Cycle 18 Abstract catalog (based on Phase I submissions)
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Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12120
Title: The Next Generation of Numerical Modeling in Mergers-Constraining the Star Formation Law
PI: Li-Hsin Chien
PI Institution: Space Telescope Science Institute

Spectacular images of colliding galaxies like the "Antennae", taken with the Hubble Space Telescope, have revealed that a burst of star/cluster formation occurs whenever gas-rich galaxies interact. The ages and locations of these clusters reveal the interaction history and provide crucial clues to the process of star formation in galaxies. We propose to carry out state-of-the-art numerical simulations to model six nearby galaxy mergers (Arp 256, NGC 7469, NGC 4038/39, NGC 520, NGC 2623, NGC 3256), hence increasing the number with this level of sophistication by a factor of 3. These simulations provide specific predictions for the age and spatial distributions of young star clusters. The comparison between these simulation results and the observations will allow us to answer a number of fundamental questions including: 1) is shock-induced or density-dependent star formation the dominant mechanism; 2) are the demographics (i.e. mass and age distributions) of the clusters in different mergers similar, i.e. "universal", or very different; and 3) will it be necessary to include other mechanisms, e.g., locally triggered star formation, in the models to better match the observations?
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12121
Title: Radiative Hydrodynamic Simulations of Reionization-Epoch Galaxies
PI: Romeel Dave
PI Institution: University of Arizona

We propose to use our newly-developed cosmological radiative hydrodynamical galaxy formation code to study the formation and evolution of galaxies at redshifts z>6 as seen with existing and upcoming HST/WFPC3 observations. We focus on the relationship between this galaxy population and the physics of reionizing the IGM. We will investigate four key questions: - Do models yield z>6 galaxies with physical & photometric properties as observed? - Can such early galaxies produce sufficient photons to reionize the universe by z~6? - What is topology and timeline of reionization, in relation to the galaxy population? - How do photoionization and superwind feedback interact to regulate early galaxies? Our code, MARCH, combines moment-based radiative transport with our advanced version of Gadget-2 to self-consistently evolve galaxies and intergalactic gas from the Dark Ages until the end of reionization. By extracting photometric properties and comparing to data using our Bayesian SED fitter SPOC, we can assess with formal statistics how well these simulations can reproduce observations of high-z galaxies. Building on preliminary model successes, we will investigate what such observations imply for how galaxies reionize the IGM, and what feedback processes must be active in order to reproduce the galaxy population and IGM evolution as observed. Our results will impact and support a wide range of HST programs designed to detect and characterize galaxies in the reionization epoch.
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Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12122
Title: ACS Archival Study of Dry Mergers in the COSMOS field
PI: Vandana Desai
PI Institution: California Institute of Technology

Dry merging (i.e., merging without gas) is invoked in models of hiearchical galaxy formation as an important mode of galaxy assembly, necessary to reproduce the observed fractions and luminosities of galaxies in the red sequence. We propose to use HST and ancillary observations in the COSMOS field to measure the merger activity among red-sequence galaxies at 0.1 < z < 0.4. We will 1) examine the relationship between different classes of morphological merger signatures and residual star formation and 2) determine the relative contributions of various types of mergers (wet, dry, minor, merger). Both analyses will be carried out as a function of stellar mass.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12123
Title: Contribution of Massive Stars to the Production of
                     Neutron Capture Elements
PI: Steven Federman
PI Institution: University of Toledo

Elements beyond the Fe-peak must be synthesized through neutron-capture processes. With the aim of understanding the contribution of massive stars to the synthesis of neutron-capture elements during the current epoch, we propose an archival survey of interstellar arsenic, cadmium, tin, and lead. Nucleosynthesis via the weak slow process and the rapid process are the routes involving massive stars, while the main slow process arises from the evolution of low-mass stars. Ultraviolet lines for the dominant ions for each element will be used to extract interstellar abundances. The survey involves about forty sight lines, many of which are associated with regions of massive star formation shaped by core-collapse supernovae (SNe II). The sample will increase the number of published determinations by factors of 2 to 5. HST spectra are the only means for determining the elemental abundances for this set of species in diffuse interstellar clouds. The survey contains directions that are both molecule poor and molecule rich, thereby enabling us to examine the overall level of depletion onto grains as a function of gas density. Complementary laboratory determinations of oscillator strengths will place the interstellar measurements on an absolute scale. The results from the proposed study will be combined with published interstellar abundances for other neutron capture elements and the suite of measurements will be compared to results from stars throughout the history of the Galaxy.
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Proposal Category: AR
Scientific Category: COOL STARS
ID: 12124
Title: The multiplicity fraction and period distribution of
                     nearby disk and halo stars
PI: Sebastien Lepine
PI Institution: American Museum of Natural History

We propose to determine the multiplicity fraction and distribution of orbital separations for populations of nearby disk and halo stars in the separation range from 1 AU to 100,000 AU. We estimate that about 2,900 of the 2,000,000

stars with proper motions >40mas/yr (now listed in the SUPERBLINK proper motions database) have been seredipitously imaged in the course of the HST mission by the various cameras. The sample includes including about 2,200 nearby low-mass disk dwarfs, and 700 low-mass halo subdwarfs. All HST pictures containing these stars will be carefully examined to identify all resolved pairs. The results will be combined with our current survey of very wide binaries in common proper motion pairs, to determine with unprecedented precision the distribution of orbital separations for low-mass stars from both the disk and halo populations. The comparison will provide powerful constraints on the formation environments of disk and halo stars and on their dynamical evolution.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12125
Title: Plasma simulations that meet the challenges of COS and STIS
PI: Gary Ferland
PI Institution: University of Kentucky

The installation of COS and the refurbishment of STIS bring significant UV/Optical spectroscopic capabilities back to HST. Their science drivers include fundamental questions about the intergalactic medium, star birth, and the formation of cosmic structure. The gas producing the UV/Optical spectrum is seldom in equilibrium and numerical simulations are required to understand the observations. I am requesting support for the expansion of the plasma code Cloudy, which has come into widespread community use as a way to understand such spectra, to meet the challenges posed by these instruments. Cloudy predicts the full ionic and molecular spectrum over the COS/STIS passbands. The first step is a major update to the part of Cloudy's atomic/molecular database covering this spectral range. Recent development had emphasized the IR and X-Ray and this passband had not been a priority. Next, Cloudy is often used by large-scale structure or dynamics codes as an atomic physics server. The second step is to develop an interface to facilitate access to the basic atomic data and Cloudy's atomic physics solvers. These infrastructure developments will facilitate the broad range of investigations made possible by this new HST instrumentation.
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Proposal Category: AR
Scientific Category: HOT STARS
ID: 12126
Title: The Local Environments of Supernovae from Archival HST Images
PI: Alex Filippenko
PI Institution: University of California - Berkeley

The locations of supernovae (SNe) in the local stellar and gaseous environment in galaxies, as measured in high spatial resolution WFPC2, ACS, and WFC3 images, contain important clues to their progenitor stars. They provide accurate determinations of any association of SNe with H II regions or star clusters. Since multi-filter observations are generally available, we can determine the local stellar population, setting constraints on the mass of the progenitor; we can also search for possible attenuation of the SN by dust in the host galaxy by studying the colors of the stars in its environment. By checking the fields for background sources, we can correct the existing SN light curves and luminosities if necessary. When a SN has been observed incidentally, information can be gained on its optical and UV emission. Deep HST images can be used to find light echoes of SNe, as well as recover SNe

interacting with circumstellar material at very late times. A direct search for the progenitor stars of SNe can be made in pre-existing HST images of their locations; as the number of archival HST images steadily increases, along with the number of newly discovered SNe, positive identifications become progressively more likely. In Cycle 18, we plan to extend our successful work from previous cycles. This proposal is complementary to our Cycle 18 snapshot proposal, whose primary purpose is to obtain late-time photometry of SNe. It is also complementary to our Cycle 18 TOO proposal, which is designed to pinpoint the locations of recent SNe to help determine their progenitor stars.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12127
Title: A Detailed Analysis of Stellar Populations in Galaxies During Reionization
PI: Steven Finkelstein
PI Institution: Texas A & M Research Foundation

We request archival funds to complete a robust study of galaxies in the z > 7 Universe using a new set of unprecedentedly deep data from HST WFC3/IR. These data probe an epoch when the Universe was only 500 - 800 Myr old, placing constraints on the earliest phases of galaxy formation. We recently completed a thorough study of the HUDF with WFC3. Using robust analysis techniques to study the stellar populations in these galaxies, we improved upon early release papers to provide a valuable analysis to the community. We will continue this work, combining the HUDF, HUDF-01 and HUDF-02 datasets to compile a sample ~ 3X larger. We will search for galaxies at z = 7 - 9 within this dataset by computing photometric redshifts, which offers a smaller redshift uncertainty than typical Lyman break color-criteria selection, as well as allowing a more complete census of the galaxy population at z > 7. We will run bootstrap Monte Carlo simulations on our sample, which place strong constraints on the presence of primordial stellar populations in these galaxies - this is more physically accurate than other studies, which have only reported the standard error on the mean, which does not give information on how well one can rule out certain scenarios. Lastly, we will fit the full spectral energy distributions of these objects to a suite of stellar population models, computing confidence ranges on each property. As we found in our previous work, although the age and dust are difficult to constrain, the stellar mass is well constrained with only rest-UV detections due to the old age of the Universe. A 3X increase in sample size nearly doubles the accuracy with which we can pin down the stellar populations in these galaxies. At such high redshifts, large samples of galaxies are expensive and extremely hard to come by. The opportunity to examine a sample of ~ 100 z > 7 galaxies is a unique one, and by applying our robust techniques, we will present the most complete analysis of the galaxy population in the young universe.
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Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 12128
Title: The Reel Deal: Interpreting HST Multi-Epoch Movies of YSO Jets.
PI: Adam Frank
PI Institution: University of Rochester

The goal of this proposal is to bring the theoretical interpretation of Young Stellar Object jets and their environments to a new level of realism. We propose to build on the results of a successful Cycle 16 observing proposal that has obtained 3rd epoch images of HH jets. We will use Adaptive Mesh

Refinement MHD simulations (developed by our team) to carry forward a detailed program of modeling and interpretation of the time-dependent behavior revealed in the new, extended multi-epoch data set. Only with the third epoch observations can we explore forces: i.e. accelerations, decelerations and structural changes to develop an accurate understanding of physical processes occurring in hypersonic, magnetized jet flows. Our studies will allow us to characterize the jets and, therefore, make the crucial link with jet central engines. We note an innovative feature of our project is its link with laboratory astrophysical experiments of jets. Our analysis of the observations will be used to determine future laboratory experiments which will explore “clumpy” jet propagation issues.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12129
Title: Modeling UV Luminosity of High Redshift Galaxies
PI: Oleg Gnedin
PI Institution: University of Michigan

The reionization of cosmic hydrogen is a critical process in the evolution of the intergalactic medium. Absorption spectra of high-redshift quasars indicate that reionization was largely completed by redshift z=6, but the duration of this process and its sources remain uncertain. The newest ultra-deep HST ACS and WFC3 observations revealed high-redshift galaxies that are contributing to reionization. Do they indicate that galaxies produce enough ionizing photons for reionization? We propose to model the uncertainty in the constraints on the epoch of reionization resulting from the current HST surveys. We will use several complementary approaches to estimate the number of ionizing photons per atom. We will build a theoretical model for the evolution of the UV luminosity function at z=6-10, based on globular clusters as tracers of most active star formation. We will use this model to predict the comoving number density of z>8 Lyman break dropouts. We will provide an easy-to-use public code to connect the observational UV LF and SFR data to the theoretical quantities such as the number of ionizing photons per atom. This code will assist on-going HST campaigns for the highest-redshift galaxies and will serve as a guide for planning future JWST observations.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12130
Title: Calibrating the Optical Luminosity of Red Clump Stars: An Archival Study of Star Clusters
PI: Aaron Grocholski
PI Institution: Space Telescope Science Institute

The core helium burning stars of the red clump (RC) are a conspicuous feature in the color-magnitude diagram of many stellar populations. Its ease of identification, along with its relative brightness ($M_I \sim 0$) make the RC a popular feature for HST studies of stellar populations in galaxies out to a few Mpc. Such studies generally interpret the data through comparison to theoretical isochrones. For accurate results, the theoretical predictions must be calibrated to match the RC properties of observed populations of known age and metallicity. However, no large scale studies of the luminosity of the RC currently exist in the optical bands. We propose to remedy this situation with an archival study of RC properties in star clusters in the Milky Way, LMC, and SMC. We will focus on HST images of globular clusters, but we will augment the sample with ground-based open cluster observations to extend the coverage of parameter space. The goal is to build a large and homogeneous database,

through new analysis and incorporation of literature data, of cluster ages, abundances, distances, and RC photometry. This database will allow us to explore the variations in the RC luminosity as a function of age and [Fe/H] over the full range of parameter space where the RC exists, for both the V and I bands. The results will provide a fundamental calibration for all future HST studies of stellar populations and distances of nearby galaxies using the RC. They will also allow for verification or improvement of theoretical models for red giant phase evolution. This in turn will help many subjects, from stellar modeling to population synthesis and fitting of spectral energy distributions of distant galaxies.
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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12131
Title: Understanding the IGM Absorbers with Numerical Simulations of the WHIM
PI: Eric Hallman
PI Institution: Harvard University

The total baryon content of the universe can be deduced both from observations of the cosmic microwave background, and the observed Deuterium to Hydrogen ratio (D/H) through the theory of big-bang nucleosynthesis. Though observations can account for all of the baryons at high redshift, roughly half the baryons are referred to as``missing'' in the low redshift universe since they are not observed in known baryonic structures like galaxies, clusters, and the Lyman-alpha forest. Cosmological simulations predict that the missing baryons can be found in a cosmic web of sheets and filaments that thread the halos, in the ``warm-hot intergalactic medium'' (WHIM) phase (10^5 - 10^7K). The WHIM gas should be detectable in Ly-alpha or Ly-beta (10^4 K gas) and in shock-heated gas (10^5 - 10^6 K) in Ly-alpha and OVI absorption. Ultraviolet (UV) spectroscopy with the Far Ultraviolet Spectroscopic Explorer (FUSE) and HST has detected IGM absorbers in various metal species and HI along lines of sight to bright quasars that are likely associated with gas in the WHIM phase. This gas may account for the bulk of the missing baryons in the low redshift universe. Using Enzo hydro/N-body grid-based cosmology simulations, we will determine whether there is a unique interpretation given the current IGM absorber observations, and how new observations may provide strong tests of these theories. We propose to, with a suite of high-resolution Enzo simulations and novel analysis techniques, characterize the UV absorbers, and to model observational metrics to compare with the data. In particular, we study the metal diffusion throughout the IGM using various prescriptions for star formation, galaxy formation and thermaland chemical feedback, and study the numerical convergence of these algorithms.
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Proposal Category: AR
Scientific Category: TAC
ID: 12132
Title: PRONOUNCED - Polarimetry Reduction Of NICMOS Observations Using New Calibations and Enhanced Data
PI: Dean Hines
PI Institution: Space Science Institute

We propose a complete, rigorous, and systematically complete and consistent recalibration of all raw NICMOS polarimetric science imaging data in the MAST archive to enable science deferred or unachieved by many diverse approved investigation teams. The NICMOS instrument intrinsically provides powerful, and unique polarimetry capabilities that are not possible with ground-based instrumentation, and will not be replicated by any space-based facility in the

foreseeable future (e.g., none of the JWST instruments have polarimetric capabilities). Knowing this, HST TACs have wisely allocated significant numbers of orbits to NICMOS polarimetry programs over the past decade. However, various issues with ground data processing and calibration (not the raw data themselves), especially in those data acquired in the pre-NCS era that represent the majority of near-IR polarimetry programs attempted, have impeded these various investigators in analyzing and interpreting these otherwise valuable data sets. Here, as a service to the astronomical community at large, we propose to remedy this situation and enable the recovery of science until now lost by a rigorous re-calibration of all archived raw NICMOS polarimetric data from which we will create high-level analysis-quality data sets (e.g., Stokes images, polarization maps, polarized and total intensity mages) with quantitative error estimation to return and enter into the MAST for public dissemination. These value-added data products will not only assist investigators to meet and complete their initial science goals, but will enable new science that was not anticipated previously. By our undertaking this activity, we will enable the full potential of NICMOS polarimetric data acquired over the past decade to be realized through the creation of a rich polarimetric legacy data set to be publically disseminative through the MAST.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12133
Title: A Comprehensive Reevaluation of the Relation Between Black Hole Mass and Bulge Luminosity in Nearby Active Galaxies
PI: Luis Ho
PI Institution: Carnegie Institution of Washington

The scaling relations between black hole (BH) mass and bulge properties serve as powerful tools to study the interplay between BH growth and galaxy formation. The BH mass-bulge luminosity relation for galaxies hosting AGNs holds special promise because it can be more easily traced out to earlier epochs when both BH growth and star formation were more active. Recent studies suggest that at higher redshifts BH growth outpaced bulge assembly, but this potentially very important result critically depends on our knowledge of the local scaling relations, which are still poorly known. In an archival study approved for Cycle 15, we characterized, for the first time, the intrinsic scatter of the BH mass-bulge luminosity relation and its dependence on AGN properties for a sample of 45 local quasars containing the most massive BHs hosted by early-type galaxies. Our analysis employs a sophisticated new technique to decompose the two-dimensional structure of the host galaxies with unprecedented accuracy. Here we propose to extend our program to a large, comprehensive sample of 223 lower mass, lower luminosity AGNs at $z < 0.35$, most of which are hosted by disk galaxies. We will derive accurate photometric parameters for the bulge, taking into account, when necessary complex components such as bars, spiral arms, and nonaxisymmetric structures. We will use these measurements to reevaluate the slope, zero point, and scatter of the BH mass-bulge luminosity relation, and their possible dependence on AGN and host galaxy properties. Combined with our previous analysis, our study covers the largest possible dynamic range in BH mass, AGN luminosity, and host galaxy morphological type. It will serve as a fundamental reference point for all future investigations of the cosmic evolution of the BH-host scaling relations.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 12134
Title: A Census of Milky Way Dwarfs from WFC3 Pure Parallels
PI: Benne holwerda
PI Institution: University of Cape Town

Dwarfs belonging to the Milky Way are found as contaminants in many observations of the high-redshift universe with HST. Any high-redshift study therefore becomes a census of the Milky Way's smallest stellar members. But to study the Galaxy disk's shape, many lines-of-sight are needed. We propose to capitalize on this painstakingly assembled sample of Milky Way dwarfs, by identifying and classifying them in an ongoing WFC3 Pure Parallel program that produces deep near-infrared imaging. We expect to be complete up to 26 mag, sampling the M, L and T dwarfs along at least 31 independent lines-of-sight out of the Milky Way, possibly more. From the numbers of dwarfs, we will constain current models of the size and shape of the dwarf contribution to the Milky Way.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12135
Title: Principal Component Analysis of PSF for WFC3 and ACS/WFC
PI: Myungkook Jee
PI Institution: University of California - Davis

Astronomers' endless efforts to push to the limits of their scientific observations with HST ever increase the demand for the better knowledge of the instrument's PSF. We propose to carry out principal component analysis (PCA) of point spread function (PSF) for WFC3 and ACS/WFC. Both the cuspiness and the extended diffraction wing of HST PSF do not allow us to model it accurately using Gauss-Laguerre or Gauss-Hermite functions, which are commony referred to as shapelets. PCA by definition provides the optimal set of basis functions, which enables us to describe the position- and time-dependent variation of HST instruments accurately with as little as 20 basis functions or eigenPSFs. This study will construct a high-fidelity PSF model and provide the community with the library. This PSF will be described in the native pixel coordinate system of the detector prior to distortion correction. Therefore, the delivered PSF is of practical use regardless of the choice in drizzling parameters such as interpolation kernel, output pixel size, drop size, etc.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12136
Title: Galaxy bias measurement with weak-lensing in COSMOS
PI: Eric Jullo
PI Institution: Jet Propulsion Laboratory

We propose to use weak gravitational lensing to measure the astrophysical bias between the density of galaxies and that of the surrounding dark matter structure. The COSMOS/ACS observations provide a unique dataset for this analysis, and we will leverage recent extensions to achieve measurements an order of magnitude more precise than previously possible -- spanning both larger and smaller scales, and higher redshifts. In particular, our new 3D weak lensing catalog benefits from (i) improved photometric redshifts, especially out to z>1, and (ii) correction of the raw ACS images for charge transfer inefficiency trailing, and (iii) an improved calibration of shear measurements as a function of redshift.
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Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12137
Title: Stellar Clustering and Associated Disruption Times in Nearby Galaxies
PI: Catherine Kaleida
PI Institution: Arizona State University

We propose to catalog the stellar associations and clusters in a set of ~50 nearby galaxies. Our primary goals are to assess the fraction of stars that are born in the field versus in clusters, and to determine the timescales for the disruption of the star clusters asa function of size, density, and mass. We will make extensive use of the source lists available through the Hubble Legacy Archive (HLA) to make this a practical reality. The galaxies in our sample have observations in the UBVI and H-alpha bands, using a combination of the ACS and WFPC2 detectors. This will allow for selection of stellar associations in various bands, subsequent age-dating of each association or cluster using Spectal Energy Distribution (SED) fitting, and the determination of red/blue stellar fraction in the associations. Once the stellar clusters and associations have been identified and age-dated, we can deduce disruption times from the age distribution (i.e., the dN/dt diagram) as a function of a variety of properties, including the morphological type of the galaxy, the position of the cluster/association within the galaxy, and the existence of global versus flocculent spiral structure. Some of our primary questions include: Are there prefered size scales for stellar clustering or does clustering of stars occur continuously on all size scales? What is the disruption time for the different size scales? Are these disruption times uniform in the nearby universe, or are they dependent on local galactic environment? In the process of answering these questions, we will produce compreshensive catalogs of stellar groupings on all scales, to complement and enhance the catalogs already available through the HLA.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12138
Title: Using HST/WFC3 to Constrain the Lyman Cutoff and Colors of the Cosmic Infrared Background Fluctuations Detected by Spitzer/IRAC
PI: Alexander Kashlinsky
PI Institution: Science Systems and Applications, Inc.

The cosmic infrared background (CIB) contains accumulated emission from objects and epochs inaccessible to direct telescopic studies. Using deep Spitzer/IRAC data we have succeeded in detecting spatial structure (fluctuations) in the CIB at arcminute angular scales. This was achieved by applying sophisticated map-making procedures designed to self-calibrate the data and avoid adding any correlations in the noise. The IRAC maps were then masked and cleaned of resolved sources, which permits the detection of residual fluctuations well above the instrument noise and remaining systematics. This signal possibly originates in early stellar populations, but potentially it can also contain contribution from very small, and so far unobserved, local populations. This proposal designs an experiment, using the HST WFC3 data at near-IR wavelengths, to directly identify the epoch and nature of the populations that produce the observed CIB fluctuations. We will employ cross-correlation analysis of WFC3 data with the source-subtracted images constructed by us and also compute/constrain source-subtracted CIB fluctuations at WFC3 wavelengths down to the level limited by the instrument noise and systematics.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12139
Title: Classical Novae in M87
PI: Arunav Kundu
PI Institution: Michigan State University

Classical novae are luminous probes of the evolved stellar populations in external galaxies. Ground-based surveys suggest that the luminosity specific nova rate (LSNR) is roughly constant across Hubble type, with the possible exception of late-type irregular galaxies like the Magellanic Clouds. But some preliminary HST studies suggest that the nova rate in M87 may be a factor of 3 higher (or even more). We propose to study the nova population in the deep, multi-epoch ACS V and I band images of M87 obtained during the course of GO-10543 (PI: Baltz) for a microlensing survey. The GO program surveyed the galaxy daily in both V (1440s per day) and I (500s per day) for 45 consecutive days, with a few additional observations at other epochs, for a total baseline of 72 days. This study will likely yield the statistically best defined nova population in any galaxy studied to date, and definitively answer whether M87 is a particularly prolific nova factory. We will also search for novae in the roughly 2000 globular clusters (GC) within the M87 field. The discovery of a single nova in an M87 GC to date hints that GCs may be two orders of magnitude more efficient at producing novae than field stars. The discovery of additional GC candidate(s) will confirm that dynamical interactions in GCs enhance the rate of nova formation (and that of some of their close cousins like single degenerate Type Ia supernovae and CVs). Finally, we will compare the nova population of M87 to an extant WFPC2 study of novae in M49 to investigate whether the apparent factor of 3 difference in the nova rate can be attributed to novae that are spawned in the high specific frequency M87 globular cluster system and subsequently injected into the field. We estimate that, depending on the nova rate, we will detect at least 20, and possibly more than 100 novae in this data set.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12140
Title: Mergers of Dark Matter Halos and Galaxies in a LCDM Universe
PI: Chung-Pei Ma
PI Institution: University of California - Berkeley

We propose to use the database of the Millennium and Millennium-II simulations -- two of the largest cosmological simulations ever performed -- to study the merger rates of galaxies and their host dark matter halos. The proposed work complements the many HST studies of galaxy mergers by advancing and refining the predicted rates from theories and simulations to allow for a more definite comparison with observations. We will focus on (1) quantifying the subhalo-subhalo merger rates as a function of a wide range of halo mass, redshift, and merger types (minor vs major; satellite vs central galaxy; mergers within a common halo vs distinct halos); and (2) understanding the relationship among halo-halo, subhalo-subhalo, and galaxy-galaxy mergers in simulations, semi-analytic models of galaxy formation, and observations. We will take advantage of the unprecedentedly large dynamic range provided by the combined results from the two Millennium simulations to test how numerical resolution affects the fate of subhalos in dense environments and the inferred subhalo and galaxy merger rates and timescales. Results from the proposed work will provide a key step towards a quantitative interpretation of HST observations of galaxy pairs and morphological fractions, as well as offer valuable

guidance for merger prescriptions in galaxy catalogs that are currently being constructed on the two Millennium simulations.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12141
Title: Constraining the Low-mass End of the Stellar Mass Function at z=2-4
PI: Danilo Marchesini
PI Institution: Tufts University

One of the major goals of observational cosmology is to understand the physical processes responsible for shaping the galaxies into their present forms. The stellar mass function (SMF) of galaxies is one of the most fundamental of all cosmological observables. As the redshift range z=2-4 represents a key epoch in the buildup and evolution of galaxies, probes of the SMF at these redshifts provide important constraints on the processes at work in galaxy formation and evolution. While currently there are strong constraints on the high-mass end of the SMF in this epoch, the low-mass end is less well-known. Here we propose to use the HST archival data to robustly measure the low-mass end of the SMFs at 2<z<4 by exploiting the ultra-deep optical and near-IR data available in the two GOODS fields over a total surveyed area of ~203 square arcmin. We expect to increase the number of galaxies with 0.1M*<M<0.5M* by a factor of ~8. Moreover, we will push the determination of the SMFs about 1.5 dex deeper, allowing us to probe the SMFs down to ~0.004 M* at z=2.5 and ~0.01 M* at z=3.5. This analysis will ultimately result in the most accurate measurements of the SMF of near-IR selected galaxies at z=2-4. The resulting mass-selected sample of galaxies, spanning more than 3 orders of magnitude in stellar mass, will also allow us to study the relations between galaxy properties (e.g., specific star formation rates) and stellar mass, and how these relations evolve with cosmic time from z=4.
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Proposal Category: AR
Scientific Category: TAC
ID: 12142
Title: The Planet Pipeline: data curation and mining of Solar System images from WFPC2
PI: Max Mutchler
PI Institution: Space Telescope Science Institute

With the removal of the Wide Field Planetary Camera 2 (WFPC2) in May 2009, during Hubble Space Telescope (HST) Servicing Mission 4 (SM4), came the end of a remarkable scientific tour-de-force. The collection of WFPC2 Solar System observations is enormous and diverse: on the order of 10,000 individual exposures spanning over 15 years. It includes long-term monitoring of planetary surfaces and atmospheres, targeted and serendipitous observations of moons, and many cometary targets-of-opportunity. Some of these observations were taken to support the planning of other NASA and ESA planetary missions, and to complement the data they obtain. The standard HST data pipelines, which calibrate and combine images, are largely optimized for the processing of fixed-target data. Moving-target data cannot be simply combined and cleaned, due to the rapid motion and rotation of the targets. New multi-extension FITS formats and recent improvements to basic WFPC2 calibrations means that the entire data set can now be reduced better than ever before. We propose to take full advantage of this by creating a comprehensive, uniformly processed, well documented, and searchable collection of Solar System data. Our "planet pipeline" will populate the image headers with information unique to planetary

data, to produce a truly science-ready collection of WFPC2 Solar System imaging data. Our final data products will be ingested into the Multimission Archive at Space Telescope (MAST), as High Level Science Products (HLSP). We will conduct new scientific analyses of our own, but we expect our data products to enable a wide range of analyses by other researchers for many years to come, and form an essential piece of Hubble's archival legacy.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12143
Title: Physical properties of high-redshift WFC3 galaxies at z=7-10
PI: Kentaro Nagamine
PI Institution: University of Nevada - Las Vegas

Over the past decade, large samples of Ly-break galaxies (LBGs) have been assembled at z=3-6. The observers are now pushing the forefront of galaxy formation study into the range of z=7-9 utilizing the new data from the WFC3 camera. However, due to the faintness of the sources at these redshifts, it is difficult to derive the physical parameters such as stellar mass and star formation histories of the candidate galaxies. Therefore, it would be helpful to obtain predictions on these quantities from theoretical models using self-consistent, cosmological hydrodynamic simulations of galaxy formation. In the proposed work, we will examine the physical properties of high-redshift star-forming galaxies at z=7-10 using cosmological hydrodynamic simulations. In the first step, we will develop a model for estimating the variable extinction values of individual galaxies based on their metal column densities. We will also examine the spectro-photometric properties, stellar masses, star formation histories, and spatial correlations, and provide feedback to the WFC3 observations. The second step of our project is to perform the radiative transfer calculations of stellar radiation from high-z galaxies using the Authentic Radiative Transfer (ART) code. This exact RT calculation will allow us to check the accuracy of our earlier results from part (1), and to develop a better model of dust distribution in cosmological simulations.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12144
Title: PROBING THE RELATION BETWEEN LIGHT AND MASS COMBINING FLEXION WITH SHEAR
PI: Priyamvada Natarajan
PI Institution: Yale University

Using archival data from the ACS COSMOS Survey and from the Extended Groth Strip, we propose to study the relation between light and mass for galaxies out to z = 1. We will use a powerful combination of lensing mass estimators by measuring the flexion and shear fields for these galaxies and couple that with measurements of their light profiles. Exploiting these data sets, we will trace the evolution of the relation between light and mass in 3 redshift bins, namely 0.1 < z < 0.4; 0.4 < z < 0.7 and 0.7 < z < 1.0.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12145
Title: Modeling of the H2 Fluorescence spectrum in Eta Car's ejecta
PI: Krister Nielsen

PI Institution: Catholic University of America

Molecular hydrogen is the most abundant species in the interstellar medium and is observed in emission and absorption towards a wide range of astronomical objects. The presence of H2 is fundamental for the formation of complex molecules and dust. The H2 Lyman bands long-ward of 1200 A are usually not detected in a cold gaseous environment but, surprisingly, appears strongly in the spectrum of Eta Car's cold Homunculus. More than 800 H2 transitions have been identified in the mid-UV. The H2 absorption spectrum changes with Eta Car's 5.54 year spectroscopic period. These changes in H2 absorption strengths can provide information regarding the radiative flux variability caused by the companion star. We propose to use HST/STIS data recorded with the E140M grating between 1990.0 to 2004.3 to model the H2 spectrum and derive H2 column densities in the Eta Car Homunculus and how the column densities vary with phase. This will provide necessary input for accurate modeling of the Homunculus, which is an important step in the analysis of this unusual ejecta, and can be used for future studies of other massive stars.

