imaging of a z~8 galaxy overdensity
Principal Investigator:	Michele Trenti
PI Institution:	University of Cambridge

Our pure-parallel WFC3/BoRG survey identified the highest redshift (z~8) protocluster candidate, presenting the unique opportunity for follow-up observations that will unveil the nature and properties of star formation at the earliest stages of galaxy cluster assembly. We found a rare overdensity of 5 Y-dropout galaxies, with m_AB=26-27, all brighter than m_*(z=8) and strongly clustered in a region of about 1 arcmin diameter (~2 Mpc/h comoving). The existing data establish at 99.9% confidence that the overdensity is physical and not a line-of-sight effect, but only show a glimpse of the protocluster structure and properties. Not only is the protocluster center near the edge of the imaged field but theoretical modeling predicts the presence of dozens of fainter galaxies. We propose follow-up multi-band WFC3 observations centered on the protocluster and reaching m_AB=27.5 to image the only known galaxy overdensity at z>7, missing in legacy surveys such as CANDELS because of cosmic variance. From the new dataset we will detect 5 -10 new protocluster members, tighten redshift uncertainty to +/-0.1, and double the S/N of current detections to characterize their stellar population properties. The new data, combined with, and compared to detailed numerical and theoretical modeling will characterize the earliest stages of galaxy and cluster formation, shedding light on the processes that drove cosmic reionization in overdense environments. Because of a one order of magnitude boost in the number density of galaxies with m_AB<m_* in the protocluster region, the proposed observations will create the best legacy pointing for follow-up spectroscopy at z~8 with multi-object instruments.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER

ID: 12906

Program Title: Chemical composition of an exo-planetary debris disk

Principal Investigator: Klaus Werner

PI Institution: University of Tuebingen

In the recent years, four white dwarfs with gaseous planetary debris disk were discovered. It is thought that they were created by tidally disrupted planetary bodies. This offers the unique possibility to determine directly the composition of exo-planetary material by spectroscopic means. However, only very few bright emission lines from the optically thin gas disk are detectable because the white dwarf´s photospheric flux in the near-IR to UV spectral band is rather strong. Here we propose to perform far-UV observations of one of these WDs shortward of 115 nm where the WD flux is effectively blocked by broad and deep photospheric hydrogen Lyman lines. We expect to detect disk emission lines from carbon and silicon. Together with optical and near-UV archival spectra that exhibit lines from Ca, Mg, and Fe, this enables us for the first time to determine the relative abundances of most of the abundant elements in the disk. In particular, we may decide whether the planetary debris was formed from chondritic or bulk-Earth like material.

Proposal Category: GO

Scientific Category: STAR FORMATION

ID: 12907

Program Title: Stationary components in the DG Tau jet: A new challenge for jet models?

Principal Investigator: Peter Schneider

PI Institution: Universitat Hamburg, Hamburger Sternwarte

Jets from young stellar objects play an important role for star formation as they can regulate the angular momentum balance of the system. The jet from the classical T Tauri star DG Tau stands out due to its stationary very high temperature plasma (T>10^6 K) very close to the driving source observed in deep multi-epoch X-ray observations. This X-ray emitting jet material is significantly hotter than previously studied material and not predicted by current jet theories.

Our HST observations during Cycle 18 reveal intermediate temperature FUV C IV emission (T~10^5 K) co-spatial with the X-rays and indications for a further stationary low temperature component (T~10^4 K). In order to investigate the nature of the stationary component(s), we propose to obtain new epoch STIS long-slit spectra with the slit oriented along the jet axis. By studying the evolution of the individual emission components we will determine if C IV and X-ray emission are physically connected and constrain their respective heating processes. We will also test if further stationary components exist in addition to the known moving emission regions which result from episodic mass-loss events.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12908
Program Title: What Causes Extended Main Sequence Turn-offs in Intermediate-Age Star Clusters?

Principal Investigator: Paul Goudfrooij
PI Institution: Space Telescope Science Institute

Recently, deep images from the ACS camera aboard HST provided conclusive evidence that several massive intermediate-age star clusters in the Magellanic Clouds present extended main-sequence turn-off regions (eMSTOs), and in some cases also dual red clumps. These observations challenge the notion that star clusters are simple stellar populations, and pose serious questions regarding the mechanisms responsible for star cluster formation. We propose to collect HST imaging that should lead to an understanding of the nature of the eMSTO phenomenon. We will perform deep WFC3 imaging in F438W and F814W for 3 Magellanic Cloud star clusters whose ages and dynamical properties (mass, radius) will allow a critical study of the physical conditions that cause the eMSTO phenomenon. The data will allow us to derive detailed star formation histories via CMD reconstruction methods. The underlying field population will be characterized by means of ACS images of nearby areas obtained in parallel. Without high-quality HST imaging data for these three pivotal clusters, the discussion regarding the onset of multiple stellar populations in star clusters may persist for years.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12909
Program Title: WFC3 Micro-arcsecond astrometry of the possible SNIa progenitor BPM 71214

Principal Investigator: John Debes
PI Institution: Space Telescope Science Institute

We propose to use the newly commissioned scanning mode on WFC3 to obtain astrometric measurements of the ~0.008 AU WD/M dwarf binary BPM 71214. This system is a fascinating mystery for post-common envelope binary evolution and may be a SN1a progenitor. COS spectra of the WD in the system shows that it is rapidly rotating with a vsin i of 200 km/s, implying that it has already accreted significant mass from its companion, but mass transfer has

since stopped. The COS spectra imply a near Chandrasekar mass for the WD, while optical spectroscopy suggests a mass of 0.8 M_Sun. We propose to take four orbits of WFC3 observations in scanning mode to obtain astrometric measurements of this system at a per-measurement precision of ~30~micro-arcseconds. Such measurements will definitively constrain the mass of the WD and fully solve for both masses in the binary.

Proposal Category:	GO
Scientific Category:	SOLAR SYSTEM
ID:	12910
Program Title:	A pure parallel survey of the colors of small trans-Neptunian objects to constrain the collisional history of the Outer Solar System
Principal Investigator:	Cesar Fuentes
PI Institution:	Northern Arizona University

We propose to use 150 Pure Parallel ACS/WFC orbits within 5 degrees of the ecliptic to search for faint (R>25) trans-Neptunian objects (TNOs). Based on our prior experience we expect to discover 50 faint TNOs, 24 of which will be members of the dynamically isolated cold classical subpopulation. We predict, based on theory and preliminary observational evidence, that cold classical TNOs that are smaller than the location of the observed break in the size distribution should be significantly bluer than large cold classical TNOs due to ongoing collisional evolution of those small bodies. We will obtain V-I colors for all detected TNOs, allowing a statistically significant test of the hypothesized color difference for small cold classicals. If smaller cold classicals exhibit bluer colors than large cold classicals then the nature of the break in the size distribution is collisional. On the contrary, if the small cold classicals are as red as their larger counterparts then the break instead is most likely primordial and a product of the environment in which these objects formed. We have extensive experience detecting faint TNOs in HST data. This well-posed experiment will offer for the first time direct observational evidence about the broad collisional history of the outer Solar System and is only possible with HST.

Proposal Category:	GO
Scientific Category:	RESOLVED STELLAR POPULATIONS
ID:	12911
Program Title:	A search for binaries with massive companions in the core of the closest globular cluster M4

Principal Investigator: Luigi Bedin

PI Institution: Osservatorio Astronomico di Padova

We propose to constrain the number of binaries with massive companions (black holes, neutron stars, or white dwarfs) in the core of M4 by measuring the "wobble" of the bright (main-sequence) companion around the center of mass of the pair. The wobble will be measured by leveraging the high-precision spatial resolution of WFC3/UVIS with our expertise in high-accuracy astrometry on HST images.

We will constrain the total number of binaries with massive companions and periods between 0.5 months < P < ~15 years. Mass segregation predicts these binaries should be strongly concentrated in the core and we will measure their radial distribution. Moreover, as a by-product, we can identify and measure the mass of a central black hole, if this cluster happens to host one. This proposal will complement other ongoing investigations on the binary population in M4, and will allow us to construct a dynamical model of the cluster to help us understand why its core is not collapsed.

Stellar-mass black holes, neutron stars, and white dwarfs must form as a result of normal stellar evolution, and we have designed this program to leave no chance of failing to see their influence on their binary companions.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12912

Program Title: Imaging the Crab nebula when it is flaring in gamma-rays

Principal Investigator: Andrea De Luca

PI Institution: INAF, Instituto di Astrofisica Spaziale e Fisica, 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 in September 2010. In April 2011 a similar flare, lasting several days, made the nebula the brightest source in the gamma-ray sky. A critical reassessment of long term behavior of the Crab flux clearly showed that both Agile and Fermi had already detected similar events in October 2007 and February 2009, pointing to a recurrence time of once per year. A HST observing strategy must be set up to react promptly to any possible new brightening of the Crab in gamma rays. In September 2010 we requested a DD observation which was promptly accepted and carried out. However, the lack of a suitable reference image hampered our efforts to pinpoint the sites of possible variability inside the nebula. Thus, while now we ask 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 Fermi missions, we are also organizing a regular (monthly) monitoring of the source both in X-ray and optical through a joint Chandra-HST proposal.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12913
Program Title: The Peculiar Type Ia Supernova 2012Z: A Massive Star Progenitor?

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

Despite the tremendous importance of type Ia supernovae (SNe Ia), from their use as cosmological distance indicators to their contribution to the chemical enrichment of the Universe, we are still puzzled by the basic questions: what are their progenitor systems and how do they explode? Peculiar SNe Ia, objects that resemble normal SNe Ia spectroscopically, but lie off the one-parameter Phillips relationship the vast majority of SN Ia follow, play a useful role in answering these questions. By understanding what makes a small, but significant, fraction of SNe Ia different than their normal cousins, we may identify the key initial conditions and physical processes at work. Here we propose late-time HST WFC3/UVIS optical photometry of SN 2012Z, the most recent member of the peculiar SN 2002cx-like subclass of SNe Ia. We will compare our observations with extremely deep pre-explosion HST ACS images of the host galaxy NGC 1309, to test whether bright (M_I = -6) stars near the position of the SN are in fact coincident with it, testing a massive star progenitor hypothesis for this subclass of explosions, contrary to the most likely progenitor models for normal SNe Ia. We will also continue to follow the optical light curve of SN 2012Z to epochs later than any peculiar SNe Ia has been observed, in order to test signatures of explosion models for these objects.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12914
Program Title: Measuring the Milky Way Mass with the Proper Motion of Leo T

Principal Investigator: Tuan Do
PI Institution: University of California - Irvine

The Milky Way has long been used to study galaxy evolution and cosmology, but these studies are currently limited by the large uncertainty in its dark matter halo mass. The halo mass is poorly constrained mainly because it is difficult to find appropriate tracers of the potential at large Galacto-centric distances. Satellite galaxies are the best such tracers, and recent cosmological simulations have shown a well-defined relationship between a satellite's orbital energy -- which depends on halo mass -- and its infall time. The recently discovered dwarf galaxy Leo T is an optimal candidate for measuring the halo mass in two respects. It is the most distant of the MW satellites, providing a probe of the mass distribution at large scales. It is also the only MW dwarf spheroidal galaxy with any gas; this makes it very likely that Leo T is currently falling into to MW for the first time. We propose to measure the bulk proper motion of Leo T using

ACS/WFC in order to reconstruct its orbit. Using a well developed method of measuring the stellar proper motions with respect to an absolute reference frame composed of distant galaxies, we will be able to achieve a proper motion uncertainty of 0.03 mas/yr with a two year time baseline. Previous similar HST proper motion programs have shown that this precision is well within reach. A proper motion measurement of this precision, combined with the knowledge of Leo T's infall epoch, will allow for a determination of the mass of the MW within 400 kpc from the Galaxy, which is otherwise impossible. This knowledge will significantly reduce one of the largest uncertainties in interpreting the Milky Way in cosmological context.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12915
Program Title: PROPER MOTIONS OF ISOLATED MASSIVE STARS NEAR THE GALACTIC CENTER

Principal Investigator: Daniel Lennon

PI Institution: Space Telescope Science Institute - ESA

The Galactic Center is one of the most perplexing and unusual regions of the Galaxy. Not only is it home to the central massive black hole but it contains three very massive young star clusters within the central 30 pc; the Arches, Quintuplet and Central clusters. Furthermore, emission-line surveys have revealed the presence of what appears to be a diaspora of ~40 very massive isolated Wolf-Rayet-like stars scattered throughout the region, outside of these massive clusters. Their origin is currently unkown but the suspected causes include such diverse and exotic mechanisms as ejection by dynamical interaction within the massive clusters, ejection by supernovae events within those clusters old enough to have SN, ejection by interaction with the central black hole, stellar mergers in the field, and in situ star formation of isolated massive stars. These processes however should all leave clear and distinct dynamical signatures on their products.

We propose using WFC3/IR to conduct a survey of ~150 square arcminutes the Galactic Center region to measure relative proper motions to an accuracy of 10 km/s for stars with masses as low as a few solar masses (late B-type). Our objectives include determining which of the known isolated massive stars are runaways, estimating their probable places of origin, discovering less luminous runaways that are invisible to emission line surveys, characterizing the dynamical properties of runaway stars in all luminosty ranges, and searching for signs of tidally disrupted massive clusters. The survey will have lasting legacy value to those trying to unravel the physics of galactic centers and the environments around massive black holes.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12916
Program Title: Continuing a Successful Multiwavelength Campaign: Watching the AGN Outflow from Mrk 509 with COS

Principal Investigator: Gerard Kriss

PI Institution: Space Telescope Science Institute

Measuring variations in UV absorption lines is an important tool for determining the location, the mass, and the kinetic flux in outflows from active galaxies. Our team has been carrying out a highly successful multiwavelength campaign using XMM-Newton, Swift, INTEGRAL, Chandra, and HST to characterize the physical properties of the outflow from the Seyfert 1 galaxy Mrk 509. Here we propose to continue that campaign and obtain HST/COS spectra of Mrk 509 covering the main absorption lines in O VI, Ly alpha, Ly beta, Ly gamma, N V, Si IV, and C IV for comparison to previous observations obtained with COS, STIS, and FUSE. We will coordinate these observations with already scheduled Chandra HETG grating spectra in the fall of 2012. The high throughput of COS down to 1000 A allows us to observe several Lyman series lines for measuring accurate total H I column densities, as well as O VI. This gives a direct tie to our X-ray spectra for determining absolute abundances in the outflow. Our observations will sample intermediate-to-longer-term timescales for variations in the outflow, ranging from 3 years since our prior COS observations, to 12 years since the prior FUSE observations. These timescales will allow us to detect variations in more distant, lower density gas that may comprise more massive components of the outflow, and thus have greater cosmological influence on the host galaxy and its surroundings.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12917

Program Title: The FUV bow-shock nebula of PSR J0437-4715

Principal Investigator: Martin Durant

PI Institution: University of Florida

We serendipitously detected a small part of the bow-shock around PSR J0437-4715 in FUV, during our spectroscopic observations of this nearby pulsar. This pulsar is known to be accompanied by a prominent H-alpha bow-shock but, to our surprise, we have discovered its clear counterpart in the FUV image (Figure 1). We are not aware of any instance where both H-alpha and FUV emission are seen from a bow-shock outside the Solar system. The origin of the FUV emission is enigmatic, and the spatial structure of the FUV emission and its relative extent compared to the H-alpha bow are not yet known.

We wish to understand the origin of the FUV emission and use both H-alpha and FUV images to constrain the bow-shock physics and the local ISM properties. Using three long-pass filters in the FUV, we will probe the spatially resolved spectrum of the FUV emission and, at the same time, image most of the bow-shock with subarcsecond resolution. We will also obtain a contemporaneous, high-resolution H-alpha image. This, together with knowledge of the pulsar energetics, will allow us to model the emission mechanism and physical conditions throughout the bow-shock, a unique opportunity only available for this object and only using HST's FUV capabilities.

Proposal Category: GO

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12918

Program Title: Origin of UCDs in the Coma Cluster

Principal Investigator: Kristin Chiboucas

PI Institution: Gemini Observatory, Northern Operations

We propose to explore the nature and origin of ultra-compact dwarf galaxies through two passband imaging with the ACS/WFC of 6 fields in the Coma cluster core. This is part of an on-going ACS survey of the Coma cluster which was cut short by the ACS failure. The proposed 6 fields will provide contiguous coverage of the central core assuring legacy value of this treasury program while concurrently targeting regions expected to harbor large UCD populations where specific tests will help distinguish between different formation scenarios. Through the high spatial resolution of ACS we have successfully identified a population of UCDs in the Coma cluster, strongly concentrated around the central giants and along a narrow band through the core region. Based on the UCD properties, distribution, and similarities to the Coma cluster GC population in our current dataset, we find more evidence for UCDs originating as star clusters than as stripped nuclei from tidally disrupted dwarf ellipticals. However, other formation scenarios are not ruled out. The proposed observations fill in the principal axis of the core, targeting regions around 3 major galaxies, where we expect high concentrations of UCDs based on this previous work. With more complete coverage in the central core, we will establish whether GCs and UCDs maintain similar distributions and similarly higher densities around the 3 targeted galaxies, investigate previously noted color affiliations of UCDs with these host galaxies, and determine whether the number counts of UCDs are consistent with the bright tail of the GC luminosity function or the implied numbers of disrupted dwarfs with intracluster light measurements.

Proposal Category: GO

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12921

Program Title: Multiwavelength Spectroscopy of the Interstellar Medium: O and Ne Abundance ratio

Principal Investigator: Yangsen Yao

PI Institution: Eureka Scientific Inc.

The solar abundances have been referenced in studies of the interstellar and intergalactic media. But the recent downward revision of several light elements has broken the accordance of these abundances with helioseismological measurements. A much higher Ne/O abundance ratio may solve this problem. But due to the absence of the suitable photospheric lines of Ne, this scenario has not been tested observationally. The interstellar medium (ISM) provides a natural laboratory for testing such a hypothesis. We propose a joint program by requesting COS-HST and LETG-Chandra observations of the low mass X-ray binary 4U 0512-401. The required observations will utilize the high resolving power of the COS to resolve the kinematic velocity components of the ISM absorbers and to measure column densities of OI and HI, and then utilize LETG observations to measure column densities of OI, OII, NeI, NeII, and NeIII. The results will enable us to evaluate the depletion level of oxygen into dust grains, measure the Ne/O abundance ratio of the ISM along the line of sight, and then examine whether the ratio is substantially higher than that usually adopted.

Proposal Category:	GO
Scientific Category:	AGN/QUASARS
ID:	12922
Program Title:	Calibrating black hole mass estimators using the enlarged sample of reverberation-mapped AGNs
Principal Investigator:	Jong-Hak Woo
PI Institution:	Seoul National University

Accurate estimates of black hole masses are crucial to understanding the growth of black holes and the co- evolution of black holes and galaxies. Black hole masses can be determined in AGNs using the kinematics of the broad-line region based on the virial assumption. The velocity profiles of the Hbeta, Mg II, and CIV lines from single-epoch spectra are commonly used to infer the gas kinematics of low-z, mid-z, and high-z quasars, respectively. However, this method is well calibrated only in the local universe based on the Hbeta and Halpha lines, while high redshift results depend on the CIV- and Mg II-based mass estimators. Particularly, CIV results have been extensively debated, because of evidence for non-virial outflows and the effects of absorption. The best sample for calibrating single-epoch mass estimators is the set of reverberation-mapped AGNs with direct measurements of the BLR size, which provides a unique local baseline for determining the BLR size-luminosity relation and for calibrating UV mass estimators. We will test and calibrate single-epoch mass estimators, using the enlarged sample of reverberation-mapped AGNs by combining new data for 6 objects at M_BH < 10^7.5 M_sun, with archival data for 30 additional AGNs that have suitable previous UV observations. The enlarged sample provides an important new opportunity to better constrain and test the UV mass estimators by extending both the total sample size and the mass range over which the UV methods can be applied. We propose to obtain STIS UV and optical spectroscopy of 6 AGNs which currently lack high-quality UV spectra for measuring the C IV and Mg II line properties and UV continuum.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER
ID:	12923
Program Title:	Pointing the Finger: Calibrating the Hidden Features of STIS and Enabling New Coronagraphy at Separations of 0.15"
Principal Investigator:	Andras Gaspar
PI Institution:	University of Arizona

We propose a STIS calibration program to enable HST coronagraphy at its ultimate inner working angle (IWA) limit, with anticipated greater than previously possible contrast performance, well characterized at IWAs as small as 0.15", at optical wavelengths that cannot be broached from the ground even with AO augmented telescopes. Achieving such

small IWAs with high contrast will enable the pursuit of some of the most compelling questions in astrophysics today. Observations enabled by our calibrations will advance exoplanetary science by revealing the inner regions of circumstellar protoplanetary and debris disks, and detect and resolve close orbit substellar companions to nearby stars. Extragalactic studies of host galaxies of bright QSOs, damped Lyman alpha absorbers, and feedback mechanisms in the bulges of AGN can be pursued at distances closer to their hosts than ever before. The STIS occulting WEDGEA & B provide IWAs to only ~ 0.3" before aperture edge intrusion and cut-off. Our calibration program will mitigate this unintended deficiency unplanned in the STIS design to, for the first time on orbit, explore the "finger" occulter - unfortunately bent on the ground but quite likely still a functional, small IWA, focal plane occulter. We will also explore the BAR10 occulter corners, unused in this fashion on-orbit, to comparatively demonstrate the merits of both with new capabilities for optical coronagraphy. By carrying out this program in Cy 20, sufficient time will remain before intended HST end of mission to exploit this potentially unmatched capability in unexplored observational domains required for high contrast science and uniquely at visible light wavelengths.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12924
Program Title: Measuring the Wind Properties of a Galactic SN1987A analog with COS

Principal Investigator: Nathan Smith

PI Institution: University of Arizona

We propose to use COS to obtain an FUV spectrum of the B supergiant SBW1, in order to measure this star's wind speed and mass-loss rate. This star is of particular interest because it is surrounded by a ring nebula that closely resembles the triple-ring nebula around SN 1987A. The unusual nebula, combined with the luminosity and spectral type of the star, make SBW1 the closest known Galactic twin of the progenitor of SN 1987A. We recently obtained WFC3 images and STIS spectra of SBW1 that not only verify this close comparison with SN 1987A and elucidate some of the detailed structures in the nebula, but the new HST images also show additional features that we didn't expect. Namely, our HST images and ground-based mid-IR images from Gemini show evidence for a structure interior to the ring that appears to be the terminal shock of the wind interacting with a backflow from the ring. Such structures were predicted to exist around the SN 1987A progenitor based on models for the speed of the expanding blast wave, but they were never actually seen. The reason we want to measure the wind speed and mass-loss rate from the COS spectrum is so that we can test whether or not the terminal wind shock provides a suitable physical explanation for the structure seen in WFC3 and Gemini images. If so, it would significantly alter ideas about the formation of the SN 1987A rings, because it would mean that the B supergiant wind is actually not interacting directly with the outer ring nebula, as proposed based on some hydrodynamic models.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12925
Program Title: Splendid Isolation: Using DDO 210 to Benchmark Dwarf Galaxy Evolution

Principal Investigator: Andrew Cole

PI Institution: University of Tasmania

Dwarf galaxies are sensitive probes of galaxy formation theory because of their vulnerability to local and cosmic environmental effects. The star formation histories (SFH) of nearby galaxies can test the effects of post-reionization photoheating, supernova-driven outflows, and harassment. We are undertaking a study of the SFH, chemistry, structure, and dynamics of Local Group dwarf galaxies to inform the next generation of theory and simulations. This combines HST photometry, wide-field ground-based data, and spectra of individual stars from 8-10m class telescopes for isolated dwarf galaxies in the Local Group. Dwarf galaxies that have never interacted with either M31 or the Milky Way (MW) are a pristine environment in which to study the progress of galaxy evolution without external influences. Theory and observation suggest that star formation should be delayed in low-mass, low-metallicity galaxies that evolve in isolation; we propose to test that assertion using DDO 210. DDO 210 is the closest galaxy which can never have interacted with the MW or M31 and is thus a uniquely powerful testbed for models of dwarf galaxy evolution. We propose to photometer over 100,000 stars using ACS/WFC in order to measure its star formation rate vs. time with age resolution better than 15% over its entire lifetime. These observations will be combined with our Keck/DEIMOS spectra of red giant stars spanning the age of the galaxy to build a complete picture of its chemical and kinematic evolution. DDO 210 is the only galaxy that is both isolated and nearby enough to use in this way, as a link between deep studies of nearby galaxies and the ANGST survey of galaxies from 1.5-4 Mpc.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12926

Program Title: Local Thermonuclear Runaways in Dwarf Novae?