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Proposal Category: AR
Scientific Category: COOL STARS
ID: 12146
Title: Binary-induced Jet Precession in Post-AGB Stars and Planetary Nebulae
PI: Jason Nordhaus
PI Institution: Princeton University

Binary companions are likely required to explain bipolar shaping in post-Asymptotic Giant Branch and Planetary Nebula outflows. Observationally, determination of the fraction of systems harboring binaries is difficult as obscuration and pulsation mask binary signatures. We propose a theoretical study of an indirect signature: jet precession induced by a binary companion. We have selected 13 HST archival images of evolved stars which show clear evidence of jet precession. For each object, we will determine the binary parameters required to match the precession frequency including the companion masses, separations and disk radii. We will numerically simulate binary-induced precession using the 3-D, hydrodynamic code FLASH. The simulation data will be compared to observations via use of the morpho-kinetic code SHAPE. This work will provide unique constraints on binary precession scenarios in evolved stars and is applicable to other systems which exhibit precession in their jets including: young stellar objects, active galactic nuclei and compact binaries.

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Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12147
Title: Ultra-Compact Dwarfs Across All Environments: Tracing Major and Minor Merger Histories
PI: Mark Norris
PI Institution: University of North Carolina at Chapel Hill

We propose to carry out the first comprehensive survey for ultra-compact dwarfs (UCDs) located in all environments from isolated to cluster core. To do this we will analyze archival HST WFPC2 and ACS imaging of 528 galaxies located between 5 and 60 Mpc. This project will build upon a successful pilot archival survey of 76 low-density environment galaxies studied with HST, which has discovered 11 UCD candidates of which 4 have been spectroscopically confirmed as UCDs. By combining structural information from HST imaging with dynamical masses and stellar population parameters from follow-up SALT

spectroscopy, we will be able to robustly classify each UCD into one of two categories: massive star clusters (formed by gas-rich major galaxy mergers), or, stripped nuclei (formed by minor mergers). Because many of the target galaxies are located in field/group environments where merger events may be recent and involve star formation, this survey should produce the first significant sample of young UCDs. The population of young UCDs will reveal their intrinsic numbers before losses due to dynamical friction. Our final dataset will provide the frequency of each UCD type as a function of environment, allowing us to measure (1) the dominant formation mechanism of UCDs, and (2) the major and minor merger histories of their host galaxies.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12148
Title: Star Cluster Dissolution in Various Environments
PI: Anne Pellerin
PI Institution: Texas A & M Research Foundation

The possibility that stellar clusters may disrupt and dissolve at young ages has far-reaching consequences for our understanding of star formation and galaxy evolution, including the number of modes of star formation, the low-end of the stellar initial mass function, and how reliably stellar clusters trace the parent galaxy's population. However, this crucial stage of cluster evolution is still poorly constrained both theoretically and observationally. Unlike young, bright clusters, or globular clusters, dissolving star clusters are usually too scattered and have too low surface brightnesses to be detected in traditional surface photometric studies. Therefore, the physical parameters that determine whether, how, and on which timescale a young stellar cluster will dissolve are not constrained yet. We propose to study the importance of various physical processes on the dissolution of young star clusters using a sample of 25 nearby galaxies. Our new technique utilizes the high spatial resolution and sensitivity of HST/ACS to detect individual stars in galaxies as far as 5 Mpc in multiple colors (~BVI). A clustering algorithm, together with stellar population synthesis models, will allow us to find groups of stars and obtain their ages, stellar masses, sizes, and compactness. Our sample covers a wide range of galaxy properties (morphology, luminosity, structure [bars, etc.], metallicity, activity level), and will enable us to study the impact of various environmental parameters on the dissolution and disruption processes. This will be the first extensive study of a poorly constrained aspect of star cluster evolution, and optimally leverages on the rich HST archival data.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12149
Title: Does the C IV Emission Line in AGN Spectra Yield Accurate Black Hole Mass Estimates?
PI: Bradley Peterson
PI Institution: The Ohio State University Research Foundation

The masses of the black holes that power quasars can be estimated from individual emission-line spectra by using the quasar luminosity to infer the size of the line-emitting region and the emission-line width to infer the velocity dispersion of the line-emitting gas. This seems to be well-established, at least for certain emission lines. However, whether or not the C IV 1549 emission line can be used for such purposes is controversial. It is our contention that studies in which the masses estimated from C IV do not agree with those inferred from other emission lines are based on spectra with

insufficient signal-to-noise ratios for precision line width measurements. Nearly every study that challenges the use of C IV for black hole mass estimation is based on spectra from large surveys, such as SDSS, and the quality of many of these spectra is too low to measure the chracteristics of spectral features in individual objects with the necessary precision. We propose to demonstrate this by taking a sample of high-quality HST spectra of AGNs for which masses inferred from C IV and Hbeta are consistent and then adding random noise to the UV spectra to replicate SDSS-quality data and remeasuring the lines. This apparently trivial exercise has significant consequences for studies of the evolution of black hole masses with host galaxy properties because use of low signal-to-noise spectra for black hole mass measurement not only increases random errors but also introduces large systematic errors.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12150
Title: Broad emission and absorption lines in AGN: contribution from disk winds.
PI: Daniel Proga
PI Institution: University of Nevada - Las Vegas

We propose to study the theory of broad line regions in AGN. We will focus on assessing the role of radiation driven disk winds in producing both emission and absorption lines. Four key factors motivate our study: (1) the importance of broad lines in AGN spectra and in AGN physics, (2) the wealth and quality of the optical and UV data obtained by HST, (3) the success of radiation driven disk wind models in explaining gross properties of outflows in AGN and other disk accreting systems and finally (4) AGN outflows might play a key role in the so-called AGN feedback. We will use state-of-the-art Monte Carlo techniques to compute a detailed photoionization structure of a wind predicted by our radiation-hydrodynamical simulations. We will also use Monte Carlo techniques to compute line spectra based on our wind solutions. We will explore the effects of the black hole mass, luminosity, and inclination angle. Our goal is to test whether radiation driven disk winds can account for the observed shapes, strengths, and occurrences of single- and double-peaked emission lines, BALs, detached BALs, and mini-BALs.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 12151
Title: Theoretical Models of the Tidal Disruption of Stars by Massive Black Holes
PI: Eliot Quataert
PI Institution: University of California - Berkeley

High-resolution imaging and spectroscopy by HST have established that all classical bulges host a massive black hole (BH). The BH-bulge connection is less clear for lower mass BHs (~10^5-10^6 Msun) which inhabit lower mass galaxies, preferentially pseudobulges. The tidal disruption of stars produces a particularly unique probe of these BHs: if a star passes close to the BH, the BH's tidal gravity shreds it, releasing a flare of energy. Lower-mass BHs can produce extreme disruptions in which stellar debris feeds the BH at a rate far above the Eddington rate, producing an optically luminous outflow of gas. New optical transient surveys are expected to detect many of these tidal disruption events (TDEs) in the next few years. HST data will be critical to this endeavor: 1) ACS imaging to pinpoint candidates as nuclear, 2) STIS/COS spectroscopy to distinguish TDEs from other transient sources (we find UV

lines to be the strongest discriminant), and 3) photometric and kinematic measurements of low-mass galaxies to enable calculations of tidal disruption rates. Our theoretical work will support HST's vital contribution to this method of studying massive BHs in galaxies. We will: 1) use photoionization calculations to predict the spectral signature of TDEs, particularly in the UV, and 2) use HST observations of pseudobulges to predict tidal disruption rates for low-mass BHs.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 12152
Title: Separating environmental triggers of morphological transformation and star formation quenching
PI: Gregory Rudnick
PI Institution: University of Kansas Center for Research, Inc.

Dense regions of the universe, such as groups and clusters, have a significantly higher fraction of red and dead early-type galaxies than the field. Despite much work on the subject, it is nonetheless unclear if this difference actually results from a transformation of galaxies as they enter dense environments. We will address this in a new way by measuring the current star formation rate (SFR), recent star formation history (SFH), and evidence for ongoing morphological transformation in a set of very well studied cluster, group, and field galaxies, all at an epoch where the galaxy population was rapidly evolving. With this analysis we will determine the relative sequencing of star formation suppression and morphological transformation in a range of environments and as a function of galaxy mass. We have all the elements in place to carry out this program and ask in this proposal for funds to: 1) analyze HST/ACS data for a set of z~0.7 galaxies in 12 clusters, 7 groups, and the field to measure weak morphological distortions of the sort likely to produce early type galaxies from spirals; 2) use the detailed output of state-of-the-art minor merger simulations to determine the timescales over which the distortions are observable; 3) link the evidence of morphological transformation to the recent SFH and current SFR using our extensive 8-meter spectroscopy and multi-wavelength data for our target galaxies.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12153
Title: Variable Stars in the Andromeda System
PI: Ata Sarajedini
PI Institution: University of Florida

We propose to reduce and analyze WFPC2 and ACS/WFC imaging of 7 fields in the Andromeda galaxy (M31) and its environs in order to characterize its variable star content. We will likely isolate a variety of different types of variable stars including Cepheids and RR Lyraes. The presence of RR Lyrae variables suggests the presence of an old (Age >~ 10 Gyr) stellar population. In addition, because the minimum-light color of ab-type RR Lyraes is a constant irrespective of metallicity or period, these stars can be used to study the extinction along the line of sight. Furthermore, the period of ab-type RR Lyraes is directly related to their metal abundance so that we can also study the metallicity distribution function of different regions of M31 as well its radial metallicity gradient. We will also determine the slope of the RR Lyrae luminosity - metallicity relation.
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Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 12154
Title: Measuring the Kuiper Belt Size Distribution using Stellar Occultations
PI: Hilke Schlichting
PI Institution: Canadian Institute for Theoretical Astrophysics

The study of the size distribution of small, sub-km-sized Kuiper belt objects (KBOs) provides fundamental constraints on their material properties, their collisional evolution and the formation of debris disks. Sub-km-sized Kuiper belt objects elude direct detection, but the signature of their occultations of background stars is detectable. The first sub-km-sized KBO has been reported recently by Schlichting et al. (2009), who analyzed about 40,000 star hours of archival data taken by the Fine Guidance Sensors (FGS) on board the Hubble Space Telescope (HST). This work provides the first measurement of the abundance of hectometer-sized KBOs. This new archival proposal builds and on our initial work and expands it to include: (I) The analysis of the remaining FGS data, which will more than triple the number of star hours. (II) Further development of the detection algorithm, allowing the search for more impact parameters and including the actual angular sizes of the star (III) A faster method of calculating the significance of candidate events, allowing more precise significant estimates separately for each orbit data. (IV) The creation of an open database that will contain all FGS data. This work will therefore go deeper than the original one, and together with more than tripling the number of star hours the new survey will be about 5 times more powerful. It holds the promise for additional detections of KBO occultations and will shed light onto the material properties and collisional evolution of sub-km-sized KBOs.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12155
Title: Tracing Carina's protostellar jets to the source with WFC3-IR
PI: Nathan Smith
PI Institution: University of California - Berkeley

Based on a recent H-alpha imaging survey of the Carina Nebula with ACS, we discovered 39 new Herbig-Haro (HH) jets marking the bipolar outflows from newly formed low-mass stars. This provides a valuable sample of jets that are all at the same distance, allowing us to study the relationship between protostars and their outflows where nearby massive stars are shredding the molecular cloud as new stars are forming. Carina has been studied extensively with Spitzer and Chandra, providing IR spectral energy distributions and X-ray luminosities for all detectable sources in the field. However, 29 of the jets seen at visual wavelengths emerge from opaque clouds or dark globules seen in silhouette against the bright background H II region, so the protostellar driving sources are still embedded in their natal clouds and are not identifiable in optical images. This makes the identification of the driving sources in lower resolution Spitzer and Chandra images ambiguous. Three of these jets (HH666, HH901, and HH902) have already been imaged with WFC3 as ERO targets after the servicing mission, demonstrating that near-IR [Fe II] emission lines in the F126N and F164N filters provide an excellent way to trace the jet emission back into the cloud and to thereby identify which embedded star is driving the outflow. Here we propose to obtain WFC3-IR images of [Fe II] emission from the remaining embedded jets in order to link the jets to the protostars that launch them. This will then permit a comparison of the jet properties to protostar properties for the full sample.

Additionally, the flux ratio of these two [Fe II] lines will probe the spatially dependent extinction through the cloud all the way back to the source, providing a map of the density structure in the protostar's extended circumstellar envelope.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12156
Title: N-body modeling of globular clusters: detecting intermediate-mass black holes by non-equipartition in HST proper motions
PI: Michele Trenti
PI Institution: University of Colorado at Boulder

Intermediate Mass Black Holes (IMBHs) are objects of considerable astrophysical significance. They have been invoked as possible remnants of Population III stars, precursors of supermassive black holes, sources of ultra-luminous X-ray emission, and emitters of gravitational waves. The centers of globular clusters, where they may have formed through runaway collapse of massive stars, may be our best chance of detecting them. HST studies of velocity dispersions have provided tentative evidence, but the measurements are difficult and the results have been disputed. It is thus important to explore and develop additional indicators of the presence of an IMBH in these systems. In a Cycle 16 theory project we focused on the fingerprints of an IMBH derived from HST photometry. We showed that an IMBH leads to a detectable quenching of mass segregation. Analysis of HST-ACS data for NGC 2298 validated the method, and ruled out an IMBH of more than 300 solar masses. We propose here to extend the search for IMBH signatures from photometry to kinematics. The velocity dispersion of stars in collisionally relaxed stellar systems such as globular clusters scales with main sequence mass as sigma ~ m^alpha. A value alpha = -0.5 corresponds to equipartition. Mass-dependent kinematics can now be measured from HST proper motion studies (e.g., alpha = -0.21 for Omega Cen). Preliminary analysis shows that the value of alpha can be used as indicator of the presence of an IMBH. In fact, the quenching of mass segregation is a result of the degree of equipartition that the system attains. However, detailed numerical simulations are required to quantify this. Therefore we propose (a) to carry out a new, larger set of realistic N-body simulations of star clusters with IMBHs, primordial binaries and stellar evolution to predict in detail the expected kinematic signatures and (b) to compare these predictions to datasets that are (becoming) available. Considerable HST resources have been invested in proper motions studies of some dozen clusters, but theoretical simulations are generally not performed as part of such programs. Our methods are complementary to other efforts to detect IMBHs in globulars, and will allow new constraints to be derived from HST data that are already being obtained.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12157
Title: Differential Proper-Motion Study of the Enigmatic Concentric Arcs of the Cygnus Egg Nebula with Imaging-Polarimetry
PI: Toshiya Ueta
PI Institution: University of Denver

We will undertake differential proper-motion measurements of the enigmatic concentric arcs in the circumstellar shell of the Cygnus Egg Nebula using the archived two-epoch optical imaging-polarimetric data taken with WFPC2 and ACS.

These circular concentric arcs are enigmatic because they co-exist and seemingly overlap with the object's well-known bipolar nebulosities, imposing a very perplexing mass-loss history to fathom. Previously we performed differential proper-motion measurements of the bipolar lobes of the object using two-epoch NICMOS images and determined the distance to the object to be 420 pc. Given this distance and the 7.25-yr time baseline of the optical wide-field imaging-polarimetric data, we can measure the expansion velocities of these concentric arcs directly and determine the mode of expansion of the arcs with respect to that of the bipolar lobes in order to assess the nature of these arc structures. Our proposed investigation is novel because we attempt to defy the confusion due to the projection effects by using imaging-polarimetric data. It is suspected that the observed concentric arcs are projections of the concentric spherical shells onto the plane of the sky, and hence, the apparent intervals between the neighboring arcs do not truly represent the physical spacing between the adjacent concentric spherical shells because of the confusion that arises as a result of the projection effects. Our proposed use of the polarized-flux-only maps permits us to recover the cross-section of the concentric spherical shells by exploiting the scattering-angle-dependent nature of the polarized flux. In such cross-sectional polarized surface brightness maps, the apparent spacing between two adjacent arcs truly represents the physical spacing between them. Therefore, we can measure relative motion of these concentric arcs/spheres without the confusion due to the projection effects and assess how the arcs expand in relation to the bipolar lobes, yielding new observational insights pertaining to kinematics of these enigmatic concentric arcs that can be tested against various existing theoretical models.
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Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12158
Title: Dynamical Evolution of Multiple Stellar Populations in Globular Clusters
PI: Enrico Vesperini
PI Institution: Drexel University

A number of recent photometric and spectroscopic observational studies have shown that several globular clusters host multiple stellar populations and raised a major challenge to the common paradigm according to which globular clusters are `simple stellar populations'---systems made up of stars all with the same age and chemical composition. Such a major paradigm shift raises a number of fundamental questions and challenges concerning the formation and the dynamical evolution of globular clusters. We propose here to carry out a detailed study of the long-term dynamical evolution of multiple populations in globular clusters. We will explore how the presence of multiple populations affect the dynamics of globular clusters, their current structural properties and the extent of the differences between the mass function, the structural and kinematical properties of different populations during a cluster dynamical history.
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Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12159
Title: Cosmologically-Constrained Star Formation Histories from the Reionization Epoch to the Present
PI: Risa Wechsler
PI Institution: Stanford University

The WFC3 camera on HST has allowed new measurements of the evolution of the

stellar mass function and galaxy clustering as a function of stellar mass and star formation rate out to redshifts as high as z ~ 8. This theory proposal requests funding for a project to combine these new and ongoing observations with published surveys from z = 0 - 6 in order to determine galaxy star formation histories from the epoch of reionization to the present day, including a detailed treatment of uncertainties. Our method would associate galaxies with dark matter halos in a large cosmological simulation and use halo merger trees to inform the possible evolution paths of galaxies. This work would result in new constraints on the star formation rate in galaxies as a function of halo mass, galaxy environment, and redshift as well as mock catalogs of galaxies with full star formation histories which have statistically identical properties to observations. Thus, we would place a diversity of galaxy observations from HST as well as other space and ground-based telescopes into full cosmological context, connecting their stellar population histories and spatial relationships over cosmic time.
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Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 12160
Title: Comparative impactology on Jupiter: Cataloging the clumps
PI: Michael Wong
PI Institution: Space Telescope Science Institute

Seven months after Hubble's first servicing mission, the impact of Comet Shoemaker-Levy 9 (SL9) captured worldwide attention—and the newly-installed WFPC2 captured 472 images of Jupiter in Program 5642. We will complete a census of each impact, including evolution, size, morphology, and color, now that the geometric and photometric calibration of WFPC2 has reached its best and final state. The data from Program 5642 prove their great value by still continuing to generate science publications, and we will upload deprojected (latitude-longitude mapped) data as High Level Science Products to further enhance the usability of this unique data set. The WFPC2 data are needed to understand recent observations of the 2009 impact on Jupiter, in which only 36 WFC3 and ACS images were obtained in Program 12003. In the isolated 2009 impact, the debris formed clumps that lasted at least until Jupiter was imaged again on 22 September (Program 11559), two months after the impact. Clumps were observed in a subset of SL9 impact sites, but a complete survey of all the available WFPC2 impact site imaging data will enable us to measure clump formation, favored dynamical environments, frequency of occurrence, interactions with other Jovian atmospheric features, and rates of change in size and albedo. Based on the 2009 WFC3 and ACS data, we suggest that these clumps are lower stratospheric eddies that maintain aerosol concentrations against dissipation. We will search the proposed complete catalog of 1994 WFPC2 data to isolate the determining factors for the formation and evolution of these clumps, with the goal of finding out whether they are commonplace Jovian dynamical features simply traced by impact-generated aerosols, or unique features generated by the impacts themselves (either through impact-related thermochemical processes, or through differences in particle microphysics). If the clumps mark commonplace but normally invisible eddies, they may play interesting roles in the chemistry and dynamics in Jupiter's lower stratosphere.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12161
Title: Accretion in Close Pre-Main-Sequence Binaries
PI: David Ardila
PI Institution: California Institute of Technology

The role of multiplicity in the accretion process remains an open issue for young stars. We propose to use COS to observe the circumbinary accretion flow in pre-main sequence binaries as a function of orbital phase. These observations will help us understand how the magnetosphere captures circumbinary gas, test model predictions regarding the importance of the mass ratio in directing the accretion flows, and study the kinematics of the gas filling the circumbinary gap. We will observe UZ Tau E (mass ratio q=0.3, e=0.33) and DQ Tau (q=1, e=0.58) in four phases, over three orbital periods, using G160M and G230L. The targets are Classical T Tauri stars for which the circumstellar disks are severely truncated. Our primary observables will be the CIV (1550 A) lines, formed at the footpoints of the accretion flow onto the star. We expect to observe the ebb and flow of the line shape, centroid, and flux as a function of orbital phase. The low-resolution NUV continuum observations will provide an independent measurement of the total accretion rate.

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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12162
Title: A Definitive Gas-Dynamical Measurement of the Black Hole Mass in M87
PI: Aaron Barth
PI Institution: University of California - Irvine

M87 contains the most massive black hole that has been detected dynamically in any nearby galaxy, and it provides a crucial anchor for the uppermost end of the correlations between black hole mass and host galaxy properties. However, the best current measurements of the black hole mass from stellar dynamics and from the dynamics of the circumnuclear ionized gas disk disagree by a factor of 2, and the discrepancy is significant at the 3-sigma level. Since M87 provides crucial information on the top of the M-sigma relation, it is important to determine the cause of this disagreement and to resolve this discrepancy. Our goal is to improve the gas-dynamical measurement of the central mass of M87. This work will improve on the past measurements by (a) fully mapping out the kinematic structure of the nuclear emission-line disk, and (b) carrying out comprehensive dynamical modeling, including the possible effects of pressure support or asymmetric drift, which were not considered in past measurements for M87. To accomplish this, we propose to obtain new STIS G750M spectra with the 52X0.1 slit, at five parallel and contiguous positions covering the inner portion of the nuclear disk. Our kinematic measurements and dynamical modeling will provide one of the best comparison tests between gas and stellar dynamical measurements of black hole masses, and an important new constraint on the upper end of the M-sigma relation.

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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12163
Title: Structure and Stellar Content of the Nearest Nuclear Clusters in Late-Type Spiral Galaxies
PI: Aaron Barth
PI Institution: University of California - Irvine

HST surveys have shown that nuclear star clusters are nearly ubiquitous in late-type, bulgeless disk galaxies. In early-type galaxies, the central black hole mass correlates with the bulge mass and velocity dispersion, but the relationship between black hole mass and host galaxy properties in bulgeless galaxies is not yet understood. Some nuclear clusters (such as the

one in M33) do not contain a central massive black hole at all, while other late-type galaxies (such as NGC 4395) are known to contain accretion-powered active nuclei within their nuclear clusters, indicating that a central black hole is present. But, the overall "occupation fraction" of black holes within nuclear clusters is largely unconstrained. Measurement of the structure, dynamics, and stellar content of nuclear star clusters is an important pathway toward understanding the demographics of low-mass black holes in late-type galaxies. We propose to obtain multi-filter WFC3 UV, optical, and near-IR images of 10 of the nearest and brightest nuclear clusters in late-type spiral galaxies. We will use the new WFC3 data to measure the cluster radial profiles, to search for color gradients, and in combination with ground-based spectroscopy and stellar population modeling, to determine the stellar masses of the clusters. Since nuclear clusters are known to contain stellar populations with a wide range of ages, the broad wavelength coverage of our data will provide new leverage to constrain the star formation history of the clusters. We will carry out dynamical modeling for the clusters, using the cluster structural parameters and stellar M/L ratios measured from the WFC3 data and kinematics measured from ground-based, adaptive-optics assisted integral-field spectroscopy (already obtained or approved for 8 of the 10 targets). This will yield tight new constraints on the masses of intermediate-mass black holes (IMBH) within the clusters, and may result in the first dynamical detections of IMBHs in the nuclei of late-type spirals.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12164
Title: Astrometry of New Horizons KBO candidates
PI: Susan Benecchi
PI Institution: Planetary Science Institute

The New Horizons (NH) spacecraft is on its way to study the Pluto system during a flyby. After the Pluto encounter, it is planned that the spacecraft will be retargeted to one or more yet-to-be-discovered Kuiper Belt Objects (KBOs) to learn about small KBOs and the Kuiper Belt debris body population. Ground-based observations using large class telescopes are underway to discover a KBO target that will be within the trajectory cone of NH. Unfortunately, the NH trajectory's line of site is within the galactic plane (Sagittarius) making stellar confusion a major problem in detecting and tracking KBOs in this region. HST’s sensitivity, resolution and PSF stability are a significant advantage in these confusion-limited starfields. We are requesting TOO orbits for up to 3 KBOs (2 orbits per KBO) to be triggered in the event that a candidate object is found in the NH trajectory. Objects must be recovered at multiple epochs to determine if their orbits will continue to place the object within the NH trajectory in the future. The observations we propose will also determine if the candidate is binary (~30% probability per candidate) and make a preliminary color determination.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12165
Title: Characterizing the UV environment of GJ1214b
PI: Jean-Michel Desert
PI Institution: Harvard University

The recent detection of a super-Earth transiting a nearby low-mass star GJ1214 (Charbonneau et al., 2009) has opened the door to testing the predictions of low mass planet atmosphere theories. Theoretical models predict that low mass planets are likely to exist with atmospheres that can vary widely in their

composition and structure. Some super-Earths may be able to retain massive hydrogen-rich atmospheres. Others might never accumulate hydrogen or experience significant escape of lightweight elements, resulting in atmospheres more like those of the terrestrial planets in our Solar System. Planets which orbit close to their parent stars, such as close-in hot-Jupiters and super-Earths, are exposed to strong XEUV flux that influence their atmospheres and may trigger atmospheric escape processes. This phenomenon, which shapes planetary atmospheres, determines the evolution of the planet. This can also dramatically enhance the detectability of a heavily irradiated hydrogen atmosphere when the planet transits in front of its parent star. We propose to use HST/STIS/G140M to determine the intensity and variability of the Lyman-alpha chromospheric emission line and provide observational constraints to super-Earth atmospheric models. We propose to coordinate this measurement with a planetary transit in order to detect large upper atmospheric signatures if present. This short measurement also enables us to determine whether a larger program dedicated to upper atmospheric study is feasible for a following cycle.
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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 12166
Title: A Snapshot Survey of The Most Massive Clusters of Galaxies
PI: Harald Ebeling
PI Institution: University of Hawaii

We propose the continuation of our highly successful HST/ACS SNAPshot survey of a sample of 123 very X-ray luminous clusters in the redshift range 0.3-0.7, detected and compiled by the MACS cluster survey. As demonstrated by dedicated HST observations of the 12 most distant MACS clusters (GO-09722) as well as by the MACS SNAPshots of an additional 25 obtained with ACS so far in Cycles 14 and 15, these systems frequently exhibit strong gravitational lensing as well as spectacular examples of violent galaxy evolution. A large number of additional MACS SNAPs have since been obtained with WFPC2, leading to the discovery of several more powerful cluster lenses. The dramatic loss, however, of depth, field-of-view, and angular resolution compared to ACS led to significantly reduced scientific returns, underlining the need for ACS for this project. The proposed observations will provide important constraints on the cluster mass distributions, on the physical nature of galaxy-galaxy and galaxy-gas interactions in cluster cores, and will yield a set of optically bright, lensed galaxies for further 8-10m spectroscopy. For those of our targets with existing ACS SNAPshot images, we propose SNAPshots in the WFC3 F110W and F140W passbands to obtain colour information that will greatly improve the secure identification of multiple-image systems and may, in the form of F606W or F814W dropouts, lead to the lensing-enabled discovery of very distant galaxies at z>5. Acknowledging the broad community interest in this sample (16 of the 25 targets of the approved MCT cluster program are MACS discoveries) we waive our data rights for these observations. This proposal is an updated and improved version of our successful Cycle 15 proposal of the same title. Alas, SNAP-10875 collected only six snapshots in the F606W or F814W passbands, due to, first, a clerical error at STScI which caused the program to be barred from execution for four months and, ultimately, the failure of ACS. With ACS restored, and WFC3 providing additional wavelength and redshift leverage, we wish to resume this previously approved project.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12167

Title: Resolving the Matter of Massive Quiescent Galaxies at z=1.5-2
PI: Marijn Franx
PI Institution: Universiteit Leiden

We and other groups have discovered that galaxies with little or no star formation exist at redshifts beyond 1.5, and that these galaxies are very small for their stellar mass. These galaxies as a class are approximately 5 times smaller than nearby early-type galaxies of the same mass. These results have very significant implications, as they demonstrate that even the most boring galaxies at high redshift, which have no or little starformation, must undergo dramatic structural changes while evolving to low redshift. The results are still uncertain, however, as the stellar masses of these galaxies have been estimated from stellar population models. These masses have unknown errors, mostly due to uncertainties in the stellar initial mass function. The stellar population masses can be tested using dynamical mass estimators. We have taken high signal-to-noise deep spectra of quiescent galaxies at z ~1.5 - 2 using X-Shooter and LRIS on Keck. The spectra are exquisite and allow us to measure the velocity dispersions of these galaxies. To convert the dispersion to mass we need to measure accurate sizes of the galaxies. Here we propose to take WFC3 imaging so that we can measure the structural properties of these galaxies and derive their sizes, dynamical masses, and mass-to-light ratios.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12168
Title: The temperature, mass and chemical composition of the bare ONe white dwarf SDSS1102+4054
PI: Boris Gaensicke
PI Institution: The University of Warwick

SDSS1102+2054 is a cool white dwarf with a helium-dominated atmosphere that exhibits strong oxygen and carbon lines in its optical spectrum. The oxygen-to-carbon (O/C) abundance ratio implied by the line strengths is much larger than unity, which rules out out a carbon-oxygen core composition and provides strong evidence that SDSS1102+2054 is a naked oxygen-neon (ONe) core. Stellar evolution models predict that such extreme O/C abundance ratios are achieved only in the most massive stars that just avoid core-collapse, and we hence believe that SDSS1102+2054 descends from an intermediate mass star close to the 8-10Msun boundary between stars leaving behind either white dwarfs, or neutron stars. As such, this white dwarf has the potential to provide important constraints on our understanding of the evolution of intermediate mass stars, in particular testing predictions of mass loss, the efficiency of convective core mixing, and the relevant nuclear reaction rates. We propose to obtain intermediate-resolution HST/COS spectroscopy of SDSS1102+2054 to overcome the limitations of the available ground-based data and accurately measure its effective temperature, mass, and Mg abundance, and stringently test the current models of stellar evolution.
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Proposal Category: SNAP
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12169
Title: The frequency and chemical composition of planetary debris discs around young white dwarfs
PI: Boris Gaensicke
PI Institution: The University of Warwick

Throughout the past few years, it has become increasingly clear that the most

plausible scenario to explain the metal-pollution observed in ~20% of all cool white dwarfs is accretion from rocky debris material - suggesting that these white dwarfs may have had, or may still have terrestial planets as well. This hypothesis is corroborated through the infrared detection of circumstellar dust around the most heavily polluted white dwarfs. Traditionally, the detection of metal pollution is done in the optical using the Ca H/K lines, leading to a strong bias against hot/young white dwarfs. Hence, most of our knowledge about the late evolution of planetary systems is based on white dwarfs with cooling ages >0.5Gyr. We propose an HST/COS ultraviolet spectroscopic snapshot survey to carry out the first systematic investigation of the fraction of metal-pollution among young (20-100Myr) white dwarfs, probing the correlation with white dwarf (and hence progenitor) mass, and determining the Si/H, C/H, and potentially N/H and O/H abundance ratios of their circumstellar debris material.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12170
Title: A direct UV search for the progenitor of the nearby type Ib SN 2007fo
PI: Avishay Gal-Yam
PI Institution: Weizmann Institute of Science

Understanding the explosive death of massive stars is a key open question in astrophysics. Direct observational information about the pre-explosion properties of supernova progenitors would provide explosion models with a set of initial conditions, and a crucial complement to supernova observations that constrain the explosive outcome. In recent years, identifying the progenitors of the most nearby supernovae in pre-explosion HST images has allowed significant progress in this field. However, this is limited mostly to H-rich type II supernova explosions of red supergiants. The improtant class of stripped (H-poor) type Ib and Ic supernovae, which are especially interesting due to their possible relation to long Gamma-Ray Bursts, remain obscure, with many attempts to discover progenitors yielding only upper limits. The hunt for these elusive progenitors is difficult probably due to a combination of factors: SN Ib/c are intrinsically rare, and their stripped progenitors (probably blue Wolf-Rayet stars) are difficult to detect in archival pre-explosion HST images, mostly obtained in red bands. The nearby type Ib SN 2007fo exploded in NGC 7714, a galaxy with archival imaging uniquely extending to the UV. We have used ground-based Gemini AO imaging of the supernova to localize it on the pre-explosion HST grid, and found that it resides in a complicated area where a single progenitor cannot be pinpointed (though candidates exist). Next, we propose to reimage this location and compare the post-explosion images to archival templates in order to robustly identify the progenitor. Using image-subtraction we will compare the two HST epochs, identify objects that decay or disappear, and thus locate the progenitor of this SN, a very exciting prospect. Failing to detect the progenitor would place strong limits on its luminosity, adding to the growing body of information on SN progenitors. A modest investment of 2 HST orbits has the potential to reveal the first W-R progenitor of a type Ib supernova.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12171
Title: Target of Opportunity Imaging of an Unusual Cloud Feature on Uranus
PI: Heidi Hammel
PI Institution: Space Science Institute

The planet Uranus is demonstrating increased atmospheric activity as it passes the equinox, likely in response to extreme insolation change. Convective sites in the planet's southern hemisphere reached unprecedented altitudes in 2003 (Hammel et al. 2005, Icarus 175, 284); a bright northern feature showed the highest contrast yet detected in an outer planet atmosphere (Sromovsky et al. 2007, Icarus 192, 558); and a dark atmospheric feature was detected by HST in late 2006 (Hammel et al. 2009, Icarus 201, 257). The historical record makes references to discrete structures (both bright and dark) on Uranus during previous equinoctial apparitions (the last equinox occurred in 1965). The best amateur facilities are now just able to resolve the disk of Uranus and detect such activity if it is very large or has very high contrast. Amateurs also have access to a great many nights of telescope time. If a discrete cloud feature on Uranus is reported through the amateur network, we propose to obtain follow-up images with HST's WFC3. The proposed TOO images will permit determination of detailed structure of the feature at visible wavelengths, and will provide vertical and horizontal constraints on the feature's scattering properties. HST is the only facility that can provide such information at visible wavelengths. The proposal was accepted in both C16 and C17, but not executed because the defined criteria for activation were not met. Because the timescales of change on Uranus are unknown, we resubmit this for Cycle 18.

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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12172
Title: Is the Extraordinary Super Star Cluster NGC 3125-1 an Imposter?
PI: Claus Leitherer
PI Institution: Space Telescope Science Institute

We propose a short, 4 orbit COS+STIS spectroscopic program to observe the extraordinary super star cluster in the local starburst galaxy NGC 3125. The cluster has the strongest He II 1640 emission ever observed in a starburst region in the local universe. This line is the tell-tale sign of Wolf-Rayet stars, the evolved descendants of very massive O stars. Taken at face value, the anomalous He II 1640 line indciates a Wolf-Rayet population that is very different from other starburst regions. However, previous attempts to interpret the observational data of the super star cluster were hampered by the low resolution of the ultraviolet spectra and the lack of co-spatial panchromatic data. As a result, the suggestion of the extraordinary nature of this super star cluster is still not unambiguous. The proposed program will settle the matter. We will test the upper initial mass function from several angles: the N V and Si IV stellar wind-lines, the elusive O V line associated with the hottest, most massive stars, and the ionizing radiation as probed by recombination lines. We will determine the dust redening with three independent methods: the SED, the Balmer decrement, and the He II 4686/1640 ratio. The STIS long-slit capabilities will allow us to perform a comparative study with a nearby super star cluster in the host galaxy. The ultraviolet spectrum of the super star cluster may be the missing link between local starbursts and star-forming galaxies at cosmological redshift. The UV spectra of the two classes of objects are rather similar, except for the He II 1640 line, which is much stronger at high redshift. Detailed observations of NGC 3125 may help shed light on understanding the details of star-formation at high redshift.

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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM

ID: 12173
Title: Feedback between Stars, ISM and IGM in IR-Luminous Galaxies
PI: Claus Leitherer
PI Institution: Space Telescope Science Institute

We propose COS G130M mode spectroscopy between 1150 and 1450 Angstroms of four ultraviolet-bright, infrared-luminous starburst galaxies. Our selected sightlines towards the starburst nuclei probe the physical conditions in the starburst-driven galactic superwinds. The spectral resolution of about 20 km/s is an order of magnitude improvement over existing HST data and allows a study of the complex gas conditions. Previous observations at lower resolution found strong, blueshifted interstellar absorption lines whose strength and velocity indicate signficant mass outflow. High-resolution data are required to verify or reject suggestions of velocity dispersion and/or covering factor variations being the prime mechanism responsible for the line properties. The proposed observations will constrain the energetics of the cool and warm gas and help determine if the outflow material can escape from the galaxies. Several weak lines will be measured at sufficiently high S/N to derive the column densities and abundances in the dominant ions entrained within the outflow. In combination with the kinematic properties we will estimate the mechanical energy and mass outflow rate and perform a comparison with the star-formation rate. We will investigate whether the outflows quench star formation and ultimately regulate the starburst as has been suggested for high-redshift galaxies. The chosen sightlines will allow us to generalize our results to the overall properties of galaxy outflows, to search for implications for similar galaxies at cosmological distances, and to add to our understanding of QSO absorption lines. Outflows may be the long-sought mechanism for distributing the products of stellar nucleosynthesis over large volumes in the universe.
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Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12174
Title: An HST/WFC3 mapping of optical emission lines from the nuclear spiral in M31
PI: Zhiyuan Li
PI Institution: Smithsonian Institution Astrophysical Observatory

The nuclear spiral in M31, consisting of ionized and neutral dusty gas clouds of typically sub-parsec sizes, shows optical emission lines characteristic of LINERs. Yet the lack of UV radiation from either an active nucleus or massive young stars makes the ionizing source of this nearest LINER a longstanding puzzle. We propose a WFC/UVIS observation of the nuclear spiral, using appropriate narrow-band filters to map the H alpha, [N II] and [O III] lines. The resolving power of HST is essential to measuring the line intensities and their ratios from discrete gas clouds across the nuclear spiral, based on which we can derive the physical properties of gas such as density and ionization state. We will then assess the relative importance of ionization/excitation mechanisms, in particular UV radiation provided by evolved stars and heating by cosmic-rays, by confronting with theoretical models. This study advances our understanding of the regulation of galactic circumnuclear environments, which is in turn crucial to understanding the evolution of the central super-massive black hole and the host galaxy.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12175
Title: The past and future evolution of the unique double white

dwarf binary SDSS1257+5428
PI: Thomas Marsh
PI Institution: The University of Warwick

The past 15 years has seen the unmasking of a vast population of close double white dwarfs (DWDs) with over 100 million in our Galaxy alone. So numerous are DWDs that they may themselves be the progenitors of significant populations such as accreting ultra-compact binary stars, isolated millisecond pulsars, hot subdwarfs and Type Ia supernovae. They are also expected to be the dominant sources for space-based gravitational wave astronomy. We have discovered a unique DWD, SDSS1257+5428, composed of two white dwarfs with masses of 0.2 and > 1 Msun, from the low and high-mass extremes of the white dwarf mass distribution. The high mass white dwarf is rapidly rotating, suggestive of accretion-induced spin-up, and yet in current models of the evoluton of such systems in which the low mass white dwarf should have emerged from a common envelope phase, there could not have been time for such spin-up to have occurred. Our current knowledge of the system, particularly the fainter high mass white dwarf, is limited by the blending of the two spectra at optical wavelengths. We don't know for instance whether or not the total system mass exceeds the Chandrasekhar mass. We will acquire ultraviolet spectra of SDSS1257+5428 which will pin down the masses and temperatures of the compoanent white dwarfs to define the past and future evolution of this puzzling system.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12176
Title: Long term observations of Saturn's northern auroras
PI: Jonathan Nichols
PI Institution: University of Leicester

Auroral emissions are a vital tool in diagnosing the dynamics of planetary magnetospheres. While Saturn’s southern UV auroras have been observed with high-sensitivity cameras onboard the Hubble Space Telescope (HST), the northern auroras have only been observed at very oblique angles. Our understanding of Saturn’s auroral emissions is thus only half complete. However, Saturn has now passed equinox and is moving toward summer in the northern hemisphere, such that the northern auroras are now visible from Earth, and recent results from HST have indicated that Saturn’s northern auroras are not simply mirror images of the southern. The changing seasons are also expected to result in significant changes in magnetospheric phenomena related to the auroras. Observing these changes is a specific goal of the Cassini Solstice Mission (CSM) and, since joint HST-Cassini observations have repeatedly proved to be invaluable, CSM operations are currently being planned specifically with joint HST observations in mind. The observations proposed here will thus execute over Cycles 18-20, and will address the following science questions: What is the morphology of Saturn’s northern auroras? Do Saturn’s auroras change with the planet’s season? How are the auroral emissions of different wavelengths related? The importance of long term HST observations of Saturn’s northern auroras are highlighted by the fact that recent key discoveries would have been missed without the multiyear archive of observations of the planet’s southern auroras. The opportunity to obtain HST images while Cassini makes specifically-tailored supporting observations is an extremely valuable opportunity, and HST is the only instrument capable of providing sustained, high time resolution observations of Saturns auroral emission.
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Proposal Category: GO

Scientific Category: TAC
ID: 12177
Title: 3D-HST: A Spectroscopic Galaxy Evolution Treasury
PI: Pieter van Dokkum
PI Institution: Yale University

The Hubble Space Telescope has given us a dazzling imaging legacy, which has enabled us to establish a broad picture across cosmic epochs of how galaxies came to be. Here we propose to extend this legacy with 3D-HST, a peerless near-IR spectroscopic program for studying the physical processes that shape galaxies in the distant Universe. Ground-based optical spectroscopy has provided redshifts of large numbers of UV-bright Lyman break galaxies, but they make up only a fraction of the general galaxy population at z>1. 3D-HST will provide rest-frame optical spectra for a complete sample of ~9000 galaxies at 1<z<3.5, when ~60% of all star formation took place, the number density of quasars peaked, the first galaxies stopped forming stars, and the structural regularity that we see in galaxies today must have emerged. The proposed rest-frame optical spectra not only provide redshifts but also spatially-resolved maps of well-calibrated diagnostics of star formation, stellar age, metallicity, stellar mass-to-light ratio and AGN activity, diagnostics that are completely inaccessible otherwise. Combined with already planned WFC3 imaging, the spectra track the emergence and growth of disks and bulges, identify the processes responsible for shutting off star formation in galaxies, and determine the roles of mergers and the larger environment in the shaping of today's galaxies. The survey also has immense legacy value as it provides spectra for all objects in the target fields: 3D-HST should reveal faint quasars at z~7-8 and identify the first spectroscopically-confirmed galaxies at z~9. We waive all proprietary rights and also commit to making the extracted spectra, redshifts, and other derived quantities publicly available. The survey area will cover most of the Faber et al. MCT imaging area, leveraging this 912-orbit WFC3 imaging investment and greatly enhancing the scientific returns from that program. The combination of the two surveys will provide the definitive imaging and spectroscopic dataset for studies of the distant Universe until JWST.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12178
Title: Spanning the Reionization History of IGM Helium: a Highly Efficient Spectral Survey of the Far-UV-Brightest Quasars
PI: Scott Anderson
PI Institution: University of Washington

The reionization of IGM helium likely occurred at redshifts of z=3 to 4. Detailed studies of HeII Ly-alpha absorption toward a handful of quasars at 2.7<z<3.3 confirm the potential of such IGM probes, but the small sample and redshift range limited confidence in cosmological inferences. The requisite unobscured sightlines to high redshift are extremely rare; but we've cross-correlated 10,000 z>2.8 SDSS DR7 (and other) quasars with GALEX GR4/5, to identify 630 candidates potentially useful for HST HeII studies. Our cycle 15-16 HST trials confirm our approach, verifying twenty new HeII quasars at unprecedented 40% efficiency. We propose to complete the first efficient (80% with refinements) survey for HeII quasars, via reconnaissance (~1 orbit) COS spectra of a highly select subset of 17 SDSS/GALEX quasars at 2.8<z<4.1. Along with past work, this program will yield 3-4 of the brightest far-UV HeII sightlines within each of 10-12 redshift bins spanning 2.8<z<4.1, enabling a community sample suitable for detailed spectral follow-up with HST. Herein, we will also directly obtain quality UV spectral stacks within each redshift bin to trace the reionization history of IGM helium; such spectral stacks average

over cosmic variance and individual object pathology. Our high-yield HeII sightline sample and spectral stacks will enable confident conclusions about the IGM baryon density, the spectrum and evolution of the ionizing background, the evolution of HeII opacity, and the epoch of helium reionization.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12179
Title: The Stellar Winds of Evolved, Braked O-Type Magnetic Oblique Rotators
PI: Jean-Claude Bouret
PI Institution: CNRS, Laboratoire d'Astrophysique de Marseille

Magnetic fields have recently been discovered on several massive stars, but their origin and influence on the evolution of these stars are poorly understood. Two of these objects, HD 191612 and HD 108, are of particular interest. Very recent spectropolarimetric observations have shown that they are most likely magnetic oblique rotators, like the young O star Theta1 Ori C, whose 15d periodically variable field was found somewhat earlier. However, the two new objects are much slower rotators, unusually so for O stars, with periods of 538d and 50-60yrs, respectively, and there are other indications that they are older. They provide an opportunity to study the efficiency of wind braking of magnetic O stars through angular momentum loss. We shall perform STIS high-resolution UV spectroscopy of HD 191612 and HD 108 (phase resolved for the former) to derive more complete estimates of fundamental quantities than available from optical data alone. We shall measure the mass-loss rates from the UV wind profiles, which will constrain the extreme wind confinement of these stars and establish whether the large H-alpha emission variations are wind-related or geometrical. We shall also derive more accurate ages and stellar surface properties. In turn, these results will support a more definitive discussion of the angular momentum evolution versus the ages of HD 191612 and HD 108, and of the comparison with the younger and faster Theta1 Ori C.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12180
Title: The Holistic Evolution of Dwarf Galaxies: Internal and External Processes in NGC 6822
PI: John Cannon
PI Institution: Macalester College

Low-mass galaxy evolution is driven by both internal (e.g., star formation and feedback) and external (e.g., tidal interaction) processes; however, few nearby systems show evidence of both mechanisms operating in tandem. The Local Group dwarf galaxy NGC 6822 presents a unique opportunity to study important evolutionary processes because of proximity and timing: it harbors one of the largest known holes in its neutral ISM (a signpost of violent stellar feedback), and it appears to be undergoing a tidal interaction with a very low mass companion dwarf galaxy. To capitalize on this opportunity, we propose to undertake an ACS and WFC3 imaging study of the stellar populations throughout NGC 6822. We will study the role of both internal and external processes by sampling the stellar populations associated with the main body (using archival WFPC2 data), the giant HI hole, the companion dwarf galaxy, and the tidal material at the ends of the disk. From these data we will extract precise color magnitude diagrams; we will measure the full 13 Gyr star formation history of each field, with high time resolution (20-250 Myr) over the past 1 Gyr, and quantify the relative contributions of internal and

external drivers of dwarf galaxy evolution. Specifically, we will study: 1) the nature of the companion object (differentiating between infalling gas and a genuine low-mass galaxy); 2) the energetics of giant HI hole creation; 3) the role of interactions in the system's evolution; 4) the nature of feedback in governing the star formation process; and 5) the patterns of star formation over time. We have optimized our field placements to extract the most information possible about the competing forces that drive galaxy evolution; in only six orbits, we will gain fundamental insights into the contributions of both internal and external processes that bear on the evolution of low-mass galaxies.
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Proposal Category: GO
Scientific Category: TAC
ID: 12181
Title: The Atmospheric Structure of Giant Hot Exoplanets
PI: Drake Deming
PI Institution: NASA Goddard Space Flight Center

Characterization of close-in giant exoplanets has proceeded rapidly over the past few years, due largely to Spitzer and HST observations in transiting systems. Low resolution thermal emission spectra of over two dozen planets have been measured by Spitzer, and HST observations of a few key planets have indicated unusual molecular abundances via transmission spectroscopy. However, current models for the atmospheric structure of these worlds exhibit degeneracies wherein different combinations of temperature and molecular abundance profiles can fit the same Spitzer data for each planet. Fortunately, the advent of the IR capability on HST/WFC3 allows us to solve this major problem in exoplanet science. We propose to inaugurate a Large HST program that is scientifically complementary to Spitzer, Kepler, and CoRoT exoplanet results. We will obtain transmission spectroscopy of the 1.4-micron water band in a sample of 13 planets, using the G141 grism on WFC3. Among the abundant molecules, only water absorbs at this wavelength, and our measurement of water abundance will enable us to break the degeneracies in the Spitzer results with minimal model assumptions. We will also use the G141 grism to observe secondary eclipses for 7 very hot giant exoplanets at 1.5-microns, including several bright systems in the Kepler and CoRoT fields. The strong temperature sensitivity of the thermal continuum at 1.5-microns provides high leverage on atmospheric temperature for these worlds, again helping to break degeneracies in interpreting the Spitzer data. Moreover, our precise eclipse photometry, in combination with extant Spitzer data, will enable us to extrapolate the thermal continuum to optical wavelengths. Kepler and CoRoT teams will be thereby able to subtract the thermal contribution from their increasingly precise measurements of optical eclipses, and measure, or place extremely stringent limits on, the albedo of these exotic worlds.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12182
Title: Measuring the physical properties of the Milky Way nuclear star cluster with proper motions
PI: Tuan Do
PI Institution: University of California - Los Angeles

Nuclear star clusters have been proposed as a byproduct of galaxy formation, analogous to supermassive black holes, because their mass scales with host galaxy properties in a similar way as the (M_bh-sigma) and (M_bh-M_bulge) relationships. While the nuclear star cluster at the center of the Milky Way offers us an opportunity to study such a system with a level of detail not

possible in external galaxies, this potential has not been realized due to the impracticality in obtaining wide-field, high angular resolution, and high precision kinematic measurements from the ground. We propose to use WFC3 on HST to measure, for the first time, the proper motions of stars out beyond the half-light radius of the cluster (~7 pc). These observations will allow us to derive three fundamental properties of the cluster that have been poorly constrained in the past: (1) the total mass, (2) the distribution of mass, and (3) the rotational signature of the cluster. The underlying mass distribution and total mass are requirements for placing the Milky Way nucleus in context with galaxy scaling relationships. The rotational profile will provide constraints on the origin of the nuclear star cluster, offering perhaps a physical explanation for the link between supermassive black holes and nuclear star clusters.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12183
Title: The magnetar SGR 0418+5729 in the optical and infra-red
PI: Martin Durant
PI Institution: University of Florida

The newly-discovered SGR 0418+5729 offers a unique opportunity to study the optical and infra-red emission of a magnetar: it is closer and less extincted than any other. The optical/IR counterpart has not yet been identified, so we ask for a short observation to find it, and establish its usefullness for further detailed study.
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Proposal Category: SNAP
Scientific Category: AGN/QUASARS
ID: 12184
Title: A SNAP Survey for Gravitational Lenses Among z~6 Quasars
PI: Xiaohui Fan
PI Institution: University of Arizona

We propose a SNAP imaging survey of a complete sample of 54 quasars at 5.7 < z < 6.4 using HST/WFC3-IR to quantify the prevalence of strongly lensed quasars at z~6. Gravitational lensing magnification bias, boosted by the observed steep luminosity function of high-redshift quasars, strongly suggest that lenses should be common amongst the highest-redshift quasars known. However, the highest redshift strongly lensed quasar known is only at z=4.8; but among the 59 quasars known at z>5.9, only five have been imaged with HST. Our HST images will be sensitive to the multiple images of lensed quasar, even at small separations and large flux ratios. Based on the current best estimate of the quasar luminosity function, we expect to discover 2-9 strongly lensed quasars in our entire sample, or 1-4 for the nominal SNAP completion rate of 40%. This program will likely discover the first quasar lenses at z~6, enabling detailed follow-up observations to constrain lensing models, to study quasar host galaxy properties and to probe the small-scale structure of the IGM. The measurement of or upper limit on the lensing fraction will strongly constrain the bright end of the quasar luminosity function, leading to important constraints on models of quasar evolution and allowing us to better quantify the quasar contribution to the reionization photon budget.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12185
Title: The Hosts of Megamaser Disk Galaxies

PI: Jenny Greene
PI Institution: Princeton University

We propose to obtain multi-wavelength imaging of a new sample of exquisite megamaser disk galaxies. Much like in NGC 4258, the megamasers in our sample trace sub-pc, circumnuclear gas in Keplerian rotation around the central supermassive black holes (BHs). We are thus able to derive remarkably precise BH masses in these systems. As the megamasers are found in spiral galaxies with BH masses ~10^7 M_sun, they offer a unique opportunity to study BH-bulge scaling relations in later-type galaxies. Existing ground-based imaging is inadequate to disentangle the many structural components (star clusters, bars, spirals, and dust lanes) found in the nuclei of these galaxies. Thus, we propose F336W, F438W, F814W, F110W, and F160W observations of these galaxies with WFC3 to simultaneously model the stellar populations and structures of their inner regions. With these data we will constrain BH-bulge scaling relations at low mass, study the relation between nuclear star clusters and supermassive BHs, and look for evidence of coincident star formation and accretion. The mass-to-light ratio profiles will provide important inputs to complementary stellar- and gas-dynamical modeling of the BH masses. The high-precision masses afforded by this sample of new megamaser galaxies provides a tremendous resource for our community that can only be adequately exploited with complementary HST imaging.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12186
Title: Jet launching and evolution in the weakly magnetized Herbig Ae star HD 163296
PI: Hans Guenther
PI Institution: Smithsonian Institution Astrophysical Observatory

Jets are common in young stars, however, their driving mechanism and many details about their evolution are still unknown. We propose to reobserve HH 409, the jet driven by the Herbig Ae star HD 163296. One orbit each will be used for optical (G750M, covering Ha and the density and temperature sensitive forbidden lines [OI], [SII] and [NII]) and FUV (G140M, covering Lya) long-slit spectroscopy with STIS. Similar HST data were taken between 1998 and 2003 already. Comparing archival to new observations we have a long time baseline to study the evolution of velocity, temperature and density in the Herbig-Haro objects of the jet. We can infer their energy budget from radiative cooling, expansion and continuous shock reheating. Furthermore, we will spectrally resolve the emission lines. If a high-velocity component is found, we can rule out disk winds as jet launching scenario. HH 409 is the only jet with detected X-ray emission from a young star with a weak magnetic field.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12187
Title: A New Sample of Circumnuclear Gas Disks for Measuring Black Hole Masses in Spiral Galaxies
PI: Luis Ho
PI Institution: Carnegie Institution of Washington

The correlation between central black hole (BH) mass and bulge stellar velocity dispersion has become a fundamental tool to investigate the link between BH growth and galaxy formation. However, the current BH census in nearby galaxies is highly biased toward early-type galaxies. It is important to increase the number of direct BH mass measurements along the spiral

sequence, not only to better delineate the M-sigma relation but also to verify tentative claims that the scatter and zero point of the relation may vary with galaxy morphology and the formation history of the bulge. With these goals in mind, we carried out an ACS/WFC narrow-band (F658N) imaging survey of nearby S0-Sbc galaxies to identify circumnuclear Halpha disks suitable for follow-up STIS spectroscopy. Past experience indicates that such a pre-selection strategy significantly improves the chances of obtaining successful dynamical models to measure BH masses. We found 6 good new candidates of circumnuclear gas disks in spiral galaxies. STIS G750M spectra will be obtained for each source using three parallel slits to map out the gas kinematics in the inner portion of the nuclear disks: a 52X0.1 slit centered on the nucleus and one flanking 52X0.2 slit positioned on each side of the nucleus. We will perform dynamical modeling to measure the central BH masses. If successful, this study will provide a significant increase in the current sample of spirals with secure BH masses, with important ramifications for improving and refining the M-sigma relation.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12188
Title: Tests of Extreme Physics in Very Cool White Dwarfs
PI: Jay Holberg
PI Institution: University of Arizona

A program of low resolution Near UV STIS spectroscopy is proposed that will critically test new improved models of photospheric opacity in cool (Teff < 6000 K) DA and DC white dwarf stars. Such stars possess either weak or no Balmer lines from which spectroscopic information such as temperature, surface gravity and photospheric composition can be determined. These critical parameters must be estimated from fits to the overall Spectral Energy Distribution (SED), a method that is inherently less sensitive than spectroscopic methods. Our new models implement a detailed treatment of collisional perturbations to H atoms in cool dense WD photospheres that naturally account for an acknowledged missing opacity, due the red wing of the H I Lyman alpha transition. This in tern modifies the SED in the wavelength region from 2500 A to 4000 A. A full validation of these models over a significant range of temperature and gravity will greatly improve the analysis of the cool white dwarfs and provide new insights into atmospheric compositions, cooling ages, and luminosities of this important component of the white dwarf population.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12189
Title: Do stars ionise the filaments in NGC 1275 ?
PI: Walter Jaffe
PI Institution: Sterrewacht Leiden

Brightest Cluster Galaxies (BCGs) in cool core clusters show filaments of line emitting gas whose ionization physics has been much studied but little understood. Some filaments show blue knots suggesting young star clusters; others do not. We request deep COS G140L FUV spectra of five regions in the filaments surrounding the BCG NGC 1275 in the nearby Perseus cluster. Analysis of the spectra, and particularly the [CIV] feature will clarify whether the filaments are ionized by normal stars, ultrahot stars, or a nonthermal source weak in FUV photons. The possible role of the active nucleus will be investigated by selecting regions located at various distances from the nucleus. Understanding the ionization and heating of these filaments, and why

some filaments form stars, whilst others are prevented from collapsing, is important not only to the understanding of cool core clusters, but also to the wider issue of galaxy formation.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12190
Title: WFC3/IR Spectroscopy of the Highest Redshift Black Hole Candidates
PI: Anton Koekemoer
PI Institution: Space Telescope Science Institute

We propose to obtain WFC3/IR grism spectrocopy of our most robust sample of z>7 active galactic nuclei (AGN), selected from the most extensive X-ray and multiband surveys to date, drawing from both GOODS and COSMOS. These sources are the most robust z>7 candidate AGN that have been selected from any surveys to date, and represent our best opportunity to understand the formation and growth of black holes, and their role in galaxy evolution, within the first 800 Myr of cosmic time. A key mystery in our understanding of black hole growth is how they are able to grow so rapidly by z~6.4, which is the highest redshift for any spectroscopically confirmed AGN to date. Extensive ground-based NIR spectroscopic efforts on 8-10m telescopes to extend this redshift frontier to more distant AGN have so far proved fruitless, predominantly limited by the ground-based IR sky and the faintness of these sources. The unique gains afforded by WFC3/IR now provide us with the ability to open up this piece of parameter space, crucial to understanding how these sources form and evolve. We will also search for signatures of star formation that may be occurring in conjunction with the black hole feeding phase, which is of particular importance in the context of scenarios that invoke rapid accretion-driven black growth at these early epochs. Hence, this program will provide crucial information on our understanding of the formation and accretion processes associated with black holes in the very early universe, and how the relationships between black holes and galaxies are set in place that persist throughout the rest of cosmic time.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12191
Title: Prospecting for Rare Elements in the Interstellar Medium
PI: James Lauroesch
PI Institution: University of Louisville Research Foundation, Inc.