Principal Investigator: Michael Shara

PI Institution: American Museum of Natural History

We have no hope of understanding the structure and evolution of a class of astrophysical objects if we cannot identify the dominant energy source of those objects.The Disk Instability Model (DIM) postulates that Dwarf Nova (DN) outbursts are powered by runaway accretion from an accretion disk onto a White Dwarf (WD) in a red dwarf-WD mass transferring binary. Ominously, HST observations (e.g. Sion et al. 2001) of WD surface abundances hint at a significant shortcoming of the DIM. The data from the present proposal will be able to unequivocally demonstrate if the observed highly Carbon-depleted and Nitrogen-enhanced abundances on WD surfaces (NOT predicted by DIM) vary with binary orbital phase, or throughout a DN quiescence cycle, or from cycle to cycle. These same data will test if predicted (but never observed) Local Thermonuclear Runaways ("Nuclear-powered mini-novas") occur on the WDs of DN. Such events could trigger or even power DN, providing the long-sought physical mechanism of DN eruptions that DIM lacks. As a "free" bonus, the same data may also directly detect the diffusion of accreted metals in a WD atmosphere for the first time, or provide significant limits on the diffusion rate.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12927
Program Title: The role of the environment in the growth of compact red galaxies at z~2

Principal Investigator: Andrew Newman
PI Institution: California Institute of Technology

Many observations now indicate that the progenitors of today's massive galaxies are very compact at high redshift and that they must have experienced significant growth in size over the past 11 Gyr. Remarkably, the rate of growth appears to increase toward z~2, posing a challenge for physical mechanisms proposed to account for this assembly. Environmental trends can discriminate between growth mechanisms that are sensitive to local density (galaxy mergers) and those that are not (secular processes). While the size evolution of field galaxies is probed adequately in exisiting HST field surveys, these do not sample the densest environments. We propose WFC3 imaging and grism spectroscopy of the z~2 evolved galaxy cluster JKCS041, detected as a strong overdensity of red galaxies that present a tight red sequence. This is among the most distant clusters known and is seen at an epoch when the growth of massive galaxies appears quite rapid. Uniquely among the few known clusters at z > 1.5, JKCS041 exhibits an intracluster medium unambiguously detected in extended X-ray emission by Chandra. The goals of this proposal are (1) to confirm the cluster membership of red galaxies, (2) to measure the structral properties of these members in order to establish whether growth is accelerated in cluster environments at z~2, and if so, whether this is likely due to enhanced merging, (3) to determine the stellar ages, masses, and star-formation activity of cluster galaxies seen at a lookback time of 10 Gyr to constrain the effect of environment in quenching star formation in the early universe.

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12928
Program Title: Gaseous outflows from low mass galaxies: Understanding local laboratories for high redshift star formation

Principal Investigator: Alaina Henry
PI Institution: University of California - Santa Barbara

The evolution of galaxies and the intergalactic medium is undoubtedly affected by starburst-driven outflows. These galactic winds are responsible for regulating the growth of galaxies, as well as enriching the intergalactic medium with metals. To date, our understanding of outflows at early cosmic times is based strictly on features in the ultraviolet spectra of galaxies. For these high redshift objects, detailed analyses are often hampered by extreme distances. Therefore, we propose COS spectroscopy of a sample of nine local dwarf starburst galaxies. These objects, selected from their high equivalent width nebular line emission in the SDSS (i.e. the "Green Peas"), are some of the most active star-forming dwarfs in the local universe. With lower masses and metallicities than other nearby starbursts, these

galaxies may represent the best high redshift analogs that can be found locally. The proposed observations will measure galactic winds and mass loss, and determine how the outflows scale with other galaxy properties. Furthermore, COS spectroscopy will constrain the dust content and elemental abundances in the ISM, as well as the covering fraction of the outflowing gas and its role in regulating the escape of Lyman alpha and hydrogen-ionizing photons. By comparing these observations to higher redshift samples, we will clarify the relation between these local analogs and their high redshift counterparts. These data will provide a lasting legacy for HST and COS, as existing samples of local high redshift analogs with quality UV spectra remain small.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12929
Program Title: COS Observations of Pulsating DB White Dwarfs

Principal Investigator: Judith Provencal
PI Institution: University of Delaware

Convection is an important energy transfer process for most stars. Yet convection is poorly understood, and remains one of the largest sources of theoretical uncertainty in stellar modeling. Pulsating white dwarfs are the ideal laboratories to provide to a self consistent description of convection in different environments. We can combine asteroseismology with nonlinear analysis of pulsating white dwarf light curves to provide empirical descriptions of convection across the hydrogen and helium instability strips. However, our ability to interprete the convection turnover timescale and its dependence on effective temperature across the helium white dwarf instability strip is severely limited by the large errors associated with optical spectroscopic temperature determinations for these objects. Our proposed COS observations of pulsating DB white dwarfs will determine the slope of their energy distributions and determine the presence of trace abundances of H, C, O, and Si, leading to greatly improved effective temperature determinations for these stars.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12930
Program Title: WISE Discovered Ly-alpha Blobs at High-z: The missing link?

Principal Investigator: Carrie Bridge

PI Institution: California Institute of Technology

Using data from the NASA Wide-field Infrared Survey Explorer (WISE) mission coupled with deep optical spectroscopy, we have discovered a new population of z>2 dusty Lyman-alpha emitters (LAEs) a third of which are Lyman-alpha ``blobs'' (LABs;>50kpc). These systems are among the most ultra-luminous galaxies at mid-IR wavelengths in the Universe - too rare and distant to have been discovered in previous IR surveys. They have unusually hot mid-/far-infrared colors, are radio quiet, and are almost certain to contain AGN growing at their maximal rates, and therefore experiencing intense feedback effects. The combination of spatially extended Ly-alpha (20-50 times the size of the galaxy), large amounts of dust, and extreme IR luminousities suggest we are catching the key transition from a dusty starburst to a quasar (QSO). These unique properties, make them strong candidates for being one of the ``missing links'' in the evolution of massive ellipticals.

We propose WFC3/F160W (rest-optical) observations of the complete sample of WISE Lyman-alpha blobs (21) to characterize their morphologies, physical sizes, environments, stellar populations, and power source. Related and well-established populations (i.e sub-mm galaxies, QSOs, Lyman break galaxies, and optically selected Lyman-alpha blobs) already have extensive HST observations, and as such provide excellent comparison samples.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12931

Program Title: Ultra-Faint Galaxies at the Peak Epoch of Star Formation

Principal Investigator: Brian Siana

PI Institution: University of California - Riverside

There has been much recent interest in the ultra-faint galaxies that are near or beyond our current detection limits at z>1. These galaxies are likely responsible for reionizing the intergalactic medium and make up a significant fraction of the global star formation rate density. Unfortunately, we can not study them in detail as they are too faint (27 < V < 30) for morphological studies or follow-up spectroscopy. With previous UVIS F275W imaging, we have demonstrated that we can efficiently select ultra-faint galaxies at z~2 by using magnification from strong gravitational lensing by the massive cluster Abell 1689. This unique cluster offers the largest area with high magnifications (1.5-4 magnitudes). We selected 81 galaxies at 1.7<z<2.3 behind Abell 1689, extending the previous luminosity function a factor of 100x fainter.
We propose to extend this study to a much broader redshift range. 10 orbits of F225W and 16 orbits of F336W imaging will allow identification of 50-100 ultra-faint star-forming (SFR < 0.1 M_sol/yr) galaxies at each of the two target redshifts, 1<z<1.7 and 2.3<z<3.0, respectively. The high magnification of these samples enables ultra-high resolution (<100 pc) morphologies as well as rest-frame UV and optical spectroscopy from the ground.
We will extend the measurement of the faint-end of the UV luminosity function 30-100x fainter than before and measure the evolution of the faint-end slope from 1<z<3, allowing the ultimate determination of the global star formation rate density at the epoch of peak star formation. Finally, we will measure the Lyman continuum escape fraction in these galaxies that are analogous to those that reionized the universe.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12932
Program Title: COSMIC-LAB: Hunting for optical companions to binary MSPs in Globular Clusters

Principal Investigator: Francesco Ferraro
PI Institution: Universita di Bologna

As part of the project "Cosmic-Lab" aimed at using globular clusters (GCs) as natural laboratories to study dynamics and stellar evolution, here we present a proposal focussed on binary Millisecond Pulsars (MSPs). While the link between these objects and GC dynamics is firmly established, much needs to be still understood in terms of both the details of such a connection and the MSP evolutionary paths. This is mainly because only 7 optical counterparts to binary MSP companions are known to date in GCs. Noteworthy, 4 out of these 7 objects have been discovered by our group, thanks to our large experience in high-precision stellar photometry, spectroscopy and astrometry in crowded stellar fields, and our very efficient collaboration with the major groups leading extensive MSP search in the radio bands.

Here we propose to further pursue this prolific route by exploiting the ACS and WFC3 imaging capabilities in order to search for 3 new companions to binary MSPs in two GCs (namely NGC6838 and NGC6544). The selected targets present the double advantage of already showing promising candidate counterparts in archive ACS images and sampling three different stages of the MSP evolution. We also propose phase resolved spectroscopy with STIS to measure the radial velocity curve of COM-M28H, recently discovered by our group. This will allow the full characterization of the system, yielding the direct determination of the pulsar mass (that in MSPs is expected to be significantly larger than the canonical 1.4 Msun, due to heavy mass accretion during the recycling process).

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12933
Program Title: COSMIC-LAB: unveling the true nature of Terzan 5, a pristine fragment of the Galactic bulge

Principal Investigator: Francesco Ferraro
PI Institution: Universita di Bologna

We have discovered that Terzan5, a stellar system in the Galactic bulge, harbors two stellar populations with different iron content (Delta[Fe/H]~0.5 dex) and possibly different ages (Ferraro et al. 2009, Nature 462, 483). Moreover, the observed chemical patterns (Origlia et al. 2011, ApJ 726, L20) significantly differ from those observed in any known genuine GC. These evidences demonstrate that, similarly to omega Centauri in the halo, Terzan5 is NOT a genuine globular cluster (GC), but a stellar system that was able to retain the gas ejected by violent supernova (SN) explosions.

Indeed the striking chemical similarity with the bulge stars suggests that Terzan5 and the Galactic bulge shared the same star formation and chemical enrichment processes, driven by an exceptional amount of SNeII explosions (this is also the key to understand the origin of the extraordinary population of millisecond pulsars in Terzan5). A quite intriguing scenario is emerging from these observations: Terzan5 could be the relic of one of the massive clumps that

contributed (through strong dynamical interactions with other pre-formed and internally-evolved sub-structures) to the formation of the Galactic bulge.

Here we propose to use the WFC3 to accurately measure the age of the two populations directly from the main sequence turn-off luminosities. Precisely dating the first and second burst of star formation is a crucial step for the correct reconstruction of the evolutionary history of Terzan5, with a significant impact on our comprehension of the formation processes of the Milky Way bulge and, more in general, of galactic spheroids.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12934
Program Title: The importance warm outflows in the most rapidly evolving galaxies in the local Universe

Principal Investigator: Clive Tadhunter
PI Institution: University of Sheffield

Although there is increasing speculation that the evolution of galaxy bulges may be regulated by AGN-induced outflows associated with the growth of the central supermassive black holes, the importance of AGN-induced outflows relative to those driven by starbursts has yet to be established observationally. Therefore we propose to use the unique capabilities of ACS/WFC and STIS on board HST to measure the spatial scales, structures and velocity gradients of the emission line outflows in a complete sample of nearby ULIRGs with optically-detected AGN. Combined with information derived from existing ground-based spectra, the HST data will be used to quantify the mass outflow rates and kinetic powers of the warm outflows for the first time in a significant sample of nearby ULIRGs. In this way we will establish whether the warm, AGN-driven outflows are energetically important and a major factor in the evolution of the host galaxies. Given that the ULIRGs represent low redshift analogues of the rapidly evolving galaxies now routinely detected in surveys of the distant Universe, the results will be important for our understanding of the co-evolution of supermassive black holes and their host galaxies at all redshifts. Only the HST is capable of the high spatial resolution required for this project at optical wavelengths.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12935
Program Title: Witnessing the Expansion of Hydrogen-Poor Ejecta in Born-Again Planetary Nebulae

Principal Investigator: Martin Guerrero
PI Institution: Instituto de Astrofisica de Andalucia (IAA)

Abell 30 and Abell 78 are ``born-again'' planetary nebulae whose central stars have experienced a very late thermal

pulse. This event led to the ejection of hydrogen-poor material some 1000 yr ago. This ejecta is being photo-evaporated and swept up and accelerated by a newly developed fast stellar wind. We have used archival HST F502N ([O III]) and F555W images to detect the expansion of the ejecta knots in Abell 30. We request new WFC3/UVIS [O III] images of Abell 30 and Abell 78 to be compared with WFPC2 [O III] images taken in the mid 90's. The comparison will allow us to determine the expansion rate and geometry of the hydrogen-poor ejecta, estimate the time since the born-again event, and study the interaction of fast stellar winds with material photo-evaporated from the hydrogen-poor knots.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12936
Program Title: The Physical and Dynamical Properties of Gas that Molds the Fermi Bubbles

Principal Investigator: Edward Jenkins
PI Institution: Princeton University

Two sharply defined lobes of gamma-ray emission emerging from the center of our Galaxy, called the Fermi Bubbles, have been discovered in the Galactic halo. Their emissivity appears to be uniform and extends up to 8 kpc on either side of the plane. Accompanying the Fermi Bubbles are excess emissions seen in X-rays and microwaves. It is generally believed that cosmic ray particles emitted from the central portion of the Galactic disk (or perhaps the nucleus itself) are responsible for these emissions. These particles must have been advected into the halo by a wind or shock. Our goal is to gain a better understanding of the nature of this gaseous transport by viewing the UV spectra of bright, extragalactic sources behind one of the Fermi Bubbles and its surrounding regions. We plan to obtain COS spectra of 6 such objects, with the goal of measuring absorption features from Si III, Si IV, C IV and N V. We expect that our mapping of column densities and kinematics of the gases will help us to distinguish a shock from a wind. Moreover, if a shock is present, we should be able to evaluate the product of its age and the density of the gas by comparing the column densities of different species.

Proposal Category: GO
Scientific Category: HOT STARS

ID: 12937

Program Title: Direct Confirmation of Intracluster Stars as SN Ia Progenitors

Principal Investigator: Dennis Zaritsky

PI Institution: University of Arizona

To help resolve the progenitor problem for Type Ia supernovae (SNe Ia) and ensure their dependability as cosmological standard candles, we seek direct confirmation that SNe Ia explode in >2 Gyr old stellar populations. The Multi-Epoch Nearby Cluster Survey (MENeaCS) monitored 60 low redshift, rich galaxy clusters for two years, and spectroscopically confirmed four apparently hostless cluster SNe Ia. The intracluster medium hosts a purer population of old stars than elliptical galaxies, which have been shown to often harbor low levels of star formation. We propose to obtain deep HST images at the locations of these four SNe Ia (now faded), to confirm that they are truly associated with the population of intracluster stars, and not hosted by a faint cluster galaxy or globular cluster. This proposal will also provide the necessary support for the use of IC SNe -- as bright representatives of IC stars -- in determining the fraction of IC stellar mass and light, which has low surface brightness and is difficult to measure directly. The required observations are only possible with HST, which has both the necessary resolution to limit contamination from background sources, and the sensitivity to detect or rule out the presence of a faint cluster galaxy or globular cluster at the SNe Ia locations.

Proposal Category: GO

Scientific Category: COOL STARS

ID: 12938

Program Title: Probing Fundamental Stellar Parameters with HST/STIS Spectroscopy of M Dwarf Binaries

Principal Investigator: Sergio Dieterich

PI Institution: Georgia State University Research Foundation

We propose to obtain spatially resolved intermediate resolution HST/STIS spectra of six M dwarf binaries ranging in spectral type from M2V to M8V and in mass from 0.40 to 0.074 Solar Masses. All binaries have previously had their orbits mapped by HST/FGS, leading to individual dynamical masses with a precision < 5%. The last fifteen years have seen the development of sophisticated theoretical models for the interior structure, evolution, and atmospheric properties of low mass stars. These models have thus far been difficult to test in a holistic manner due to the complex interplay of the variables effective temperature, mass, age, surface gravity, and metallicity. Fortunately these parameters are now measurable directly via comparisons with synthetically generated spectra, as has been successfully demonstrated by various studies. By assuming co-evolution and equal metallicity for the components of a binary system with known masses, we will be able to test model spectra and constrain the modeling of fundamental structural, evolutionary, and atmospheric parameters throughout most of the M dwarf spectral class. The proposed observations are part of the PI's thesis effort to better characterize M dwarfs and objects near the hydrogen burning mass limit.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12939
Program Title: Hubble Tarantula Treasury Project (HTTP: unraveling Tarantula's web)

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

The Tarantula Nebula is the nearest and only starburst that can be studied down to the sub-solar mass regime (<0.5Mo), and thus it offers us the rare opportunity to investigate the process of star formation in an environment that resembles in metallicity, dust content, and star formation rate, the extreme conditions of the early universe. Its importance to astronomy is reflected in the fact that it has been subject to large-scale multi-wavelength studies from the other Great Observatories. However less than 10% of the region has been studied with HST. With HTTP we will take advantage of the full power of HST using ACS and WFC3 in parallel to study this unique object over its entire extent (~200x200 pc) in the near-UV (F275W and F336W), optical (F435W and F658N) and near-IR (F110W and F160W), building on an existing HST monochromatic (F775W) proper-motion survey. By dissecting its stellar populations and inferring an accurate description of its anatomy, we will reconstruct for the first time the temporal evolution of a prototypical starburst on a <2 pc scale. This study will serve as a touchstone for all future work on the Tarantula Nebula in particular, and on starbursts in general. We will deliver a unified star catalog for all the filters, accompanied by artificial-star tests to quantify completeness and crowding effects. Co-registered stacked images in all filters, maps for the differential reddening and ages and a catalog with the properties of all the star clusters and stellar associations will also be released in a timely fashion. As a treasury survey HTTP will become the definitive catalog of the field, and have lasting value for future studies with ALMA and JWST.

Proposal Category: SNAP
Scientific Category: HOT STARS
ID: 12940
Program Title: The Unevolved Massive Star Content of the Magellanic Clouds

Principal Investigator: Philip Massey
PI Institution: Lowell Observatory

The Magellanic Clouds offer a unique astrophysical laboratory where we can actually obtain an unbiased estimate of the number of unevolved massive stars above a certain mass. Comparing this number with the (known) number of evolved massive stars, such as Wolf-Rayets, yellow supergiants, and red supergiants, provides a hiterto unavailable test of massive star evolutionary theory. We are engaged in a long-term (5 year) effort to characterize the massive star

content of select OB associations of the SMC and LMC using spectroscopy with the Magellan 6.5-m telescopes. Here we are asking for a short (~1 sec) SNAPshot of each of 23 OB associations in the F225W filter. These HST data will provide a crucial complement to our ground based data, allowing us to concentrate on the early and mid O-type stars with our spectroscopy, and to recognize close doubles that would otherwise be unrecognized from the ground.

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12941
Program Title: Probing Isolated Massive Star Formation in the LMC

Principal Investigator: Ian Stephens
PI Institution: University of Illinois at Urbana - Champaign

Whether massive stars can form in isolation is one of the most debated questions in star formation. Observations of main sequence O-stars indicate that 5-10% of them form in isolation, but models of massive star formation suggest that massive stars should form in cluster environments. Isolated massive young stellar objects (YSOs) are better suited to address whether or not massive stars truly form in isolation since YSOs have had less time to disrupt their natal environment or move away from their stellar siblings. We have developed a unique sample of 7 candidates for isolated massive YSOs in the LMC. Within 80 pc, these objects are not associated with 1) other massive and intermediate-mass YSOs, 2) OB associations, and 3) giant molecular clouds (GMCs). In all cases ground-based H-alpha observations show that they are affiliated with non-elongated, small HII regions and therefore are unlikely to be part of a runaway population. We request WFC3/UVIS and IR observations in the F656N, F555W, F814W, F110W, and F160W bands to examine the interstellar environment and determine the main sequence and pre-main sequence (PMS) populations down to ~0.7 solar masses. In addition, coordinated parallel ACS/WFC F555W, F814W, and F658N observations will be used to assess the nearby control-field populations. From these observations we can search for lower-mass PMS stars, infer the local star formation history, and determine whether evidence exists for remnants of a disrupted GMC. With this statistically significant sample, we will have the ability to assess the possibility of massive stars forming in isolation.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12942
Program Title: Testing the Merger Hypothesis for Black Hole/Galaxy Co-Evolution at z~2

Principal Investigator: Eilat Glikman

PI Institution: Yale University

We propose to use WFC3 in the near-infrared to image the host galaxies of a sample of luminous, dust-reddened quasars at z~2 to look for evidence of mergers and interaction. We have identified a large sample of red quasars by matching the FIRST and 2MASS surveys and spectroscopically following up very red objects. Detailed study of this population reveals that red quasars are the most intrinsically luminous objects in the Universe at all redshifts, and appear to represent a transitional phase in the merger-driven black hole growth scenario, based on Hubble Space Telescope imaging at z~0.7. The images proposed here will sample the host galaxies in rest-frame visible light, which will reveal the presence of any tidal features and other merger signatures. Since morphologies of the host galaxies of lower-luminosity AGN at z=2 do not support the merger-driven co-evolution picture, it is important to test this picture in high luminosity systems. Evidence for mergers in these quasar hosts would support a picture in which luminous quasars and galaxies co-evolve through major-mergers, which trigger both star formation and black hole growth. The absence of mergers in our data would call for a new theoretical framework for co-evolution.