The complex history and evolution of element production is reflected in the abundance ratios of the elements. The distinctive abundances patterns produced by nucleosynthesis in supernovae and stars can be used to explore the history of star formation and evolution in galaxies. Recent observations of damped Lyman-alpha systems have suggested that observations of r and s-process elements at high redshifts may soon provide a new window to explore chemical evolution. Paradoxically, we may soon have more detections of some elements in the interstellar medium of these high redshift galaxies than in the Galactic ISM. However, without an understanding of the depletion behavior of these elements based upon observations of nearby sightlines we may be unable to correctly disentangle the effects of dust depletion and nucleosynthesis. We therefore propose to determine the depletion of r and s-process elements in two sightlines with relatively mild depletion patterns on nearly opposite parts of the sky. In addition to providing a baseline for studies at high redshift, the long pathlength studied will enable us to search for abundance variations within our Galaxy.

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Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12192
Title: A SNAPSHOT Survey of Interstellar Absorption Lines
PI: James Lauroesch
PI Institution: University of Louisville Research Foundation, Inc.

We propose to obtain SNAPSHOT high-resolution STIS echelle observations of the interstellar absorption lines between 1160 and 1370 Angstroms towards a sample of stars with known UV fluxes which have been previously observed with {\it FUSE} or high proper motion stars with previous {\it HST}/STIS 1271\AA\ observations. By taking advantage of the SNAPSHOT observing mode we will efficiently obtain large numbers of spectra of O and B-type stars for ISM studies. Our goals are to explore the homogeneity of the ISM on large scales and to search for variations in interstellar absorption lines indicative of small scale structure.. The selected wavelength range contains numerous interstellar absorption lines which enable us to measure the physical properties (density, temperature, depletions) in individual components. By taking advantage of differential Galactic rotation we can probe clouds as a function of Galactic radius, and differentiate between various models for interstellar enrichment.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12193
Title: Globular clusters as galaxy building blocks
PI: Jae-Woo Lee
PI Institution: Sejong University

Our recent study of Galactic globular clusters using ground-based Ca & Stromgren by photometry has shown that many globular clusters have multiple red giant branch populations with distinct calcium abundances. This suggests that these globular clusters, like omega Cen, are most likely the relics of more massive primeval dwarf galaxies that merged and disrupted to form the proto-Galaxy. We seek to perform a pilot program to obtain main-sequence photometry for a carefully selected sample of five globular clusters with mutiple red giant populations, and one control cluster with a simple stellar population using the WFC3/UVIS and F395N, F467M, and F547M filters to investigate the presence of subtle differences in heavy elemental abundances between multiple main-sequence populations. This will play a crucial role to test our idea on the origin of globular clusters. Our proposed observations will provide unique opportunity to explore fundamental aspects of stellar evolution, the star formation and chemical enrichment histories of globular clusters, and furthermore, the formation of the Milky Way Galaxy in the Lambda CDM hierarchical merging paradigm.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12194
Title: High resolution Near-Infrared imaging of the first sub-mm selected gravitational lens candidates in the Herschel Astrophysical Terahertz Large Area Survey (H-ATLAS)
PI: Mattia Negrello
PI Institution: The Open University

We propose HST/WFC3 near-IR high-resolution imaging of five gravitational lens

candidates produced by the Herschel Astrophysical Terahertz Large Area Survey (H-ATLAS). These sources are among the brightest sub-mm objects detected in H-ATLAS. Their spectral energy distribution, sub-mm colors and optical IDs are consistent with a gravitational lensing system where a nearby (z<~0.3) elliptical galaxy is acting as a lens on a dust-obscured high-redshift (z>~3) galaxy. However, the background galaxy is predicted to be too faint in the optical/near-IR to be detectable in the ancillary SDSS and UKIDSS images, therefore our proposal for deep near-IR imaging with HST/WFC3. The discovery of gravitational lenses is one of the scientific goals of H-ATLAS and, if achieved, it will demonstrate the efficiency of blank wide-area sub-mm survey in producing unbiased and complete samples of gravitational lensing systems. Thanks to its sensitivity and unique spatial resolution HST/WFC3 will allow us to constrain the morphology of the brightest sub-mm sources detected by Herschel and therefore to eventually confirm their nature as gravitational lenses. In that case we will use HST/WFC3 images to reconstruct the intrinsic morphology of the background source and constrain the mass and matter profile of the lens.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12195
Title: Understanding the Largest Quasar Lens SDSS J1029+2623
PI: Masamune Oguri
PI Institution: National Astronomical Observatory of Japan (NAOJ)

We propose multi-band WFC3/ACS imaging of the unique quasar lens SDSS J1029+2623. It consists of three quasar images at z=2.2 produced by a massive cluster of galaxies at z=0.60. The lens system represents a very rare example of the ``naked cusp'' image configuration, and moreover, the maximum image separation of 22.5'' makes it the largest known quasar lens. We will use the deep WFC3/ACS images to identify many additional multiply-imaged background galaxies, which greatly helps the mass modeling of the central region of the cluster. An accurate mass model is essential to addressing several outstanding questions for this lens, including the anomalous flux ratios between the quasar images and the dynamical state of the lensing cluster. The model will be particularly good because we can combine the strong lensing constraints from HST with our weak lensing measurements on large scales, and also with our deep 60 ksec Chandra X-ray observations.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12196
Title: Disk Truncations: Probing Galaxy Formation at the Limits
PI: David Radburn-Smith
PI Institution: University of Washington

Traditionally, the radial surface-brightness profile of a galaxy disk has been modelled by a single exponential profile. However, the vast majority of disk galaxies actually show signs of a disk truncation, where the profile suddenly breaks to a steeper second exponential profile. The cause of this break remains poorly understood. In Lambda-CDM cosmology, the radii at which disk truncations are found are also the most recently formed. Disk truncations may therefore be a direct result of the disk-galaxy assembly process. Many theories have thus been proposed to connect the truncations to theories of disk galaxy formation. Generally, break formation models either form the stars in the observed distribution (e.g., a star formation threshold) or employ dynamical effects to redistribute them into the current configuration (e.g., tidal stripping). These models need to be constrained observationally to probe

the underlying mechanism of outer-disk formation responsible for creating the truncations. Using our previous experience with deep CMDs from HST observations of resolved extragalactic stellar populations, we propose a comprehensive survey of disk truncations across a variety of disk morphologies and sizes. With resolved stellar populations we are able to map the truncations as a function of age to a very low equivalent surface brightness. Additionally, we will carry out simulations of different truncation formation scenarios for each galaxy (based on disk type and mass) to compare directly with the observations. Combining the two will prove crucial to understanding the mechanism for creating disk truncations and the ongoing processes in disk formation. HST is the only observatory capable of discriminating the formation models due the unique resolution and depth of the ACS and WFC3 instruments.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12197
Title: Evolution in the Size-Luminosity Relation of HII regions in Gravitationally-lensed galaxies
PI: Johan Richard
PI Institution: University of Durham

The gravitational magnification of distant galaxies by foreground clusters has enabled the first measurement of the size-luminosity relation for HII regions at redshift z~2-5. A significant offset is seen in this relation with respect to that determined locally. This evolutionary trend has been interpreted as possible evidence for a dfferent mode of star formation in the early universe. To test this hypothesis, we propose to image a sample of 7 lensed galaxies at intermediate redshifts, z~1.0-1.5, carefully chosen so that the Halpha emission falls precisely within an appropriate narrow-band fiter with WFC3/IR. As each galaxy is magnified by a significant factor, this will enable us to resolve and measure the luminosities of ~50 individual HII regions as small as 50 pc to a star formation rate limit of 0.015 Mo/year. By tracking the size-luminosity relation over the full redshift range from 0 to 5, we can differentiate between various explanations proposed for the change in this fundamental relationship.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12198
Title: Unravelling the Mysteries of the Leo Ring: An Absorption Line Study of an Unusual Gas Cloud
PI: Jessica Rosenberg
PI Institution: George Mason University

We propose an absorption-line study of 3 QSO sight lines behind the Leo Ring with COS. The Leo Ring is a huge (~200 kpc in diameter, HI mass of 2x10^9 solar masses) neutral gas cloud that has been postulated to be either tidal or primordial in origin. Despite over 25 years of investigation, the mystery of its origin remains unsolved. By obtaining the most robust measurement of metallicity to date and constraining the ionized gas content along these sight lines, we will finally be able to determine the origin of the gas. The observations include Ly-alpha plus low and high ionization metal lines in absorption that will be modeled with the photoionization code, CLOUDY. If the gas in this feature is primordial (low metallicity and highly ionized), it provides an interesting challenge for those who model the formation and evolution of galaxies and reveals a unique mode of galaxy formation. Alternatively if the feature is tidal in origin, these observations represent one of the first absorption line studies of tidal gas which has been argued to

be a significant component of the enrichment of the intergalactic medium.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12199
Title: The shocking truth about DG Tau's jet
PI: Peter Schneider
PI Institution: Universitat Hamburg, Hamburger Sternwarte

We propose to use STIS to obtain the first FUV long-slit spectrum of DG Tau's jet. The classical T Tauri star DG Tau shows signatures of magnetic activity, accretion, a circumstellar disk and outflows. The detection of soft X-ray emission from hot plasma with temperatures above 10^6 K within DG Tau's jet at a few tens of AU from the power source, distinctly different from coronal emission, challenges current jet theories, since observations and modeled scenarios concentrated on warm material with temperatures up to a few 10^4 K. With the slit oriented along the jet axis and supplementary broad band ACS/SBC FUV images, we will use the C IV emission line doublet (peak formation temperature 10^5 K) to measure, for the first time, the kinematics of the intermediate temperature gas along the jet axis, which is not possible with any other instrument. Our goals are to find (1) the relation of the intermediate temperature material to the hot X-ray emitting material, (2) the correlation of temperature and velocity in stellar jets, and (3) the heating source of the hotter material.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12200
Title: STIS UV spectroscopy of a bright classical nova during its super soft X-ray phase
PI: Gregory Schwarz
PI Institution: American Astronomical Society

We propose ToO observations of a bright classical nova (CN) in outburst using the STIS echelle to obtain ultraviolet spectroscopy while the source is X-ray luminous. The data will complement our existing ground based optical/infrared and Swift X-ray CN programs and provide continous spectral information from X-ray to the IR during this important X-ray phase for the first time. The UV spectroscopy is a critical bandpass that enables determination of ejecta physical properties, including the elemental abundances, mass, and structure. This information provides insight into the role of CNe in the isotopic enrichment of the interstellar medium, pre-solar grain abundances, details on the mass and composition of the underlying white dwarf, needed checks on hydrodynamic models of the outburst, and constraints on the relationship of CNe as SN Ia progenitors. UV data are key to these analyses, providing the only opportunity to observe strong carbon lines in these objects as well as direct measures of the interstellar reddening. With slit spectroscopy from ~ 1100-3100 Angstroms, HST is currently the only facility that can fill this important gap in the spectral energy distribution.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12201
Title: Ionizing Emission from the Faint Galaxies Responsible for Reionization
PI: Brian Siana
PI Institution: California Institute of Technology

The epoch of formation of the first galaxies, and the subsequent reionization of the universe is the final frontier in galaxy evolution studies. In order to reionize the intergalactic medium by z=6, large fractions of ionizing photons must be escaping from the numerous feeble galaxies which we are now just beginning to detect at 6<z<10. Semi-analytic models and numerical simulations have suggested several different mechanisms to explain the required high escape fractions in these systems. Unfortunately, these feeble galaxies are far too faint to actually measure the escape fraction of Lyman continuum photons. Given their importance to the global star formation rate in the early universe and to reionization, our team has been identifying and characterizing large numbers of intrinsically very faint (-15<M_UV<-19) galaxies at 1.5<z<4 that are highly magnified by foreground massive clusters. Here we propose a single deep (34 orbit) near-UV (F275W) image of the restframe HI-ionizing continuum of 13 of these galaxies with 2.52<z<2.66 lying behind the cluster Abell 1689. The increased sensitivity and spatial resolution provided by the strong gravitational lensing allows an unprecedented measurement of the escape fraction of ionizing radiation from the types of galaxies deeemed responsible for reionization. When combining these data with existing HST optical/IR imaging and our own very deep Keck/Subaru near-IR/optical spectra, we will be able to determine the mechanisms that allow for large escape fractions, and better understand the process of reionization.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12202
Title: Wide-Field Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy
PI: Gregory Sivakoff
PI Institution: The University of Virginia

Extragalactic low-mass X-ray binaries (LMXBs) can constrain galaxy histories, but we must first understand whether LMXBs present in the fields of galaxies were formed primordially in situ or dynamically in globular clusters (GCs). We propose 8 orbits of HST-ACS on NGC1023, one of the nearest, massive lenticular galaxies, which will complement 192 ks of ACIS-S observations. We will detect ~70 Field-LMXBs and ~400 stellar clusters. Our comparison of the spatial distributions of field-LMXBs, GCs, and field stars in NGC1023 will constrain the origin of field LMXBs. Our observations will also perform the most complete census of diffuse star clusters (DSCs) to date. By probing the connection of DSCs to LMXBs, we will also test the dynamical formation model of LMXBs in stellar clusters.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12203
Title: Rest Frame Optical Spectroscopy of Galaxy Clusters at 1.6 < z < 1.9
PI: S. Stanford
PI Institution: University of California - Davis

We propose to obtain WFC3 IR grism spectroscopy of IRAC-selected galaxy clusters at 1.6 < z < 1.9 in the Bootes field. The candidate clusters were identified as three dimensional overdensities, based on full photometric redshifts determined from optical-NIR-MIR photometry. These 5 cluster candidates are being imaged by WFC3+ACS in Cycle 17 to obtain rest frame optical morphologies for the galaxies, and precise color-magnitude diagrams.

Obtaining firm redshifts for the red galaxy populations in the absence of emission lines is extremely difficult from the ground at these redshifts. With the WFC3 IR grism data we will be able to measure the redshifts and determine the star formation histories of the red galaxy populations through SED fitting of the rest frame optical spectra that will include continuous coverage of the Balmer and 4000 Angstrom breaks.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12204
Title: Probing the Ionized Gas in the Magellanic Stream
PI: Christopher Thom
PI Institution: Space Telescope Science Institute

We propose a 14 orbit pilot study to investigate the ionized gas in the interface region between the cool neutral gas of the Magellanic Stream and the ambient hot gas of the Milky Way halo. We have chosen 3 bright QSOs clustered around a small (~1 sq. deg.) cloud associated with the Magellanic Stream. One of these QSOs (Ton S210) probes the neutral 21cm gas, while the other two lie just outside 21cm contours. Observations of Ton S210 will be used in conjunction with neutral and low-ionization absorption lines to set the metallicity of the gas. The outer two targets will be used to detect higher ionization states such as CIV, SiIV and NV, that typically trace warm ionized gas. The observed metallicity, gas temperature and line ratios will be used as inputs to modeling in order to determine the ionization state and physical conditions of the gas in the cool-hot interface region. Contingent on the success of this pilot program, we anticipate future observations to fully characterise the ionization state along the full length of the Magellanic Stream. These observations would be a significant advance in our understanding of the nature of Milky Way halo, the evolution of clouds in the halo, and the formation and ultimate fate of the Magellanic Stream. They will also have important implications for the inpretation of z > 0 QSO absorption-line studies.

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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12205
Title: Verifying the Dust-Gas Coupling in the AGB Wind of IRC+10216 via Differential Proper-Motion Measurements
PI: Toshiya Ueta
PI Institution: University of Denver

We will undertake differential proper-motion measurements of the circumstellar dust shell of an asymptotic giant branch star, IRC +10 216, to understand kinematics and the dust-gas coupling in the shell. We will take the second-epoch long-exposure images of the so-called concentric arcs in F606W and short-exposure images of the central asymmetric lobes in F814W using WFC3 and compare them with the first-epoch archived WFPC2 images. These circular concentric arcs are enigmatic because their apparent time intervals (on the order of 100 yr) do not seem to be consistent with any obvious physical processes associated with the central star (pulsation of the star on the order of 1 yr and thermal pulses of 10,000 to 100,000 yr). With proximity to the target (~ 135 pc) and a relatively long interval between two-epoch observations (12-13 yr), we expect that these shells show translational shifts of at most 7-8 pixels measurable with the cross-correlational analysis of distinct local shell structure. With such measurements of the translational shift of the shell structures, we can measure the expansion velocities of these concentric arcs and the central lobes directly. We will then compare

the HST imaging results which probe the dust component of the shell with the previous CO mapping results which probe the gas component of the shell. Because the shell's 3-D kinematics is known from the CO data the concentric arcs can be deprojected to trace their true space motion, allowing us to disentangle the mysterious discordance of the arcs' apparent time intervals with respect to the time scales of relevant physical processes. By comparing the CO and HST results, we wil attempt to verify if the dust-gas coupling is indeed at work in AGB winds. This will be the first attempt to address observationally this one of the fundamental assumptions of dust-driven mass-loss.
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Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12206
Title: Starburst-driven shocks and feedback in the near-IR at high resolution
PI: Mark Westmoquette
PI Institution: University College London (UCL)

Starburst-driven feedback (both in terms of stellar and supernova activity) is one of the primary engines of galaxy evolution throughout the Universe. Yet, the theoretical foundation of mechanical feedback is, to date, unconstrained by observations. We propose to investigate this fundamental aspect of star formation directly through near-IR narrow-band imaging of Pa-beta emission and the shock-excited [FeII] line in a small but representative sample of nearby (2.5-20 Mpc) starbursts with known H-alpha outflows. These data will allow us to [1] map, and provide a complete census of, the shocks inside and around the starburst regions, and relate these to the potential sources of shocks in the form of the young star-forming regions; [2] measure the supernova (SN) rate in combination with available radio data through calibrations of the [FeII] point-source luminosities, and relate this to the level of mechanical energy deposited by these SNe into the ISM; [3] investigate the relation between the shocked regions and the galaxy morphology, X-ray wind structure, and merger/interaction state, and hence study the conditions under which feedback morphs from a localised process to a galactic-scale phenomenon; [4] study what implications this has on our understanding of star formation histories, and the spatial evolution of star formation in these galaxies. The unprecedented angular resolution, sensitivity, and field-of-view of WFC3/IR is crucial for separating the spatially narrow shock fronts (~20 pc ~ 0.1" at 20 Mpc) and for resolving individual SN remnants.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12207
Title: Confirming the first Double Degenerate Sn Ia Progenitor
PI: Carles Badenes
PI Institution: Weizmann Institute of Science

We propose to determine whether the nearby (50-100 pc) binary WD system SDSS 1257+5452, recently discovered by the SWARMS survey, is the first example of a Type Ia supernova progenitor. Our careful radial velocity measurements disocvered that this white dwarf has a companion. The companion's nature could not be definitely established from the ground-based optical observations alone, but observations by two independent groups determine a high mass (> 1.3 solar masses) for the system, near or exceeding the Chandrasaekhar mass. Near-UV photometry taken with the UVOT camera on SWIFT detected an additional spectral component bluewards of the WD strongly arguing that the companion is another white dwarf. We request use of HST to acquire a spectrum of this

binary system, from the far UV to optical wavelengths in order to measure the mass and temperature of both objects in the binary system. If the combined mass of the system is greater than the Chandrasekhar mass, this system would be the first known example of the long-sought for double degenerate progenitors of Type Ia SNe.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12208
Title: Resolving Disks and Jets in a New, Benchmark Low-Mass Binary
PI: John Bochanski
PI Institution: Massachusetts Institute of Technology

We propose to obtain high resolution imaging of two recently discovered TW Hydrae Association members, TWA 30A and B, which show clear spectroscopic evidence of accretion disks and outflows. With WFC3 imaging in three broad-band filters sampling forbidden emission lines, accretion signatures and scattered light, we will measure or constrain the physical extent and grain size of the circumstellar disks around these sources, the masses of the jets, associated mass loss rates and timescales between outflow events, the electron densities within any shocked regions, and the magnetic field topologies.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12209
Title: A Strong Lensing Measurement of the Evolution of Mass Structure in Giant Elliptical Galaxies
PI: Adam Bolton
PI Institution: University of Utah

The structure and evolution of giant elliptical galaxies provide key quantitative tests for the theory of hierarchical galaxy formation in a cold dark matter dominated universe. Strong gravitational lensing provides the only direct means for the measurement of individual elliptical galaxy masses beyond the local universe, but there are currently no large and homogeneous samples of strong lens galaxies at significant cosmological look-back time. Hence, an accurate and unambiguous measurement of the evolution of the mass-density structure of elliptical galaxies has until now been impossible. Using spectroscopic data from the recently initiated Baryon Oscillation Spectroscopic Survey (BOSS) of luminous elliptical galaxies at redshifts from approximately 0.4 to 0.7, we have identified a large sample of high-probability strong gravitational lens candidates at significant cosmological look-back time, based on the detection of emission-line features from more distant galaxies along the same lines of sight as the target ellipticals. We propose to observe 45 of these systems with the ACS-WFC in order to confirm the incidence of lensing and to measure the masses of the lens galaxies. We will complement these lensing mass measurements with stellar velocity dispersions from ground-based follow-up spectroscopy. In combination with similar data from the Sloan Lens ACS (SLACS) Survey at lower redshifts, we will directly measure the cosmic evolution of the ratio between lensing mass and dynamical mass, to reveal the structural explanation for the observed size evolution of elliptical galaxies (at high mass). We will also measure the evolution of the logarithmic mass-density profile of massive ellipticals, which is sensitive to the details of the merging histories through which they are assembled. Finally, we will use our lensing mass-to-light measurements to translate the BOSS galaxy luminosity function into a mass function, and determine its evolution in combination with data from the original Sloan

Digital Sky Survey.
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Proposal Category: SNAP
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12210
Title: SLACS for the Masses: Extending Strong Lensing to Lower Masses and Smaller Radii
PI: Adam Bolton
PI Institution: University of Utah

Strong gravitational lensing provides the most accurate possible measurement of mass in the central regions of early-type galaxies (ETGs). We propose to continue the highly productive Sloan Lens ACS (SLACS) Survey for strong gravitational lens galaxies by observing a substantial fraction of 135 new ETG gravitational-lens candidates with HST-ACS WFC F814W Snapshot imaging. The proposed target sample has been selected from the seventh and final data release of the Sloan Digital Sky Survey, and is designed to complement the distribution of previously confirmed SLACS lenses in lens-galaxy mass and in the ratio of Einstein radius to optical half-light radius. The observations we propose will lead to a combined SLACS sample covering nearly two decades in mass, with dense mapping of enclosed mass as a function of radius out to the half-light radius and beyond. With this longer mass baseline, we will extend our lensing and dynamical analysis of the mass structure and scaling relations of ETGs to galaxies of significantly lower mass, and directly test for a transition in structural and dark-matter content trends at intermediate galaxy mass. The broader mass coverage will also enable us to make a direct connection to the structure of well-studied nearby ETGs as deduced from dynamical modeling of their line-of-sight velocity distribution fields. Finally, the combined sample will allow a more conclusive test of the current SLACS result that the intrinsic scatter in ETG mass-density structure is not significantly correlated with any other galaxy observables. The final SLACS sample at the conclusion of this program will comprise approximately 130 lenses with known foreground and background redshifts, and is likely to be the largest confirmed sample of strong-lens galaxies for many years to come.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12211
Title: Are Weak-Line T Tauri Stars Still Accreting?
PI: Nuria Calvet
PI Institution: University of Michigan

The interesting events marking the end of accretion and the dispersal of gas in circumstellar disks are not well understood. This is due, in part, to the difficulty of detecting very low accretion rates, as accretion indicators become masked by stellar emission. At the same time, observing gas in the inner disk is difficult. The majority of the mass is in H2, which has no strong transitions in the optical and infrared. However, strong FUV H2 lines, excited by the high energy fields of young stars, are conspicuous in accreting stars and can be used as a probe of low accretion, detecting accretion rates four orders of magnitude lower than traditional accretion indicators. We propose to obtain FUV spectra of 13 Weak-line T Tauri stars with the ACS PR130L prism. Our previous work has shown that the presence of H2 is linked to accretion onto the star, so our observations will test if these supposedly non-accreting stars are still accreting at previously undetectable rates. Our results will have significant impact on the understanding of the end of the accretion phase.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12212
Title: What are the Locations and Kinematics of Mass Outflows in AGN?
PI: D. Crenshaw
PI Institution: Georgia State University Research Foundation

Mass outflows of ionized gas in AGN, first revealed through blueshifted UV and X-ray absorption lines, are likely important feedback mechanisms for the enrichment of the IGM, self-regulation of black-hole growth, and formation of structure in the early Universe. To understand the origin, dynamics, and impact of the outflowing absorbers on their surroundings, we need to know their locations (radial positions and polar angles with respect to the AGN rotation axes) and kinematics (radial and transverse velocities). We will use COS high-resolution spectra of 11 Seyfert 1 galaxies to derive velocity-dependent covering factors, ionic column densities, number densities (via metastable lines or variability), and ionization parameters (via photoionization models) of the UV absorbers, and thereby determine their radial locations as we have done for NGC 4151. We will use absorption variability over time scales of up to ~20 years, to determine transverse velocities and detect changes in radial velocities. We will use STIS G430M long-slit spectra and WFC3 [OIII] images to resolve the kinematics of the narrow-line region (NLR) and determine the inclinations of the AGN, to investigate the connection between nuclear absorption and NLR emission outflows and their dependence on polar angle.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12213
Title: The Stellar Halo Profiles of Massive Disk Galaxies
PI: Roelof de Jong
PI Institution: Astrophysikalisches Institut Potsdam

Stellar halos surrounding massive galaxies are of prime interest in hierarchical galaxy formation models: most of the halo is formed by the very early accretion of small, metal poor satellite galaxies each with their independent evolution history. As such, halos contain the fossil remnants of the earliest star formation and accretion phases of a galaxy in formation. The resulting size, shape, age, and metallicity of stellar halos provide therefore a direct test of the basic ingredients (reionization, feedback from star formation, density fluctuation power spectrum) of hierarchical galaxy formation models. In our GHOSTS survey we have sampled the principle axes of a sample of 11 nearby galaxies with Vrot>100 km/s. Our detection of resolved stellar halo populations ~1.5 mag below the tip of the Red Giant Branch has revealed halos that extend as far as 30 kpc around the most massive galaxies in our sample. Those extended stellar halos seem more compact than current model predictions, they have unexpectedly high metallicity up to the last detected point, and have a luminosity that is more closely related to the bulge luminosity than to the galaxy mass. We propose to extend the light profiles of 4 massive galaxies with a range in bulge-to-disk ratio to the background limit at ~70 kpc. This will enable us to: - confirm the stellar halo shape (compactness) and assess with confidence any conflict with models using these very extended and accurate halo profile characterizations; - establish whether stellar envelopes beyond 30 kpc are still morphologically connected to inner bulges, or whether a break occurs at larger radii revealing a distinct new component; - determine whether every massive galaxy has an old, metal-poor halo at large radius like the Milky Way and

M31; if not, constrain for the first time the range of stellar metallicity gradients in extended stellar halos.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12214
Title: Low redshift damped Lyman alpha systems selected by 21cm absorption: A new route to high efficiency?
PI: Sara Ellison
PI Institution: University of Victoria

The identification of z<1.6 damped Lyman alpha (DLA) systems requires UV spectroscopy, but blind surveys are less than 10% efficient at finding them, making low z DLA surveys unpalatable for precious HST resources. Pre-selecting QSOs which exhibit strong intervening MgII absorption has increased the detection effiency to 35%. However, the last survey for low z DLAs was carried out 8 years ago and (combined with previous archival data) still only yielded 41 DLAs, compared to ~1000 known systems at z>2. In this proposal, we aim to test a new selection technique, whereby we pre-select DLA candidates towards radio-loud QSOs which exhibit both MgII absorption AND 21cm absorption in optical and radio spectra respectively We expect this technique to be close to 100% efficient, but UV spectroscopy is the final step in the proof of concept. In this short pilot proposal we will observe five 21cm absorbers to confirm their DLA nature and pave the way for larger samples in the future. These data will also yield 5 new temperature measurements of the ISM in the 1<z<1.7 "redshift desert" where only 1 previous measurement exists, hence providing a 6-fold improvement and immediate science return, in addition to establishing the success of the technique.
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Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 12215
Title: Searching for the Missing Low-Mass Companions of Massive Stars
PI: Nancy Evans
PI Institution: Smithsonian Institution Astrophysical Observatory

Recent results on binary companions of massive O stars appear to indicate that the distribution of secondary masses is truncated at low masses. It thus mimics the distribution of companions of G dwarfs and also the Initial Mass Function (IMF), except that it is shifted upward by a factor of 20 in mass. These results, if correct, provide a distribution of mass ratios that hints at a strong constraint on the star-formation process. However, this intriguing result is derived from a complex simulation of data which suffer from observational incompleteness at the low-mass end. We propose a snapshot survey to test this result in a very direct way. HST WFC3 images of a sample of the nearest Cepheids (which were formerly B stars of ~5 Msun) will search for low-mass companions down to M dwarfs. We will confirm any companions as young stars, and thus true physical companions, through follow-up Chandra X-ray images. Our survey will show clearly whether the companion mass distribution is truncated at low masses, but at a mass much higher than that of the IMF or G dwarfs.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12216
Title: Taming the Invisible Monster with COS: Eclipse

Spectroscopy of Epsilon Aurigae
PI: Steve Howell
PI Institution: National Optical Astronomy Observatory, AURA

We request three single orbit COS observations of the enigmatic binary epsilon Aurigae. This 27-year binary will be in total eclipse during all of 2010 and into spring 2011. COS observations are needed in order to (1) confirm, via higher S/N UV spectroscopy, the FUSE observation that a B5V star lurks inside the eclipse-causing dust disk, (2) obtain temperature and density diagnostics of the line of sight columns during eclipse for inclusion in the ongoing, panchromatic studies of this rare event, and (3) allow, in coordination with Spitzer Space Telescope observations, a detailed view of the "invisible" large eclipsing dust disk surrounding the B star. Only COS has the full UV wavelength coverage to sample two of the three components in this binary (the F and B stars) with the SNR to accomplish our scientific goals.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12217
Title: Spectroscopy of faint T dwarf calibrators: understanding the substellar mass function and the coolest brown dwarfs
PI: Philip Lucas
PI Institution: University of Hertfordshire

More than 100 methane brown dwarfs, or T dwarfs, have now been discovered in the local field with 2MASS, SLOAN and UKIDSS, opening up a new area of physics describing objects at 450-1400 K. However, very few calibrator objects exist with well established ages and metallicities. A very surprising result from the UKIDSS sample (supported by 2MASS and SLOAN) is that the substellar mass function in the local field appears to decline to lower masses, in marked contrast to the rising initial mass function (IMF) observed in young clusters. Given that such a difference between the present day IMF and the Galactic time-averaged IMF is unlikely, it is very possible that the apparently falling IMF is an artifact of serious errors in either T model atmospheres or the evolutionary isochrones. We propose WFC3 spectroscopy of 4 faint T dwarf calibrators with well established ages and metallicities in the Pleiades and Sigma Ori clusters, and 2 faint field T dwarfs from UKIDSS for comparison. These spectra will constitute vital calibration data for T dwarf atmospheres with a wide range of surface gravities, which will be used to test and improve the model atmospheres. They will also aid preparation for future spectroscopy of the much larger numbers of field T dwarfs to soon be found by VISTA and WISE. These new surveys will permit a more precise measurement of the mass function and detection of even cooler objects.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12218
Title: Toward Resolving the Mass loss Discrepancy
PI: Derck Massa
PI Institution: Space Telescope Science Institute

Recent observations have raised serious questions about the mass loss rates of O stars, suggesting that they may be up to 10 times smaller than previously believed. Such a severe revision in the mass loss rates would have wide ranging astrophysical consequences, and has been termed the "mass loss discrepancy". We propose new HST observations aimed at addressing this problem. The new data will be combined with FUSE and existing HST spectra, Spitzer photometry, and optical spectra to create a data set of lasting value.

Our proposed analysis will highlight how different wind diagnostics in the same star can yield different results, thereby providing clues to the origin of the discrepancies.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12219
Title: Multiple stellar generations in the Large Magellanic Cloud Star Cluster NGC 1846
PI: Antonino Milone
PI Institution: Universita di Padova

The recent discovery of multiple stellar populations in massive Galactic globular clusters poses a serious challenge for models of star cluster formation and evolution. An unique angle on this problem is being provided by intermediate-age clusters in the Magellanic Clouds with peculiar main-sequence turn-off morphologies. These clusters are young enough to allow us to measure age differences of the order of 100 Myr, as the expected age for the different stellar generations according to the most popular theories of their origin. Recent discoveries, based on ACS data of unparalleled photometric accuracy, have demonstrated that the CMDs of a large fraction of these clusters (~70%) are not consistent with the simple, single stellar population hypothesis. The conditions under which massive Galactic globular clusters experience the formation of multiple generations remain controversial, and even more so within intermediate-age star clusters. To properly constraint the multi-population phenomenon in Magellanic Cloud star clusters, we propose deep UV/IR imaging of NGC 1846, a star cluster where multiple populations are already identified. The proposed observation will allow us to accurately measure the age difference between the stellar populations providing fundamental clues on the formation mechanism, and discover possible main sequence splitting due to different He contents. Our simulations of WFC3 performance suggest that we will be able to detect main sequence splitting caused by He differences as small as DeltaY=0.02.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12220
Title: Linking Star Formation with Intracluster Medium Cooling and AGN Heating in a Sample of Herchel Galaxy Clusters
PI: Rupal Mittal
PI Institution: Rochester Institute of Technology

Numerous studies of the cores of galaxy clusters have revealed that the gas in central regions is not cooling at the rates predicted by the traditional cooling flow model. This discrepancy has inspired a search for heating models that can explain current observations. AGN feedback is considered an attractive solution to several connected problems, such as the high-mass end truncation of galaxy distribution and the absence of cooling-flows in centers of galaxy clusters. Amidst the emerging hypothesis of self-regulated AGN feedback, infrared, optical and FUV observations of clusters also indicate the presence of large amounts of cold gas in their brightest cluster galaxies (BCGs). There are over 30 BCGs that exhibit active star formation based on their mid-infrared and several of those have direct evidence based on FUV and/or optical imaging. In this proposal we aim to investigate a sample of 11 BCGs forming the basis of a Herschel Key Project, which has been awarded 130 hrs to study the detailed properties of the cold gas and dust in these clusters. We propose ACS/SBC FUV observations of five of the 11 BCGs lacking high resolution FUV data needed to probe the star forming regions. The

remaining six already have archival ACS/SBC FUV data. We further propose ACS/WFC and WFC3/UVIS observations of two BCGs lacking HST optical data which will allow us to obtain FUV-optical colours to discriminate between young and old stellar populations. These observations are vital to understand the complex inter-relationship between the cooling of the intracluster-medium, cold gas and dust, star formation and AGN activity.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12221
Title: The role of photoevaporation in clearing protoplanetary disks: mapping flows and determining mass flow rates
PI: Ilaria Pascucci
PI Institution: Space Telescope Science Institute

The lifetime of an isolated protoplanetary disk is thought to be set by the combination of viscous accretion and photoevaporation driven by high-energy photons from the central star. While diagnostics of accretion are numerous and mass accretion rates are routinely measured, diagnostics of centrally driven disk photoevaporation are just emerging. The [OI] 6300 angstrom is expected to trace slow disk winds extending out to 30-40 AU from the central star if driven by stellar Xrays. We propose to use this line diagnostic to measure for the first time the radial extent of the photoevaporative flow and the disk photoevaporation rate. Our targets are two nearby T Tauri disks with dust depleted inner regions, low stellar accretion rates, and ancillary evidence for on-going photoevaporation. Slitless spectroscopy with STIS will enable us to map these flows at a spatial resolution of ~6 AU. From their extension we will determine whether stellar EUV or Xrays drive most of the photoevaporation, provide the first measurements of mass flow rates, and thus constrain expected disk lifetimes.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12222
Title: Constraints on Super/Hypernova Nucleosynthesis from the Hyper-Runaway Star HD271791
PI: Norbert Przybilla
PI Institution: Universitat Erlangen-Nurnberg

HD271791 is an extreme run-away star of B-type travelling so fast that it is likely to leave the Galaxy. We have shown that this star was ejected from the metal-poor outer rim of the Galaxy in a binary super- or hypernova. The star provides a unique opporotunity to study the chemical composition of SN/HN ejecta, because nuclear-processed debris was deposited onto its surface in the course of the explosion. From optical spectra we have already demonstrated that the signature of the explosion is visible in its atmospheric abundance pattern, because the alpha-elements are enhanced. Our aim is to derive abundances for a large number of chemical elements, which are accessible only in the UV spectral range, to constrain the nucleosynthesis in the SN/HN in detail. If we succeed to detect tale-telling signatures of r-process elements in the UV spectrum, we may finally pin down the long-sought site of the r-process.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12223
Title: Exploring the Bright Side of Massive Stellar Death with

NUV Spectroscopy
PI: Robert Quimby
PI Institution: California Institute of Technology

A new class of stellar outbursts dwarfing the most powerful supernovae observed in the past century has recently been uncovered by wide field optical imaging surveys. With peak luminosities in excess of 10^44 erg/s and total radiative outputs greater than 10^51 erg, these events push the limits of conventional supernova explosion theory. One possibility is that these luminous supernovae (LSNe) are triggered by the electron-positron pair instability, and they may thus represent local analogs of the first stellar explosions to shape the universe. Another is that an additional source of power, such as that provided by spin-down of a nacent magnetar, adds energy into the ejecta after the initial supernova explosion. Near UV spectroscopy from HST/STIS can help break the observational degereracy to reveal the true physical origin of these events. We propose a non-disruptive ToO program for STIS spectroscopy to follow-up new LSNe discoveries in Cycle 18 supplemented with Swift UV photometry and ground based optical imaging and spectroscopy from the Keck and Palomar observatories.

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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12224
Title: Measuring the Stellar Populations of Individual Lyman Alpha Emitters During the Epoch of Peak Star Formation
PI: Naveen Reddy
PI Institution: National Optical Astronomy Observatory, AURA

Selecting galaxies by their strong Lyman-alpha emission provides a powerful means of probing the reionization epoch and the faint/low-mass galaxies that dominate star formation at high redshift. Yet, our understanding of high-redshift Lyman-alpha emitters (LAEs) has lagged behind that of other well-studied populations (e.g., Lyman break galaxies) due to their continuum faintness and the shifting of age/mass-sensitive features into the near-IR where the high terrestrial background inhibits deep observations. All existing studies of LAEs at z>2 have used stacked optical and/or Spitzer infrared data to discern their median properties, but the actual distributions of ages, reddenings, and stellar masses for these populations are poorly characterized. To fill this glaring gap in the observations and advance our understanding of this important population, we propose WFC3/IR+F160W imaging of fields where we have conducted a survey of low redshift (z~1.9) Lyman-alpha emitters (LAEs), in order to measure their ages and stellar masses at an epoch where such observations directly probe the age-sensitive Balmer/4000 AA breaks. The targeted sample will include 45-50 spectroscopically confirmed LAEs at z=1.7-2.1 and roughly twice as many candidates, making it the largest sample of homogeneously selected LAEs with individual measurements of the ages, masses, and dust extinction. With these data we will (1) carefully take into account the age-dependence of the extinction curve to make robust comparisons between LAEs and continuum-selected galaxies at the same redshifts; (2) combine clustering and stellar mass measurements to infer the duty cycles of LAEs and determine if they are triggered in the presence of large-scale structures; and (3) quantify the importance of the LAE phase at different galaxy luminosity and mass scales, over a large dynamic range in these properties. An economical investment of just 12 orbits will allow us to accomplish these goals, and remains the only hope of efficiently studying such low luminosity high-redshift galaxies in the near-IR prior to the JWST-era.

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Proposal Category: GO

Scientific Category: STAR FORMATION
ID: 12225
Title: Imaging accretion sources and circumbinary disks in young brown dwarfs
PI: Ansgar Reiners
PI Institution: Universitaet Goettingen, Institut fuer Astrophysik

We propose to obtain deep WFC3/UVIS imaging observations of two accreting, nearby, young brown dwarf binaries. The first, 2M1207, is a brown dwarf with a planetary mass companion that became a benchmark in low-mass star formation and low-mass evolutionary models. The second, 2M0041, is a nearby young brown dwarf with clear evidence for accretion, but its space motion suggests a slightly higher age than the canonical accretion lifetime of 5-10 Myr. It has recently been discovered to be a binary and is likely to become a second benchmark object in this field. With narrow band images centered on the Halpha line that is indicative of accretion, we aim to determine the accretion ratio between the two components in each system. Halpha was observed in both systems but so far not spatially resolved. In particular, we want to search for accretion in the planetary mass companion of 2M1207. The evidence for accretion in 2M0041 and the possibility that it is in fact older than 10Myr suggests that the accretion lifetime is longer in brown dwarfs than in stars, and in particular that it is longer in brown dwarf binaries. Accretion could be sustained for a longer time if the accreting material is replenished by a circumbinary disk that might exist in both systems. We propose deep WFC/UVIS observations in the optical to search for circumbinary disks, similar to the famous disk around the binary TTauri system GG Tau.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12226
Title: The Hot Stellar Content and HB morphology of the massive globular cluster G1
PI: R. Rich
PI Institution: University of California - Los Angeles

We propose to obtain deep WFC3 imagery of the Local Group's most luminous globular cluster, G1. Our primary aim is to define the hot stellar content and the extent of what appears to be a multimodal horizontal branch, analogous to those known in Omega Cen and NGC 2808. G1 is 40 kpc distant in the M31, and it would have been highly unlikely that collision with a giant molecular clould would be responsible for the complex populations which must therefore be the result of self-enrichment. We will obtain data very similar to those obtained for the known Galactic multimodal globular clusters NGC 6388 and 6441, and compare the stellar distribution on the horizontal branch with models. We can constrain the fraction of helium-enriched stars, if present, and search for supra-horizontal branch and other anomalous hot, evolved, stars. Parallel ACS observations will be the deepest ever obtained in the adjacnt field to G1, and will help to constrain whether G1 was the nucleus of a now disrupted galaxy.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12227
Title: Tracking the Evolution of a Knotty, High-Speed Jet in the Carbon Star, V Hydrae
PI: Raghvendra Sahai
PI Institution: Jet Propulsion Laboratory

The carbon star V Hydra is experiencing heavy mass loss as it undergoes the transition from AGB star to pre-planetary nebula. This is possibly the earliest object known in this brief phase, which is so short that few nearby stars are likely to be caught in the act. Molecular observations reveal that a bipolar nebula has been established even at this early stage. Using STIS, in Jan 2002, we discovered a high-velocity (> 200 km/s) jet or blob of gas in V Hya which had been ejected a few years prior from near the star. 2nd and 3rd epoch STIS observations over 2 years clearly revealed both its proper motion and strong deceleration. We propose STIS monitoring of this remarkable event over a period of 3 years, in order to obtain a precise dynamical and cooling history of this blob and any successor blobs that may have been ejected since then. This ejection event is likely to hold the key to understanding why initially spherical mass outflows adopt a bipolar geometry during the post-AGB phase of stellar evolution. The goal is to understand the interaction of the blobby jet outflow with the ambient circumstellar medium. We not only have the opportunity to look on as the circumstellar envelope is sculpted by this and perhaps other collimated mass ejections, but we also have an unprecedented chance to constrain the mechanism for mass ejection, and thereby help solve the long-standing puzzle of how the spherical mass-loss envelopes of AGB stars evolve into bipolar planetary nebulae.

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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12228
Title: Probing for Exoplanets Hiding in Dusty Debris Disks: Inner (<10 AU) Disk Imaging, Characterization, and Exploration
PI: Glenn Schneider
PI Institution: University of Arizona

We propose new visible-light observations of a well-selected sample of circumstellar (CS) debris disks, all with HST pedigree, using STIS PSF-subtracted multi-roll coronagraphic imaging. Our new observations will probe the interior CS regions of these debris systems (with inner working distances of < approximately 8 AU for half the stars in this sample), corresponding to the giant planet and Kuiper belt regions within our own solar system. These new images will enable us to directly inter-compare the architectures of these exoplanetary debris systems in the context of our own Solar System. These observations will also permit us, for the first time, to characterize the material in these regions at high spatial resolution and to look for sub-structures within the disks that are the sign posts of planetary formation and evolution; in particular, asymmetries and non-uniform debris structures signal the presence of co-orbiting perturbing planets. Additionally, all of our objects have been observed previously at longer wavelengths (but much lower spatial resolution and imaging efficacy) with NICMOS, but with an inner working angle comparable to STIS multi-roll coronagraphy. The combination of new optical and existing near-IR imaging will strongly constrain the dust properties, thus enabling an assessment of grain processing and planetesimal populations. These results will directly inform upon the posited planet formation mechanisms that occur after the ~ 10 My epoch of gas depletion, at a time in our solar system when giant planets were migrating and the terrestrial planets were forming, and directly test theoretical models of these processes. The outer reaches (only) of most of these systems were previously observed with a much larger (~ 6x on average), spatially limiting, effective inner working angle of the ACS coronagraph. The previous ACS images are therefore completely inadequate to address our science goals of imaging the inner structures of these CS disks. Our proposed investigation, enabled ONLY with HST STIS visible-light coronagraphy, will uniquely probe into the interior regions of these systems for the first time with spatial resolution comparable

to ACS and with augmenting NICMOS near-IR disk photometry in hand.
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Proposal Category: SNAP
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12229
Title: HST U-band Survey of Star Clusters in Nearby Star-Forming Galaxies
PI: Linda Smith
PI Institution: Space Telescope Science Institute

We propose a small Snapshot program to obtain U-band imaging of a sample of 22 nearby star-forming galaxies with existing HST B, V, and I-band imaging. With the high UV efficiency and large field of view of WFC3/UVIS, it is now possible to obtain deep U-band imaging for a large sample of galaxies, and address fundamental questions on the cluster systems which can only now be answered. We will focus mainly on the young stellar cluster populations of these galaxies and use the deep U-band observations to accurately age date tens or even hundreds of clusters in each galaxy. By measuring the ages and masses of the cluster populations, we will be able to answer many of the outstanding questions regarding their properties, survival rates, cluster formation histories and environmental dependencies. The overall aim will be to relate cluster formation and cluster properties to the star formation rates and morphologies of their host galaxies. In particular, this dataset will be used to: 1) constrain the fraction of stars that form in clusters and search for environmental dependencies; 2) study the cluster luminosity/mass function and determine if a characteristic mass exists in the distribution; 3) measure the size (radius) distribution of the clusters and determine if this has a dependence on environment; 4) empirically constrain cluster disruption laws; and 5) determine the star/cluster formation histories of these galaxies over the past Gyr. This survey will complement existing imaging and will provide a rich legacy dataset for the entire community. We waive the 12 month proprietary period.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12230
Title: The effect of radiation forcing on an exoplanet atmosphere
PI: Mark Swain
PI Institution: Jet Propulsion Laboratory

We propose to determine the effects of radiation forcing by the stellar primary on the atmosphere of the hot-Jupiter exoplanet WASP-12b using WFC3 near-IR spectroscopy. We will accomplish this by obtaining a completely unique data set consisting of the emission spectra sequence from the dayside, terminator, and nightside regions of the exoplanet's atmosphere. In addition we will obtain the terminator region transmission spectrum; the combination of emission and transmission spectra will be used to help resolve the temperature/composition ambiguity present in interpreting emission spectra. The wavelength range we have selected, 1.1 to 1.7 microns, includes features from H2O, CH4, and CO2 – all of which have been detected in this wavelength range in the hot-Jupiter XO-1b with Hubble. The molecules H2O, CH4, and CO2 have been detected in three hot-Jupiter exoplanets to date; we expect to use these molecules as probes of the temperature and composition of the atmosphere of WASP-12b in the dayside, terminator, and nightside regions and thus determine the role of powerful radiation forcing on this exoplanet.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12231
Title: An Unprecedented Opportunity to Follow 4 Accreting WDs
                     into the Instabilty Strip
PI: Paula Szkody
PI Institution: University of Washington

While the accreting pulsating white dwarfs in dwarf novae systems only have outbursts recur on 20-30 yr timescales, 4 of the 13 known had outbursts in 2006-2007. The white dwarfs stopped pulsating, as the outburst heating caused them to move out of the instability strip. These outburst events give us the unprecedented opportunity to follow the emergence of the non-radial pulsations as they re-enter the strip. Unlike single white dwarfs, where cooling takes place on thousand year timescales, the cooling rates for white dwarfs following dwarf nova outbursts are only 3-5 yrs, with Cycle 18 ideally suited to catch this transition. Our past HST observations have shown that the UV is critical to a correct temperature determination (the white dwarf dominates over the disk emission in the UV and the Ly alpha turnover provides a crucial constraint) and mode identification (the UV/optical pulsation amplitude is typically 6-17 and indicative of low order modes). We propose to use COS in TIME-TAG mode to obtain the temperatures and UV pulsation amplitudes of the 4 post-outburst systems.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12232
Title: Detection and Mass Measurement of an Isolated Brown Dwarf
PI: David Bennett
PI Institution: University of Notre Dame

We propose observations that are likely to detect the brown dwarf lens object for microlensing event MACHO-179-A, which was observed observed by the MACHO collaboration some 15 years ago. The strong microlensing parallax signal seen in the light curve and follow-up Keck adaptive optics images imply that the lens is a brown dwarf within about 300 parsecs. If the lens object is at least as massive as 0.015 Solar masses at an age of 1 Gyr or 0.03 Solar masses at an age of 10 Gyr, these observations will detect the lens and measure its relative lens-source proper motion. The relative proper motion can be combined with the microlensing parallax measurement and a precise WFC3/UVIS measurement of the source star brightness to yield a mass measurement of the source star to 3% or better.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12233
Title: Strong Gravitational Lensing by Quasars
PI: Frederic Courbin
PI Institution: Ecole Polytechnique Federale de Lausanne

The title is correct: we propose to confirm low redshift quasars acting as strong gravitational lenses on background emission line galaxies. Our sample is selected from 22,298 SDSS spectra of quasars with z < 0.7. Using cross-correlation techniques, we identify 10-15 quasars that have at least two emission lines in their background, among [OII], H beta and the [OIII] doublet. Four of our quasars have all four lines clearly visible in their background. We propose to confirm the lensing nature of these objects with WFC3/UVIS images in the F555W and F814W filters, and to constrain lens models

of the quasar host galaxies. Our sample is similar to the SLACS sample of strong lenses, but with quasar host galaxies as lenses. As these galaxies are massive, we expect that most of the background objects will be strongly lensed (as in SLACS), displaying well visible arcs and multiple images within 1-2 arcsec. We propose to obtain sharp images of our targets along with clean PSF. With image deconvolution techniques, we shall remove the quasar and its host galaxy and we shall measure the size and shape of the background Einstein Ring allowing, for the first time, to weigh directly quasar host galaxies and to measure their total radial mass profile with strong gravitational lensing.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12234
Title: Differentiation in the Kuiper belt: a search for silicates on icy bodies.
PI: Wesley Fraser
PI Institution: California Institute of Technology

We currently have a large on-going program (Go Program 11644, 120 orbits) to exploit the superb stability and photometric characteristics of HST and the broad range in wavelength coverage of the WFC3 to make broad-band vis/IR spectral observations of a large sample of Kuiper belt objects. Though the survey is currently only ~50% complete, the quality and unprecedented signal-to-noise of these observations has revealed the existence of a previously undiscovered spectral variability not explainable within our current understanding of these objects. A possible explanation for this variability is that with this faint set of Kuiper belt objects, we are beginning to see the difference between larger differentiated objects and smaller non-differentiated objects. Its seems that the small and likely undifferentiated objects are exhibiting silicate features that affect our photometry - features not exhibited by the icy mantles of larger icy bodies. We propose a small add-on survey to dramatically increase the scientific results of our large program. The proposed observations will use the proven capabilities of WFC3 to make broad and narrow-band photometric observations to detect spectral features in the 1.0-1.3 micron range of a small subset of our sources. The 13 targets have been carefully selected to cover the range of spectral variability detected in our large program as well as sample the entire dynamical range and physical sizes of these targets. These observations will allow the identification of undifferentiated Kuiper belt objects by detection of their silicate features. As a probe for differentiation, these observations could constrain the natal locations of different Kuiper belt classes, a constraint currently unavailable to formation models. This small set of observations will allow the calibration of the spectral variability seen in our large program, and drastically enhance the scientific output of our full Cycle 17 sample.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12235
Title: The energy of auroral electrons at Saturn and the associated atmospheric heating
PI: Jean-Claude Gerard
PI Institution: Universite de Liege

Past HST observations of Saturn’s aurora have concentrated on the morphology and the relationship between the solar wind and the brightness of the aurora. With STIS back to work, time has come to move into a more quantitative era where FUV spectroscopy is used as a powerful tool to remotely sense the

characteristics of the precipitated electrons and their effect on the H2 gas. In the proposed program, we focus on images and spectroscopy linking precipitated particles with the morphology observed quasi simultaneously. We have a unique opportunity to address key questions concerning the characteristic energy of the auroral electrons and their effects on the temperature of the upper atmosphere. In particular, we propose to combine HST FUV imaging with STIS long slit low and medium resolution spectroscopy to determine the spatial variations of the FUV color ratio, the altitude of the aurora and to map the temperature in the high-latitude region. A combined HST-Cassini campaign has been planned at the time of Saturn's opposition in 2011 to complement HST spatial spectroscopy with observations from UVIS covering both hemispheres from a different vantage point. This compact and timely program is designed to provide key observations toward a better understanding of the physical interactions taking place in Saturn's aurora.