Proposal Category: GO

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12943

Program Title: Testing the Cold Stream Accretion Model Using Lyman Alpha Blobs

Principal Investigator: Yujin Yang

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

We propose to use WFC3/F502N narrowband imaging to search for filamentary/stream structures within Ly-alpha blobs in the SSA22 proto-cluster of these objects at z=3.1. It has been suggested that these giant Ly-alpha emission line nebulae (typical sizes of ~100kpc) are massive galaxies onto which "cold gas streams" are being accreted. In this scenario, filamentary streams of Ly-alpha emission should be seen. The detailed morphology of the Ly-alpha-emitting gas has never been observed due to a lack of spatial resolution in ground-based imaging observations. By exploiting a narrowband filter that fortuitously coincides with Ly-alpha emission at the proto-cluster redshift, we can obtain deep, narrowband imaging at sufficient resolution for 5 Ly-alpha blobs and ~4 compact emitters in a single pointing. These data will allow us to spatially resolve the predicted streams and thereby confirm or disprove the cold mode accretion scenario for these most promising candidates for gas-accreting galaxies at high redshift. Furthermore, the proposed observations will provide the first direct constraints on theoretical models that explore the observational signatures of gas flows (in or out), which are vital to our understanding of galaxy formation and evolution.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12944
Program Title: A High-Resolution Survey of the Very Youngest Brown Dwarfs

Principal Investigator: Katelyn Allers

PI Institution: Bucknell University

We propose to image the youngest (~0.5 Myr) brown dwarfs in the nearby Ophiuchus star-forming region (d=125 pc). These observations will complete our high resolution imaging survey of a well-defined sample of young brown dwarfs and very low mass stars spanning the age range of 0.5-100 Myr (Allers et al. 2009, Allers et al. 2010, Biller et al. 2011). Our proposed survey will be the culmination of the most extensive high resolution search for companions to young substellar objects conducted to date. We have established a novel, reddening-insensitive approach, which uses imaging in three WFC3 UVIS and IR filters to discern candidate companions from contaminant background stars. Our proposed survey is sensitive enough to discover planetary-mass companions. As only two planetary-mass companions to brown dwarfs are known (Chauvin et al. 2005, Todorov et al. 2010), such discoveries will provide valuable new benchmark objects for testing atmospheric and evolutionary models of planetary-mass objects. Our survey will put the strongest constraints to date on the primordial binary fraction for brown dwarfs. By comparing results in Ophiuchus with our completed survey of the Upper Sco region (Biller et al. 2011), we can directly measure how the binary characteristics change with age (i.e. as a cluster dynamically evolves), providing key inputs for refining models of brown dwarf formation. The proposed observations are only possible with HST WFC3. Because of the high extinction of the Ophiuchus cloud, suitable tip-tilt stars are not available to allow for ground-based LGS AO imaging of our sample.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12945
Program Title: Spatially Resolved Observations of Gas Stripping in Intermediate Redshift Clusters and Groups

Principal Investigator: Gregory Rudnick

PI Institution: University of Kansas Center for Research, Inc.

We propose to determine the relative importance of the group vs. cluster environment in transforming galaxies from star-forming to passive objects. We will use WFC3 G102 grism spectroscopy and imaging to make the first high-spatial-resolution maps of the gas and stellar content of 55 cluster and infalling group galaxies at an epoch (z=0.5) when galaxy transformation was still in full swing and when clusters were rapidly building up their population of passive galaxies. The most common mechanisms proposed for depleting gas make different predictions as to the size and symmetry of the gas and stellar disks. Therefore, by comparing the morphology of H-alpha emission relative to that of the stellar light for galaxies in clusters and nearby infalling groups we will determine the relative effectiveness of group and cluster-based depletion mechanisms. We will couple our measurements at z=0.5 with a wealth of H-alpha imaging

of z=0 group and cluster galaxies, allowing us to understand how gas depletion processes in different mass halos have changed over time. This project is only now possible thanks to (1) the high spatial resolution emission line maps produced by the WFC3 grism and (2) an extensive wide-field spectroscopic survey that provides accurate membership information out to many virial radii and allows us to identify groups in the infall regions around distant clusters.

Proposal Category:	GO	
Scientific Category:	HOT STARS	
ID:	12946	
Program Title:	What Powers Nature's Most Luminous Supernovae?	
Principal Investigator:	Alicia	Soderberg
PI Institution:	Harvard University	

Thanks to the recent advent of wide-field transient surveys, supernovae with extreme peak luminosities, M < - 22 mag, are being revealed at alarming rates. The origin of these events is hotly debated and popular ideas range from pair instability supernovae to central engine driven explosions. The Pan-STARRS survey, now in full operation, provides an unprecedented opportunity to discovery and study this new class of ultra-luminous at redshifts of z~1. Here we propose (non-disruptive) HST Target-of-Opportunity observations of nature's most luminous supernovae to crack the mystery of what powers these beasts which may be (i) radioactive decay, (ii) circumstellar interaction, or (iii) a central engine.

Proposal Category:	GO	
Scientific Category:	SOLAR SYSTEM	
ID:	12947	
Program Title:	determination of the line-spread function of the E140H grating with the 0.2 x 0.5 slit	
Principal Investigator:	Frederic	Vincent

PI Institution: University of California - Davis

We propose to take an E140H observation of the 0.2" x 0.5" slit illuminated by one calibration lamp, in order to determine the line-spread function (LSF). Almost 50 archival observations will benefit from this LSF, so there will be a immediate return for the scientific community. There will be a direct application for Lyα observations of the interplanetary hydrogen. Moreover any future observation will also benefit of this lamp observation.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12948

Program Title: Late Time STIS Spectroscopy of the Extremely Nearby Type Ia SN 2011fe

Principal Investigator: Rollin Thomas

PI Institution: Lawrence Berkeley National Laboratory

In the first 2-3 months after the explosion of a Type Ia supernova, the innermost layers of the ejecta are concealed from view by a brilliant pseudo-photosphere. Observations obtained many months later, when the ejecta become nebular, enable us to peer deep into these layers and probe different explosion physics than is possible earlier on --- but at a cost. By this point, the supernova has faded dramatically, so only the closest events may be observed. SN 2011fe is the nearest Type Ia supernova discovered in a quarter century. We propose to obtain STIS spectroscopy of this remarkable supernova, a year after explosion, and combine these space-based observations with ground-based optical and near-infrared spectroscopy for analysis. Using the focusing lens of radiative transfer simulations, we will constrain the amount of radioactive nickel produced in the explosion, explore the extent of large-scale hydrodynamical mixing, and reconstruct the abundance stratification of the innermost ejecta. SN 2011fe represents a unprecedented opportunity to study how Type Ia supernovae explode, and is likely to remain so for decades to come.

Proposal Category: GO

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 12949

Program Title: Unveiling the Dusty Universe with the Host Galaxies of Obscured GRBs

Principal Investigator: Daniel Perley

PI Institution: California Institute of Technology

Recent observations have unveiled a previously hidden population of highly dust-obscured long-duration GRBs, many of which have now been associated with dusty and metal-rich galaxies quite unlike "canonical" GRB hosts. This discovery has the potential to significantly affect our view of the GRB progenitor (and its connection to metallicity) and the ability to use GRBs as a tracers of cosmic star-formation at high redshifts. We propose to observe the hosts of 18 moderately to highly obscured GRBs with WFC3-IR, supplementing existing Spitzer and ground-based observations and allowing direct comparison of the properties of dust-obscured GRB hosts (morphology, color, redshift, stellar mass, etc.) to unobscured hosts and to field populations. Many of the afterglows in the sample also tightly constrain the wavelength-dependence of extinction along the host galaxy sightline, a measurement that is exceedingly difficult to make via almost any other method outside the Local Group. With these observations we will correlate both the amount and the nature of the dust obscuration along a GRB sightline with the host's overall properties, in order to: (1) determine the relation between the new class of red, dust-obscured GRB host galaxies and the dusty galaxies which contributed substantially to cosmic star-formation at z=1-3, (2) investigate the nature of very blue galaxies which show no extinction in integrated starlight but nevertheless host highly obscured GRBs, indicating an extremely patchy dust distribution, (3) determine the types of high-z environments which lead to the production of dust with different observational signatures, such as the 2175 Angstrom absorption feature.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12950

Program Title: A Deep, Near-UV Probe of the Faint Cataclysmic Variable Population of 47 Tucanae

Principal Investigator: Craig Heinke

PI Institution: University of Alberta

Dense globular clusters are rich sites for the production of interacting binaries, such as cataclysmic variables (CVs), millisecond radio pulsars (MSPs), and double WD systems. Previous HST WFPC2 and Chandra X-ray observations have identified 22 CVs in 47 Tuc with M_V<10. The unprecedented near-UV sensitivity, field of view, and resolution of the WFC3, in combination with subarcsecond Chandra positions, will allow us to probe the faint CV population down to M_V=11.6, identifying a large population of CVs at very low mass-transfer rates. The distribution of CV mass transfer rates inferred will constrain models of CV evolution and dynamical formation. We will also survey the population of helium-core WDs, another window into binary evolution.

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12951
Program Title: Do Lyman-alpha photons escape from star-forming galaxies through dust-holes?

Principal Investigator: Aida Wofford
PI Institution: Space Telescope Science Institute

The hydrogen Lyman-alpha line is arguably the most important signature of galaxies undergoing their first violent burst of star formation. Although Lya photons are easily destroyed by dust, candidate Lya emitters have been detected at z>5. Thus the line can potentially be used to probe galaxy formation and evolution, as long as the astrophysical processes that regulate the escape of Lya photons from star-forming galaxies are well understood.

We request 15 orbits for imaging in Lya and the FUV continuum with ACS/SBC, and in the H-beta/H-alpha ratio (proxy for dust extinction) with WFC3/UVIS, a sample of isolated non-AGN face-on spirals for which our team previously obtained and analyzed COS FUV spectroscopy of the central regions. Each target shows a different Lya profile, i.e., pure absorption, P-Cygni like, and multiple-emission. From the COS data, we already know the starburst phase and H I gas velocity. The images would greatly increase the impact of our spectroscopic study by enabling us to 1) conclusively determine if Lya photons escape through dust-holes, 2) assess the relative importance of dust extinction, ISM kinematics, and starburst phase in regulating the Lya escape, 3) clarify what we can really learn from the Lya equivalent width, and 4) provide constraints on the dust extinction to Lya 3D radiative transfer models. Ultimately this program will inform our understanding of the Lya escape at high redshift by providing spatially resolved views of the local conditions within star-forming galaxies that favor escape.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12954
Program Title: A New Instability Strip in the HR Diagram of Massive Globular Clusters

Principal Investigator: Thomas Brown
PI Institution: Space Telescope Science Institute

We propose far-UV time-series imaging of the core of NGC 2808, a massive globular cluster exhibiting a triple main sequence, in order to search for pulsators among its large population of hot subdwarfs (a.k.a. extreme horizontal branch stars). For more than a decade, pulsating subdwarfs were only found in the Galactic field population, where

they have enabled precise measurements of stellar parameters through asteroseismology. However, recent observations of the massive globular cluster omega Cen have revealed pulsating subdwarfs clustered at a temperature (~50,000 K) much hotter than those found in the field (~30,000 K). Globular clusters offer a superior laboratory for studying such pulsators because they avoid the uncertainties in distance, reddening, age, and initial chemical composition that plague the field population. NGC 2808 is the prime target to search for these new pulsators and to characterize their instability strip, given its size, distance, low reddening, and wealth of extant UV data. Our previous UV imaging and spectroscopy of NGC 2808 found a large population of hot subdwarfs with temperatures that span those of both the omega Cen pulsators and the field pulsators. Far-UV time-tag imaging with STIS is the only way that these short-period (~100 sec) pulsators can be found in the NGC 2808 core. The discovery of this new class of pulsators opens the exciting possibility of using asteroseismology to constrain the formation mechanisms of hot subdwarfs (binary mass transfer, mergers, flash mixing, helium-rich subpopulations), and of exploring the role of iron enhancement via radiative levitation as the driving mechanism for the pulsations.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12955
Program Title: Comparing Planet Formation Signatures in two Systems

Principal Investigator: Pieter Deroo

PI Institution: Jet Propulsion Laboratory

Following the discovery of exoplanet systems with multiple transiting planets - unique laboratories for studying planet formation and evolution - we propose to characterize and compare the exoplanet atmospheric composition in the compact solar system analog Kepler-11. We propose WFC3/G141 transmission spectroscopy of three low-density super-Earth/Neptune planets in the six-planet system. The proposed grism spectroscopy targets the strong 1.4-micron water band and the distinct 1.6-micron methane features, thus probing the principal thermochemical reservoirs of oxygen and carbon for the planets we will observe. The carbon and oxygen abundance and their ratio are key diagnostics of planet formation and evolution, and the proposed observations will provide a unique observational constraint because comparing planets in the same exoplanet system removes the variables that influence inter-system comparative exoplanetology. Together with the only other multi-planet system observation (PI Desert), the proposed observations aim at starting the process of observationally differentiating inter-system and intra-system parameters that influence the composition of individual planets. In so doing, we will improve our understanding of whether our own solar system is typical or exceptional.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12956
Program Title: The First Transmission Spectrum of an Eccentric Cool Jupiter

Principal Investigator: Catherine Huitson

PI Institution: University of Exeter

The techniques of transmission/emission spectroscopy are at the forefront of the characterization of exoplanetary atmospheres, allowing for a direct determination of elemental abundances, chemistry and temperature-pressure profiles. Hot Jupiters have dominated such studies due to their large spectroscopic signals. Despite this well-studied sample of similar exoplanets, the measured spectra exhibit surprising diversity, a fact which remains poorly understood.

Since the hotter gas giants are well-observed, advancing our understanding of exoplanetary atmospheres requires the multi-wavelength detection of transits for exoplanets residing in cooler temperature regimes. We propose the very first transit observations, from the optical to the near-infrared, of a moderately-irradiated (~650-960 K), Jupiter-like exoplanet residing on an eccentric orbit (e=0.346): HAT-P-17b. Besides being in a previously unobserved temperature regime, its eccentric orbit allows the atmosphere of HAT-P-17b to periodically cross the condensation curves of sodium and potassium, implying that these alkali metals exist in the gas phase at periapsis and condense out into clouds/hazes at apoapsis. Furthermore, the range of temperatures allow for the carbon budget to be based on comparable amounts of CO and CH4.

Our proposed observations will determine if the spectral features of K I, Na I, CH4 and H2O are present or absent from the optical to the near-infrared, thereby allowing us to constrain elemental abundances and atmospheric temperatures. This first dataset of a unique transition object will provide an insightful compliment to existing transmission observations of hot Jupiters.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12957

Program Title: The Proper Motion of Palomar 5 and its Tidal Tails

Principal Investigator: Andreas Kuepper

PI Institution: Universitat Bonn, Argelander Institute for Astronomy

The outer-halo Milky Way globular cluster Palomar 5 (Pal 5) shows prominent tidal tails (TT) extending over tens of degrees. Published ground-based proper motion (PM) measurements of Pal 5 are inconsistent with each other, and also with predictions from our numerical modeling (PM greater than 2 mas/yr in each component). Accurate PM would allow a detailed reconstruction of Pal 5's dissolution history and provide independent constraints on the shape of the Galactic potential. We propose to measure the PM of the Pal 5 cluster and a field 5 deg (2 kpc) along its TT with an accuracy of < 0.4 mas/yr via multi-epoch WFC3 and ACS observations in Cycles 20 and 22. We have identified a large number of QSOs and galaxies in these fields, which will allow us to achieve this accuracy on a three-year baseline. Combined with the large amount of available radial velocity data and detailed numerical modeling, the proposed observations will constrain the orbit of Pal 5 to greater accuracy than any other outer-halo satellite (< 30 km/s). Hence, it will enable us to tightly constrain the Galactic circular velocity and the flattening of the Galactic potential to less than 10% uncertainty. We will further use the PM-cleaned sample of stars in Pal 5 and its TT to unambiguously probe for variations of the present-day stellar mass function down to 0.2 Msun, enabling a direct estimate of Pal 5's mass loss rate. Together with the orbital information this will provide unique insights to the complex interplay of two-body relaxation and tidal shocking, which will have direct consequence for our understanding of the build-up of galaxy field populations and the evolution of cluster mass functions.

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12958
Program Title: Large Scale Structure in Absorption up to z~0.4

Principal Investigator: Nicolas Tejos
PI Institution: University of Durham

We propose to observe and characterize IGM absorption systems associated with Large Scale Structure (LSS) in a statistical manner up to redshift ~0.4. For this purpose, we have used a recently published cluster catalog (GMBCG; Hao et al., 2010) to identify massive nodes in the 'cosmic web'. Then, we used cluster pairs with small separations (<20 Mpc) at similar redshifts to identify zones where filaments should reside with high probabilities. Combining the GMBCG cluster catalog with the SDSS DR7 QSO catalog, we selected a single QSO whose sightline passes through a total of 6 predicted filaments (3 of which are independent) and 3 clusters with spectroscopic redshifts at impact parameters <1.5 Mpc. This will considerably increase the sample of known LSS (especially filaments) at low redshift. We propose to observe the QSO with HST/COS using the G130M and G160M gratings to cover the full FUV spectral range at high resolution (R~20000). We require observations at S/N>10 to ensure a full characterization of HI and OVI lines at small column densities (N~10^13 cm^-2). These low column densities will allow us to detect broad and shallow HI lines with OVI, believed to be associated with portions of the warm-hot intergalactic medium (WHIM). Our results will also be suitable for testing an alternative hypothesis which states that the majority of OVI absorbers at low-z are confined within <300 kpc from galaxies and are not directly related to the WHIM (Prochaska et al., 2011; Tumlinson et al., 2011). Our findings will test our understanding of galaxy formation and the importance of AGN/supernova feedbacks by comparing them with state-of-the-art hydrodynamical simulations.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12959
Program Title: A Critical Test of the Nature of Lyman Continuum Emission at z~3

Principal Investigator: Alice Shapley
PI Institution: University of California - Los Angeles

Escaping Lyman-continuum (LyC) radiation from star-forming galaxies is likely responsible for the reionization of the universe. However, the direct measurement of escaping LyC radiation has proven exceptionally challenging. Recent spectroscopic and imaging detections of LyC emission from z~3 galaxies have revealed unexpectedly high values for the escape fraction of LyC photons, as well as spatial offsets between the apparent LyC emission and non-ionizing UV continuum. These results may indicate the processes governing the production and escape of LyC photons from distant star-forming galaxies, but may also signify contamination by low-redshift interlopers near the line of sight. We have obtained ultra-deep ground-based data probing the LyC region at z~2.85 in the Q1549+19 field. Our sample includes

both spectroscopically confirmed Lyman Break Galaxies (LBGs) and Lyman-Alpha Emitters (LAEs), with 24 apparent detections of LyC radiation. However, without high spatial resolution redshift estimates for the specific regions associated with apparent LyC emission in the vicinity of LBGs and LAEs, our interpretation of these intriguing sources is fundamentally limited. Spatially-resolved photometric redshifts based on multi-band HST imaging represents the most effective path forward. Here we propose for 32 orbits of deep WFC3/F336W, ACS/F606W, WFC3/F125W, and WFC3/160W observations in two pointings covering the majority of our apparent LyC detections. Analysis of these data will robustly remove contamination from low-redshift interlopers, and reveal the processes through which galaxies reionized the universe and maintained the ionizing background.

Proposal Category:	GO
Scientific Category:	COSMOLOGY
ID:	12960
Program Title:	The nature of star formation in two spectroscopically confirmed exceptionally-luminous galaxies beyond a redshift 7
Principal Investigator:	Yoshiaki Ono
PI Institution:	University of Tokyo

We propose deep WFC3/IR imaging for two very luminous Lyman alpha emitters with Keck spectroscopic redshifts of z=7.213 and 7.308 discovered through large area imaging surveys undertaken with Subaru. We demonstrate that both sources are exceptional in their properties compared to typical Lyman break galaxies being identified at this redshift and deduce that both rare sources are being seen during a special moment in their history. As such their detailed study offers a valuable perspective into the origin of star formation and the physical processes that power the intense line emission. This will complement on-going statistical surveys of star formation during the reionization era. We propose deep broad-band (F125W and F160W) images to improve our understanding of the stellar continuum and, taking advantage of the unique coincidence of Lyman alpha emission at this redshift with the intermediate-band F098M filter, to map the morphological distribution of line emitting gas. The combination will permit us to determine whether the continuum-derived star formation rate is sufficient to power Lyman alpha emission, to robustly estimate the stellar mass and age of both galaxies and, via resolved imaging, to determine the possible role of cold accretion or merging as the origin of the intense activity in these spectacular objects.

Proposal Category:	GO
Scientific Category:	AGN/QUASARS
ID:	12961
Program Title:	A Cepheid Distance to NGC6814
Principal Investigator:	Misty Bentz

PI Institution: Georgia State University Research Foundation

We propose to obtain multi-epoch imaging of the face-on spiral galaxy NGC6814 with the Wide Field Camera 3 to identify Cepheid variable stars, measure the periods of their lightcurves, and determine the galaxy's distance from the Cepheid period-luminosity relationship. The Cepheid distance will be combined with the spatially resolved spectroscopy we will obtain through Gemini observations in 2012A to determine the dynamical mass of the active supermassive black hole. We already have a reverberation mass for NGC6814, and an accurate distance is required to allow us to obtain a meaningful dynamical mass for comparison with the in-hand reverberation mass. Additionally, an accurate distance is required for any meaningful luminosity measurements in NGC6814. The face-on orientation of the galaxy precludes a Tully-Fisher distance, which is the only other viable distance indicator for spiral galaxies at ~20-30Mpc.

As one of only three galaxies where the supermassive black hole mass may currently be determined through dynamical modeling AND reverberation mapping, NGC6814 acts as a linchpin for the entire active galaxy black hole mass scale (both in the local universe and at cosmological distances). It is also an anchor for the low-luminosity end of the radius-luminosity relationship, which is widely-used for black hole mass estimates out to z~6. Futhermore, recent work has shown that quasars out to z~4 may soon be used as standard candles, in which case NGC6814 could provide a crucial foundation for observations that test the expansion and the ultimate fate of the universe.

Proposal Category: GO

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12962

Program Title: Optical Line Emission Impact Polarization: SN1006

Principal Investigator: William Sparks

PI Institution: Space Telescope Science Institute

We propose to probe the physics of shocks and transport processes by seeking the intrinsic line emission polarization predicted to be present in the classical non-radiative fast-shock remnant of SN1006. The prediction, Laming (1990), is that the narrow Balmer line core of the 2000 km/s shock in SN1006 will be polarized in the range 5-10% and that the broad wings will be unpolarized. The polarization is sensitive to shock velocity and ionization equilibrium. By measuring polarization for SN1006 we validate and enable a completely new diagnostic that has important applications in a wide variety of astrophysical situations involving anisotropic excitation mechanisms in general, such as shocks, intense radiation fields, high energy particle streams and conductive interfaces along with a substantial body of theoretical work that cuts across disciplines in this area. We also apply this diagnostic directly to the case of SN1006 and determine if our current theoretical expecations based on inferences on the shock velocity and structure are fullfilled. The observations will yield a spectacularly precise measurement of the proper motion distribution in the filaments of SN1006 and allow a direct estimate of its deceleration.

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12963
Program Title: Spatially Resolving the Disk Mass Accretion Process In Young Star Binaries

Principal Investigator: Tracy Beck
PI Institution: Space Telescope Science Institute

We request HST ACS SBC images in the F140LP and F165LP filters in order to spatially resolve UV emission from H2 gas and scattered light emerging from structures in the planet-forming environments of two young binary systems: GG Tau A and UY Aur. These data, in conjunction with a suite of high-angular resolution ground-based observations -- including spectral images of near-IR H2 emission, mm observations of dust continuum and CO gas emission through allocated ALMA "Cycle 0" observations -- will allow us to characterize the morphology of gas and dust passing between the circumbinary and circumstellar disks. Multi-wavelngth mapping of the distribution of material in GG Tau and UY Aur will reveal the role tidal truncation plays in the formation of planets in binary systems and help to constrain a growing number of hydrodynamic simulations of the complex disk-disk interactions.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12964
Program Title: Probing the outermost halo in a giant galaxy: is it metal-poor and where does it end?

Principal Investigator: Marina Rejkuba
PI Institution: European Southern Observatory - Germany

Centaurus A (NGC 5128), the nearest gE/S0 galaxy is taking up an increasingly important role in stellar population and galaxy evolution studies with the potential to rival the Local Group members. From our previous HST-based studies of its red-giant population, we know that ~80% of its halo stars are old (11-13 Gyr), and relatively metal-rich ([Fe/H] ~ -0.5). In contrast, new measurements of the outer-halo of NGC 3379 (Leo group), and of M31 revealed the classically metal-poor component (as the Milky Way halo) at radii beyond R~10 R(eff) where the metal-rich stars disappear. This extremely extended "outermost halo" -- which has long been suspected to exist in giant galaxies but has been hard to isolate -- may be the evolutionary relic of the first stars formed in the extended dark-matter potential well of the galaxy at its earliest stages. This triggers the question whether such an extended halo also exists around NGC 5128 and what is its composition?

We propose to use WFC3 and ACS in parallel to probe the NGC 5128 halo to its outermost detectable limits beyond 15 effective radii, in search for its oldest, most metal-poor stars. Combined with our earlier HST work, which has sampled the metallicity distribution function (MDF) from 10 to 38 kpc (1.5-7 Reff), we will obtain a complete MDF profile extending from the outer bulge to the farthest limits of the halo. This study will be the first for any gE galaxy, and it will add entirely new constraints to understanding its formation history. We will be able to assess the relative importance of halo stars produced by protogalactic dwarfs at the beginning of hierarchical merging vs. late accretion from dwarf satellites.

Proposal Category:	GO
Scientific Category:	EXTRA-SOLAR PLANETS
ID:	12965
Program Title:	Properties and dynamics of the upper atmosphere of the hot-Neptune GJ 436b
Principal Investigator:	David Ehrenreich
PI Institution:	Universite de Grenoble I

Atmospheric escape of highly-irradiated exoplanets can be detected -only by HST- as strong absorption in the stellar Lyman-alpha line of neutral hydrogen (121 nm) during planetary transits. So far, it has been observed only for hot-Jupiters. Nonetheless, lower-mass hot-Neptunes should be significantly impacted by this phenomenon, thought to be driven by the absorption of stellar X/EUV radiation in the upper layers of the atmosphere. Here, we propose to detect atmospheric escape from a hot-Neptune, GJ 436b. This planet transits a nearby, quiet M dwarf. We demonstrated with HST/STIS in a past Cycle that this star is a bright Lyman-alpha target. Hence, we will use this same instrument to measure the properties of the upper atmosphere of this hot-Neptune, constrain its escape rate, and search for temporal variations in its exosphere, thus bringing new insights on the physics of the atmospheric escape for a completely different range of masses. We also propose coordinated Chandra observations of GJ 436b's transits to measure the atmospheric escape efficiency factor and test the impact of stellar X-ray variability on the atmospheric properties of the planet.

Proposal Category:	GO
Scientific Category:	RESOLVED STELLAR POPULATIONS
ID:	12966
Program Title:	The Nature of Dark Matter: Halo Cusps or Cores from dSph internal proper motion dynamics
Principal Investigator:	Roeland van der Marel
PI Institution:	Space Telescope Science Institute

An important discriminator between different models for the dark matter (DM) in the universe (cold vs. warm) is the

density profile slope near the center of DM halos. CDM predicts a steep cusp, whereas WDM predicts a homogeneous core. Interpretation of observational results from disk galaxy rotation curves has been ambiguous, due to the influence of the luminous baryons on the measured DM halo structure. To better address this so-called "core-cusp" problem it is important to focus on the most DM-dominated systems known: Milky Way dwarf spheroidal galaxies. While good line-of-sight (LOS) velocity datasets exist (some thousand stars per galaxy), interpretation is plagued by the well-known mass vs. velocity-anisotropy degeneracy of stellar dynamics. This can be resolved with stellar proper motion measurements, but none exist to date. Such measurements were anticipated to be a key program for the NASA/SIM mission, but this was canceled. Fortunately, time baselines are now long enough for HST to address this problem for the very first time. We propose imaging of previously imaged fields in Draco and Sculptor (five fields total) to measure the internal proper motion dynamics for hundreds of stars. This will yield the best determinations to date of the DM density slope in any galaxy, discriminating between a core or cusp at 3-sigma confidence. This will provide important new constraints on the nature of DM. Our team brings together the necessary expertise in HST astrometry, LOS-velocity studies, and dynamical and cosmological modeling. The proposed program is a prime example of how after 20 years HST can still be used to tackle totally new forefront science.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12967

Program Title: Establishing a Network of DA White Dwarf SED Standards

Principal Investigator: Abhijit Saha

PI Institution: National Optical Astronomy Observatory, AURA

Systematic uncertainties in photometric calibration are the dominant source of error in current type Ia supernova dark energy studies, as well as other forefront cosmology efforts, e.g. photo-redshift determinations for weak lensing mass tomography. Current and next-generation ground-based all-sky surveys require a network of calibration stars with 1) known SEDs (to properly and unambiguously take into account filter differences), and 2) that are on a common photometric zeropoint scale. HST affords us the ability to establish this essential network of faint primary photometric standards, exploiting the well-understood spectral energy distributions of DA white dwarf stars, without the complications of observing through the time-variable Earth's atmosphere.
We have selected an initial set of equatorial DA targets that will have SNR ~200 in the LSST (and PanSTARRS and Dark Energy Survey) survey images, while avoiding saturation. This places primary photometric standards directly into in the multi-epoch all-sky LSST and other simailar databases. By using ground-based spectra, not
for spectrophotometry, but 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 will benefit essentially all existing and upcoming survey projects, and directly addresses one of the current barriers to understanding the nature of dark energy.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12968

Program Title: Stellar Forensics IV: A post-explosion view of the progenitors of core-collapse supernovae

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 on pre-explosion images. These studies have set constraints about the nature of massive stars and their evolution just prior to their explosion as SNe. Now, at late-times when the SNe have faded sufficiently, it is possible to return to the sites of these core-collapse supernovae to search for clues about the nature of their progenitors.

We request time to conduct deep, late-time, high-resolution imaging with WFC3 UVIS of the site of the core-collapse SN 2009hd. 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 the pre-explosion images with this late-time imaging to determine accurate photometry of the progenitor to constrain its temperature and luminosity; and 3) use the stellar population in the immediate vicinity of the SN to determine the reddening and extinction that affected the progenitor. HST provides the unique combination of high-resolution optical/IR imaging at very faint magnitudes that will facilitate this study.

Proposal Category: SNAP

Scientific Category: HOT STARS

ID: 12969

Program Title: Global Properties Are Not Enough: Probing the Local Environments of Type Ia Supernovae

Principal Investigator: Peter Garnavich

PI Institution: University of Notre Dame

The Sloan Digital Sky Survey Supernova Survey discovered more than 500 type Ia supernovae and created a large, unique and unbiased sample of these important cosmological tools. As part of a comprehensive study of the supernova host galaxies, we propose to obtain high-resolution Hubble images of SDSS hosts with redshifts less than 0.15. Integrated optical colors have been measured from the ground for these hosts, but we require HST imaging to provide intensity and color information at the site of the explosion. The correlation between the supernova position and star formation in the host will allow an estimate of the delay time which may be correlated with Hubble residuals. Recent studies suggest a class of type Ia supernovae that explodes promptly after star formation which may have different properties than supernovae with longer delay times. A snapshot program with these science goals was accepted for Cycle 17, but only 12% of the targets were observed due to the timing of the Hubble repair mission.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12970
Program Title: Completing the Census of Ultracool Brown Dwarfs in the Solar Neighborhood using HST/WFC3

Principal Investigator: Michael Cushing
PI Institution: University of Toledo

Despite the spectacular success of wide-field sky surveys (2MASS, SDSS, and UKIDSS) in uncovering a large population of brown dwarfs in the solar neighborhood, it was not until the launch of NASA's Wide-field Infrared Survey Explorer (WISE) that a moderate-size population of ultracool brown dwarfs (Teff < 700 K), including the new class of Y dwarfs, was identified. A complete census of the nearby population of cold brown dwarfs is essential to measuring the low-mass stellar mass function and the low-mass limit of star formation. With atmospheric conditions similar to those of giant planets, cold brown dwarfs are also excellent proxies with which to test the ultracool model atmospheres that are critical to our understanding of exoplanets. As part of a larger followup campaign that involves both ground- and space-based observatories (including Cycle 7 and 8 Spitzer programs and small Cycle 18 and 19 HST programs), we propose a Large GO program to observe twenty of the coldest brown dwarfs and brown dwarf candidates uncovered by

WISE. These are the brightest representatives of their type over the entire sky, but they are too dim, J>20, to be characterized from the ground. WFC3 G102 and G141 grism spectroscopy will be used to derive accurate classifications and effective temperatures of the targets, and the direct images required for wavelength calibration will be used to anchor the astrometric grid of our ground-based adaptive optics parallax program. HST/WFC3 observations provide a vital link in characterizing this ultracool brown dwarf population in the immediate Solar Neighborhood.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12971
Program Title: Completing the Empirical White Dwarf Cooling Sequence: Hot White Dwarfs in 47 Tucanae

Principal Investigator: Harvey Richer
PI Institution: University of British Columbia

In HST Cycle 17 we obtained panchromatic imaging data in 47 Tuc covering the UV through to the IR over 60 square arcmins in 14 different fields. From the UV data obtained with WFC3 we were able to construct an empirical white dwarf cooling sequence and compare it with various theoretical models. The data exhibited a sharp break in slope at ~20,000K. Cooler than this it followed the expected Mestel slope of -0.4 in Log Temperatue vs Log Age and above this

temperature the slope was somewhat more gentle (-0.2). The number of white dwarfs detected with temperatures above 30,000K (only 10) was too small to constrain the slope of the cooling sequence at the very hot end. This is because hot white dwarfs cool quite quickly and are thus rare objects. This segment of the cooling sequence is of great interest as white dwarfs are expected to cool mainly by neutrino emission at these hot temperatures. An empirical cooling sequence extending well into this region containing ~100 white dwarfs above 30,000K, will allow us to test several predictions of neutrino physics and possibly provide a hint whether axions are produced in processes similar to those that manufacture neutrinos.

Proposal Category:	GO
Scientific Category:	COOL STARS
ID:	12972
Program Title:	In Search of the Coldest Atmospheres: Identifying Companions to the Latest WISE Brown Dwarfs
Principal Investigator:	Christopher Gelino
PI Institution:	California Institute of Technology

The multiplicity properties of brown dwarfs are critical empirical constraints for stellar formation theories, while multiples themselves provide unique opportunities to test evolutionary and atmospheric models as well as examine empirical trends. Brown dwarfs with estimated effective temperatures below 500 K are just now starting to be discovered, filling in the gap between brown dwarfs and Jupiter-like planets (Teff=128K). The Wide-field Infrared Survey Explorer mission (WISE) is uncovering the closest, brightest examples of these objects, making them the best targets for further study. We propose to obtain high resolution images of 13 WISE brown dwarfs with spectral types T8 and later (Teff<700K) using WFC3 in order to search for companions down to effective temperatures of 300K. This proposal compliments our existing NASA Keck LGS-AO program by observing objects for which high resolution imaging is not possible from any ground-based LGS system. The binaries discovered by this program will provide critical information for characterizing the properties of objects at the very bottom of the Main Sequence thus helping to bridge the modeling efforts between brown dwarfs and extrasolar planets.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	12973
Program Title:	UV Spectroscopy of a Peculiar White Dwarf Supernova

Principal Investigator: Curtis McCully

PI Institution: Rutgers the State University of New Jersey

While type Ia supernovae (SNe Ia) have been extremely useful for studying the cosmic expansion history, their explosion mechanism and progenitor system remain unsolved problems. Moreover, as large samples of SNe are observed, the diversity among these explosions has grown: not all exploding white dwarfs look like normal SNe Ia. Understanding why these "peculiar" objects are different from the normal ones can help explain the standard SN Ia scenario, as well as give us a better understanding of the many endpoints of stellar evolution. Connecting observations to physical models has been difficult for both normal and peculiar white dwarf supernovae. The ultraviolet is an unexplored wavelength region for peculiar SNe Ia; the high opacity in the UV from typical thermonuclear burning products means that the UV flux in white dwarf supernovae is very sensitive to the outermost layers of ejecta. This material is the least processed, and is thus an ideal place to look for clues to progenitors and explosion mechanisms. Here we propose target-of-opportunity UV spectroscopy of a peculiar white dwarf SN using the STIS NUV-MAMA instrument to add a unique piece of the puzzle connecting peculiar SNe Ia and their progenitors.

Proposal Category: GO

Scientific Category: AGN/QUASARS

ID: 12974

Program Title: WFC3IR Imaging of UV-Faint z=6 Quasars: Star-Forming Host Galaxies of AGN in the Early Universe

Principal Investigator: Matthew Mechtley

PI Institution: Arizona State University

We propose to study the star-forming host galaxies of AGN at z~6 with WFC3/IR in F125W and F160W. Recently, far-infrared (FIR) continuum has been detected in five UV-faint (rest-frame m_1450>20.2) quasars at z~6, suggesting that they have star formation rates (SFRs) of ~1000 MSun/yr, comparable to UV-bright z~6 quasars. Such SFRs imply a significant young, UV-bright stellar population. These host galaxies have yet to be seen in starlight, however, since light from the AGN still dominates the rest-frame UV emission.

We successfully subtracted the point source in the UV-bright (m_1450=19.03) quasar J1148+5251 down to mu_J>24.4, mu_H>24.9 mag arcsec^-2, giving upper limits of m_1680>22.5, m_2160>23.0 mag for the host galaxy (Program 12332, PI Windhorst). Uncertainties in the PSF model remain the dominant source of residuals. Since these uncertainties scale with brightness, low-contrast quasars with UV-faint point sources and UV-bright hosts are the best targets for this method.

Using the observing and subtraction methods we developed, we propose to observe all 5 FIR-detected, UV-faint z~6 quasars with WFC3/IR in F125W and F160W. We request 5 orbits per quasar, for a total of 25 orbits. This program is beyond the capability of ground-based AO facilities, due to depth and PSF stability required. Observations of these host galaxies are critical to determine:

(a) The existence of a luminous stellar component

(b) Luminosity and color profiles, to constrain star formation histories

(c) Morphologies and sizes, to look for mergers and hierarchical formation processes

(d) Stellar mass, to understand formation and co-evolution of SMBHs and galaxy bulges

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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12975
Program Title: Do winds transport magnetic fields out of high redshift galaxies?

Principal Investigator: Simon Lilly
PI Institution: Eidgenossiche Technische Hochschule (ETH)

The primary goal of this proposal is to use HST observations to identify the location of magnetized plasma around high redshift galaxies, to understand its origin and to test the idea that winds carry substantial magnetic fields out from these galaxies into the circumgalactic medium. We have recently presented evidence for magnetized plasma extending upto 60 kpc from high redshift galaxies, and also for azimuthal (bipolar) asymmetries in the distribution of MgII absorption on the same scales. The two phenomena may be linked via galactic-scale winds. We here propose to observe the fields of thirteen compact radio quasars (supplementing three already observed with HST) that have (a) a Faraday Rotation measurement, (b) a single strong intervening MgII absorption system, and (c) an unambigously identified parent galaxy for the absorbing system. The goal is to determine the orientations of the parent galaxies, i.e. both the inclination to our line of sight and the projected angle phi between the minor axis of the galaxy and the direction to the quasar on the plane of the sky. By correlating phi with the observed Faraday Rotation, we hope to see whether the magnetised plasma is above the pole of the galaxy or in an extended disk, and thereby constrain its origin.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12976
Program Title: The Most Complete Template for r-process Nucleosynthesis beyond the Solar System

Principal Investigator: Ian Roederer
PI Institution: Carnegie Institution of Washington

We propose to observe two metal-poor stars that present a unique opportunity to expand the chemical inventory to unprecedented levels in an environment beyond the solar system. The proposed observations will allow us to detect several key elements, including arsenic (As, Z=33) and selenium (Se, Z=34), that cannot be detected from the ground. These elements are key to understanding the nature of the r-process in the first generations of stars that drive chemical evolution of the Galaxy, yet their abundance in the one star where they have been detected is not fully explained by current models. We will use STIS to obtain high-resolution UV spectra from 1900 to 2380 Angstroms in two metal-poor stars enriched with modest but differing amounts of r-process material, HD 108317 and HD 128279. We will perform an abundance analysis and derive abundances or meaningful upper limits for the heavy elements Cu, Zn,

Ge, As, Se, Zr, Mo, Cd, Te, Yb, Os, Ir, Pt, and Pb. This work is supported by recent laboratory experiments and theoretical studies that continue to provide data of wider interest to the atomic, nuclear, and astrophysics communities.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12977
Program Title:	Local Turbulent Disks: analogs of high-redshift vigorously star-forming disks and laboratories for galaxy assembly?
Principal Investigator:	Ivana Damjanov
PI Institution:	Harvard University

Kinematical investigations at redshifts 1<z<3 with Keck and VLT have revealed that star-forming high-redshift galaxies exhibit very high internal velocity dispersions. Dynamical data collected with integral field spectrographs (IFS) suggest that the level of rotational support in these systems follows a trend in mass, with compact dispersion-dominated Lyman Break Galaxies at lower stelar masses and large dynamically unstable turbulent disks at stellar masses larger than 10^10 solar masses. The high velocity dispersion of these young disks results in a large characteristic scale for star-forming clusters thereby also explaining their 'clump cluster' morphology. Galaxies like these were thought to be absent from the local Universe. As part of a IFS campaign to observe the most H-alpha luminous galaxies in SDSS, we have discovered a sample of very rare objects seemingly identical to these high-z turbulent disks. In this proposal we seek imaging in H-alpha of thirteen local disk galaxies in our sample, using the ACS tunable-wavelength ramp filters. Our goal is to measure the size distribution of the star-forming complexes in these objects, with ten times the typical physical resolution of HST observations of high-z galaxies, in order to test the idea that they are indeed dynamically unstable turbulent disks caught in the process of formation. In synergy with existing high resolution HST imaging of the local analogs of low-mass dispersion-dominated galaxies at high redshift (Lyman Break Analogs), our proposed observations of the local counterparts to large turbulent disks at high redshift will help to paint a complete picture of local analogs of high-z star-forming galaxies.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER
ID:	12978
Program Title:	Properties of Diffuse Molecular Gas in the Magellanic Clouds
Principal Investigator:	Daniel Welty

PI Institution: University of Chicago

Studies of the interstellar medium in the lower-metallicity Magellanic Clouds explore somewhat different environmental conditions from those typically probed in our own Galactic ISM. Recent studies based on optical/UV spectra of SMC and LMC targets, for example, have revealed unexpected differences in gas-phase abundance patterns (for various atomic and molecular species) and have begun to explore the effects of differences in metallicity on the atomic-to-molecular transition and resulting molecular fraction f(H_2) -- a key aspect in the formation of molecular clouds. We propose a more detailed study of the abundances, depletions, and local physical conditions characterizing diffuse molecular material in the Magellanic Clouds, using STIS E140H and E230M spectra of two sight lines with N(H_2) > 10^20 cm^-2 (both probing the outskirts of molecular clouds seen in CO emission). The two STIS settings will include lines from various neutral and ionized species (with a range in depletion behavior), several C I multiplets, and several bands of CO and C_2. By probing and characterizing the atomic-to-molecular transition in the Magellanic Clouds, we will address key issues regarding the effects of differences in metallicity on the relationship between the atomic and molecular gas in galaxies; on cloud structure, physical conditions, and diffuse cloud chemistry; and on the composition and properties of interstellar dust. The results of this project should thus aid in the interpretation of observations of atomic and molecular material in more distant low-metallicity systems.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 12980

Program Title: Absolute Measurement of the Cosmic Near-Infrared Background Using Eclipsed Galilean Satellites as Occulters

Principal Investigator: Kohji Tsumura

PI Institution: Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency

The Cosmic Infrared Background (CIB) as an integrated history of the early universe is important for the study of the Dark Ages, and it may include the light from the first stars at z~10. However, previous CIB measurements suffer from residual contamination from strong foreground emission (e.g. the zodiacal light). We propose to observe two Galilean satellites eclipsed in the shadow of Jupiter as occulting disks at near-infrared wavelengths in order to detect the absolute CIB intensity without any zodiacal light subtraction error. The zodiacal light originates inside the orbit of Jupiter; since the Galilean satellites in eclipse shield all light beyond the Jovian orbit, they should be detected as 'dark spots' if the strong CIB implied by previous observations exists. The intensity deficit of this dark spot relative to the surrounding sky directly measures the strength of the CIB, free from any assumptions about the zodiacal light. The size of the dark spot is approximately 1 arcsec in diameter and the predicted surface brightness is 70 nW/m2/sr lower than that of surrounding sky brightness, which can be detected by WFC3 IR imaging with F140W filter by 3.5 minutes integration with S/N=10. Even if the bright CIB does not exist, the integrated galactic light of about 10 nW/m2/sr still should exist, which can be detected by WFC3 IR imaging with F140W filter by 30 minutes integration with S/N=5. An HST observation of just one orbit will guarantee the detection of the dark spot of the eclipsed satellite.