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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12236
Title: The Nuclear to Global Connection: a Detailed View of Compact Stellar Nuclei in a Complete Sample of Virgo Ellipticals
PI: Lisa Glass
PI Institution: Dominion Astrophysical Observatory

Recent HST observations have unveiled the presence of compact stellar nuclei in a large fraction of galaxies across the entire Hubble sequence. These nuclei may be the low-mass analogues of the supermassive black holes found in bright galaxies, and part of the wider class of central massive objects believed to exist in virtually every galaxy. Understanding the history of gas accretion, star formation, and chemical enrichment of compact stellar nuclei has thus emerged as key to the study of galactic cores and gaining further insight into the overall galactic structure. Despite this, there have been no spectroscopic studies of the stellar populations of nuclei in early-type galaxies to date, due to the difficulty of observing compact (~0.1 arcsec) nuclei projected against a bright galaxy background. HST is the only telescope capable of rectifying this. Accordingly, we propose to capitalize on the exceptional spatial resolution of STIS to obtain spectra of a complete sample of 11 nuclei in early-type galaxies located in the nearby Virgo cluster. These spectra will be fully leveraged using HST IR, optical, and UV imaging already in hand to measure the masses and provide the most complete picture currently possible of the history of star formation and chemical enrichment of these surprisingly commonplace objects. This window into the nature of nuclei is crucial to our understanding of how processes in the innermost regions can reflect and impact galaxies as a whole.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12237
Title: Orbits, Masses, Densities, and Colors of Two Transneptunian Binaries
PI: William Grundy
PI Institution: Lowell Observatory

Binaries are the key to learning many crucial bulk properties of transneptunian objects (TNOs) including their masses. Perhaps the most interesting mass-dependent property of a TNO is its bulk density, which provides unique information about its bulk composition and interior structure. Densities have so far only been measured for a handful of binary TNO systems.

This proposal seeks to determine orbits and thus masses of two more binary TNOs, both of which are also to be observed at thermal infrared wavelengths by the Herschel spacecraft. Combining the masses from Hubble with the sizes from Herschel will enable us to compute their densities. We will also obtain multi-wavelength photometric colors of the individual components of each binary system. It is imperative to link colors to the physical properties measurable in binary systems in order to use the remnant planetesimals in today's Kuiper belt to learn more about the early history of our own solar system, and more generally about how planetesimals form in nebular disks and subsequently evolve.

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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12238
Title: Supermassive Star Clusters in Supergiant Galaxies: Tracing the Enrichment of the Earliest Stellar Systems
PI: William Harris
PI Institution: McMaster University

The cD-type Brightest Cluster Galaxies contain the richest globular cluster systems (GCSs) that exist. The wealth of results gathered from previous HST imaging programs in many smaller galaxies show that GCSs are powerful and unique tracers that link to origin and evolution of structure in two directions simultaneously: one direction is inward to the structure of the protoglobular clouds, star formation in the densest known conditions, and their chemical enrichment history. The other direction is outward to constraining early galaxy formation history, the nature of the pregalactic dwarfs, or the spatial and dynamic structure of the halo. But we have not yet tapped the vast mine of GCS data waiting for exploitation in the most luminous galaxies of all, the cDs. Surprisingly, we know little about these systems beyond the globular cluster populations in the nearby cDs M87 (Virgo) and NGC 1399 (Fornax), and these two cases no longer provide adequate tests of the new phenomena now being uncovered, such as the correlation between GC mass and metallicity, the strikingly different formation efficiencies of metal-poor and metal-rich clusters, the galaxy-to-galaxy differences in GC mass distribution, and connections to Ultra-Compact Dwarfs and dE nuclei. We propose to image 7 cD-type systems within 200 Mpc that are representative of the very biggest galaxies known (Mv < -23). These lie in far richer Abell-cluster environments than we could ever probe in Virgo, Fornax, or nearer systems. We will use ACS/WFC and WFC3 to image their GCSs down to the turnover point of the GC luminosity function, using the B and I filters for an optimal combination of exposure time, field size, and metallicity sensitivity. Our complete survey will produce luminosities, metallicities, and spatial distribution functions for more than 35,000 GCs, the largest GC database in existence and an order of magnitude larger than even the recent Virgo Cluster Survey. The legacy value of our survey will supply a rich resource for a wide array of other GC science and the formation histories of these unique systems.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12239
Title: Springtime at Uranus: Upheaval in the Stratosphere?
PI: Floyd Herbert
PI Institution: University of Arizona

The upper atmosphere (stratosphere and thermosphere) of Uranus is highly anomalous among the giant planets, for reasons that are poorly understood. One likely factor is Uranus' uniquely large obliquity and low internal heat

source, so that during its year, localized atmospheric heating varies drastically. Thus, to understand the influence of this seasonal variation on upper atmospheric dynamics, observations made over at least one Uranian solstice-to-equinox season are key. The most comprehensive observations of Uranus were made in 1986 by Voyager 2 during its flyby, which occurred when the planetary spin axis pointed nearly at the sun (i.e., extreme solstice), nearly suppressing local diurnal variation of insolation. At present, Uranus has just passed equinox, so that local diurnal insolation variation is nearly 100\%, and so re-observing Uranus' upper atmosphere now would comprise the ideal comparison for understanding its seasonal dynamics. Therefore, we propose two orbits of HST/STIS FUVMAMA/G140L time-tagged spectral images of the sunlit disk of Uranus, in order to obtain spatially resolved spectra of its airglow in the 1300-1650 A region. By comparing these spectra with those from 1986, we will determine the influence of seasonality on Uranus' upper atmospheric dynamics.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12240
Title: ACS polarimetry of the Vela Pulsar Wind Nebula
PI: Oleg Kargaltsev
PI Institution: University of Florida

Observations of the nearby Vela pulsar with the Chandra X-ray observatory have revealed the fine structure of its synchrotron pulsar-wind nebula (PWN). Deep radio observations have shown a large, highly polarized (~70%) radio nebula located farther away from the pulsar. However, no firm optical detection of the Vela PWN has been reported yet. The detection of the extended emission in previous observations was hindered by the presence of a bright background due to SNR filaments and field stars. Since the degree of polarization in the optical should be similar to that observed in radio, we propose to use the ACS/WFC imaging polarimetry to detect the polarized optical emission from the Vela PWN. By subtracting the images obtained with different polarizers we will eliminate the very weakly polarized background component and preserve the strongly polarized PWN emission. Polarimetry will allow us to determine the magnetic field structure inside the prominent X-ray features seen in the inner PWN. This approach has been successfully tested with ASC/WFC polarimetry of the Crab PWN. Detection of the optical nebula, combined with the radio and X-ray data, will establish the properties of the relativistic pulsar wind, including its energetics, magnetic field structure, spatial evolution and interaction with the ambient medium.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12241
Title: SAINTS - The SN 1987A Intensive Study
PI: Robert Kirshner
PI Institution: Harvard University

SAINTS is a program to observe SN 1987A, the brightest supernova since 1604, as it matures into the youngest supernova remnant at age 23. HST is the essential tool for observing SN 1987A's many physical components. A violent encounter is underway between the fastest-moving debris and the circumstellar ring: shocks excite "hotspots." Radio, optical, infrared and X-ray fluxes have been rising rapidly: we have organized VLT, Spitzer, and Chandra observations to understand the several emission mechanisms at work. The inner debris, excited by radioactive isotopes from the explosion, is now resolved and seen to be aspherical, providing direct evidence on the shape of the

explosion itself and on dust that formed in the debris. Questions about SN 1987A remain unanswered. For example, where is the compact object whose formation sent neutrinos our way in February 1987 ? A rich and unbroken data set from SAINTS will help answer these central questions and will build an archive for the future to help answer questions we have not yet thought to ask. For Cycle 18, these data will include novel observations with the IR channel of WFC3 and UV observations with COS.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12242
Title: UV Studies of a Core Collapse Supernova
PI: Robert Kirshner
PI Institution: Harvard University

The UV spectrum of a core collapse SN encodes unique information about nucleosynthesis, the star's mass loss history, shock physics, and dust formation. This proposal aims at a detailed study of one bright core collapse SN, discoved as a result of the many ongoing surveys, either a Type IIP, IIn or Ib or Ic supernova. We will address the role of circumstellar interaction and mass loss through CNO lines in the UV, the nature of dust formation from UV line profiles, and we will use the UV continuum as a diagnostic of non-thermal emission from the shock. The overall goal is to achieve a better understanding of these objects by combining ground-based observations with complementary HST data. We have used HST to obtain critical UV spectra from the explosion to the nebular phase with good results for a limited number of objects. The advent of COS provides new capability for UV observations which we would like to exploit. Over the past decade, we have conducted studies of a small number of nearby SN with HST, and we have published an extensive series of papers. When nature provides a bright candidate, HST should be ready to respond. We are ready to run that program.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12243
Title: Determining the Size and Shape of Dwarf Planet Haumea from a Mutual Event
PI: Darin Ragozzine
PI Institution: Smithsonian Institution Astrophysical Observatory

The history of Haumea is closely intertwined with several unanswered questions relating to the formation and evolution of the outer solar system. Understanding Haumea and its satellites gives us unique insights on the physics of KBO collisions, tides, surfaces, and interiors. Yet, the most important physical properties of this dwarf planet, its density and shape, remain only weakly constrained by degenerate light curve inversions. The existence of mutual events between Haumea and its inner satellite, Namaka, provide a rare opportunity to measure Haumea's size, shape, density, albedo, and spin orientation with HST photometry. These observations also constrain the size of Namaka, the orbits of both satellites, and, through resolved photometry, the totally unexpected rapid rotation of the outer satellite, Hi'iaka. After extensive attempts at ground-based observations, it is clear that only HST photometry is capable of securely observing and characterizing a Haumea-Namaka mutual event. The proposed observations will observe the ~5-hour transit and shadowing of Haumea by Namaka on June 28, 2010 with high signal-to-noise using straightforward photometric observations with WFC3.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12244
Title: Mapping Ganymede's time variable aurora in the search for a subsurface ocean
PI: Joachim Saur
PI Institution: University of Cologne

A very exciting, unresolved question about Jupiter’s moon Ganymede is whether Ganymede harbors a saline subsurface water ocean under its icy crust. A saline, electrically conductive water ocean will modifiy Ganymede's magnetic field enviorment and thus also the locations of Ganymede's northern and southern auroral ovals. Without an ocean, Ganymede's auroral ovals will rock by ~10 degrees towards and away from Jupiter within 5.25 hours. However, with an ocean the shift will be up to only ~4 degrees. We propose two visits of five consecutive STIS orbits at eastern elongation to monitor and resolve with sufficient precision the shift in locations of Ganymede's auroral ovals to determine wheter an ocean is present on Ganymede. Addressing this question is timely as NASA/ESA are planing a Jupiter system mission including a Ganymede orbiter with the objective to characterize Ganymede as potential habitat.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12245
Title: Orbital Evolution and Stability of the Inner Uranian Moons
PI: Mark Showalter
PI Institution: SETI Institute

Nine densely-packed inner moons of Uranus show signs of chaos and orbital instability over a variety of time scales. Many moons show measureable orbital changes within a decade or less. Long-term integrations predict that some moons could collide in less than one million years. One faint ring embedded in the system may, in fact, be the debris left behind from an earlier such collision. Meanwhile, the nearby moon Mab falls well outside the influence of the others but nevertheless shows rapid, as yet unexplained, changes in its orbit. It is embedded within a dust ring that also shows surprising variability. A highly optimized series of observations with WFC3 over the next three cycles will address some of the fundamental open questions about this dynamically active system: Do the orbits truly show evidence of chaos? If so, over what time scales? What can we say about the masses of the moons involved? What is the nature of the variations in Mab's orbit? Is Mab's motion predictable or random? Astrometry will enable us to derive the orbital elements of these moons with 10-km precision. This will be sufficient to study the year-by-year changes and, combined with other data from 2003-2007, the decadal evolution of the orbits. The pairing of precise astrometry with numerical integrations will enable us to derive new dynamical constraints on the masses of these moons. Mass is the fundamental unknown quantity currently limiting our ability to reproduce the interactions within this system. This program will also capitalize upon our best opportunity for nearly 40 years to study the unexplained variations in Uranus's faint outer rings.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12246
Title: Weak Lensing Mass Calibration of SZ-Selected Clusters
PI: Christopher Stubbs
PI Institution: Harvard University

We request observations of a uniformly selected sample of high mass galaxy clusters at redshift 0.58 < z < 0.88, in order to obtain weak lensing mass measurements of these systems. The clusters are drawn from the sample detected by the South Pole Telescope using the spectral distortion that high mass clusters impose on the Cosmic Microwave Background, the Sunyaev-Zeldovich effect. These clusters comprise a nearly mass-limited sample, which is an unprecedented resource for constraining cosmological parameters and for studying galaxy populations in these extreme environments. The weak lensing mass estimates will be used in conjunction with existing data sets (X-ray, infrared, and optical) to establish an accurate overall mass normalization. Uncertainty in the overall mass scale has not been previously determined for this combination of masses and redshifts, and is the dominant uncertainty in extracting constraints on cosmological parameters from cluster abundance studies. We are undertaking a coordinated program of weak lensing measurements, using ground-based telescopes for clusters at redshift z < 0.55, and HST, as requested here, for higher redshifts.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12247
Title: Identifying and studying gamma-ray bursts at very high redshifts
PI: Nial Tanvir
PI Institution: University of Leicester

Gamma-ray bursts are bright enough to be seen to very high redshifts and their afterglows can provide redshifts and positions of their host galaxies, and in some cases details of the host ISM and the IGM close to the burst. Thus GRBs offer a unique probe of early star formation and the galaxy populations in the era of reionization. Our efforts to identify high-z GRBs were rewarded with the recent discovery of GRB 090423 at redshift 8.2. However, it remains the case that some good candidate high-z GRBs cannot be followed up quickly or deeply enough with ground-based IR spectroscopy, and indeed for others it is likely the Ly-alpha break falls in difficult regions of the IR spectrum. WFC3/IR on HST can obtain redshifts based on the location of the Ly-alpha break via slitless grism spectroscopy, to considerably deeper limits (and hence later times) than is possible from the ground, thus offering a solution to this problem. Our proposal aims to increase the efficiency of locating z>7 GRBs over the next three years by performing such spectroscopy on candidates for which photometry suggests they are very high redshift, but where the redshift can't be secured from the ground. We also propose to monitor the afterglows of any high-z GRBs found, and to perform an initial search for their hosts.
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Proposal Category: GO
Scientific Category: TAC
ID: 12248
Title: How Dwarf Galaxies Got That Way: Mapping Multiphase Gaseous Halos and Galactic Winds Below L*
PI: Jason Tumlinson
PI Institution: Space Telescope Science Institute

One of the most vexing problems in galaxy formation concerns how gas accretion and feedback influence the evolution of galaxies. In high mass galaxies, numerical simulations predict the initial fuel is accreted through 'cold' streams, after which AGN suppress star formation to leave galaxies red and gas-poor. In the shallow potential wells that host dwarf galaxies, gas

accretion can be very efficient, and "superwinds" driven either by hot gas expelled by SNe or momentum imparted by SNe and hot-star radiation are regarded as the likely source(s) of feedback. However, major doubts persist about the physics of gas accretion, and particularly about SN-driven feedback, including their scalings with halo mass and their influence on the evolution of the galaxies. While "superwinds" are visible in X-rays near the point of their departure, they generally drop below detectable surface-brightness limits at ~ 10 kpc. Cold clumps in winds can be detected as blue-shifted absorption against the galaxy's own starlight, but the radial extent of these winds are difficult to constrain, leaving their energy, momentum, and ultimate fate uncertain. Wind prescriptions in hydrodynamical simulations are uncertain and at present are constrained only by indirect observations, e.g. by their influence on the stellar masses of galaxies and IGM metallicity. All these doubts lead to one conclusion: we do not understand gas accretion and feedback because we generally do not observe the infall and winds directly, in the extended gaseous halos of galaxies, when it is happening. To do this effectively, we must harness the power of absorption-line spectroscopy to measure the density, temperature, metallicity, and kinematics of small quantities of diffuse gas in galaxy halos. The most important physical diagnostics lie in the FUV, so this is uniquely a problem for HST and COS. We propose new COS G130M and G160M observations of 41 QSOs that probe the gaseous halos of 44 SDSS dwarf galaxies well inside their virial radii. Using sensitive absorption-line measurements of the multiphase gas diagnostics Lya, CII/IV, Si II/III/IV, and other species, supplemented by optical data from SDSS and Keck, we will map the halos of galaxies with L = 0.02 - 0.3 L*, stellar masses M* = 10^(8-10) Msun, over impact parameter from 15 - 150 kpc. These observations will directly constrain the content and kinematics of accreting and outflowing material, provide a concrete target for simulations to hit, and statistically test proposed galactic superwind models. These observations will also inform the study of galaxies at high z, where the shallow halo potentials that host dwarf galaxies today were the norm. These observations are low-risk and routine for COS, easily schedulable, and promise a major advance in our understanding of how dwarf galaxies came to be.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12249
Title: Reionization of Intergalactic Helium at the Highest Redshifts
PI: Wei Zheng
PI Institution: The Johns Hopkins University

In recent years, the number of quasars with clear sightlines to HeII Ly-alpha has more than tripled, enabling us to map IGM reionization between z=2.5-3.9. We propose COS/G140L spectroscopy for four quasars at z~3.5-3.9, as the brightest in the highest redshift range ever studied. We aim to probe the "penumbra" of the IGM's "dark ages" at the epoch of He II reionization, providing the longest trace yet of reionization history. The proposed quality COS spectra will reveal features of the patchy and rapidly evolving IGM helium ionization near this epoch; COS resolution may also reveal a predicted spectral signature that would establish the redshift of HeII reionization, disentangling the effects of damped absorption, associated absorbers, and proximity zones. The broad wavelength coverage of G140L will enable us to trace helium absorption all the way to the Lyman limit at 228*(1+z) A, and comparison of the four sightlines will unravel the effects of cosmic variance. Our proposed study of z>3.4 quasars complements ongoing COS GTO and GO programs for z<3.3, and will add enormously to our understanding of the fluctuations in the patchy HeII Ly-alpha IGM optical depth, the growth in opacity to higher redshifts, and may reveal the onset epoch/redshift of IGM

HeII reionization. By analogy, our study of HeII reionization may also shed light on the morphology of hydrogen reionization between z~6-10.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12250
Title: Irradiated Jets and Proplyds in NGC 1977, Orion Nebula's Cousin
PI: John Bally
PI Institution: University of Colorado at Boulder

We propose to use WFC3 and coordinated parallel observations with ACS to study a cluster of irradiated jets, photo-ablating disks (proplyds), and clouds in the low excitation HII region NGC 1977. Located 30' north of the Orion Nebula at a distance of about 410 pc , NGC 1977 contains over 100 young stellar objects identified by Spitzer and a half-dozen outflows found on ground-based narrow-band H-alpha images. The star Parenago 2042 powers a knotty jet and a bipolar chain of bow shocks with a C-shaped bend indicating deflection by a side-wind. We will take advantage of the new WFC3 capability to image [MgII] and [OII], species that can outshine H?alpha in UV-dominated shocked environments, to study the structure and excitation conditions in these jets with unprecedented resolution. H-alpha observations with WFC3, and ACS in coordinated parallel mode, will be used to study giant proplyds detected in ground-based images, to search for embedded protoplanetary disks, and to find additional proplyds and micro-jets among the dozens of Spitzer-detected young stars in this field. NGC 1977 is an ideal laboratory for the study of disk survival and evolution in a soft-UV dominated environment lit up by an early B star. Disk sizes and ionization fronts are expected to be larger than in Orion. In the Orion Nebula, photo-ablating plasma flows from the ionization front towards our line-of-sight, making it difficult to determine the distance between any disk and the ionization front. In NGC 1977, the plasma flow is closer to the plane of the sky. Thus, for a constant velocity ionization front, the projected distance of a proplyd from the front is expected to be proportional of its UV exposure-time. A study of disk-size versus distance from the front can be related to the disk photo-erosion rate. This study will make important contributions to our understanding of the impacts of the environment on protostellar jet and proto-planetary disk evolution.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12251
Title: The First Characterization of a Super-Earth Atmosphere
PI: Zachory Berta
PI Institution: Harvard University

Our team recently discovered the first transiting super-Earth exoplanet whose atmosphere can be studied with HST. GJ1214b is a 2.7 Earth radius, 6.6 Earth mass exoplanet that transits a low-mass M dwarf located a mere 13 pc away. With only a mass and radius known, structural models show that GJ1214b may either have an extended H-rich envelope or consist of a body that is mostly water, surrounded by a thin, H-poor atmosphere. We propose to observe the planet in transit with WFC3 IR's G141 grism and NICMOS' G206 grism to measure its transmission spectrum between 1.1 and 2.5 microns. Our primary science goal is to determine the super-Earth's atmospheric scale height, thus distinguishing between its possible bulk compositions. These data shall also constrain the relative methane and water abundances on GJ1214b. The summed light curve will permit a search for transiting moons around GJ1214b the size

of Ganymede, and potentially as small as the Moon. Among the presently known transiting exoplanets, GJ1214b is the smallest, coolest, most Earth-like planet that has a substantial atmosphere. Fortunately, the small radius of the star means studying GJ1214b's atmosphere requires no better precision than has already been demonstrated by HST observations of transiting hot Jupiters.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12252
Title: The Relative Kinematics of Galaxy Emission and Multiple Gas Phases in z~0.5 Extended Galaxy Halos
PI: Christopher Churchill
PI Institution: New Mexico State University

Evidence abounds from quasar absorption line data that the extended gaseous halos of galaxies comprise multiple phases (densities, temperatures, ionization conditions). Developing a comprehensive and deeper understanding of the origin and persistence of extended galaxy halos, and their role in galaxy evolution, requires that these multiple phases be observed and analyzed. However, such studies that incorporate the host galaxies are virtually non-existent. The new COS instrument opens a new window in which the forest of FUV lines arising in neutral, low, AND high ionization halo gas can be probed with high resolution and sensitivity for multiple chemical species. For intermediate redshift galaxies, these lines are free of Ly-alpha forest contamination. We propose to obtain G160M COS/FUV high resolution spectra of the two quasars Q0454-220 (J0456-2159) and Q1038+064 (4c 06.41) in order to measure the neutral hydrogen Ly-beta, gamma, and delta transitions and the OVI 1031,1038 doublet and CII 1036 and CIII 977 transitions (as well as a few others that fall on the spectral format) in three intervening z~0.45 intervening gaseous halos. We augment the proposed observations with a similar pending COS spectrum (scheduled May 2010, PID 11667, PI Churchill) of the quasar TON 153, which will provide the multiphase absorption kinematics for two additional gaseous halos at z~0.67. The proposed observations will bring our final sample size to five. For these five systems, we have quantified the host galaxy morphologies (WFCP-2/HST images), measured the galaxy emission lines and rotation curves (ESI/Keck spectra), and analyzed the MgII 2796,2803 and FeII multiplet absorption (HIRES/Keck spectra). Our goal is to undertake a comprehensive analysis of the multiphase physical conditions in these five galaxy-absorber pairs. We aim to perform the first ever quantitative comparison of the relative relationships between neutral, low, and high ionization absorbing halo gas kinematics with the galaxy kinematics and morphologies. We will interprete the data using synthetic absorption line data of the same transitions for "quasar sightlines" through a Eulerian adaptive resolution hydrodynamic cosmological simulation following the methods of Kacprzak etal. (2010).
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12253
Title: Gravity in the Crossfire: Revealing the Properties of Dark Matter in Bullet-like Clusters
PI: Douglas Clowe
PI Institution: Ohio University

We propose to study the physical nature of dark matter by using massive, merging clusters of galaxies. As shown with the Bullet Cluster (1E0657-56), such massive well-measured systems are critical for our understanding of dark matter. By more than doubling the number of clusters in the sample and

obtaining systems at different observation angles, impact parameters, geometrical arrangements, and merger velocities, the systematic uncertainties in the dark matter cross section calculations can be improved substantially, allowing us to move from rough order of magnitude estimates to measurements with quantifiable uncertainties that can be compared usefully with the predictions from numerical simulations, and the constraints on alternate gravity models become unambiguous. Our proposed targets are three extraordinary, merging galaxy clusters with X-ray and optical offsets that are placed at ideal redshifts for such a study; A520, A1758N, and A2163. To pin down the position of the dark matter component we require high resolution, absolutely calibrated mass maps. High resolution gravitational lensing data is needed to attain this goal, which can only be achieved with the excellent resolving power of the HST.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12254
Title: Helium-core White Dwarfs and Cataclysmic Variables in NGC 6752: New Clues to the Dynamical Evolution of Globular Clusters
PI: Adrienne Cool
PI Institution: San Francisco State University

We propose to search for binary stars containing white dwarfs in the post-core-collapse globular cluster NGC 6752 whose unusual dynamical status has yet to be fully explained. Using F435W, F625W and F658N filters with ACS/WFC, our search will be sensitive to double-degenerate binaries of the type we have recently uncovered in NGC 6397, which contain helium-core white dwarfs (WDs) paired with probable heavy carbon-oxygen WDs. We will use He WDs found in NGC 6752 to set new constraints on binary populations in the cluster and, by comparing them to those in NGC 6397, illuminate the role of binaries in the dynamical history of both clusters. The proposed H-alpha imaging will also enable us to search for optical counterparts of numerous as-yet unidentified X-ray sources in our deep Chandra imaging; these are likely to be a mixture of cataclysmic variables (CVs), active binaries, and millisecond pulsars. We will determine whether NGC 6752 harbors a class of very faint CVs as have been recently found in the field and in NGC 6397. Those in NGC 6397 have been interpreted as an old population that formed near the cluster center and migrated outward as it aged, in contrast to the bright young CVs that reside close to the center. We will test for a similar pattern of spatial distribution with CV magnitude in NGC 6752.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12255
Title: Probing Ultracool Atmospheres and Substellar Interiors with Dynamical Masses
PI: Trent Dupuy
PI Institution: University of Hawaii

After years of patient orbital monitoring, there is now a large sample of very low-mass stars and brown dwarfs with precise (~5%) dynamical masses. These binaries represent the gold standard for testing substellar theoretical models. Work to date has identified problems with the model-predicted broad-band colors, effective temperatures, and possibly even luminosity evolution with age. However, our ability to test models is currently limited by how well the individual components of these highly prized binaries are characterized. To solve this problem, we propose to use NICMOS and STIS to characterize this

first large sample of ultracool binaries with well-determined dynamical masses. We will use NICMOS multi-band photometry to measure the SEDs of the binary components and thereby precisely estimate their spectral types and effective temperatures. We will use STIS to obtain resolved spectroscopy of the Li I doublet at 6708 A for a subset of three binaries whose masses lie very near the theoretical mass limit for lithium burning. The STIS data will provide the first ever resolved lithium measurements for brown dwarfs of known mass, enabling a direct probe of substellar interiors. Our proposed HST observations to characterize the components of these binaries is much less daunting in comparison to the years of orbital monitoring needed to yield dynamical masses, but these HST data are equally vital for robust tests of theory.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12256
Title: The Ultraviolet and Optical Counterparts of the
                     Intermediate Mass Black Hole Candidate ESO 243-49 HLX-1
PI: Sean Farrell
PI Institution: University of Leicester

We request imaging observations of the record breaking hyper-luminous X-ray source and intermediate mass black hole candidate HLX-1 in the galaxy ESO 243-49, in order to investigate the nature of recent detections of UV emission and an optical counterpart. HLX-1 is currently the best candidate for an intermediate mass black hole, the possible building blocks of super-massive black holes found in the centres of galaxies. UV emission possibly associated with the X-ray source position was recently detected in lower resolution observations with the Swift and GALEX satellites. If this emission can be tied to HLX-1 and is point-like in nature, it will likely be dominated by emission from a hot accretion disc. By obtaining UV photometry we will be able to place constraints upon the temperature of the disc and therefore the mass of the black hole. The optical counterpart may be related to disc emission, though it is also possible that it is associated with a globular cluster or nucleated dwarf galaxy. By obtaining photometry of the counterpart in near-infrared to UV wavelengths we will be able to construct a broad-band SED, which will allow us to place firm constraints on the environment around this intriguing object.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12257
Title: The Nature of Multiple Main Sequence Turn-offs and Dual
                     Red Clumps in Magellanic Cloud Star Clusters
PI: Leo Girardi
PI Institution: Osservatorio Astronomico di Padova

Recently, deep images from the ACS camera aboard HST provided conclusive evidence that several massive intermediate-age star clusters in the LMC and SMC present multiple main-sequence turn-offs (MMSTO), 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. In this project, we propose to collect WFC3 imaging that should lead to an understanding of the nature of the MMSTO phenomenon. We will perform deep F475W and F814W imaging for a complete sample of star clusters covering well-defined intervals of age and total mass. The sample comprises star clusters spanning a wide variety of concentrations and locations within the LMC and SMC, so as to allow a study of the physical properties causing the MMSTO phenomenon. The data will allow us

to derive detailed star formation histories via CMD reconstruction methods, and locate the targets in the robust absolute age scale provided by clusters with dual red clumps. The underlying field population will be characterized by means of ACS images of nearby areas obtained in parallel. For all sample clusters more massive than 10^5 solar masses (including those with previous ACS/WFC imaging) we will also obtain high-S/N F336W imaging to probe star-to-star abundance variations in C and N along the RGB. Such variations are expected from self-enrichment from intermediate-mass stars within the clusters, in analogy with what is observed in the most massive old globular clusters. Thanks to its photometric depth and accuracy, the resulting dataset will constitute an invaluable resource for studies of stellar evolution and dynamics in star clusters.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12258
Title: The Environmental Dependence of Ultraviolet Dust Extinction Curves in the Small Magellanic Cloud
PI: Karl Gordon
PI Institution: Space Telescope Science Institute