Proposal Category: GO

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12981

Program Title: Our Interstellar Backyard: Determining the Boundary Conditions for the Heliosphere

Principal Investigator: Nicolas Lehner

PI Institution: University of Notre Dame

Understanding the outer heliosphere, which is formed from the interaction of the solar wind and the Local Interstellar Cloud (LIC) surrounding the Sun, is essential to interpreting the data from the NASA Voyager 1, Voyager 2, and IBEX missions and for being able to characterize our past and future galactic environment. We propose to determine the boundary conditions of the heliosphere from high resolution (114,000-200,000) and high signal-to-noise (50-200) STIS UV observations of the LIC toward the nearby white-dwarf Sirius B. With these observations, we will be able to independently and accurately determine the LIC temperature, density and ionization, which are the required parameters to set the boundary conditions. We will use the CIV diagnostic to search for and characterize the conductive interface theoretically required to maintain the He ionization and explain interstellar neutrals observed inside of the heliosphere. The high spectral resolution and high sensitivity data are key to modeling weak (CII*, MgI, CIV) and strong features (e. g., OI, CII) and to resolve the two clouds known to exist along this sightline. The results of this study will provide a detailed look at the heliosphere boundary conditions from an interstellar perspective for comparison with the results of MHD heliosphere models and a better understanding of the ionization conditions in galactic warm, diffuse, partially-ionized interstellar gas. Only STIS on HST can provide the key missing diagnostics to help us understand the heliospheric observations made by these NASA missions.

Proposal Category: GO

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12982

Program Title: Are the Milky Way's High Velocity Clouds Fuel for Star Formation or for the Galactic Corona?

Principal Investigator: Nicolas Lehner

PI Institution: University of Notre Dame

With our HST Cycle 17 program we used a novel method to statistically determine the distance to the population of high-velocity clouds (HVCs), fast-moving ionized and neutral gas clouds found at high Galactic latitudes. Based on similar detection rates of HVCs in UV absorption toward stellar and AGN samples, we ruled out several categories of models that place the HVCs beyond the Galactic halo. We demonstrated instead that HVCs are streams of gas in the lower halo of the Milky Way's halo. The mass flux of gas in these streams is likely sufficient to provide for the on-going star formation in the Milky Way. However, this assumes the gas can make it to the disk, an assumption that may not be valid if numerical simulations of such clouds are to be believed. We now propose an experiment to determine the final evolution of the HVCs, testing whether this gas can make it to the disk to become available for star formation. We propose to obtain high resolution COS/STIS UV spectroscopy of an additional 27 stars at smaller distances (2<d< 8 kpc, 1<|z|<4 kpc) than our previous sample to search for and characterize the high velocity gas in the lower halo. We will determine the covering factor of HVC gas as a function of z-height and bracket the distance of the HVC

population. We will determine whether the HVCs are completely disrupted as they fall and incorporated into the coronal gas of the halo or if they survive as neutral or ionized gas to reach the disk. The net result will be an observational constraint on how the Milky Way gets the gas it needs to form stars over billions of years. This survey is only possible because of the high UV sensitivity of STIS and COS.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12983
Program Title: The active pair-instability supernova PTF10nmn: late-time photometry, host properties and precise localization.

Principal Investigator: Ofer Yaron
PI Institution: Weizmann Institute of Science

Pair-instability supernovae (PISN) may be the brightest and most energetic explosions in the Universe, arising from the most massive stars. However, they are rare! Only a single promising candidate has been published to date (SN 2007bi; Gal-Yam et al. 2009, Nature, 462, 624). During the last two years we have been monitoring a second good candidate, discovered by the Palomar Transient Factory - PTF10nmn, whose observed features (both light curve and spectra) closely resemble those of SN 2007bi. The SN, at redshift z=0.123, is now more than 1.5 years after peak brightness, but became nebular only around 100 days ago and is still visible; its late-time emission powered by the huge synthesized 56Ni mass and slowly declining. We propose to obtain accurate late-time photometry of the SN in order to measure the late-time decay rate and constrain the relevant physics (continued decline following the 56Co rate vs. possible contribution from late CSM interaction). We will acquire accurate photometry of the dwarf host galaxy (an important clue to the origin of these explosions) and determine the exact location of the SN within its host. This should serve future studies (after the SN light has completely disappeared) that will be able to unveil in detail the immediate surrounding of this SN, and test recent theoretical work concerning the nature of PISNe at low redshift galaxies.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12984
Program Title: Probing the evaporation of HD189733b atmosphere

Principal Investigator: Ignazio Pillitteri
PI Institution: Smithsonian Institution Astrophysical Observatory

We propose to observe in the FUV the star HD189733, which hosts a transiting hot Jupiter, in order to study the dynamics of the evaporation of the planet's atmosphere. The inflated planet is exposed to high irradiation and it plays

a key role in determining the overall activity of the parent star. To date, HD189733 is one of the few cases where star-planet interaction (SPI) is at work. We have strong suggestion that SPI is enhancing the stellar X-ray activity and variability in a systematic way. HST is the best facility to accomplish our scientific program. It can effectively probe the amount of mass evaporating from the planet, and determining the dynamics of the gas around the planet, confirming or disproving currenct state-of-art MHD models of this system.

Proposal Category: GO
Scientific Category: COOL STARS
ID: 12985
Program Title: Determining the Mass of Proxima Centauri through Astrometric Microlensing

Principal Investigator: Kailash Sahu
PI Institution: Space Telescope Science Institute

We propose to determine the mass of our nearest neighbor, Proxima Centauri, using the novel technique of astrometric microlensing. Proxima is a dM6e star, with an estimated mass of about 0.12 Msun, lying at a distance of 1.3 pc and having a large proper motion of 3.8 arcsec/yr. In a reprise of the famous 1919 solar eclipse that verified general relativity, Proxima will pass in front of a pair of 18th-magnitude background stars in 2015, affording us two independent opportunities to measure the relativistic deflection. The first passage will occur in May 2015 (impact parameter 1.5 arcsec), and the second in June 2015 (impact parameter 1.4 arcsec). As Proxima passes in front, it will cause a relativistic deflection of the background stars' images by ~0.5 milliarcsec, an amount readily detectable with HST/WFC3.

The gravitational deflection angle depends only upon the distances and relative positions of the stars, and the mass of the lens (Proxima). Since the distance to Proxima is well known from accurate parallax measurements, and the relative stellar positions can be determined precisely before the event, the astrometric measurement offers a unique and direct method to measure the mass of a single, isolated star. We anticipate better than 10% accuracy for the mass determination. The mass of Proxima is of special interest because it is the nearest M dwarf, representing the most common type of star in the Galaxy, for which the mass-luminosity relation is still uncertain at present.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 12986

Program Title: Detecting Isolated Black Holes through Astrometric Microlensing

Principal Investigator: Kailash Sahu

PI Institution: Space Telescope Science Institute

A significant fraction of the mass of an old stellar population should be in the form of non-luminous, isolated black holes (BHs). Yet there has never been an unambiguous detection of a solitary BH---not surprisingly, since the expected accretion rate from the ISM is extremely low, and thus they emit essentially no radiation.

The only technique available to detect such isolated BHs is astrometric microlensing---the relativistic deflection of light from background stars. HST is the only instrument currently capable of detecting such tiny deflections.

We have underway a multi-year program of HST high-precision astrometry of long-duration microlensing events in the Galactic bulge, using the WFC3 camera. Our aim is the first detection of stellar-mass black holes, by monitoring five optimally selected events. Our program has met with success, with clear detections of the deflections in two events, indicative of non-luminous massive lenses. However, the 25 orbits allocated to this project for Cycles 17, 18, and 19 have proven to be insufficient to complete the program. We had to abandon 3 of our initial targets part way through the monitoring, due to problems with the associated ground-based photometry. We selected instead three other high-priority targets, which we are monitoring. However, we will need 6 more orbits in Cycle 20 to complete the original objectives of the program.

Proposal Category: GO

Scientific Category: EXTRA-SOLAR PLANETS

ID: 12987

Program Title: Possible Disintegrating Short-Period Super-Mercury Orbiting KIC 12557548

Principal Investigator: Saul Rappaport

PI Institution: Massachusetts Institute of Technology

We recently identified a star in the Kepler database with a unique light curve, featuring periodic transit-like events with unusual and highly variable characteristics. We suspect that we are witnessing the destruction of a strongly irradiated rocky exoplanet, with the "transits" being due to extinction by dust ejected from the planet. If we are correct, then this object would be the first known case of a geologically active rocky exoplanet, undergoing significant mass loss.

We request 15 orbits with HST to test this idea by helping to answer two crucial questions: (1) do the observed 0.5% flux dips really represent transits of the Kepler target star, or are they larger-amplitude occultations of a fainter, accidentally aligned, background star or binary?, and (2) are the dips really due to attenuation by dust? The observations would comprise one visit of 5 orbits utilizing WFC3 visible and NIR imaging, and two visits (of 5 orbits each) of WFC3 grism observations. The direct imaging data will identify any neighboring stars and test whether they are the source of the flux variations. The grism data will enable a search for the wavelength dependence of the transit depth that is expected under the dust hypothesis. Only HST can achieve both the high spatial resolution and precise spectrophotometry that are required for these goals.

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12988
Program Title: Mapping Baryons in the Halo of NGC 1097

Principal Investigator: David Bowen

PI Institution: Princeton University

We propose observing 5 background QSOs whose sightlines pass through the halo of NGC 1097 at impact parameters of 53-183 kpc. NGC 1097 is a bright (-21.1) spiral galaxy that has the highest surface density of background, UV-bright QSOs in the nearby Universe. The galaxy hosts a low luminosity AGN at its core, surrounded by a ring of intense star-forming regions; there is also evidence from stellar tidal streams that the galaxy has recently cannibalized a number of dwarf galaxies, and a companion dwarf elliptical is still clearly merging with the outer disk. We aim to examine the physical conditions of gas that fills the halo of such an active galaxy. We will search primarily for Lya and SiIV absorption lines in the spectra of the background QSOs, as well as weak NV from hot gas. At the lowest impact parameters, we may also be able to find absorption lines from low ionization species. Our goals are to test whether the halo of NGC 1097 contains the same distribution of Lyman-alpha forest clouds seen at higher redshifts out to large distances from galaxies, and determine how the HI column density, covering fraction, and temperature of the gas decline with radius in a single galaxy halo. We will examine whether the velocities of the absorbers are consistent with those expected from gas co-rotating in the dark matter halo of the galaxy, or whether there exists a distribution of velocities that might indicate outflows from the galactic disk or from the central AGN, or, alternatively, from inflows from the IGM. Our map of Lya and SiIV around NGC 1097 will provide an important template for understanding the origin of higher redshift QSO absorption line systems.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 12989
Program Title: The Ultraviolet View of Globular Clusters in the Giant Elliptical M87

Principal Investigator: Alvio Renzini

PI Institution: Osservatorio Astronomico di Padova

With a single WFC3/UVIS pointing, we propose to obtain UV photometry for over 600 globular clusters in M87, the massive cD galaxy hosting ~10,000 globulars at the center of Virgo. When combined with deep archival ACS optical photometry of the same field, we will be able to characterize the contribution of hot horizontal branch stars to the integrated light of these clusters. In the Milky Way, these evolved stars are prevalent in those globular clusters that host complex stellar populations, because both phenomena are symptoms of sub-populations which are highly enriched in helium. The discovery of multiple populations in Galactic globular clusters, driven by the photometric accuracy of

HST, has revolutionized globular cluster research, in particular concerning their very formation in the early Universe that must have been a much more complex phenomenon than ever imagined before. This large, fully representative sample of globular clusters with UV-to-optical photometry will reveal to what extent globular cluster formation has proceeded in a distinct fashion in a giant elliptical environment, in particular with respect to the multiple population phenomenon.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12990
Program Title:	Size Growth at the Top: WFC3 Imaging of Ultra-Massive Galaxies at 1.5 < z < 3
Principal Investigator:	Adam Muzzin
PI Institution:	Leiden Observatory

It is now well established that massive (LogM/Msun ~ 11.0) quiescent galaxies at 1.5 < z < 3.0 are substantially smaller in size than their counterparts in the local universe. Abundance matching shows that these galaxies should reside in dark matter halos with masses of LogM/Msun ~ 13.0 and are the progenitors of local Brightest Group Galaxies. Little is known about the size evolution of galaxies several times more massive than this (LogM/Msun > 11.6) because their space density is a factor of ~30 lower. These galaxies reside in halos of LogM/Msun = 14.0 and are the progenitors of local Brightest Cluster Galaxies. At present there are four galaxies of this mass at z > 1 with published sizes, and unlike their lower-mass cousins, they obey the local mass-size relation. This suggests there may be "size-downsizing", whereby the most massive galaxies reach their final sizes earlier. If confirmed, this will be an important clue for ascertaining what physical processes drive size evolution. Using new data from the 4.75 sq. deg. NMBS-II and ULTRAVISTA surveys we have selected a high-confidence, mass-complete sample of 30 galaxies at 1.5 < z < 3.0 with LogM/Msun > 11.6. Here we propose WFC3 imaging of these galaxies to measure their sizes, morphologies and light profiles. Our objective is to confirm if size-downsizing exists, and if so, at which redshift the most massive galaxies reach their final sizes. There are only three similar galaxies in the CANDELS fields; therefore we will increase the sample of these objects by an order-of-magnitude as well as extend the mass range over which the size-mass relation has been measured at high-redshift by a factor of ~5.

Proposal Category:	GO
Scientific Category:	COSMOLOGY
ID:	12991
Program Title:	Red galaxies in CL J1449+0856 at z=2.07: the red sequence in the most distant galaxy cluster

Principal Investigator: Veronica Strazzullo

PI Institution: CEA/DSM/DAPNIA/Service d'Astrophysique

We propose to obtain WFC3 NIR imaging in the F105W band in the field of the cluster CL J1449+0856 at z=2.07. This is the most distant X-ray detected cluster known thus far, the most evolved system discovered at a redshift very close to the expected main formation epoch of massive cluster galaxies. The core of this cluster is populated by red galaxies, several of which already exhibit an early-type morphology. At the same time, other red galaxies have disk-like structures, some are involved in mergers or interactions, some are suspected to be dusty star-forming sources.

Given the importance of the red-sequence population in galaxy clusters over more than half of cosmic time, it is clear how critical is the investigation of these sources in this unique system so close to their expected formation. In spite of an extensive multi-wavelength data set, the faintness and red colors of our targets make it impossible to study the red sequence in detail with ground-based imaging blueward of the targets 4000A break. The proposed observations, coupled with the already available WFC3 imaging in the F140W band, and deep Subaru imaging in the Ks band, will allow a detailed analysis of the actual nature of red galaxies in this structure, and push for the first time beyond redshift 2 the study of the evolution of the red sequence in galaxy clusters.

Proposal Category: GO

Scientific Category: STAR FORMATION

ID: 12992

Program Title: Are Young Stars Condensing Out of the Rapidly-Cooling Intracluster Medium?

Principal Investigator: Michael McDonald

PI Institution: Massachusetts Institute of Technology

The delicate balance between cooling and feedback processes is responsible for the slow build-up of massive elliptical galaxies in the cores of galaxy clusters. In the absence of feedback, the intracluster medium (ICM) should deposit ~1000 Msun/yr of cool material onto the central galaxy, leading to massive, starburst galaxies - a stark contrast to the passive, red galaxies we observe. Understanding this balance between radiative cooling in the hot ICM and feedback, likely from AGN, is critical to understanding the evolution of galaxies in the cluster environment. Recent observations have found significant evidence for ongoing star formation in central cluster galaxies (~1 Msun/yr), suggesting that this balance may be slightly off in favor of cooling. However, it is not possible from the current observations to distinguish between young stars forming in situ, fueled by the cooling ICM, or if they have been stripped from infalling, gas-rich galaxies. We propose a simple test, using the strongly-cooling cluster Abell 1795, to determine the origin of this young stellar population via far-UV COS spectroscopy. We show that, by combining these new data with our existing high spatial resolution, multi-wavelength dataset for this system, we will be able to a) identify intermediate-temperature gas, which would provide proof that the hot and cold phases are thermally coupled, and b) constrain, for the first time, the ages and metallicities of the stars in the extended, cooling filaments. This program will have a significant impact on our understanding of galaxy formation and cluster evolution, and may provide the first direct evidence of young stars condensing out of the ICM.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12993
Program Title: The Stellar Environment of SN 2008jb: Resolving the Nature of the Progenitor

Principal Investigator: Jose Prieto
PI Institution: Princeton University

Type IIP supernovae, the most common kind of core-collapse supernova (ccSN) explosions, have been associated with the deaths of red-supergiant stars with main sequence masses M = 8-15 Msun, through the direct detection of several progenitors using HST. These studies have also shown a dearth of high-mass (40 > M > 15 Msun) SN progenitor stars when compared to local populations of supergiants. However, the sample of nearby ccSNe (< 20 Mpc) used for progenitor studies is highly biased to large spiral galaxies, limiting the range of physical properties (like metallicity) that affect stellar evolution. We propose to obtain deep multi-color images with WFC3 of the birthplace of SN 2008jb to study its resolved stellar environment and constrain the age and mass of its progenitor. This ccSN was discovered by a galaxy-unbiased survey in a low-metallicity, Magellanic-type dwarf irregular galaxy at 10 Mpc. The photometric light curve properties of the event were consistent with normal Type IIP SNe; however, the explosion occurred within a large star-forming region. The approximate age of this region of ~9 Myr is more consistent with the young age and high-mass estimated for the progenitor of SN 1987A in the LMC, than with any nearby Type IIP SN. The deep optical and near-IR HST data will allow us to detect massive stars in the environment of SN 2008fb and accurately constrain the ages of the stellar populations using well-calibrated stellar evolution and population synthesis models. These data will also allow us to constrain the late-time SN energetics, dust formation in the SN ejecta or circumstellar medium, and stellar feedback from massive stars and SNe in the star-forming region.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12994
Program Title: A Lensing Study of IDCS J1426.5+3508: A Massive Galaxy Cluster at z=1.75

Principal Investigator: Anthony Gonzalez
PI Institution: University of Florida

We propose ACS/WFC and WFC3/IR imaging of IDCS J1426.5+3508, which at z=1.75 is the most massive cluster yet discovered at z>1.4, and the first cluster at this epoch for which the Sunyaev-Zel'dovich effect has been observed. Our previous work also revealed a giant arc associated with this cluster, making it the most distant known strong lensing cluster. The existence of this arc revives the longstanding arc statistics problem -- theoretical calculations predict that no such arc should exist across the entire sky. The aim of this program is to constrain the total mass and concentration of the dark matter halo to understand the origin of this discrepancy. A weak lensing determination of the total mass will also provide the first direct calibration of the SZ-lensing mass relation at this epoch. This calibration is of central relevance to programs aiming to use cluster counts out to this redshift to constrain dark energy, such as eROSITA and ground-based SZ searches. Moreover, our observations are designed to also enable detection of multiply imaged

sources to enable joint strong+weak lensing analysis to better constrain the mass model. This cluster is extreme in mass for the redshift, anomalous as a strong lensing system, and unique among all clusters currently known.

Proposal Category:	SNAP
Scientific Category:	STAR FORMATION
ID:	12995
Program Title:	Testing Disk Locking in the Orion Nebula Cluster

Principal Investigator:	Christopher	Johns-Krull
PI Institution:	Rice University	

Understandig how stars form and evolve to reach the main sequence is a key focus area in modern astronomical research. In particular, understanding the rotational evolution of stars during the pre-main sequence phase and how these young stars interact with their surrounding accretion disks is critical. Observations suggest that accretion disks can strongly influence the rotation of the central star which in turn affacts how the star and disk interact. This interaction determines how matter accretes onto the star and may thereby play a role in setting the final stellar mass and may even help determine the final close orbits of inward migrating giant planets. As a result, this star-disk interaction has implications for many key areas in astronomy. Magnetospheric accretion and disk-locking are two key ideas in low mass star formation studies. While the magnetospheric accretion paradigm is well accepted, the related notion of disk-locking (the idea that the star-disk interaction leads to a relatively slow equilibrium stellar rotation rate as opposed to the star continuing to spin up) remains highly controversial. We propose to critically test the predictions of disk-locking and to look for evolution of this pheonmena by measuring the accretion properties of a large sample of young stars in the Orion Nebula Cluster. Combining these measurements with already determined values for the stellar mass, radius, and rotation period will permit the most careful study to date of this phenomena.

Proposal Category:	GO
Scientific Category:	STAR FORMATION
ID:	12996
Program Title:	Exploring the Role of Stellar Magnetic Fields in Accretion and Outflows from Young Stars using the Hot Emission Lines of Herbig Ae/Be Stars

Principal Investigator:	Christopher	Johns-Krull
PI Institution:	Rice University	

Most stars form surrounded by a circumstellar accretion disk. It is in these disks that planetary systems form. The ultimate fate of the material in these disks is determined by the competition between matter accreting onto the stellar surface, matter being launched into an outflow away from the star, and the formation of solar system like bodies. For low mass stars, strong stellar magnetic fields play key roles in the accretion and possibly outflow processes. While it is often assumed that stellar magnetic fields play a similarly important role for intermediate mass stars, the observational evidence for this is far from complete. This is due in part to a lack of detected accretion or outflow diagnostics in optical line profile studies which trace these mass flows. The limited existing UV data suggests that this may simply be the result of different temperatures in the flows for these two mass regimes; however, there is not enough data to know for certain. Here, we propose a small survey of a carefully selected sample of intermediate mass Herbig Ae/Be stars to determine the incidence of accretion and outflow signatures in their high temperature line profiles in order to establish whether these stars interact with their surrounding accretion disks in the same manner as their younger cousins.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	12997
Program Title:	The Blue Horizontal Branch as a Reliable Tracer of Galaxy Stellar Halos

Principal Investigator:	Benjamin	Williams
PI Institution:	University of Washington	

We propose ACS and WFC3 F475W and F814W imaging in two fields between 5 and 10 kpc along the minor axis of M31. These locations sample the transition between the bulge/disk-dominated and halo-dominated regions. The images would cover a total of 19 square arcminutes and would be used to characterize the complete blue horizontal branch (BHB) populations within the halo/bulge transition zone. The observations will test model predictions of the density of BHB stars and the ratio of BHB to red giant branch stars at these radii. Our present halo model is based on HST measurements of BHB stars from 2 to 35 kpc, but has a large gap in coverage from 5 kpc to 10 kpc. The proposed observations will result in the first reliable M31 halo profile covering such a large radial baseline, breaking degeneracies in current attempts to decompose M31 into bulge, disk, and halo components. Furthermore, this test will validate the use of the BHB to measure halo profiles in other systems, potentially making it possible to characterize galaxy halo populations with photometry that reaches only the horizontal branch. Our proposed observations will bridge the current gap between the large amounts of HST data available in the M31 halo and the excellent HST coverage of the M31 disk. Ultimately, these data will complete the most reliable profile ever measured of the inner regions of the M31 stellar halo, which yields an accurate total stellar halo mass and represents an historical record of how the halo formed.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER

ID: 12998

Program Title: STIS Coronagraphy of Bright New Debris Disks from the WISE All-Sky Survey

Principal Investigator: Deborah Padgett

PI Institution: NASA Goddard Space Flight Center

Debris disks trace the collisional breakdown of asteroid and comet parent bodies orbiting nearby main sequence stars. While present in ~15% of FGK stars - as diagnosed by infrared excess measurement by IRAS, ISO, and Spitzer - only 6 debris disks have been detected in scattered light around late-type stars. The detectability of debris disks in scattered light trends strongly with the magnitude of their infrared excess, so progress in this field depends on identifying new stars with strong excess. The Wide-Field Infrared Survey Explorer (WISE) has recently completed new, sensitive all-sky mapping in the 3.3, 4.6, 12, and 22 micron bands. Association of the WISE sources to Hipparcos stars has led to the identification of 348 nearby main sequence stars with robustly detected warm 22 micron excesses not previously known. We propose STIS coronagraphic imaging for seven of the brightest debris disks that WISE has found in association with solar-type and intermediate mass stars within 120 pc. All seven have excesses stronger than the successfully imaged disk of HD 107146, and two have disks as bright at Beta Pic. Our goal is to obtain the first resolved images of these disks at ~5 -15 AU resolution, define the disk sizes and orientations, and uncover disk substructures indicative of planetary perturbations. The results should double the number of debris disks imaged around late-type stars, opening a wider window into the structure of planetary systems.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 12999

Program Title: Are the Progenitors of SN 2002cx-like Objects Massive Stars or White Dwarfs?

Principal Investigator: Ryan Foley

PI Institution: Smithsonian Institution Astrophysical Observatory

The largest class of "peculiar" supernovae (SN) is the SN 2002cx-like class. The SN are observationally similar to Type Ia SN, but with several differences that separate them into their own class. The recently discovered SN 2008ha, which is a member of the class, was extremely faint (M_V = -14.2 mag) and ejected only 0.3 M_sun of material. Despite its similarities to SN Ia, clearly it did not fully disrupt a Chandrasekhar-mass white dwarf. This discovery provoked some to question if it was the result of a massive star whose core collapsed to a black hole shortly after creation of a proto-neutron star, allowing only a small amount of ejecta to escape and creating a weak electromagnetic signature. We propose to observe the SN sites of four very nearby (D < 20 Mpc) members of this class, allowing us to resolve stars in the vicinity of the SN, and place estimates and/or limits on the mass of the progenitor star. If these SN come from massive stars, we should detect other massive stars in their neighborhood. Constraining the progenitors of these objects has far-reaching implications for stellar evolution, SN physics, metal enrichment, and black hole creation rates. This simple experiment should determine if the progenitors were massive stars or white dwarfs.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 13000
Program Title: Impact of Environments on Lyman alpha Emitting Galaxies at High Redshift (z ~ 2.7)

Principal Investigator: Sungryong Hong
PI Institution: National Optical Astronomy Observatory, AURA

In the current paradigm of hierarchical structure formation of the Universe, environment appears to have a critical impact on galaxy formation and evolution. Our team has performed a deep intermediate-band survey for Lyman alpha emission in a ~ 1 deg^2 region (corresponding to ~ 100×100 comoving Mpc^2) around the z = 2.656 Lyα blob discovered by Dey. et al. (2005). This survey has uncovered 2200 Lyα emitting galaxies (LAEs) and two more large Lyα blobs. The blobs lie within a >~60 Mpc (comoving) long filament traced by the LAEs. The number density of LAEs is higher near the blobs, showing an overdensity at least > 3× the field density.

We propose to investigate the effect of environment on LAEs by comparing the properties of those near high density regions with those in the outlying low- density regions of the field. The WFC3/IR F110W (J) and F160W (H) filters are fortuitously positioned right at the redshifted age-sensitive Balmer break region at z = 2.7, ideal for estimating stellar mass and age in the relatively dust-free LAEs. With F139M images, we will also measure the strength of the redshifted [OII](3727,3729) doublet in the LAEs, and thereby estimate (a) the line contamination to the broad-band photometry; (b) the star- formation rate (and compare it to the SFR derived from Lyman alpha and UV continuum; and (c) discover other non-Lyα-emitting [OII] emitters in the field. A detailed comparison of the stellar populations and masses of LAEs and [OII] emitters in low and high density environments will shed light on the formation history of the densest locations in the high-redshift Universe.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 13001
Program Title: SDSS 0921+28: A unique lensed quasar system

Principal Investigator: Eran Ofek
PI Institution: California Institute of Technology

SDSS 0921+28 is a unique small-separation (1.9") lensed quasar system we found recently. Adaptive optics imaging shows several images of at least two lensed objects: A doubly lensed quasar; An inclined quad image of a lensed galaxy; and possibly an image of the lensed quasar host galaxy. As far as we know this is the first example (in visible light) of a galaxy-mass lens which is lensing multiple sources. We estimate that roughly 1\% of the quasar lensed by galaxy

mass objects have images of additional lensed sources. The existence of a lensed quasar that allows to measure the time delay along with many constraints (maybe of sources at different redshifts) will be a powerful tool for cosmological study as well as to probe the quasar host galaxy in great details. Here we propose to obtain 4 band imaging of the system using 2 HST orbits. Combined with the AO K-band observations this will allow to obtain accurate photometric redshift of the different sources; study their morphology and accurately modeling of the lensing potential. Specifically, the accurate modeling of the lensing potential will have important implications for measurements of cosmological parameters.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	13002
Program Title:	Monsters at the Dawn of the Thermal Era: Probing the extremes of galactic mass at z>2.5
Principal Investigator:	Rik Williams
PI Institution:	Carnegie Institution of Washington

There can now be little doubt that a significant population of massive early-type galaxies exists at z~2. Revealed by a combination of wide-field, deep near-IR photometric surveys and medium-resolution near-IR spectroscopy, they look like nothing in the local universe: despite having stellar masses comparable to nearby ellipticals, their average effective radii are 5 times smaller, implying enormous stellar densities. Their formation remains a mystery, as all their stellar mass must have been assembled within the first 1-2 Gyr after the Big Bang. Using new ultradeep, wide-field near-IR imaging, we have now uncovered a population of rare and extremely massive (log M/Msun>11.2) quiescent galaxies at even higher redshifts (2.5<z<3.5). Interestingly, these galaxies do not seem to follow the same size evolution trends as less-extreme galaxies; however, since their sizes are estimated from ground-based imaging, details of their structure (clumps, extended envelopes, and/or multiplicity) cannot be ascertained. These "monster" galaxies are so rare that essentially none will be covered in the infrared by existing large HST surveys. Here we propose WFC3/IR imaging of the 12 most massive quiescent galaxies in our z>2.5 sample to determine their sizes and structural parameters. By combining targeted near-IR imaging of these rare objects with robust sizes of less-massive galaxies from the complementary CANDELS MCT program, we will place the first strong constraints on the structural evolution of the extreme tail of the galaxy population at z~2.7.

Proposal Category:	GO
Scientific Category:	UNRESOLVED STELLAR POPULATIONS AND
ID:	13003
Program Title:	Resolving the Star Formation in Distant Galaxies

Principal Investigator: Michael Gladders

PI Institution: University of Chicago

The fundamental unit of star formation in the Universe is neither a star, nor a galaxy, but a star forming region with a typical scale of at most 100s of parsecs. Even at full HST resolution, these regions are unresolved beyond rather modest redshifts. HST has - and continues to be - heavily invested in studies of distant galaxies, yet has been fundamentally unable to study the relevant physical scales of star formation in the distant Universe. We propose here to overcome this resolution barrier by imaging a total of 73 strongly lensed galaxies at z~1-3 discovered in the SDSS. The combination of the exquisite image quality of HST with the magnification boost due to strong lensing will allow robust measurements of the sizes, luminosities, star formation rates and stellar populations of individual star-forming clumps in these galaxies, providing the first ever comprehensive data on star formation at its fundamental scale over the entire peak of the star formation history in the Universe. The proposed observations build on the extensive legacy of HST deep fields - including the ongoing MCT CANDELS program. A number of ancillary science goals - not least amongst them the study of the lensing systems proper - are also enabled by the proposed data.

Proposal Category: GO

Scientific Category: ISM IN EXTERNAL GALAXIES

ID: 13004

Program Title: The Life Cycle of Dust in the Magellanic Clouds: Crucial Constraints from Zn and Cr depletions

Principal Investigator: Margaret Meixner

PI Institution: Space Telescope Science Institute

Using the COS spectrograph on HST, we propose to measure the interstellar medium (ISM) abundances of Zn and Cr along 17 lines-of-sight across the Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC) with the Zn II and Cr II lines (2026 to 2066 Å). The targets are all well studied O stars, selected to sample different total hydrogen columns and molecular hydrogen fractions. By comparing the abundances of the non-refractory element, Zn with the refractory element, Cr, we can derive a metallicity ([Zn/H]), and a relative measure of dust-to-gas mass ratios ([Cr/Zn] ratio) for each line-of-sight. Our current knowledge of the LMC and SMC dust-to-gas mass ratios is based on estimates from dust emission and gas line emission in the far-infrared to radio wavelength ranges and have uncertainties of factors of >3 because of our imprecise knowledge of the dust composition and total molecular hydrogen gas mass. In comparison, we propose to measure the gas-phase abundances of Zn and Cr to directly calibrate the relative dust-to-gas mass ratio, with an estimated uncertainty of <25%. Moreover, the abundances of Si, Ni, Ti, and Co, determined with no added time, in addition to Zn and Cr, will provide insight on the dust-to-metal ratios for different phases of the ISM across the LMC and SMC. Our results provide crucial constraints for dust evolution models of these galaxies. The 17 Milky Way lines-of-sight that come for free will be an important comparison set. Finally, our experiment provides an important reference point for high-redshift (z > 1-2) observations of Zn and Cr in damped Ly-alpha systems, for which they are used to estimate metallicities and dust-to-gas mass ratios.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 13005
Program Title: Hubble Imaging of a Newly Discovered Main Belt Comet

Principal Investigator: David Jewitt

PI Institution: University of California - Los Angeles

Main-belt comets (MBCs, or ``active asteroids'') have the orbital characteristics of asteroids but also show transient, comet-like activity. Examples of mass-loss likely caused by ice sublimation and by impact 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 MBC discovered in order to help determine the process driving mass-loss.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 13006
Program Title: Measuring the Albedo of HD189733b at Optical Wavelengths

Principal Investigator: Frederic Pont

PI Institution: University of Exeter

The hot Jupiters HD 189733b and HD 209458b are the cornerstones of our current understanding of exoplanetary atmospheres, having been well-observed across a broad range of wavelengths. Significant differences exist between them: the transmission spectrum of HD 209458b reveals a transparent atmosphere dominated by alkali metal lines, in stark contrast to the haze-covered atmosphere of HD 189733b. An exoplanetary atmosphere dominated by optical scattering, due to haze, is expected to possess a relatively high albedo. Measuring the albedo requires detecting the optical secondary eclipse, which has never been accomplished for HD 189733b. We propose to measure the planetary albedo of HD 189733b, thereby elucidating the importance of the observed haze on determining the energy budget of the exoplanet. We require HST STIS observations to not only detect the albedo, but also to measure how it varies with

wavelength as expected from Rayleigh scattering. The first step towards detailed, comparative exoplanetology needs to be built upon a full comparison of the two best-studied exoplanets. Our proposed observations constitute a key part of the global picture of HD 189733b and will elucidate the importance of clouds and hazes on atmospheric chemistry and dynamics.

Proposal Category: SNAP
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 13007
Program Title: UV Imaging of Luminous Infrared Galaxies in the GOALS Sample

Principal Investigator: Lee Armus
PI Institution: California Institute of Technology

A major result of IRAS survey was the discovery of a large population of luminous infrared galaxies (LIRGs) which emit a significant fraction of their bolometric luminosity in the far-infrared, and have log LIR (Lsun) >11.0. With the Great Observatories All-sky LIRG Survey (GOALS), we are measuring the properties of a large, complete sample of low-redshift LIRGs across the electromagnetic spectrum using Chandra, GALEX, HST, Spitzer, Herschel, ALMA and the EVLA. Although selected in the far-infrared, LIRGs are prodigious emitters of UV radiation. Here we propose a WFC3 F225W snapshot imaging program of a sample of 84 LIRGs from GOALS chosen to have existing HST visual and near-infrared imaging and span a large range in IR/UV flux ratios and FUV-NUV spectral slopes. When combined with our existing data, these UV images will allow us to measure the ages and reddening towards nuclear and extranuclear star-forming clusters, gauge the dominant mode of unobscured star formation through a quantitative analysis of the clustered and diffuse UV emission, and correlate the global IR and UV properties of LIRGs with their UV, visual and infrared morphologies from sub-kpc to galactic scales. Since LIRGs become the dominant contributor to the far-infrared background at z~1, a library of rest-frame UV and visual images of local LIRGs is critical for interpreting the visual and near-infrared HST imaging now being analyzed from deep cosmological surveys. The HST imaging proposed here forms a key component of the GOALS project, which will result in the most comprehensive study of local luminous infrared galaxies to date.

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 13008
Program Title: Probing Weak Intergalactic Absorption with Flaring Blazar Spectra

Principal Investigator: John Stocke

PI Institution: University of Colorado at Boulder

We propose to exploit the flaring states of high- and unknown-redshift blazars to obtain very high S/N > 25 COS spectra in order to study details of the local intergalactic medium (IGM) not accessible for study using the plethora of lower S/N data being obtained. Only with very high S/N spectra is it possible to detect the weakest Ly alpha and metal lines wherein may lie a substantial portion of the cosmic baryons. The numbers of weak OVI absorbers can discriminate between collisionally ionized and photoionized models, as well as determine which of several galactic outflow models best matches the IGM metal enrichment. Most importantly, high S/N spectra plus the featureless UV power-law continuum of blazars facilitates the detection of broad, shallow absorbers ["broad Ly alpha" (BLA) and broad OVI-only absorbers] which uniquely probe the T = 3 x 10^5 - 3 x 10^6 K range in the IGM where many cosmic baryons are predicted to be "hiding."

In addition, these same spectra will be used to obtain lower limits on, or estimates of, the redshift for any featureless blazars observed using the foreground Ly-alpha forest absorbers. In some cases weak Lyman alpha emission may also be detected, as was recently discovered for a few well-known low-redshift BL Lac objects using COS spectra. We request up to three *non-disruptive ToOs* to carry out this program in Cycle 19. Ground-based monitoring will select objects flaring to V ~ 13.5 mag for HST observations, out of a set of about 30 monitored blazars.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 13009

Program Title: Studying pre-main sequence stars across the metallicity ladder

Principal Investigator: Guido De Marchi

PI Institution: European Space Agency - ESTEC

The fundamental goal of any star formation theory is to determine where, when, why and how stars form. Understanding where pre-main sequence (PMS) stars are located, how old and massive they are and how much they grow in mass as they approach the main sequence will provide strong constraints to any such theories. We propose to use the HST to identify several thousands PMS stars in the Galaxy and Large and Small Magellanic Clouds (LMC/SMC), so as to probe widely different star-forming conditions. We will accurately measure for each object the position in the natal cloud, the age, the mass and the mass accretion rate. This can be done very efficiently by obtaining Halpha imaging of fields where deep HST photometry already exists in the V and I bands. We have developed a novel method to reliably measure the mass accretion rate using a combination of broad-band (V,I) and narrow-band (Halpha) photometry. Since no spectroscopy is needed, our method can provide the accretion rates for several hundred objects per observed field, including relatively mature PMS stars (20-30 Myr old) still approaching the MS. These observations will tremendously augment the value of archival data by increasing by an order of magnitude to more than 10,000 the number of stars with measured accretion rates, while reaching lower-metallicity environments (~1/3 solar for LMC and ~1/9 for SMC) similar to those in place when star formation in the Universe was at its peak, at redshift z~2. Such a large sample will allow us to study in detail and with high statistical significance how PMS stars accrete mass as a function of their age, chemical composition, mass and location in the star forming region.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 13010

Program Title: A precise calibration of the zero point of the cosmic distance scale from late-type eclipsing binaries in the LMC

Principal Investigator: Fabio Bresolin

PI Institution: University of Hawaii

Eclipsing binaries represent one of the most accurate distance measurement tools available. This is especially true for systems composed of late-type stars, for which a reliable surface brightness-color relationship is now at hand. We have discovered 31 G-type eclipsing binary systems in the LMC wading through 100,000 eclipsing systems catalogued by the OGLE project. We have also uncovered two rare and unique systems in which one of the two components is a Cepheid variable. We have collected near-IR photometry and high-resolution spectroscopy from the ground for all the new systems in order to derive orbital and stellar parameters, and distances. Recently, we published the results for the first of our systems, obtaining a distance modulus to the LMC of 18.50 +/- 0.06. We also derived the dynamical mass of a Cepheid variable contained in one of our binaries with an unprecedented accuracy of 1%. We are now in a position to measure the distance to the LMC, the main anchor point of the extragalactic distance scale, with an accuracy of 1%, using the large number of binaries at our disposal. However, our photometric solutions for the eclipsing binaries assume that there is no blending with nearby companions. Therefore, in order to make full use of the very special stellar systems that we have discovered and obtain a very accurate distance to the LMC, we request multi-band, high spatial resolution WFC3 imaging of 11 of the best systems to check for the presence of companions and characterize their spectral energy distribution.

Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 13011

Program Title: Searching for the H-alpha "Smoking Gun" of Prolonged Star Cluster Formation

Principal Investigator: Thomas Puzia

PI Institution: Pontificia Universidad Catolica de Chile

Recently, deep HST images provided conclusive evidence that several massive intermediate-age star clusters (SC) in the LMC and SMC present extended main-sequence turn-offs (eMSTOs), and in some cases also dual red clumps. This poses serious questions regarding the mechanisms responsible for SC formation. While most recent studies indicate that the eMSTOs are caused by a range in stellar age of about 150-500 Myr among cluster stars, the obvious and important question is: Why has this not been observed yet in SCs in that age range? Our calculations show that prolonged star formation in SCs requires a cluster escape velocity in excess of about 10 km/s, and there really is only one SC in the Local Group that has the right mass and size to be able to retain mass loss in slow winds of the first stellar generation and be young enough to have some of its second stellar generation being still on the pre-main sequence (PMS) and showing emission-line signatures: the 300 Myr old cluster NGC 1856 in the LMC. Since this SC has no adequate HST imaging in the archive to detect an eMSTO, we propose to obtain deep broad-band imaging in F438W, F555W, F814W with WFC3/UVIS to analyze the MSTO and use F656N to search for Balmer-line emission signatures

from PMS stars of the secondary stellar generation. The detection of the PMS phase in this cluster (or lack thereof) will have a lasting impact on our understanding of the eMSTO phenomenon. This SC represents a unique opportunity to render insights on the relative importance of various types of polluter stars of the first generation that have been proposed to be responsible for the chemical enrichment of second-generation stars in star clusters.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 13012
Program Title: Near-equinox spectro-imaging of Uranus aurorae sampling two planetary rotations

Principal Investigator: Laurent Lamy
PI Institution: Observatoire de Paris - Section de Meudon

A quarter of century after their discovery by Voyager 2 in 1986, HST sucessfully re-detected Uranus aurorae in 2011 (and also in 1998), providing the first images of these emissions. Overall, they differ from other well-known planetary aurorae, and their characteristics vary at very different timescales, from minutes to decades. These results have provided the first insights on the poorly known Uranian magnetosphere in 26 years, and opened a rich field of investigation, together with a set of open questions. In addition, while solstice conditions prevailed in 1986, Uranus lay close to equinox in 2011, with the S and N magnetic poles alternately facing the Sun every half a rotation. This unique configuration of an asymmetric magnetosphere, extremely variable over a single rotation, had never been investigated before and deserved to be fully analyzed. New observations of the Uranian aurorae are therefore vital for our understanding of planetary magnetospheres, and HST is the only tool able to remotely investigate these emissions. We thus propose to re-observe Uranus with STIS spectro-imaging at next opposition (29 Sept. 2012) over two planetary rotations, in order to enlarge the set of positive detections and to sample the rotational dynamics of auroral processes and magnetosphere/solar wind interaction. To increase the probability of any possible auroral brightening triggered by magnetospheric compressions, observations will be scheduled in advance during active solar wind conditions at Uranus, near the maximum of solar cycle 24. Additional objectives will include the characterization of the extended neutral corona and the spectral response of atmospheric species.

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 13013
Program Title: How Extended was Helium II Reionization? A Statistical Census Probing Deep into the Reionization Era

Principal Investigator: Gabor Worseck
PI Institution: University of California - Santa Cruz

The advent of GALEX and HST/COS have revolutionized studies of HeII reionization. In Cycle 17 we pioneered an effective strategy that combines highly efficient GALEX/FUV selection with HST/COS spectroscopy. Our proven

approach now accounts for more than half of the science-grade HeII Ly-alpha transmission spectra in the HST archive. The clear picture emerging from these data is that z~2.7-3 marks the end of HeII reionization. However, comparison to our state-of-the-art radiative transfer simulations indicates that the duration of HeII reionization and its stochasticity remain virtually unconstrained because of the sparseness of current data at z>3. It is thus unequivocal that the path forward is COS spectra of higher redshift (z>3) QSOs deep into the reionization era. Further, a statistical census is crucial given the large sightline-to-sightline variance implied by limited existing data and verified by our numerical models. We request 21 orbits to obtain science-grade COS far-UV spectra of 7 UV-bright QSOs (newly discovered by our dedicated survey), which will double the HeII pathlength at z>3. Comparison of the distribution of HeII optical depths to our simulations will constrain the duration and stochasticity of reionization. Additional leverage will be obtained by observing the anticipated spectral hardening of the UV radiation field as reionization progresses, achieved by combining HeII transmission with ancillary coeval HI Ly-alpha forest spectra. Our survey also enables statistical investigations of the sources of HeII reionization from the HeIII QSO proximity zones, and by identifying foreground QSOs via a dedicated ground-based imaging and spectroscopic survey.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 13014
Program Title: The Host Galaxies of High-Luminosity Obscured Quasars at z~2.5

Principal Investigator: Michael Strauss
PI Institution: Princeton University

Active Galactic Nuclei play a key role in the evolution of galaxies. However, very little is known about the host galaxies of the most luminous quasars at z~2.5, the epoch when massive black hole growth peaked. The brightness of the quasar itself, which can easily outshine a galaxy by a large factor, makes it very difficult to study emission from extended gas or stars in the host galaxy. We propose to image extended emission from the host galaxies of a unique sample of six optically extincted (Type II) luminous quasars with z~2.5, with WFC3/F160W in the rest-frame optical longward of 4000A and ACS/F814W in the rest-frame near-ultraviolet. These objects are selected from the spectroscopic database of the SDSS/Baryon Oscillation Spectroscopic Survey to have strong, narrow emission lines and weak continua. Because the central engines are obscured, we are able to image their low surface brightness hosts. With these images, we will quantify the luminosity, morphology, and dynamical state of the host galaxies, and search for extended scattered light from the obscured central engine. Our proposed HST observations will be the first comprehensive study of both host galaxy light and scattered light in high-luminosity quasars at the epoch of maximum black hole growth, and will give insights into the relationship between host galaxies and black holes during this important, and yet largely unexplored period.