Observations of nearby and distant galaxies (galaxy SEDS, lensed galaxies, and gamma ray bursts) have shown that dust with a wide variation in ultraviolet (UV) extinction properties (e.g., weak and strong 2175 Angstrom bumps) is the norm and not the exception. The Small Magllanic Cloud (SMC) is known to have dust spanning the full range of UV dust properties and is relatively nearby, making it the best galaxy to study the effects of environment (nearby star formation, gas-to-dust ratio, etc.) on the dust extinction. The SMC has sightlines with the traditional SMC extinction curve (no 2175 Angstrom bump, high far-UV rise) and one sightline with a much more Galactic extinction curve (2175 Angstrom bump, weaker far-UV rise). Unfortunately, there are only five existing SMC extinction curves making any correlation between extinction behavior and environment necessarily very tentative. We are proposing to determine the ultraviolet extinction curves toward 11 additional stars in the SMC thereby tripling the number of SMC extinction curves measured. The 11 reddened and 4 comparison stars for this proposal were picked from samples of hot stars with high quality spectral types and normal U through IRAC 8 micron SEDs (e.g., no Be stars). The new sightlines have different levels of star formation activity and infrared dust properties. In addition to helping understand the origin of the UV dust extinction variations in galaxies, the study of the spatial variation of UV extinction in the SMC also holds the promise of helping to understand the origin of the 2175 Angstrom bump.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12259
Title: A Mysterious Unseen Companion Lurking at 30 Parsecs
PI: Wei-Chun Jao
PI Institution: Georgia State University Research Foundation

Astrometric perturbations are the result of unseen, sometimes mysterious, companions. When resolved, the systems provide crucial mass measurements for the components. Here we propose to use HST/STIS to image an unseen companion that causes the largest astrometric perturbation among 500 nearby stars observed using the CTIO 0.9m telescope since 1999. The primary is a red dwarf at 30 pc with V=16.86 and spectral type M5.0V, while the system has been detected by GALEX in the near-UV. From the astrometry and photometry, we can rule out that the companion is red dwarf, a brown dwarf, or a normal white

dwarf. All three of the remaining possibilities are extraordinary --- a very cool white dwarf, a neutron star, or a black hole --- making the companion one of the most unusual objects in the solar neighborhood. We propose to use HST/STIS imaging at NUV and FUV wavelengths to resolve this intriguing system to confirm its nature and constrain its mass.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12260
Title: Probing Intermediate Ionization Gas in the Perseus and Virgo Clusters
PI: Roderick Johnstone
PI Institution: University of Cambridge

The physics of the evolution of X-ray emitting gas in the cores of clusters is now known to be much more complex than the simple cooling model. In order to understand how the observed molecular/atomic and keV components interact we need to probe the full range of gas phases between these components. We therefore propose deep ultraviolet spectra of the active nucleii in NGC1275 and M87, the central galaxies in the Perseus and Virgo clusters. Discovery of absorption lines from highly ionized species such as CIV and SiIV will provide a sensitive diagnostic of this crucial intermediate phase of the intracluster medium that is not accessible in any other way.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12261
Title: Resolving the Pictor A Jet
PI: Herman Marshall
PI Institution: Massachusetts Institute of Technology

We are proposing to obtain new images of the Pictor A jet in order to measure the spatial scale of clumping and to search for variability. X-ray images show a jet that has an opening angle of less than 1 degree that is about 2' (84 kpc, projected) long, unresolved for the first 30-40", and marginally detectable out to the terminal hotspot that is 4.2' from the core. The brightest portions of the inner jet are also marginally detectable in radio images. Based on a synchrotron model of the X-ray emission, we estimate that the bright parts of the inner jet should be detectable in the optical and IR in short HST observations with the WFC3.   Three bandpasses will provide sufficient information on each knot to determine the synchrotron cutoffs, if it is in the optical band.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12262
Title: Stellar Forensics II: A post-explosion view of the progenitors of core-collapse supernovae
PI: Justyn Maund
PI Institution: University of Copenhagen, Niels Bohr Institute

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 SNe to search for clues about the nature

of their progenitors. We request time to conduct deep, late-time, high-resolution imaging with WFC3/UVIS+IR and ACS/WFC of the sites of three core-collapse SNe 2008ax, 2008bk and 2008cn. We aim to: 1) Confirm our original identifications, made in pre-explosion images, by confirming that the progenitors are now missing; 2) Apply image subtraction techniques for this late-time imaging with our pre-explosion images to determine accurate photometry of the progenitors to constrain their temperatures and luminosities; and 3) study the stellar populations in the immediate vicinities of these SNe, previously obscured by the progenitor and the SN, to provide a measure of the progenitor's age, as well. For SN 2008ax we aim to determine the possible presence of a binary companion, as a persistent source at the SN location once the SN has faded and the progenitor has disappeared. HST provides the unique combination of high-resolution optical/IR imaging at very faint magnitudes that will facilitate this study.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12263
Title: Three Dimensional Mapping of the Magellanic Bridge by High-Resolution Spectroscopy toward Multiple Sightlines
PI: Toru Misawa
PI Institution: Shinshu University

The Magellanic Bridge (the MB) is a physical connection between the Large Magellanic Cloud (LMC) and the Small Magellanic Cloud (SMC). The MB contains a young stellar population that was probably formed in local molecular clouds, while it is still not fully settled whether the larger Magellanic Stream, produced by the LMC/SMC unit sweeping through the Milky Way halo, contains only gas or has any stellar populations. We propose HST/COS spectroscopy of four sight-lines of the MB toward QSOs/AGNs behind it, covering various absorption lines such as O I, Fe II, Si II, C II, Si IV, and C IV. This will be combined with one existing STIS observation of B0312-770 which we have already modeled in detail, and with our recent high resolution VLT/UVES observations of all five sight-lines, covering Ca II H,K and Na I D_1, D_2. The five sight-lines cover a range of H I column densities from 10^19 (cm^-2) up to above the damped Lya (DLA) threshold. Effectively, the proposed COS observations of multiple sightlines through the MB will provide a map of the surroundings of a DLA absorber, allowing us to study how it connects with other classes of absorbers, and with the surrounding structures. Our goals are to (1) evaluate physical conditions of gas clouds in the MB along multiple sight-lines derived from the photoionization models, (2) search for correlations between the physical conditions of the MB gas, the H I 21cm radio emission density, and the distance from the SMC, and (3) compare the physical conditions of the MB to those of high-z absorption systems like DLA systems because the MB, with its low metallicity and possible dust deficiency, could be a local analog.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12264
Title: The Relationship between Gas and Galaxies for 0<z<1.2
PI: Simon Morris
PI Institution: University of Durham

The way in which gas cools and contracts into gravitational potentials dominated by dark matter to form stars (and hence galaxies), and the way in which these stars and their deaths then affect the incoming gas, is a topic of great importance and high current interest. It was also recognised as a key

science goal for HST by some of its original builders such as Bahcall, Spitzer and Salpeter. We propose to use COS to complement and extend the planned COS GTO and GO surveys by extending to higher redshifts (z<1.2), and also by substantially increasing the redshift pathlength within which both the gas and the galaxy distributions are known. We will do this by observing the lines-of-sight to four carefully selected QSOs in regions of the sky with extensive deep galaxy redshift surveys (VVDS and GDDS) already in place. This will allow us to study the evolution in the relationship between gas and galaxies over the second half of the history of the Universe and over a large range of physical scales. By comparing with independent, state-of-the-art hydrodynamic cosmological models, we will test our understanding of the formation of galaxies, and determine whether the AGN and supernova feedback prescriptions currently used in these simulations are correct. It is likely that only by using the combination of absorption line information from hydrogen and metals, with large galaxy samples, that the complexities of the feedback process can be unscrambled. We have assembled a strong consortium of experts in HST absorption line analysis, deep galaxy redshift surveys, and cosmological simulations including baryons. With this team, and the proposed observations, we are confident that our understanding of galaxy formation and evolution can be significantly improved.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12265
Title: Determining the Physical Nature of a Unique Giant Lya Emitter at z=6.595
PI: Masami Ouchi
PI Institution: Carnegie Institution of Washington

We propose deep WFC3/IR imaging for a giant Lya emitter (LAE) with a Keck spectroscopic redshift of z=6.595 discovered by extensive narrow-band imaging with Subaru in the SXDS-UKIDSS/UDS field. This remarkable object is unique in many respects including its large stellar mass and luminous nebula which extends over 17 kpc; no equivalent source has been found in other surveys. The nature of this rare object is unclear. Fundamental to progress is determining the origin of star formation in such an early massive object; if the age of the stellar population is short we are likely witnessing a special moment in the formation history of a massive galaxy. The heating source for the nebula is also unclear; options include intense star formation, the infall of cold gas onto a dark halo or shock heating from a merger. We will take deep broad-band (F125W and F160W) images and an intermediate-band (F098M) image which will be analyzed in conjunction with ultra-deep IRAC 3.6 and 4.5 micron data being taken by the Spitzer/SEDS project. These data will enable us to constrain the star formation rate and stellar age. Moreover, the UV continuum morphology and Lya-line distribution will be investigated for evidence of a major merger, cold accretion, or hot bubbles associated with outflows. We will address the physical origin of the remarkable object observed at an epoch where massive galaxies are thought to begin their assembly.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12266
Title: Lyman Continuum Escape Fractions with a Lensed LBG in the 'Sweet Spot'
PI: Anna Quider
PI Institution: University of Cambridge

We propose to search for Lyman continuum (LyC) emission from the Cosmic Horseshoe. This star-forming galaxy at z = 2.38115 has been strongly lensed into a nearly complete Einstein ring of 10 arcsec diameter and magnified by a factor of 25 to g=20.1. The Cosmic Horseshoe is an ideal candidate for finding escaping LyC photons and studying in detail how LyC emission happens within a galaxy. In previous work we have shown that this galaxy has gaps in its interstellar medium, which are strongly correlated with a high escape fraction of LyC photons. We will improve the sensitivity of LyC escape fraction measurements by over an order of magnitude, thanks to the flux and resolution boost from gravitational lensing and the fortuitous location of the HST/UVIS F275W filter in the 'sweet spot' just redward of the Lyman limit. We will probe LyC escape fractions down to <3% at the 3-sigma level and constrain LyC emission across hundreds of resolution elements, corresponding to galactic structures as small as 100 pc. This galaxy has been well-characterized by studies in multiple wavebands, allowing us to place the LyC emission into the broader context of the Cosmic Horseshoe's properties. These HST observations will allow us to constrain how LyC emission happens within this galaxy and will guide our understanding of cosmic reionization.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12267
Title: Dissecting star formation, extinction, and stellar populations in the brightest lensed galaxy
PI: Jane Rigby
PI Institution: Carnegie Institution of Washington

Gravitational lensing provides rare chances to study high-redshift galaxies in otherwise unobtainable ways. We propose to survey star formation in a spectacular lensed galaxy, the brightest yet discovered. We propose to map, at ~100 pc scales, the star formation (via H alpha) and the extinction (via the H-beta to H-alpha ratio) using narrow-band filters, and to map the UV spectral slope and the Balmer break using broad-band filters. In a typical galaxy at the epoch when most of the Universe's stars formed, these maps will show where stars are forming within the galaxy; the range of extinction and its morphology; and the performance of multiple diagnostics of star formation rate on a pixel-by-pixel basis.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12268
Title: Production of the Heavy Elements in the Universe
PI: Ian Roederer
PI Institution: University of Texas at Austin

We propose to use STIS to observe a sample of 4 metal-poor stars that have been enriched by only a small amount of material produced by the rapid neutron-capture process (r-process). These "r-poor" stars have 10-100 times less r-process material than the "r-rich" stars at similar metallicities (-2.5 < [Fe/H] < -1.7). The r-poor stars fill in a crucial gap in our understanding of how the heavy elements were produced in the early Galaxy by revealing whether there is a continuous distribution of r-process abundance patterns between the most strongly r-enriched stars and those with only a trace of r-process enrichment. Guided by our previous STIS observing experience, we will obtain high S/N near-UV spectra (S/N = 50 near 230.0 nm and increasing to longer wavelengths) to derive abundances or meaningful upper limits for the heavy elements Ge, Zr, Cd, Lu, Os, Pt, and Pb. All of these elements (except Pb) can only be detected in very metal-poor stars in the near-UV using HST,

and we have already made successful detections of them in r-rich stars. 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. Our proposed observations also have the potential to determine more precise ages for the oldest Galactic halo stars. This work is supported by recent laboratory experiments and theoretical studies and will provide data of wider interest to the atomic, nuclear, and astrophysics communities.
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Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12269
Title: The escape of Lya photons in star-forming galaxies
PI: Claudia Scarlata
PI Institution: California Institute of Technology

Our knowledge of the very high redshift Universe heavily depends upon the observation of the Lyman-alpha (Lya) emission line for both spectroscopic confirmation and often the actual discovery of galaxies at very high redshifts. However, no comprehensive study of the astrophysics behind the Lya production, transport, and escape fraction has so far been made, since the required supplementary observations are redshifted to inaccessible wavelengths for cosmological populations. At z~0, such studies can be undertaken, but the number of known Lya emitting galaxies is extremely small and observationally biased. With the aim of characterizing the physics of Lya escape from galaxies, our group has undertaken a major effort to followup a new well-defined sample of GALEX-selected z~0.3 Lya emitters. Here, we propose to obtain FUV COS-G160M spectroscopy of 25 GALEX star-forming Lya emitters for which we have already measured gas metallicity, nebular extinction, escape fraction of Lya photons, and stellar masses. The COS spectra will provide the shape of the Lya profile, a fundamental diagnostic of the physical conditions of the ISM, since it encodes crucial information about the kinematics, column density, and dust content of the neutral gas. By investigating the physical mechanisms driving the Lya output in a well-defined sample of low-z Lya emitters, the proposed study will provide us with the necessary knowledge to interpret the observations in the more distant universe.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12270
Title: Proper Motion of Leo I: Constraining the Milky Way Mass
PI: Sangmo Sohn
PI Institution: Space Telescope Science Institute

The mass of the Milky Way is one of the most poorly established Galactic parameters. One important reason for this problem stems from the uncertainty about the bound/unbound status of one particular object, Leo I, which has an unusually large radial velocity (v_hel = 283 km/s) at extreme distance (261 kpc). We propose to resolve this issue by measuring at high-precision the absolute proper motion of Leo I with HST. ACS/WFC F814W data that can be used as first epoch already exist in the archive. For the second epoch data, we request to obtain 6 more orbits with the same instrument and filter, yielding a 5 year time baseline. With proven techniques that use many compact background galaxies as astrometric reference sources, the predicted transverse velocity accuracy is only 26 km/s at the distance of Leo I. Our results will be accurate enough to address whether or not Leo I is bound. We will then perform new equilibrium modeling of the Milky Way satellite system to obtain an improved estimate of the Milky Way mass. We will also perform new N-body simulations of Leo I, constrained by the measured velocity, to fit

simultaneously the orbit, extra-tidal features, and unusual star formation history. This will independently constrain the Milky Way mass. Only HST can achieve the required accuracy, and considerable progress can be made on these important issues with only a small investment of HST time.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12271
Title: Probing the Physics of Gas in Cool Core Clusters: Virgo
PI: William Sparks
PI Institution: Space Telescope Science Institute

We recently detected high temperature gas at 10^5K associated with the low excitation 10^4K line emission filaments of M87. This is a profoundly important observation bearing on the physics of transport processes in cool core clusters. We propose to delve deeper into the physics of cool core clusters. We propose to use ACS to compare the spatial extent and morphology of the low and high temperature gas, to use the timely presence of COS to obtain a sensitive FUV spectrum of the hot gas, and, by introducing the notion of emission line polarimetry, seek a a potentially revolutionary new plasma diagnostic. The spatial distributions will reveal whether the hotter material is more spatially extended than the cooler; the FUV spectrum will permit derivation of the emission measure (essentially amount of gas) at each temperature between the 10^4K Halpha filaments and coronal gas at 10^7K. Together these strongly constrain plausible transport processes relating the hot and cool gas phases in this cool core cluster region, and hence the dominant physical processes at work. A novel ingredient is to obtain the optical images in polarimetric mode to probe emission line polarization levels, a diagnostic used in Solar physics to determine the relevance of collisional excitation processes such as electron impact polarization in thermal conduction or shocks. With this suite of straightforward, uniquely HST observations we may dramatically change the landscape of our understanding of the physics of cool core clusters
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12272
Title: Testing Feedback: Morphologies of Extreme Post-starburst Galaxies
PI: Christy Tremonti
PI Institution: University of Wisconsin - Madison

Theoretical models of massive galaxy formation predict that feedback from AGN and/or supernovae plays a crucial role in quenching star formation during major galaxy mergers. Efficient quenching is required to match the observed properties of early-type galaxies, including the colors of local massive ellipticals and the spectral features of ultra-compact high-redshift spheroids. However, current observational evidence provides only indirect constraints on the quenching mechanism that causes galaxies to migrate from the blue cloud to the red sequence. In order to test feedback models of elliptical galaxy formation, we select a unique sample of extremely young, massive post-starburst galaxies at 0.4<z<0.8 that have direct evidence of strong galactic-scale feedback: a high fraction of these recently quenched galaxies show spectacular gas outflows with extremely high velocities (v=500-2000 km/s). We propose to use HST/WFC3 imaging to measure the sizes and morphologies of these galaxies. With these data we will preform the first direct test of theoretical models that include strong feedback and answer two fundamental questions: 1) Are the extreme properties of these post-starbursts

related to galaxy interactions? and 2) Are we witnessing the formation of the last few ultra-compact elliptical galaxies in the Universe?
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12273
Title: Mass of the Local Group from Proper Motions of Distant Dwarf Galaxies
PI: Roeland van der Marel
PI Institution: Space Telescope Science Institute

The Local Group and its two dominant spirals, the Milky Way and M31, have become the benchmark for testing many aspects of cosmological and galaxy formation theories, due to many exciting new discoveries in the past decade. However, it is difficult to put results in a proper cosmological context, because our knowledge of the mass M of the Local Group remains uncertain by a factor 4. In units of 10^{12} solar masses, a spherical infall model for the zero-velocity surface gives M~1.3; the sum of estimates for the Milky Way and M31 masses gives M~2.6; and the Local Group Timing argument for the M31 orbit gives M~5.6. It is possible to discriminate between the proposed masses by calculating the orbits of galaxies at the edge of the Local Group, which requires knowledge of transverse velocity components. We therefore propose to use ACS/WFC to determine the proper motions of the 4 dwarf galaxies near the edge of the Local Group (Cetus, Leo A, Tucana, Sag DIG) for which deep first epoch data (with 5-7 year time baselines) already exist in the HST Archive. Our team has extensive expertise with HST astrometric science, and our past/ongoing work for, e.g., Omega Cen, LMC/SMC and M31 show that the necessary astrometric accuracy is within the reach of HST's demonstrated capabilities. We have developed, tested, and published a new technique that uses compact background galaxies as astrometric reference sources, and we have already reduced the first epoch data. The final predicted transverse velocity accuracy, 36 km/s when averaged over the sample, will be sufficient to discriminate between each of the proposed Local Group masses at 2-sigma significance (4-sigma between the most extreme values). Our project will yield the most accurate Local Group mass determination to date, and only HST can achieve the required accuracy.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12274
Title: Proper motion study of M54: an intermediate-mass black hole in the nucleus of the Sagittarius Dwarf Galaxy?
PI: Roeland van der Marel
PI Institution: Space Telescope Science Institute

Intermediate Mass Black Holes (IMBHs) are objects of considerable astrophysical significance, and the centers of globular clusters may be our best chance of detecting them. Tentative evidence has been presented for, e.g., G1, Omega Cen, and M54. These are all suspected to be the remnant nuclei of disrupted dwarf galaxies, with M54 residing at the center of the Sagittarius dwarf galaxy. IMBHs in these clusters could indicate an important connection between globular cluster black holes and the super-massive black holes known to exist in galactic nuclei. However, the line-of-sight velocity studies from which the IMBH evidence was obtained are not clear-cut. We have demonstrated that HST proper motion studies can provide much better constraints. We recently published 170,000 proper motions for Omega Cen, and our modeling of the results significantly weakened the case for an IMBH. Here we propose a similar study for M54. Ground-based spectroscopy by one of us

found a peak in velocity dispersion which could be fit by either a 10^4 solar mass IMBH or an anisotropic velocity distribution; it also found a surprising offset between the kinematic and star count centers. The proposed proper motions will validate and refine our knowledge of the dispersion peak; they will directly measure the anisotropy through the ratio of radial and tangential proper motions; and they will allow an improved determination of the kinematic center from the proper motion dispersion field. We have supporting ground based data; we have all the necessary software for the analysis in hand; we have already astrometrically analyzed the first epoch archival data; and we need only 2 orbits with WFC3/UVIS. We expect a high quality proper motion catalog of 3000 stars, with 300 in the central 5 arcsec. This will put strong new constraints on the M54 cluster dynamics, structure, and possible presence of an IMBH.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12275
Title: Measuring gas flow rates in the Milky Way
PI: Bart Wakker
PI Institution: University of Wisconsin - Madison

Gas flows out of and into the Milky Way are a crucial element in its evolution. Supernovae heat gas in the disk and lift it into the halo. Tidal streams and instabilities in the hot Galactic corona result in an inflow of low-metallicity gas. These flows can be observed in the form of the high-velocity clouds (HVCs). Their location, brightness, distances, ionization structure and metallicities can be used to determine the conditions in the gaseous disk and halo as well as the rate of mass flow corresponding to the different processes. So far, sufficient information to derive an associated mass flow rate is available for just 5 HVCs. We propose to observe 20 AGNs toward most of the other HVC complexes as well as toward a few small clouds, in order to derive a metallicity for almost every HVC complex, which will complement distance measurements that have been or will be obtained in our ongoing program. Combining all the data, we can derive (a) the rate of the circulation of gas between disk and halo, constraining the Galactic supernova rate and (b) the accretion rate of low-metallicity material that feeds star formation over ~10 Gyr, which will constrain both models of galactic chemical evolution and models of the conditions in the hot galactic corona.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12276
Title: Mapping a nearby galaxy filament
PI: Bart Wakker
PI Institution: University of Wisconsin - Madison

Most of the baryons (90%) are in the intergalactic medium (IGM). Observationally, about 1/3rd of the IGM consists of photoionized hydrogen, which produces narrow Ly-alpha absorption lines. The remainder is predicted to be at temperatures >10^5 K, forming the WHIM; some of that gas produces broad Ly-alpha and OVI absorption. About half of the Ly-alpha lines originate within 400 kpc of galaxies (Wakker & Savage 2009). The relationship of the more isolated absorbers to galaxies and galaxy filaments is still unclear. We have identified a 10 Mpc long galaxy filament, toward which 4 QSOs have already been observed, showing evidence for broad Ly-alpha and OVI lines in the galaxy environments. We propose to observe an additional 23 AGNs projected on and next to this filament to study (1) the extent of the Ly-alpha producing gas, (2) whether broad lines (some of which trace the WHIM) are only seen inside

the filament or also outside, and (3) the relative velocities of the intergalactic gas and the galaxies in the filament.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12277
Title: HD 62542: Probing the Bare, Dense Core of an Interstellar Cloud
PI: Daniel Welty
PI Institution: University of Illinois at Urbana - Champaign

The line of sight to HD 62542 is remarkable for its unusual UV extinction, high column densities of various molecules (for A_v~1), and apparent dearth of diffuse atomic gas. Most of the interstellar material resides in a single cold cloud -- a small, relatively dense (n_H ~ 500--1000 cm^-3), molecular knot whose more diffuse outer layers appear to have been stripped away by stellar winds and shocks. As such, it provides an ideal venue for investigating the properties of moderately dense molecular gas -- including the production of molecules and growth of grains in such gas -- with minimal confusion from any associated diffuse atomic gas. We propose to obtain high resolution, moderately high S/N STIS spectra of C I, CO and its isotopomers, C_2, CS, C II, O I, and many other atomic species (characterized by a wide range in depletion behavior). Those data will be used to compare various diagnostics of the physical conditions (e.g., C I and O I fine-structure excitation, CO and C_2 rotational excitation), to determine the relative abundances of the various CO isotopomers (fractionation), and to determine the depletions of various elements in moderately dense gas (the predicted severe depletions have likely been masked by associated diffuse gas in other cases). Understanding the fractionation and excitation of CO in this relatively simple case will aid in understanding its behavior in other more complex regions (important because CO and its isotopomers are often used to trace and characterize molecular gas where H_2 cannot be directly measured).
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Proposal Category: GO
Scientific Category: TAC
ID: 12278
Title: Advanced Spectral Library Project: Cool Stars
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

Stars are the luminous backbone of the Universe, and without them, it would be a dull and dreary place indeed: no light, no heavy elements, no planets, no life. It also is safe to say that stellar spectroscopy is a cornerstone of astrophysics, providing much of what we know concerning temperatures and masses of stars, their compositions, planets, and the dynamics and evolution of the galaxies they inhabit. The proper interpretation of stellar spectra thus is fundamental to modern astronomy. This is especially true for the satellite ultraviolet, owing to the rich collection of atomic and ionic transitions found there. Unfortunately, the existing archive of Space Telescope Imaging Spectrograph rarely achieves the high S/N of the best ground-based spectra, and relatively few objects have the full wavelength coverage for which the powerful, highly multiplexed, second generation Hubble instrument was designed. With UVES at ESO and ESPaDOnS at CFHT, for example, astronomers routinely are obtaining broad-coverage optical spectra with S/N > 100 and resolving power of 100,000 to fuel ground-breaking analyses. Our objective is to collect comparable STIS UV echelle spectra for a diverse sample of representative stars, to build an Advanced Spectral Library; a foundation for astrophysical exploration: stellar, interstellar, and beyond.