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 13015

Program Title: WPVS 007: Acceleration or Evolution in a Broad Absorption Line Outflow

Principal Investigator: Karen Leighly

PI Institution: University of Oklahoma Norman Campus

Outflowing gas, recognised through broad absorption lines, is an important component of AGN and quasars. Outflows remove angular momentum, enrich the intergalactic medium, and possibly play a key role in the evolution of galaxies. Yet outflow astrophysics remains poorly understood. Absorption line variability is a potentially valuable too, offering constraints on distance from the continuum emission region, density, and homogeneity and stability of the outflow.

Dramatic absorption-line variability has been observed in the Seyfert-luminosity AGN WPVS 007 (M_V=-19.7, z=0.02882). Observed to have a miniBAL with maximum velocity v_max~1000 km/s in an 1996 HST observation, it was discovered to have developed an additional BAL flow by the time of the FUSE observation in 2003. The BAL flow had a maximum velocity of 6,000 km/s, and the unambiguous presence of PV indicated that it is very optically thick. A third observation by HST COS in 2010 shows further dramatic variability, a shift of the BAL to higher velocities of ~8,000 km/s. Yet the absorption profile is similar to that observed in 2003, suggesting acceleration.

We propose two COS observations designed to reveal the origin of the dramatic variability in WPVS 007. WPVS 007 is an extreme object, but it may be key to understanding outflows, since its low luminosity for such a high-velocity outflow challenges acceleration mechanisms, and its small size means that we may be able to see, on human time scales, phenomena important in all quasars.

Proposal Category: GO

Scientific Category: AGN/QUASARS

ID: 13016

Program Title: The Nature of Partial Covering in Broad Absorption Line Quasars

Principal Investigator: Karen Leighly

PI Institution: University of Oklahoma Norman Campus

Ejected gas is seen as broad absorption lines in ~20% of quasars. It has been known for ~15 years that prominent lines such as CIV are usually saturated but not black because the absorbing gas only partially covers the continuum emission region. Therefore, column densities estimated from these lines are only lower limits. Accurate column densities can be obtained from rare ions that have two or more transitions from the same lower level, so that the optical depth and covering fraction can be solved for simultanously. Suitable lines are hard to find, so such measurements are rare. We have found that metastable helium is particularly useful for these measurements. Yet despite these advances, partial covering remains a just a parameter and its physical nature is not understood.

We propose a unique experiment to constrain the physical nature of partial covering. We will compare the covering fraction measured from PV (a doublet in the far UV) with that measured from metastable HeI (optical and IR). The ions creating these lines are relatively rare, and they present similar opacity over a wide range of gas parameters. But due to their wide wavelength separation, these lines probe dramatically different regions of the continuum source, the temperature-dependent accretion disk. So we expect different covering fraction behavior for different partial covering scenarios. This experiment is relevant for understanding the geometry and clumpiness of the outflow, and the results may impact our understanding of the global covering fraction, a parameter critical for determining the outflow kinetic

luminosity, and thereby estimating feedback efficiency for broad absorption line outflows.

Proposal Category:	GO
Scientific Category:	ISM IN EXTERNAL GALAXIES
ID:	13017
Program Title:	UV Spectroscopy of Lyman Break Galaxy Analogs: A Local Window on the Early Universe
Principal Investigator:	Timothy Heckman
PI Institution:	The Johns Hopkins University

UV-selected galaxies at high redshift (LBGs at z~3-10) are the most direct tracers of the early evolution of galaxies and the IGM, but it is difficult to investigate these faint and distant objects in detail. To address this, we have been performing a major program using GALEX and the SDSS to find and study the only type of nearby galaxy that shares many properties with LBGs. These local "Lyman Break Analogs" (LBAs) resemble LBGs in terms of morphology, size, UV luminosity, SFR, mass, velocity dispersion, metallicity, and dust content, allowing us to use them as local laboratories for better understanding of the relevant processes at high-z. Our data includes UV/optical imaging with HST (95 orbits in Cy15-16), X-ray (Chandra, XMM), optical/NIR spectroscopy (VLT, Keck), infrared (Spitzer, Herschel) and radio (VLA, VLBI).

Our Cycle 17 exploratory program with COS revealed numerous new details based on a small sample of LBAs with direct implications for high-z. Most intriguingly, we found strong connections between extreme SN-driven winds (v~1000 km/s), a non-uniform covering by neutral hydrogen, complex Lya profiles, and interstellar absorption lines highly suggestive of a non-zero Lyman continuum escape fraction. Following the tenfold increase in the area surveyed in the UV by GALEX, we have compiled the largest statistical sample of LBAs to date, including many new targets bright enough for COS. We wish to extend our sample size by a factor of 3 to robustly characterize these extraordinary starbursts in the UV. In so-doing it will also shed new light on the complex astrophysics of starbursts, galaxy formation, and enrichment and heating of the IGM in the early universe.

Proposal Category:	GO
Scientific Category:	RESOLVED STELLAR POPULATIONS
ID:	13018
Program Title:	Deciphering the Assembly History of Galactic Disks: The Resolved Record in the Outer Disk of M31
Principal Investigator:	Annette Ferguson
PI Institution:	University of Edinburgh, Institute for Astronomy

Disk galaxies account for a sizeable fraction of the stellar mass in the Universe yet the details of their formation and evolution are poorly understood. Measurements of the radial star formation and chemical enrichment histories across disks provide key constraints on models and are made with the highest precision in nearby systems where stellar populations can be resolved into individual stars. In a previous cycle, we obtained deep HST/ACS observations of a field at 26 kpc in M31's outer disk which we have used to reconstruct the star formation history back to early epochs. Our results are fascinating -- star formation at this location proceeded at a near constant rate until 5 Gyr ago when there

was a rapid decline in activity followed by a short intense burst. This burst, centered at 2 Gyr, created ~25% of the stellar mass and coincides with a sharp drop in metallicity, highly suggestive of the inflow of metal-poor gas. Dynamical models of the M31-M33 interaction favour ~2-3 Gyr ago as the last pericentric passage, when the systems were within ~50 kpc of each other. In order to firmly establish the role this interaction played in triggering star formation in M31's outer disk, we request similar depth observations at two additional locations in order to determine if the behaviour derived from this single field is globally representative. Additionally, these pointings will span a considerable baseline over which to examine radial gradients in the old (> 5 Gyr) populations and, when combined with extant Keck radial velocities, will provide an exquisite dataset with which to test ideas about radial migration and disk galaxy assembly.

Proposal Category:	GO
Scientific Category:	COOL STARS
ID:	13019
Program Title:	Probing the Complicated Atmospheres of Cepheids with HST-COS: Plasma Dynamics, Shock Energetics and Heating Mechanisms
Principal Investigator:	Edward Guinan
PI Institution:	Villanova University

Classical Cepheids, although well studied in terms of their cosmologically important Period-Luminosity Law, are proving to be increasingly complex and astrophysically intriguing in terms of the atmospheric energetics. This proposal expands Cycle 17/18 programs to probe Cepheid atmospheres and understand the mechanisms by which they are heated. Our previous COS spectra revealed a wealth of 10,000-300,000K plasma emission lines (far beyond what previous IUE data show due to severe scattered light contamination), phase-locked with the Cepheid pulsation periods, indicating that a pulsation-driven heating mechanism is at work. We propose multiple observations of selected Cepheids (delta Cep, beta Dor and l Car) with HST-COS through the G130M & G160M gratings, to provide comprehensive and detailed diagnostics of the atmospheric plasmas of Cepheids with a range of periods and pulsation types, and give the best look yet at how large-scale, radial pulsations affect the upper atmospheres of supergiants. The phase constraints placed on some of the visits will allow phase-lags between the emission lines to be detailed, giving important additional information on the heating mechanism and extents of the atmospheres. Numerous emission lines are covered by the G130M and G160M wavelength range (~1150-1750A), including N V 1240, O I, C IV 1550 and He II 1640. When combined with our approved and future proposed X-ray observations of Cepheids, the HST-COS data will allow us to construct an understanding of Cepheid atmospheric plasmas with temperatures of tens of thousands to millions of degrees -- the most thorough atmospheric study to date for this important class of pulsating stars.

Proposal Category:	GO
Scientific Category:	COOL STARS
ID:	13020
Program Title:	A Comprehensive COS Study of the Magnetic Dynamos, Rotations, UV Irradiances and Habitability of dM Stars with a Broad Span of Ages

Principal Investigator: Edward Guinan

PI Institution: Villanova University

We propose HST/COS FUV spectrophotometry of a carefully selected sample of 9 dM1-5 stars with recently reliably determined ages ranging from ~1-12 Gyr. This program complements our Chandra Cycle 13 program of the same targets to determine their coronal X-ray properties. Ages (of all but one star) have recently been firmly determined from memberships in wide binaries with white dwarf (WD) companions having reliable cooling time+main-sequence evolution ages (Zhao et al. 2012, Garces et al 2011). Until these studies, reliable age determinations for dM stars >2 Gyr were nearly impossible. However, we can now carry out a comprehensive UV study of dM star atmospheres across nearly the full age-range of the current Universe. The primary goals are 1) to study the evolution of their dynamo-generated X-ray and UV (XUV) emissions with age/rotation and to better define the heating and energetics of their atmospheres (via Age-Rotation-Activity-XUV Irradiance relations) and 2) to study the effects of the XUV radiation on planets hosted by red dwarfs. The COS UV spectral region contains numerous important diagnostic emission lines for characterizing the energy transfer and atmospheric structure, while line ratios yield valuable information about the electron density. Further, these data (when combined with our coronal X-ray measures) are also important for gauging dM star XUV emissions – critical for assessing the photochemical & photoionization evolution of planetary atmospheres and ionospheres that in turn strongly affect the possible development of life on hosted extrasolar planets. We are requesting a total of 19 HST orbits to achieve the science goals of the program.

Proposal Category: GO

Scientific Category: EXTRA-SOLAR PLANETS

ID: 13021

Program Title: Revealing the Diversity of Super-Earth Atmospheres

Principal Investigator: Jacob Bean

PI Institution: University of Chicago

Recent surveys have revealed an amazing, and yet unexplained, diversity of super-Earth exoplanets. Atmospheric studies are the key to improving our understanding of the nature and origins of these mysterious worlds. HST has been successful at characterizing the atmospheres of hot, giant exoplanets through transit spectroscopy observations. However, revealing the properties of super-Earth atmospheres requires an order of magnitude more precision than is needed for Hot Jupiters.

We propose an intensive transmission spectroscopy survey of three super-Earth archetypes to definitively determine the compositions of their atmospheres. Our targets are the most compelling super-Earths because they have measured masses and radii, span a range of equilibrium temperatures, and are the most feasible for atmospheric study. WFC3 spectroscopy from 1.1 - 1.7 microns will reveal the water abundance and overall composition of the atmospheres of GJ 1214 b and HD 97658 b. STIS spectroscopy of the sodium D lines for 55 Cnc e will reveal the composition and evaporation rate of this super-hot planet's secondary atmosphere. Just detecting the atmospheres of these planets is not enough; precise measurements are now mandatory to constrain theoretical models, and such data can only be obtained with an intensive program. A survey is needed because we will only be able to understand these individual objects, and the other exoplanets they represent, by looking at their collective diversity. This project can only be done with HST because of the requisite precision and the necessity of observing water bands. This work will pave the way to the future characterization of habitable exoplanets with JWST.

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND
ID: 13022
Program Title: Staring into the Beasts' Lair: HST Observations of the Host Galaxies of Pan-STARRS Ultra-luminous Supernovae

Principal Investigator: Edo Berger
PI Institution: Harvard University

The advent of wide-field optical time-domain surveys is providing an opportunity to discover and decipher new classes of astronomical transient phenomena. One of the most unexpected results from Pan-STARRS and other time-domain surveys is the discovery of ultra-luminous supernovae (ULSNe), with bolometric luminosities up to 100 times higher than normal core-collapse and Type Ia supernovae (SNe), and with spectra that do not match known SN classes. These ULSNe represent a new challenge to our understanding of the deaths of massive stars, the standard core-collapse picture, and the mechanism for powering optical emission in SNe. Progress in our understanding of these mysterious explosions requires detailed studies of their light curves and spectra (available from our Pan-STARRS data and follow-up), and studies of their galactic and sub-galactic environments - the focus of this HST proposal. Here we propose rest-frame UV and optical observations of 5 Pan-STARRS ULSNe at z~1-1.5, whose hosts remain undetected from the ground to limits of r,i~25 mag. The observations will reach about 0.02 L* in the UV/optical (SFR~0.2 Msun/yr and M*~10^9 Msun), comparable to the least luminous hosts of GRBs and SNe. Taking advantage of HST's angular resolution we will also study the locations of the ULSNe relative to their host UV light distribution as a probe of the progenitor population (similar studies of GRBs and core-collapse SNe suggest distinct types of massive star progenitors). Thus, with a modest allocation of 8 HST orbits (combined with existing data on the transients from Pan-STARRS), we will begin to address one of the key new mysteries in time-domain astrophysics.

Proposal Category: SNAP
Scientific Category: AGN/QUASARS
ID: 13023
Program Title: Universe in transition: powerful activity in the Bright Ages

Principal Investigator: Marco Chiaberge
PI Institution: Space Telescope Science Institute - ESA

At 1<z<2, star formation is vastly more vigorous than it is currently, the AGN phenomena is about 1000 times more common, and numerous powerful, massive radio galaxies and quasars are found. Are galaxies assembling themselves at such redshifts; are black holes in the final stages of merging; what is the exact fraction of high-z radio galaxies and quasars that reside in clusters; is the AGN fundamentally influencing its cluster environment; does the AGN trigger or quench star formation on galaxy or galaxy-cluster scale; how do the fundamental relationships between star formation, black hole mass and bulge mass come into being? We propose to conduct a two-filter WFC3 SNAPSHOT of the 3C radio sources at z>1; these are the most powerful radio galaxies that exist at such redshifts, galaxies which are progenitors of the most massive, dominant cluster ellipticals. Our observations will reveal with unprecedented clarity the star formation at a critical moment in the evolution of these objects and the development of their host clusters. We will

reveal the cluster environment of these systems in the final stages of hierarchical merging, at a time when dramatic activity across the board is laying down the template for the Universe as we see it today. We will compare young and evolved populations and probe the influence of the powerful AGN, and possibly discover new unexpected features, as we did thanks to our previous snapshot programs. This program will complement and expand our previous 3C snapshots, that provide a benchmark against which to compare the activity of a critically important component of the Universe at a fundamental turning point in cosmic evolution.

Proposal Category:	SNAP
Scientific Category:	QUASAR ABSORPTION LINES AND IGM
ID:	13024
Program Title:	A Public Snapshot Survey of Galaxies Associated with O VI and Ne VIII Absorbers
Principal Investigator:	John Mulchaey
PI Institution:	Carnegie Institution of Washington

Recent simulations and observations indicate that the majority of O VI and Ne VIII absorption-line systems originate in the halos of galaxies. These systems therefore provide a unique probe of the circumgalactic medium. The study of these warm baryons is a major component of the COS mission and already over one hundred QSOs have been targetted with COS for such studies. However, a complete understanding of these systems is only possible with detailed studies of the galaxies associated with the absorbers. Ground-based spectroscopic surveys of the galaxies around COS QSOs are on-going by our team and others. Missing from these studies, however, is morphological information on the absorbing galaxies. Given the redshifts of the COS O VI and Ne VIII systems, only HST can provide the spatial resolution needed for such morphological studies. Here, we propose a snapshot imaging survey using ACS/WFC of the fields around COS QSOs to obtain morphologies of COS-discovered O VI and Ne VIII systems. Our survey will add significantly to the legacy of the COS observations by allowing a more complete understanding of the galaxies responsible for the absorption. We waive the proprietary period on these observations so COS GOs can take full advantage of the imaging data for their own analysis.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	13025
Program Title:	Unveiling the progenitors of the most luminous supernovae
Principal Investigator:	Andrew Levan
PI Institution:	The University of Warwick

Recent years have seen the discovery of a number of highly luminous core-collapse supernovae (SNe). We propose to conduct a survey of the host galaxies of a sample of the brightest of these events. By using the unmatched sensitivity and resolution of WFC3 we will characterise the locations of the SNe within their hosts and compare them with the locations of classical core collapse supernovae, and GRBs, and against theoretical predictions for the locations of massive stars. We will also determine the morphologies, sizes, and luminosities of the host galaxies and hence infer their star formation rates and stellar masses. Using this combined information we will directly test models that posit that the most luminous SNe originate from very massive, low metallicity stars which undergo pair instability core-collapse. Our proposed observations will allow us to discriminate between these models and alternatives such as magnetar powered events, and so will enable decisive steps towards the identification of the progenitors of these extreme and enigmatic transients.

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 13027
Program Title: Escape of Lyman photons from Tololo 1247-232

Principal Investigator: Goeran Oestlin
PI Institution: Stockholm University

Tololo 1247-232 is a unique galaxy in the local universe in that it is the best Lyman continuum emitter candidate in the whole FUSE archive. Moreover, it has an unusually blue continuum in the spectral region just longwards of the Lyman limit, and it is a bright Lyman alpha emitter. Hence, this galaxy has an enourmous potential as an astrophysical laboratory where the fate and transport of ionizing and Hydrogen recombination line photons can be studied in detail.

To substantiate these findings, HST follow up with COS spectroscopy, and imaging, is required. We propose to map the far UV morphology with ACS/SBC. By adding observations with WFC3/UVIS we can in addition map the near UV spectral slope, Lyman alpha, Halpha and Hbeta at HST resolution. We will use this information to properly position the COS aperture and the images will also be vital for the analysis of the COS spectra themselves.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 13028

Program Title: Is the First Epoch of Star Formation in Satellite Galaxies Universal?: M31 vs. Milky Way dSphs

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 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 due to differences in the evolutionary histories of their host galaxies. Only the proposed deep HST imaging will allow us 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 the only galaxies for which these observations are possible. Here, in phase I of this project, we propose observations for 2 of the 7 galaxies in our representative sample.

Our observational strategy has been validated in a successful large HST program on isolated Local Group dwarfs at similar distances. By combining our primary ACS imaging with parallel WFC3 observations and exquisite wide-field imaging from Subaru we will produce holistic evolutionary histories for our target galaxies. Our team, consisting of stellar population and variable star experts and stellar evolution and galaxy evolution theorists, is prepared to efficiently analyze and carefully interpret the proposed observations.

Proposal Category: SNAP

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 13029

Program Title: A Snapshot Survey of the Sites of Recent, Nearby Supernovae

Principal Investigator: Alex Filippenko

PI Institution: University of California - Berkeley

During the past few years, robotic (or nearly robotic) searches for supernovae (SNe), most notably our Lick Observatory Supernova Search (LOSS), have found hundreds of SNe, many of them in quite nearby galaxies (cz < 4000 km/s). Most of the objects were discovered before maximum brightness, and have follow-up photometry and spectroscopy; they include some of the best-studied SNe to date. We propose to conduct a survey program to image the sites of some of these nearby objects, to obtain late-time photometry that will help reveal the origin of their lingering energy. The images will also provide high-resolution information on the local environments of SNe that are far superior to what we can procure from the ground. For example, we will obtain color-magnitude diagrams of stars in these SN sites, to constrain the reddening and SN progenitor masses. We will provide statistics on the light echoes around SNe, an important clue to their progenitor systems. We also propose to image several "SN impostors" -- faint SNe IIn with massive progenitors -- to verify whether they are indeed superoutbursts of luminous blue variables and survived the explosions, or a new/weak class of massive star explosions. Finally, the data will add multi-filter, deep images of many nearby galaxies to the HST archive for future studies such as galaxy morphology, stellar populations, SN progenitors, and variable stars.

Proposal Category: GO
Scientific Category: HOT STARS
ID: 13030
Program Title: Early Time UV Spectroscopy of a Stripped-Envelope Supernova: A New Window

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

We propose to continue our Cycle 19 program and obtain 4 epochs of UV spectroscopy of a Target of Opportunity stripped-envelope core-collapse supernova during 2 weeks roughly centered on 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 supernovae (SNe) of all types will be found in future high-redshift transient surveys, but the ability to distinguish between thermonuclear Type Ia SNe and stripped-envelope core-collapse SNe will require thorough knowledge of the latter, especially at UV wavelengths. The spectra will lead to several new insights. 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. With coordinated observations of the SN in the optical and near-IR using our ground-based programs, we will be able to comprehensively characterize the nature of the emission radiated by these SNe. The heterogeneity seen in stripped-envelope SNe will allow us to choose a transient with different characteristics than the one to be observed in Cycle 19, gaining further insights into this unique class of cosmic explosion.

Proposal Category: SNAP
Scientific Category: SOLAR SYSTEM
ID: 13031
Program Title: Testing Collisional Grinding in the Kuiper Belt

Principal Investigator: William Grundy
PI Institution: Lowell Observatory

We propose a SNAP survey of 56 small Cold Classical TNOs to compare their colors and rate of binarity to larger members of this most-primitive Kuiper belt group. Collisional grinding models that can explain the observed turn-over in the magnitude-frequency distribution imply that small binaries should also be disrupted, but at a brighter, more readily observable threshold. Likewise, collisional erosion could expose differently-colored interior materials. If we do

not see a decline in binary rates and a change in color statistics, these observations would pose a challenge to the collisional grinding scenario, suggesting instead that the magnitude-frequency distribution turnover is a more ancient signature of the planetesimal accretion process.

Proposal Category:	GO
Scientific Category:	ISM AND CIRCUMSTELLAR MATTER
ID:	13032
Program Title:	Crossing the Snow Line: Mapping Ice Photodesorption products in the Disks of Herbig Ae-Fe stars
Principal Investigator:	Carol Grady
PI Institution:	Eureka Scientific Inc.

Water is a key constitutent of protoplanetary disks. In our Solar System, small, icy grains are thought to have boosted the disk solid surface density, setting the stage for icy planetesimal formation and ultimately the growth of gas giant planets, while water vapor warms the disk, facilitating chemistry. Survival of water, in either phase, is sensitive to the UV radiation field. Intermediate-mass PMS stars, the Herbig Ae stars, straddle the temperature range where icy grains can survive within 10 AU of the star to systems where ice is photodesorbed at the disk surface to beyond 100 AU. Far-IR studies with Herschel have shown that, while water vapor is rarely detected for Herbig Ae stars, its dissociation products such as OH and O I are common. Such data lack the spatial resolution to directly constrain where water in any phase is located. An alternate approach exploits HST's superb angular resolution and disk-to-star contrast in the FUV using HST STIS long-slit spectroscopy. Such observations can map the spatial distribution of water's other dissociation product, H I at Lyman alpha, with 7 AU resolution. The same spectra also simultaneously trace molecular hydrogen and dust, enabling an additional test of whether the HI traces the dust or the molecular gas in these stratified disks. We propose obtaining STIS G140M spectra at Lyman alpha for 4 otherwise well-studied Herbig Ae-Fe stars to test the hypothesis that spatially extended H I in these systems provides a fossil record of where ice was located in the disk which can be compared with where giant planets are found in these disks.

Proposal Category:	GO
Scientific Category:	ISM IN EXTERNAL GALAXIES
ID:	13033
Program Title:	COS-Halos: New FUV Measurements of Baryons and Metals in the Inner Circumgalactic Medium

Principal Investigator: Jason Tumlinson

PI Institution: Space Telescope Science Institute

To understand the origins of galaxies, we must discover how they obtain gas from the IGM and how they return it to their environment. Two key problems face us now. First, how much total mass is in the circumgalactic medium (CGM), and how does this vary with galaxy properties? Second, what is the metallicity distribution of halo gas, and does it reflect the dominance of metal-rich ejection by galaxies, accretion of gas-rich satellites, or low-metallicity accretion from the IGM? We propose to obtain a set of 14 direct measurements of total gas (H+metals) content and metallicity for a well-characterized, unbiased sample of galaxies from the Cycle 17 COS-Halos survey. We will use the G140L or G130M/1222 settings of COS to measure HI column densities, NHI, to ~0.3 dex precision using the proven "Lyman limit" (LL) technique. COS provides the unique capability to observe at wavelengths near 1000 Å, so these are measurements that only HST can do. Our data will measure the baryonic content of these galaxy halos with direct Lyman-limit based measurements of N_HI. Using the newly determined HI column densities and the metal lines detected as part of the original COS-Halos Cycle 17 program, we will measure the metallicities of these systems and with these test models of galaxy accretion and feedback. These COS-Halos galaxies are already well-characterized by ground-based spectroscopy, including precise redshifts, SFRs, and metallicities, making for a uniform and well-defined sample. This proposal maximizes the science return of the large COS-Halos program for a modest additional investment by significantly increasing the number of HI and metallicity measurements in CGM gas.

Proposal Category: GO

Scientific Category: HOT STARS

ID: 13034

Program Title: A Homunculus Around the Star NaSt1 (WR122)?

Principal Investigator: Jon Mauerhan

PI Institution: University of Arizona

Eruptive mass loss during the LBV phase is the most puzzling aspect of massive stellar evolution, posing a serious limitation to theoretical models. Yet we know this is the key channel by which massive stars lose their hydrogen envelopes and become Wolf-Rayet stars. LBV eruptions also explain the phenomenon of supernova "impostors", and are the origin of luminous Type IIn supernovae. Our ignorance has partly persisted because there are so few Galactic examples for detailed study. Eta Car is only object to have recently experienced a giant eruption that is still embedded in a dense, massive, and highly CNO-processed outflow. Because of the compact size, most of what we know about Eta Car has been the result of HST observations. There is no known Galactic analog of this extremeness, so we do not know whether Eta Car represents a unusual or universal occurrence.

NaSt1 (aka WR 122) is an evolved, luminous, hot star that is also embedded in a dense CNO-processed outflow. The system shares more characteristics with Eta Car than any other object known. The main difference appears to be the fact that the central star is suspected to be a hot WR, so the system could represent what Eta Car will look like after it experiences another giant eruption. Like Eta Car, NaSt1's nebula is very bright in the light of [NII]. Although it exhibits a hint of bipolarity, it is very compact (7" diameter). Thus, ground-based imaging is unable to elucidate the object's nature. We propose a simple, narrow-band imaging experiment with HST/WFC3 to determine the precise morphology of NaSt1's [NII] nebula. The data will reveal whether NaSt1 is truly an Eta Car analog, or something entirely different.

Proposal Category:	GO
Scientific Category:	SOLAR SYSTEM
ID:	13035
Program Title:	A unique opportunity to discover how energy is transported through Jupiter's magnetosphere
Principal Investigator:	Sarah Badman
PI Institution:	Institute of Space & Astronautical Science

The Japanese Aerospace Exploration Agency (JAXA) EUV spectroscopic mission, EXCEED, will be launched to low-Earth orbit in August 2013. EXCEED's primary mission goal is to simultaneously observe the Jovian aurora and Io plasma torus (IPT) with unprecedented temporal resolution, quasi-continuously (50 min per 100 min orbit) for at least two full months. We propose a multi-wavelength campaign of coordinated observations using HST and NOAO facilities that, together with the observations by EXCEED, provide a unique opportunity to discover how energy is transferred throughout Jupiter's vast, dynamic magnetosphere and its interaction with the solar wind. EXCEED spectral imaging of ion emission lines will reveal temporal and spatial variations in the IPT, to diagnose the dynamics in the inner magnetosphere, and relate the dynamics to Jupiter's auroral intensity and spectra. These novel observations will reveal plasma heating and electron precipitation driven by both local and global disturbances. Coordinated high spatial-resolution HST-STIS images of the UV aurora are essential to reveal the global morphology of the aurora, i.e. to pinpoint where the energy deposited in the upper atmosphere originates in the magnetosphere. Simultaneous visible wavelength observations of the IPT by WIYN will provide the low-energy component of the ion emission spectrum to identify heating and density fluctuations of the local plasma. Coordinated observations of the infrared (IR) aurora by Gemini will reveal the ionospheric heating and cooling in the corresponding auroral regions. These observations will provide a huge, novel science return for a small investment of HST and NOAO observation time.

Proposal Category:	GO
Scientific Category:	AGN/QUASARS
ID:	13036
Program Title:	Hubble Observations of Kepler-Monitored AGN - GO orbits
Principal Investigator:	Richard Mushotzky
PI Institution:	University of Maryland

It is thought that some fraction of AGN optical variability is generated internally by viscous processes in the accretion disk and the remainder by the "reprocessing" by the disk of external emission from the variable, compact x-ray source. These two processes operate on very different timescales. For the past two years we have obtained high-precision, densely-sampled, long-duration optical light curves from Kepler and coordinated x-ray monitoring for a sample of AGN. These permit for the first time the measurement of both the optical variability of AGN over a wide range of timescales and its detailed relation with the x-rays, allowing a characterization of the relative importance of these two processes.

In order to properly model the disk emission and probe the origin of the variability, it is necessary to measure and

subtract off the substantial but uncertainty contribution due to starlight in the underlying galaxy. Without this measurement it is impossible to determine the amplitude of the AGN variability. This cannot be accomplished with the Kepler data due to its poor angular resolution but instead requires high spatial resolution data that can only be obtained with HST. This and a companion proposal request 2 GO and 7 SNAP orbits for WFC3 imaging of the relatively low-redshift ($z < 0.16$) AGN that we are currently monitoring with Kepler. This will allow a determination of the absolute amount of variability, which in turn will establish the relative importance of intrinsic and reprocessing phenomena in the disk. Thus these proposed HST observations are crucial to obtain the full value of the already-extraordinary Kepler AGN light curves.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 13037
Program Title: Determining the orbit of Fomalhaut b and discovering structure in the debris belt

Principal Investigator: Paul Kalas

PI Institution: University of California - Berkeley

HST has a unique capability to detect tenuous debris disks and exosolar planets at optical wavelengths. Using the ACS/HRC in 2004-2006, we imaged the debris belt surrounding Fomalhaut, finding evidence for a planetary system in the structure of the belt, and then directly imaging a planet candidate, Fomalhaut b. New STIS data recover Fomalhaut b in 2010 with the expected flux and near its expected position. We also discover a tenuous belt halo extending 30 AU beyond the previously measured outer belt edge, demonstrating that the belt structure is more complex than initially assumed.

We propose a GO program dedicated to the study of Fomalhaut b's orbit and structure in the belt. The goals are to constrain the orbital elements of Fomalhaut b and establish with confidence that it is bound. The proposed astrometry is designed to measure the eccentricity with sufficient precision to discriminate between a circular orbit and one that is nested within the belt with $e \sim 0.12$. STIS is the only instrument that is demonstrably capable of making these astrometric observations. Moreover, we propose to build a high signal-to-noise image of the belt by combining the proposed Cycle 20 data with those obtained from previous cycles. The Fomalhaut system is of general interest to the community, particularly for studying the dynamical evolution of planetary systems relative to their outer planetesimal belts. Given its proximity (7.7 pc), Fomalhaut's belt is a rare example where we can resolve disk structure on sub-AU scales. The proposed additional STIS observations are critical for discerning between real astrophysical features and instrumental noise.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 13038
Program Title: Westerlund 2, top to bottom: how massive star clusters form.

Principal Investigator: Antonella Nota

PI Institution: Space Telescope Science Institute - ESA

Massive stellar clusters are the main indicators of star formation activity in the distant universe, still their origin and evolution is only partially understood.
We have demonstrated that combining deep high resolution optical and IR photometry is a powerful method to investigate the initial phases of massive stellar clusters. We are now proposing to obtain deep, high resolution ACS and WFC3 observations designed to individually resolve and measure stars in Westerlund 2 (Wd2), one of the youngest and most massive clusters in the Milky Way, from the upper mass cut-off down to the hydrogen-burning limit.
Wd2 is quite unique, because it is close (8kpc), young (<2Myr), massive (>10^4 Mo) and not well studied. Yet, it is perfectly suitable to investigate how it formed, since neither stellar evolution nor cluster dynamics have had enough time to significantly affect its initial conditions. We propose to determine its mass function, which will well approximate its IMF, establish whether primordial mass segregation is present, characterise the population of pre-Main Sequence stars that have been found by Spitzer, and - as a added bonus - take a high resolution view of the surroundings of WR20a, a very massive eclipsing WR binary that might have been ejected from the cluster center. Second epoch observations in two years will allow us to accurately identify the Wd2 cluster members, and will establish the presence of additional walkaway stars, in addition possibly to WR20a. Because high resolution, high dynamic range, and PSF stability - necessary for the astrometric part - are absolute requirements to complete this project, this study can only be done with HST.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 13039
Program Title: The environment of the z=7.085 QSO ULAS J1120+0641

Principal Investigator: Chris Simpson

PI Institution: Liverpool John Moores University

We propose to take ACS and WFC3/IR observations of a 1-Mpc region around the recently-discovered redshift z=7.085 quasar ULAS J1120+0641 to test the hypothesis that, while distant active galaxies represent the densest regions in the early Universe, their radiation fields can hinder galaxy formation in the immediate vicinity. Observations of quasars and radio galaxies at z~5 have shown that they are the sites of galaxy overdensities, and revealed a segregration between companion galaxies selected by the Lyman break technique compared to those found via their Lyman-alpha emission. This has been interpreted as due to suppression of star formation in low-mass haloes by ionizing radiation from the central source. Since our target lies within the Epoch of Reionization, the scale over which this process acts is much smaller and more readily accessible to HST. Our observations will detect z~7 Lyman break galaxies as faint as the characteristic galaxy luminosity L* and their surface density can be directly compared to that derived from observations made in deep blank-field surveys, allowing us to quantify the environment around the quasar. Approved deep narrow-band imaging from the ground will measure the number of Lyman-alpha emitters and thus uniquely allow us to test the hypothesis that the ionizing radiation field results in spatial segregation between galaxies in different mass haloes.

Proposal Category: GO

Scientific Category: SOLAR SYSTEM

ID: 13040

Program Title: Investigation of Emission Anomalies from Europa's Atmosphere: Search for Possible Plumes

Principal Investigator: Joachim Saur

PI Institution: Universitat zu Koeln

Previous HST/STIS and HST/ACS observations of Jupiter's satellite Europa combined with models of Europa's icy surface provide exciting hints that Europa might exhibit plume activity similar to the water geyser activty recently discovered on Saturn's satellite Enceladus. During previous HST campaigns a surplus of emission from Europa's tenuous oxygen atmosphere at 90 and 230 degrees west longitude was found. These longitudes are consistent with independent predictions for possible plume locations from tidal surface models by Nimmo et al. The previous HST/ACS observations of Europa's leading side however suffered a strong red leak problem and the two diagnostic emission patterns from the oxygen multiplets OI 1304 A and OI 1356 A could not be spatially separated. The previous HST/STIS observations of Europa's trailing hemisphere exhibited the emission anomaly near the limb of the disk. Therefore we ask for two visits of five consecutive HST/STIS orbits at OLGs near 90 and 230 degrees to observe the emission anomalies near the central meridian. With these observations we will further constrain the emission anomalies and investigate if Europa indeed exhibits plume activity. The discovery of plumes on Europa would provide observational samples of subsurface materials possibly including material from a sub-surface water ocean.

Proposal Category: GO

Scientific Category: ISM IN EXTERNAL GALAXIES

ID: 13041

Program Title: Diagnosing Ionization Mechanisms in Blue Compact Dwarfs, the Local Analogues to Primordial Galaxies

Principal Investigator: Bethan James

PI Institution: Space Telescope Science Institute

Nearby Blue Compact Dwarf (BCD) galaxies are excellent laboratories for studying star-formation (SF) and feedback in relatively pristine, low-metallicity environments analogous to those thought to exist in the early Universe. Until recently, the dominant ISM energy source in BCDs was assumed to be photoionization from the young starburst. However, recent spectroscopic evidence suggests that energy input from shocks or AGN may also play a significant role, particularly on local scales. Distinguishing between these mechanisms/sources is key to understanding the evolution and composition of the ISM, and requires spatially resolving the structure and physical properties of the BCD's ISM, particularly the spatially narrow shock fronts (~10 pc ~ 0.4" at 5 Mpc). This can only be achieved with the unrivalled angular-resolution, sensitivity and FoV of WFC3. Here we propose to take advantage of the extensive filter set available on WFC3 to diagnose the ionization mechanisms within 2 nearby (D<5 Mpc) BCDs via narrow-band imaging. These observations will allow us to 1) distinguish between ionization mechanisms on ~1pc scales using diagnostic emission line ratios (e.g. [SII]/Ha and [OIII]/Hb; BPT diagram method); 2) locate WR stars from HeII4686 emission and correlate

WR activity with shock and feedback activity; 3) investigate the electron density and metallicity (O/H) variations within these systems, via [OII] and [SII] doublet imaging. This study will provide significant insight into the role of feedback in the energetics, structure and SF history of dwarf galaxies and essentially, primordial galaxies in the early Universe.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	13042
Program Title:	Confirming the theoretical link between ultra-massive white dwarfs and heavy-weight intermediate mass stars.
Principal Investigator:	Paul Dobbie
PI Institution:	University of Tasmania

We propose to probe the theoretically predicted evolutionary link between ultra-massive O+Ne white dwarfs and stars with M_init~5-10Msolar by using HST and WFC3 to obtain good S/N (>30) imaging to ~25 mag. of 22 sq. arcmins of the young open cluster NGC6705. These observations will allow us to address gaping deficiencies in the current understanding of the late-stage evolution of heavy-weight intermediate mass stars and significantly advance the poor present level of knowledge about their role in the chemical evolution of the Galaxy and other galaxies.

Proposal Category:	GO
Scientific Category:	HOT STARS
ID:	13043
Program Title:	Multiwavelength spectra of the fine structure of the Crab
Principal Investigator:	Oleg Kargaltsev
PI Institution:	University of Florida

The Crab is one of the most famous objects in high-energy astrophysics and an archetypal example of a young pulsar with a pulsar wind nebula (PWN). Observations with HST and Chandra have resolved the remarkable dynamic PWN

structure and served as a prolific driver in advancing the theory of relativistic magnetized outflows in general and pulsar winds in particular. Despite the large amount of data collected, there are still important gaps in our knowledge, such as the lack of contemporaneous, multiwavelength spectra of the prominent PWN features. Furthermore, high-resolution, wide-field, high-quality NIR and FUV images have never been obtained.

We propose a joint HST-Chandra-EVLA campaign to understand multiwavelength spectral changes across the PWN. Thanks to the brightness of the Crab PWN and superb resolution of all the three observatories, spectral changes can be mapped on ~1 arcsecond scales in a very short time. Therefore, this program is very efficient, highly synergistic, and will also provide a legacy set of contemporaneous, high-resolution images of the Crab PWN (taken across 9 decades in frequency!) that will serve as a reference for years to come.

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 13044
Program Title: The IMF and Internal Kinematics of the Massive Young Star Cluster, Westerlund 1

Principal Investigator: Jessica Lu
PI Institution: University of Hawaii

The most massive young star cluster known in the Milky Way, Westerlund 1, represents a far more extreme environment for star formation than nearby, well-studied, and lower-mass star forming regions such as Taurus and Orion. We propose to construct a complete photometric and kinematic census of Westerlund 1 in order to identify cluster members down to 0.1 solar masses, precisely determine the initial mass function (IMF), and measure the internal kinematic structure of the cluster. With these measurements, we will test whether the IMF is universal, as may be the case for nearby lower-mass star forming regions, or favors high-mass star formation, as has been suggested theoretically and from some observational results. We will observe Wd 1 with WFC3-IR, which is the only instrument capable of delivering high spatial resolution, a well-characterized and stable PSF, and a wide field of view at infrared wavelengths. We exploit WFC3's capabilities to cover the full extent of the cluster with photometry, to correct for variable extinction and derive stellar masses, and with proper motions, to distinguish between cluster members and contaminating field stars. Our proposed observations of Westerlund 1 will help determine whether the star formation process, and the emergent stellar mass distribution, varies with initial cloud conditions.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 13045

Program Title: The Nature and Environment of a Luminous Starburst Galaxy During the Era of Reionization

Principal Investigator: Asantha Cooray

PI Institution: University of California - Irvine

We propose HST/WFC3 and ACS observations in 5 bands to characterize the nature and the environment of the most distant sub-mm galaxy (SMG) known today, FLS3, at a redshift of 6.337. The galaxy was discovered in Herschel-HerMES with redshift measured from mm-wave spectroscopy. It is IR luminous (3x10^13 L_sun), gas rich (10^11 M_sun), dusty and star-bursting. Deep optical and K-band ground-based imaging showed a near-by galaxy at 0.5 arcsecond from FLS3 with a measured redshift of 2.1. HST resolution imaging are needed to properly separate the two galaxies and constrain a lensing magnification of FLS3, if any. Previously known z < 4 SMGs are in dense proto-cluster environments. The discovery of FLS3 suggests that it may also be in a proto-cluster. The HST imaging is also aimed at identifying Lyman dropout samples at z~6.4 associated with FLS3. With proposed data we will complete the SED and determine the stellar mass of FLS at better than 30%, a key quantity needed to understand the nature of FLS3 when combined with its star-formation rate. We will also measure the UV slope-SFR relation for a galaxy at z > 6 and compare to measurements at z~0 to 3. With dropouts we will establish the presence of a proto-cluster and establish the dark matter halo mass scale of FLS3, a key ingredient needed to connect its evolution with massive elliptical and other galaxies seen today.

Proposal Category: GO

Scientific Category: COSMOLOGY

ID: 13046

Program Title: RAISIN: Tracers of cosmic expansion with SN IA in the IR

Principal Investigator: Robert Kirshner

PI Institution: Harvard University

Progress on measuring dark energy properties with supernovae was rapid when the samples were small. However, today, the statistical errors from sample size are not the most important ones. Systematic errors introduced by photometry, light curve fitters, and by dust limit progress. Observations of SN Ia in the IR offer the most promising way forward to a more accurate measurement of cosmic expansion history. Theory predicts and empirical evidence shows that SN Ia are more nearly standard candles in the Y, J, and H bands than in the optical bands. Dust absorption is similarly a much smaller problem in the near IR. The drawback is that precise measurements of the restframe infrared flux from cosmologically interesting supernovae at z ~ 0.3 to 0.5 are not feasible from the ground. HST can solve this problem. By following up the most promising of the flood of SN Ia we are discovering in PanSTARRS fields, WFC3/IR can obtain rest frame IR observations that will lead to precise cosmic distances and the best knowledge of dark energy properties. Once this approach proves its worth, a more extensive sample would provide powerful constraints on dark energy properties and could distinguish between a cosmological constant and more exotic forms of dark energy.

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 13047
Program Title: The D/H Ratio and Escape of Water from Venus

Principal Investigator: John Clarke

PI Institution: Boston University

This proposal is to make STIS E140H long aperture observations of Venus near elongation to measure the D and H Ly emissions to determine the D/H ratio in the upper atmosphere, with implications for the historic escape of water into space. It is important to determine the actual D Ly brightness in Venus' upper atmosphere, and also to measure the center-to-limb variation of the H Ly emission, to understand the radiative transfer of these emissions and derive accurate values for the densities of both H and D and thus the D/H ratio. The combination of one long-slit STIS spectrum of Venus and the coordinated sounding rocket data can put to rest uncertainties about the D/H ratio and escape of water that have lingered since Pioneer Venus orbited Venus in the late 1980's.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 13048
Program Title: The First Unambiguous Detection of a Distinct Metal-poor Stellar Halo in a Massive Early-type Galaxy

Principal Investigator: Jay Strader

PI Institution: Smithsonian Institution Astrophysical Observatory

It is well-established that many spiral galaxies, such as the Milky Way and M31, host metal-poor stellar halos. The properties of these halos place important constraints on the hierarchical formation and assembly histories of these galaxies. Observations of old globular clusters in early-type galaxies find ubiquitous evidence for bimodal color distributions (blue and red), suggesting the presence of two underlying populations of field stars: metal-poor and metal-rich. However, no direct evidence has been found for bimodal stellar populations, nor specifically for a distinct metal-poor stellar halo, in any massive early-type galaxy. We propose a study of red giant branch (RGB) stellar

metallicities in the halo of NGC 3115, a nearby (9 Mpc) lenticular that is among the closest normal massive early-type galaxies, and which hosts a particularly well-characterized bimodal color distribution of globular clusters. Our proposed observations, across three fields extending out to the distant outer halo of the galaxy, will provide the first unambiguous test for the presence of a metal-poor stellar halo in a massive early-type galaxy, and in addition will measure the stellar halo density and metallicity gradients with galactocentric radius.

Proposal Category: GO

Scientific Category: UNRESOLVED STELLAR POPULATIONS AND

ID: 13050

Program Title: The Most Massive Black Holes in Small Galaxies

Principal Investigator: Remco van den Bosch

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

Massive galaxies represent the extreme of galaxy formation and contain the most massive black holes (BH), as reflected in the scaling relations of BH masses with galaxy velocity dispersions (M-sigma) and luminosities (M-L). Our spectroscopic survey of 600 nearby galaxies revealed 17 galaxies with extremely high velocity dispersions (indicating BH masses of 10^10 solar masses) and at the same time shockingly small sizes (<2 kpc) and (bulge) luminosities. For one of these galaxies archival HST imaging allowed us to measure an extremely big BH mass of 23 billion solar masses, and confirm it is hosted by a small disk-dominated galaxy of only 90 billion solar masses in stars. This demonstrates that the BH in this system did not co-evolve with its host galaxy the way others are thought to have. It is imperative to go beyond a single anecdotal example to a real sample of galaxies with small bulges and suspected monster black holes. Here we propose to obtain HST imaging of the other 16 galaxies. The WFC3 imaging is required to resolve their small bulge and put accurate constraints (in combination with our spectroscopy) on their black hole mass. A significant sample of compact galaxies with very high black hole masses would be in stark conflict with the popular co-evolution picture and could form the missing link between local galaxies and the quiescent compact nugget galaxies found at z~2.