Our first effort involves cool stars, whose main contribution to the UV is through magnetic activity, an enigmatic phenomenon subject to close scrutiny on the Sun, and of undeniable importance to a broad range of cosmic situations: Space Weather, T-Tauri disk winds, red dwarf flares, erosion of exoplanet atmospheres, and so forth. The main product of our Treasury program will be detailed stellar "atlases," based on advanced processing of the STIS echellegrams. Members of our broad collaboration will analyze these data for specific purposes, such as detection of rare species in sharp-lined F stars, properties and kinematics of local interstellar clouds, and dynamics of chromospheres, coronae, and winds of cool stars; but rapid public release (based on the "StarCAT" model) will enable many other investigations by a much wider community, for decades to come.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12279
Title: FK Comae, King of Spin: the Movie
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

FK Comae is an ultra-fast rotating, single yellow giant, product of a recent W UMa merger. Extraordinary levels of FUV and X-ray emission rate FK Comae a coronal powerhouse on par with the most extreme of the better known activity heavyweights: short-period RS CVn binaries. As a single star, FK Comae has clear advantages as a laboratory for exploring the outer limits of magnetospheric activity among the coronal cool stars. FK Comae has a long history of attention at optical and X-ray wavelengths, thanks to its generously spotted surface, and proclivity to flare regularly at high energies. FUSE discovered ultra-broad, redshifted profiles of O VI and C III, but unfortunately the singular observation could not be repeated, thanks to the satellite's flaky attitude system. The remarkable FUV spectrum was taken just a few months before STIS failed in 2004, so there was no opportunity to turn the more powerful gaze of Hubble to the task. Now, finally, the amazing sensitivity of Cosmic Origins Spectrograph can be brought to bear: a single orbit can capture an FUV spectrum of FK Comae with S/N at instrumental limits for bright lines, and digging down to faint Fe XXI 1354 (bridge to the coordinated Chandra HETGS pointing we also are proposing). We will trace how the bright FUV regions relate spatially to the photospheric dark spots, to inform ideas of coronal structure and heating in these advanced objects. We will probe whether a global magnetosphere exists, and whether the field lines are loaded with hot coronal gas (>10 MK), as well as the cooler 0.3 MK material already suggested by highly broadened FUSE O VI. Further, we will test whether the striking 100 km/s redshifts of the FUV lines, and similar shifts seen in Ne X by Chandra HETGS, are caused by a massive coronal outflow (perhaps implicated in magnetic braking). Our method is to exploit, on the one hand, emission-line "Doppler imaging," whereby bright surface regions are mapped onto specific locations in the global profile, according to the line-of-sight rotational velocity. On the other hand, we compare features of different opacity and excitation (e.g., Si III 1206 and Si IV 1393) to deduce whether, say, a red asymmetry is caused by blueshifted absorption, or alternatively by infall of the entire feature. Multiple epochs spaced over two rotation periods break the degeneracy between profile distortions caused by disk passage of hot patches (Doppler imaging part), and those caused by large-scale flows. Contemporaneous spot maps from the ground will provide a fundamental magnetic context for the coordinated FUV and X-ray "movies."
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 12280
Title: Deep Lamp Too
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

This is a calibration proposal that addresses a significant obstacle to ongoing efforts to enhance the quality of the dispersion solutions implemented in the STIS echelle pipeline. Namely, the wavecal material representing many of the secondary grating "tilts" is in relatively poor shape. With solid lamp calibrations in all 37 supported high-res (E140H and E230H) settings, STIS itself can be exploited to bootstrap (by means of an empirical wavelength distortion correction) a "laboratory calibration" to the many lines emitted by the STIS lamps, mainly chromium, that were missing from the GHRS flight-spare units originally measured at NIST in the 1990's, and more recent work with STIS-type lamps that unfortunately only covers the FUV band. The prototype distortion correction significantly improves the quality of the pipeline spectra, to the great benefit of the many types of GO programs that require accurate velocity measurements -- stellar, interstellar, and even intergalactic -- and thus have turned to STIS in the past. (And now again, during its "second life.") The proposed exposure depth enhancements for the 28 (of 44) tilts require seven orbits, with no impact on science time. The total exposure duration (10 hours) is only 1/4 that already expended on "deep" wavecals (texp>60 s), and essentially would complete the fundamental wavelength calibration of this enormously valuable spectroscopic machine. The program should have negligible impact on lamp life, which is measured in many hundreds of hours.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12281
Title: STIS Coronagraphic Imaging of the Kuiper Belt Surrounding the HR 8799 Planetary System.
PI: Mark Clampin
PI Institution: NASA Goddard Space Flight Center

The recent imaging detection of exoplanets in wide orbits around Fomalhaut and HR8799 represents the start of a new era in the study of exoplanets. Both planet detections are associated with the presence of a debris disk. Spitzer tells us that HR 8799's debris disk has a warm inner component inside the orbit of HR 8799d, a cooler outer component with a sharp inner edge just beyond the orbit of HR 8799b, and an extended halo of small particles. The disk around HR 8799 has not been imaged in scattered light and is a prime candidate for imaging with the STIS coronagraph. Obtaining a resolved, scattered light image is a key observation, since it would allow: 1) the position angle and inclination of the HR 8799 exoplanetary system to be determined, thus providing the astrometric information required to refine the planetary orbits and constrain their masses; 2) an independent upper limit on the mass of HR 8799b, via its interaction with the outer dust disk, providing a constraint on planetary structure models; 3) constraints on the dust's physical properties and origin; 4) determination of the architecture of HR 8799's exoplanetary system; and 5) limits to be set on the optical photometry for two of the planets.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12282
Title: The Final Word on the Progenitor of the Type II-Plateau Supernova SN 2006my

PI: Douglas Leonard
PI Institution: San Diego State University

Despite recent rapid progress, the field of supernova (SN) progenitor identification remains in its infancy, with only four supernovae having had unambiguous detection and characterization of their progenitor stars made. The existence of pre-SN WFPC2 images of the site of the nearby core-collapse (Type II-Plateau) SN 2006my has enabled three independent searches for its progenitor star to be carried out. In the first, Li et. al. (2007) find spatial coincidence between the SN and a possibly extended source with properties deemed consistent with those of a red supergiant. Subsequent analyses by Leonard et al. (2008) and Crockett et al. (2010) refute the Li et al. detection claim, but recognize that existing data do not permit a definitive resolution of the issue since even the revised SN localizations place SN 2006my on part of the putative progenitor's point-spread-function in the pre-SN frames (although no longer at its center). The time is ripe to settle the issue: A single-orbit reobservation of the SN site with HST/ACS will permit the definitive determination of whether this object is indeed associated with SN 2006my. If it is, and its flux is found to have diminished (it was an extended source) or vanished (it was an isolated star), then this will enable the second conclusive characterization of a Type II-Plateau supernova's progenitor star's properties to be made. If it is not, then upper mass limits on the progenitor star will be confidently declared the final word on the topic.
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Proposal Category: GO
Scientific Category: TAC
ID: 12283
Title: WFC3 Infrared Spectroscopic Parallel Survey (WISP): A Survey of Star Formation Across Cosmic Time
PI: Matthew Malkan
PI Institution: University of California - Los Angeles

We will use the unique power of WFC3 slitless spectroscopy to measure cosmic star formation across its peak epoch. The broad, continuous, spectral coverage of the G102 and G141 grisms provides the best currently feasible measurement of the star formation rate continously from 0.5<z<2.5, over which ground-based searches are severely limited. Our Cycle 17 pure-parallel grism program has proven efficient for identifying line emission from galaxies across this large fraction of cosmic time. With less than two months of WFC3 observing completed, our new measurments have more than doubled the sample of emission-line galaxies that we found over the entire NICMOS Parallel Grism program. We propose to extend this cost-effective WFC3 Survey by using 280 orbits of pure parallel grism spectroscopy in 50 deep (4-5 orbit) fields with both G102 and G141, and 40 shallow (2-3 orbit) fields with G141 alone. This will complete a sample of 2000-3000 emission line galaxies in the "redshift desert" and search for serendipitous Lya emitters at z>5.5. Our primary science goals are: (1) Measure ratios of bright emission lines ([OII], [OIII], Ha, and Hb) in a substantial fraction of these galaxies, thereby estimating dust and metallicity evolution in a sample of galaxies that is not biased by photometric selection. (2) Derive an extinction-corrected Ha luminosity function, with a 20 times larger sample than our previous NICMOS results. (3) Measure the mass-metallicity relation at crucial intermediate redshifts, with the support of our ongoing ground-based, follow-up, observing program (4) Determine the spectroscopic close pair fraction in this sample, in order to constrain hierarchal merging models (5) Uncover a new sample of obscured AGN at these redshifts and, (6) Use the Balmer break diagnostic to constrain the ages of continuum detected sources down to H = 25. As a bonus, these observations will be sensitive to Lya emission at z>5.5, taking advantage of

continuous spectral coverage to observe large volumes for luminous galaxies at the highest redshifts. Over Cycles 17 and 18, we expect to detect 5-20 LAEs over redshifts spanning 5.5 < z < 7.5. These observations will likely place the most stringent constraint on the numbers of z>6.5 Lya emitters until JWST. We are waiving all proprietary rights to our data and will make high-level data products available through the ST/ECF.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12284
Title: Light Echoes from a Periodic Protostellar Outburst
PI: James Muzerolle
PI Institution: Space Telescope Science Institute

We propose to obtain multi-epoch WFC3IR imaging of a remarkable variable protostar in the IC 348 star forming region. This object, LRLL 54361, exhibits unique outbursts in the infrared that repeat on a roughly 25 day timescale and produce luminosity variations of over an order of magnitude. Images taken with the Spitzer Space Telescope show a resolved scattered light outflow cavity whose morphology changes in concert with the central source, indicating a light echo effect. We need HST observations to characterize the outflow cavity geometry and constrain models of the infalling envelope structure, verify the presence of a binary outflow, and measure shocked emission in the outflow itself. In combination with other proposed and existing observations, these data will help unravel the mystery of this variable source and provide important new insight into the dynamic evolution of young suns.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12285
Title: Mapping the core and lobes of the extraordinary FRII microquasar in NGC 7793
PI: Roberto Soria
PI Institution: Mullard Space Science Laboratory

We have discovered an extraordinary microquasar in NGC 7793, with all the textbook physical structures of an FRII radio galaxy: an X-ray/optical core, X-ray and radio hot spots, radio lobes, and a large cocoon with radio, X-ray and optical line emission. It reveals a new class of accreting black holes dominated by mechanical power even at high accretion rates; it is the missing link between ordinary microquasars and ultraluminous X-ray sources. After studying the system with radio, X-ray and ground-based optical telescopes, we propose a WFC3/UVIS study. We will: a) resolve and constrain the nature of the black hole counterpart; b) map density structures in the nebula (knots, filaments), measure their UV and optical line flux, and model the shock excitation process; c) resolve the forward and reverse shock, and map the outer edge of the expanding shell; d) study the age and metallicity of the surrounding stellar population. Our goals are to determine the mass and total radiative and mechanical power of the black hole, model how the power is transferred to the ambient medium, and how the accretion/ejection properties scale between non-nuclear stellar-mass black holes and supermassive black holes in radio galaxies.
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Proposal Category: GO
Scientific Category: TAC
ID: 12286

Title: Hubble Infrared Pure Parallel Imaging Extragalactic Survey (HIPPIES)
PI: Hao-Jing Yan
PI Institution: The Ohio State University Research Foundation

WFC3 has demonstrated its unprecedented power in probing the early universe. Here we propose to continue our pure parallel program with this instrument to search for LBGs at z~6--8. Our program, dubbed as the Hubble Infrared Pure Parallel Imaging Extragalactic Survey ("HIPPIES"), will carry on the HST pure parallel legacy in the new decade. We request 205 orbits in Cycle-18, which will spread over ~ 50 high Galactic latitude visits (|b|>20deg) that last for 3 orbits and longer, resulting a total survey area of ~230 square arcmin. Combining the WFC3 pure parallel observations in Cycle-17, HIPPIES will complement other existing and forthcoming WFC3 surveys, and will make unique contributions to the study in the new redshift frontier because of the randomness of the survey fields. To make full use of the parallel opportunities, HIPPIES will also take ACS parallels to study LBGs at z~5--6. Being a pure parallel program, HIPPIES will only make very limited demand on the scarce HST resources, but will have potentially large scientific returns. As in previous cycle, we waive all proprietary data rights, and will make the enhanced data products public in a timely manner. (1) The WFC3 part of HIPPIES aims at the most luminous LBG population at z~8 and z~7. As its survey fields are random and completely uncorrelated, the number counts of the bright LBGs from HIPPIES will be least affected by the "cosmic variance", and hence we will be able to obtain the best constraint on the bright-end of the LBG luminosity function at z~8 and 7. Comparing the result from HIPPIES to the hydrodynamic simulations will test the input physics and provide insight into the nature of the early galaxies. (2) The z~7--8 candidates from HIPPIES, most of which will be the brightest ones that any surveys would be able to find, will have the best chance to be spectroscopically confirmed at the current 8--10m telescopes. (3) The ACS part of HIPPIES will produce a significant number of candidate LBGs at z~5 and z~6 per ACS field. Combining with the existing, suitable ACS fields in the HST archive, we will be able to utilize the random nature of the survey to quantify the cosmic variance and to measure the galaxy bias at z~5--6, and therefore the galaxy halo masses at these redshifts. (4) We will also find a large number of extremely red, old galaxies at intermediate redshifts, and the fine spatial resolution offered by the WFC3 will enable us constrain their formation history based on the study of their morphology, and hence shed light on their connection to the very early galaxies in the universe.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12287
Title: Constraining Models of Deuterium Depletion and Galactic Chemical Evolution with Improved Measurements of D/H
PI: Scott Friedman
PI Institution: Space Telescope Science Institute

Measuring the abundance of deuterium relative to hydrogen in the interstellar medium provides a method to assess the effects of astration and subsequent chemical enrichment of the ISM by supernovae, massive star winds, infalling gas, and mixing. It is now well established that the gas phase of D/H is approximately constant within the Local Bubble, where log(N(HI)) < 19.2. At higher column densities D/H is highly variable, which has been attributed to varying levels of depletion of deuterium onto dust grains and enhancement due to the infall of low-metallicity, deuterium-rich material onto the Galaxy. We request observations of the Lyman-alpha profiles of 17 targets with the focused goal of reducing the greatest contribution to the error in Galactic

D/H measurements: the poor determination of N(HI). We will reduce the error on log N(HI) by an average of nearly a factor of 4. For all targets excellent measurements of N(DI) have already been made from FUSE observations. These new data will leverage off the more than 3 million seconds FUSE devoted to its deuterium program and give far more secure estimates of the level of spatial variability of gas-phase D/H. For 5 targets we will also observe metal lines of O I, Mn II, Mg II, Ni II, and possibly P II. Utilizing a new depletion unification method we will extend previous studies of the expected correlation between observed D/H and levels of depletion of many refractory elements, and this analysis can be applied to the remaining targets if at least one metal column density is known. These results will permit us to substantially improve constraints on models of galactic chemical evolution, including the degree of astration of gas in the Milky Way, relative to primordial estimates of D/H.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12288
Title: Hot Evolved Companions to Intermediate-Mass Main-Sequence Stars: Solving the Mystery of KOI-81
PI: Douglas Gies
PI Institution: Georgia State University Research Foundation

The NASA Kepler Science Team recently announced the discovery of two transiting binaries that have "planets" hotter than their host stars. These systems probably represent the first known examples of white dwarfs formed through mass loss and transfer among intermediate mass, close binary stars. Here we propose to obtain COS FUV spectroscopy of one of these systems, KOI-81, in order to detect the hot companion in a part of the spectrum where it is relatively bright. The spectral flux and Doppler shift measurements will yield the temperatures, masses, radii, and compositions of both components. These observations will provide our first opportunity to explore this previously hidden stage of close binary evolution.
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Proposal Category: SNAP
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12289
Title: A COS Snapshot Survey for z < 1.25 Lyman Limit Systems
PI: J. Howk
PI Institution: University of Notre Dame

We propose a snapshot survey of z < 1.25 QSO sight lines to search for optically thick Lyman limit systems. These systems by their nature probe the interfaces between the diffuse IGM and the main bodies of galaxies; they are sensitive to matter accreting onto galaxies for the first time or being expelled in galactic feedback-driven winds. Our survey will probe a mostly-unexplored redshift regime for such systems, increasing the redshift survey path by a factor of 4 to 10 at z < 1. With our on-going SDSS, WFC3 and archival HST surveys for Lyman limit systems, our program will probe the number density and column density frequency distribution for LLSs over the redshift range 0.4 < z < 4.4. We will also provide a measure of the mean free path for ionizing photons in the universe over that same redshift regime. This is an important parameter for calculations of the extragalactic UV background, and our data will constrain the redshift at which the mean free path becomes larger than the horizon. Our proposed sample of 188 0.75 < z < 1.25 QSOs is drawn from a magnitude limited selection of spectroscopically confirmed SDSS QSOs. Using the COS G140L grating with short exposures will provide sufficient signal-to-noise observations to detect log N(H I) > 16.7 systems. These QSOs are bright enough to facilitate high-resolution follow-up

spectroscopy from the ground or with higher dispersion COS observations. Our proposal will also provide a larger spectroscopic sample for the study of damped Lyman-alpha systems, metal line absorbers (e.g., O VI, C IV), and studies of the higher column density Lyman-alpha forest.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12290
Title: Do Rocky Extrasolar Minor Planets Have a Composition Similar to Bulk Earth?
PI: Michael Jura
PI Institution: University of California - Los Angeles

We propose to observe six externally-polluted white dwarfs with dust disks to measure accurate abundances of volatile elements, especially carbon and sulfur. These data will enable us to determine whether the minor planets now being accreted onto the target white dwarfs more resemble primitive meteorites such as CI chondrites or more resemble bulk Earth.
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Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 12291
Title: STIS coronagraphy of Spitzer-selected debris disks
PI: John Krist
PI Institution: Jet Propulsion Laboratory

Debris disks trace the structure, dynamic, and formation of exoplanetary systems. In the cases of Fomalhaut and HR 8799 exoplanets have been imaged at the locations expected from the disk structures. Fifteen percent of main sequence stars possess dusty circumstellar debris disks revealed by far-infrared photometry. These disks are signposts of planetary systems: collisions among larger, unseen parent bodies maintain the observed dust population against losses to radiation pressure and Poynting-Robertson drag. Images of debris disks at optical, infrared, and millimeter wavelengths have shown central holes, rings, radial gaps, warps, and azimuthal asymmetries which indicate the presence of planetary mass perturbers. Only twenty have been spatially resolved at any wavelength, and at wavelengths <10 microns (where subarcsec resolution is available), only fifteen. Imaging of dozens of other debris disk targets has been attempted with various HST cameras/coronagraphs and adaptive optics, but without success. The key property which renders a debris disk observable in scattered light is its dust optical depth. The sixteen disks imaged so far all have an infrared luminosity >~ 0.01% that of the central star; no disks with smaller optical depths have been detected. Most nearby, main-sequence stars known to meet this requirement have already been observed, so future progress in debris disk imaging depends on discovering additional stars with large infrared excess. The Spitzer Space Telescope provided the best opportunity in 20 years to identify new examples of high optical depth debris disk systems. We have conducted detailed imaging simulations of debris disks newly identified by Spitzer since 2007, including size, surface brightness, and contrast estimates. From these we have identified ten targets whose disks should be detectable with the STIS coronagraph in roll-subtracted images. In terms of their detectability and resolvability to HST, these are the best remaining targets to emerge from the now-complete Spitzer photometric surveys of nearby main sequence stars. Our goals are to obtain the first resolved images of these disks at ~3 AU resolution, define the disk sizes and orientations,and uncover disk substructures indicative of planetary perturbations.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12292
Title: SWELLS: doubling the number of disk-dominated edge-on spiral lens galaxies
PI: Tommaso Treu
PI Institution: University of California - Santa Barbara

The formation of realistic disk galaxies within the LCDM cosmology is still largely an unsolved problem. Theory is now beginning to make predictions for how dark matter halos respond to galaxy formation, and for the properties of disk galaxies. Measuring the density profiles of dark matter halos on galaxy scales is therefore a strong test for the standard paradigm of galaxy formation, offering great potential for discovery. However, the degeneracy between the stellar and dark matter contributions to galaxy rotation curves remains a major obstacle. Strong gravitational lensing, when combined with spatially resolved kinematics and stellar population models, can solve this long-standing problem. Unfortunately, this joint methodology could not be exploited until recently due to the paucity of known edge-on spiral lenses. We have developed and demonstrated an efficient technique to find exactly these systems. During supplemental cycle-16 we discovered five new spiral lens galaxies, suitable for rotation curve measurements. We propose multi-color HST imaging of 16 candidates and 2 partially-imaged confirmed systems, to measure a sample of eight new edge-on spiral lenses. This program will at least double the number of known disk-dominated systems. This is crucial for constraining the relative contribution of the disk, bulge and dark halo to the total density profile.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12293
Title: High-Precision Proper Motions in the M87 Jet
PI: John Biretta
PI Institution: Space Telescope Science Institute

As the nearest galaxy with an optical jet, M87 affords an unparalleled opportunity to study extragalactic jet phenomena at the highest resolution. We have previously obtained HST images of the jet with unprecedented resolution which show detailed shock structures as well as numerous unresolved condensations over the first few arcseconds of the jet. Our previous HST monitoring observations have found superluminal motion at speeds up to 6c in many of these features, and showed the formation of new emission regions and rapid variability. The recently repaired STIS/NUV instrument now presents a unique opportunity to measure proper motions in the M87 jet with a single highly stable, high resolution instrument across a 13 yr timebase. We will use these new data, together with STIS/NUV data from 1999-2003 to map the velocity field of the jet to much higher accuracy than previously possible. This will allow us to measure the bulk deceleration of the jet, transverse motions, accelerations / decelerations of individual features, and numerous fainter jet features. We will use this to test models for the structure and kinematics of relativistic jet flows, synchrotron emission regions, and AGN in general.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12294
Title: Boron in F stars in the Hyades - Insights into the Li-Be

Dip
PI: Ann Boesgaard
PI Institution: University of Hawaii

Dramatic deficiencies of Li in the mid-F stars of the Hyades cluster were discovered by Boesgaard and Tripicco in 1986. Using high-resolution, high signal-to-noise spectra from the Keck 10-m telescope, Boesgaard and King discovered the corresponding deficiencies in Be in the same narrow temperature region in the Hyades. We propose an investigation into the B abundance in the Hyades F stars to ascertain if there is also a B dip. Boron can only be observed with HST; we plan to use the resonance line of B I at 2497 A. Each of these three elements is destroyed inside stars, but at different depths. The threshold temperatures are 2.5 x 10^6, 3.5 x 10^6, and 5 x 10^6 K for Li, Be, B respectively. Consequently these elements survive to increasingly greater depths in a star and their surface abundances act as a report on the depth and thoroughness of mixing in the star. Although the mixing is slow, it is not straight convective mixing. These observations will help determine the nature of the mixing mechanism(s) and the connection to stellar rotation. The abundance of *all three* light elements in a cluster of known age and metallicity can provide the information needed to discern internal stellar processes. The Li and Be deficiencies occur in field and cluster stars in this mass range (1.1 - 1.25 solar masses), but the mechanisms can best be studied in a cluster of stars of common origin and known characteristics. The Hyades cluster at 7 x 10^8 yr is close enough to contain stars bright enough for this investigation.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12295
Title: Searching for the Progenitor of the Type Ib Supernova 2010O
PI: Howard Bond
PI Institution: Space Telescope Science Institute

Several progenitor stars of Type II supernovae (SNe) have been identified in archival pre-explosion HST images. All of them are consistent with being red supergiants, as had been expected but never actually confirmed until the advent of HST imaging. The hydrogen-deficient Type Ib and Ic SNe are in a less satisfactory state. They are believed to be core-collapse SNe arising from massive stars that have lost their H envelopes. Unfortunately, though, there has never been an identified progenitor of an SN Ib or Ic, so it remains uncertain whether they are massive Wolf-Rayet stars, or less-massive stars in interacting binaries. The appearance of the Type Ib SN 2010O, in the starburst interacting galaxy NGC 3690 (Arp 299), offers a tantalizing new opportunity. NGC 3690 has been the subject of extensive HST observations, ranging from the UV and optical to the near-IR. We obtained ground-based images of SN 2010O, and find that there is a blue cluster in the archival HST images close to the nominal SN position. If the SN did indeed arise in this cluster, its spectral energy distribution, obtained from the HST archival data, constrains the turnoff mass to about 14 Msun. SN 2010O has also become even more interesting because of its close proximity to a variable X-ray source discovered by our team in pre-explosion Chandra images. Both of these findings would support the interacting-binary origin of this SN Ib. The astrometric precision possible from our ground-based images is insufficient to verify the location of SN 2010O conclusively. We therefore propose a set of short WFC3 exposures, while the SN is still luminous, in order to confirm the association of the SN with the young cluster and with the X-ray source.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 12296
Title: HST Observations of Astrophysically Important Visual Binaries
PI: Howard Bond
PI Institution: Space Telescope Science Institute

We propose to continue three long-term programs. All three consist of astrometry of close visual binaries, with the primary goal of determining dynamical masses for 3 important main-sequence stars and 6 white dwarfs (WDs). A secondary aim is to set limits on third bodies in the systems down to planetary mass. Since all 3 programs needed to be proposed for Cycle 18 continuation, we are simplifying the review process by combining them into a single proposal. Three of our 5 targets are naked-eye stars with much fainter companions that are very difficult to image from the ground. Our other 2 targets are double WDs, whose small separations and faintness likewise make them difficult to measure using ground-based techniques. The bright stars, to be imaged with WFC3, are: (1) Procyon (P = 40.9 yr), for which our first HST images yielded an accurate angular separation of the bright F star and its much fainter WD companion. Combined with ground-based astrometry of the bright star, our observation significantly revised downward the derived masses, and brought Procyon A into much better agreement with theoretical evolutionary masses. With the continued monitoring proposed here, we will obtain masses to an accuracy of better than 1%, providing a testbed for theories of both Sun-like stars and WDs. (2) Sirius (P = 50.1 yr), an A-type star also having a faint WD companion, Sirius B, the nearest and brightest of all WDs. (3) Mu Cas (P = 21.0 yr), a nearby metal-deficient G dwarf for which accurate masses will lead to the stars' helium contents, with cosmological implications. The faint double WDs, to be observed with FGS, are: (1) G 107-70 (P = 18.8 yr), and (2) WD 1818+126 (P = 12.7 yr). Our astrometry of these systems will add 4 accurate masses to the handful of WD masses that are directly known from dynamical measurements. The FGS measurements will also provide precise parallaxes for the systems, a necessary ingredient in the mass determinations.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12297
Title: The Light Echoes around V838 Monocerotis
PI: Howard Bond
PI Institution: Space Telescope Science Institute

V838 Monocerotis, which burst upon the astronomical scene in early 2002, is a completely unanticipated new object. It underwent a large-amplitude and very luminous outburst, during which its spectrum remained that of an extremely cool supergiant. A rapidly evolving set of light echoes around V838 Mon was discovered soon after the outburst, and quickly became the most spectacular display of the phenomenon yet seen. These light echoes provide the means to accomplish three unique types of measurements based on continued HST imaging during the event: (1) Study effects of MHD turbulence at high resolution and in 3 dimensions; (2) Construct the first unambiguous and fully 3-D map of a circumstellar dust envelope in the Milky Way; (3) Study dust physics in a unique setting where the spectrum and light curve of the illumination, and the scattering angle, are unambiguously known. We have also used our HST data to determine the distance to V838 Mon through a novel direct geometric technique. Because of the extreme rarity of light echoes, this is almost certainly the only opportunity to achieve such results during the lifetime of HST. We propose one visit during Cycle 18, using ACS, in order to continue the mapping of the circumstellar dust and to accomplish the other goals listed above.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12298
Title: Towards a Physical Understanding of the Diversity of Type Ia Supernovae
PI: Richard Ellis
PI Institution: California Institute of Technology

Type Ia supernovae (SNe Ia) represent the most mature and productive probe of the dark energy invoked to explain the cosmic acceleration. Considerable resources are being invested with HST and ground-based facilities to detect and measure the properties of distant SNe Ia for this purpose. However, there is not yet a convincing physical model for these events and important correlations have been found between the intrinsic properties of SNe Ia and their host galaxy environment. These suggest diverse ways in which the explosions may occur and highlight the importance of the progenitor metallicity and its relationship to the resulting light curve. We propose a new Target of Opportunity campaign to track and model the time evolution of the UV via spectroscopy of 5 carefully-selected local SNe Ia from soon after the explosion through maximum light. Early phase UV spectroscopy will provide a key diagnostic of the progenitor composition and time-sequence modeling will probe the density structure and its relevance to a variety of explosive models. Recent progress in detailed SNe Ia modeling and in locating early SNe Ia with the highly-successful Palomar Transient Factory now make it practical to embark on such a detailed campaign. The results will significantly improve our ability to understand the validity and limitations of the use of SNe Ia as future cosmological probes.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 12299
Title: Spectroscopic Signatures of Binary and Recoiling Black Holes
PI: Michael Eracleous
PI Institution: The Pennsylvania State University

We propose to obtain UV the spectra of the Ly-alpha and Mg II lines of 13 SDSS quasars whose H-beta lines are offset by 1000-4000 km/s from their systemic redshifts. Such lines have been suggested to originate in recoiling or close binary black holes. However these interpretations are not unique and UV spectroscopy, possible only with the HST, can discriminate between competing possibilities. Identifying such systems is extremely important in the context of scenarios for galaxy formation and evolution and in view of recent predictions from numerical relativity. Close binary black holes represent an apparently inevitable stage in the merger of two massive galaxies. The subsequent merger of the members of the binary is expected to produce a recoiling black hole in some fraction of cases. Thus, the census of such systems, their environments, and hosts can constrain some of the more uncertain parameters in evolutionary models. But before we can find them in any numbers, we need to evaluate the candidates known so far. This is the goal of our proposal.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12300
Title: A Deep Kinematic Investigation of Cas A's Opposing High-

Velocity Ejecta Jets
PI: Robert Fesen
PI Institution: Dartmouth College

The young Galactic remnant Cas A provides perhaps our clearest look at the explosion of a high mass, core-collapse supernova. Two seemingly opposing streams or "jets" of high-velocity debris extending outward along its northeastern and southwestern limbs have expansion velocities more than twice that of the remnant's bright main shell. Interpretation of these jets has been controversial mainly based on energy considerations. However, SN debris located at the farthest tip of the NE jet is S-rich suggesting an origin deep inside the progenitor due to an overturning of layers as predicted in some aspherical explosion models. If similar ejecta were also found present in the SW jet's outermost knots, it would be strong evidence in support of an asymmetric explosion of Cas A and in turn for CCSNe in general. Unfortunately, substantial extinction toward both jets has prevented a thorough investigation of their properties and, in particular, whether they constitute a true bipolar outflow. We propose to use the WFC3/IR channel in 5 CVZ orbits to obtain a deep imaging survey of Cas A's jets to probe their true extent and structure. The combination of WFC3's high throughput at the [S II] 10287-10370 and [S III] 9069, 9531 emission lines, a pixel scale well matched to typical jet knot sizes, and decreased extinction at 1 micron will dramatically improve jet knot detections over prior ACS/WFC images. Follow-up observations in Cycle 19 will allow robust knot identification via proper motions, and KPNO 4m near-IR spectroscopy will provide knot radial velocities. Our goal is to develop a thorough 3D kinematic and chemical map of Cas A's jets which will constrain their nature and relationship to the remnant's main spherical shell of ejecta.
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Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12301
Title: Precision Age-Dating of Star Clusters in Stephan's Quintet
PI: Sarah Gallagher
PI Institution: University of Western Ontario

The compact galaxy group Stephan's Quintet, showcased in the Early Release Observations of the newly refurbished Hubble, has experienced a complex series of gravitational interactions culminating in a ~50 kpc-long strong shock from the intruder NGC 7318B ploughing into NGC 7318A and the intragroup medium. Each major event within the past 500 Myrs has triggered star formation as demonstrated by the populations of massive star clusters present. Within this single system, we have the opportunity to study star-formation in novel settings not otherwise accessible in the nearby universe. We propose to make the most of this chance by supplementing the multi-color WFC3 images of Stephan's Quintet with 8 additional orbits of WFC3 imaging to obtain critical F336W (necessary for breaking the age-reddening degeneracy) and F547M (replacing F606W observations that are badly polluted by strong emission lines) observations. The combination of broad and narrow-band photometry will enable unprecedented precision in obtaining ages and masses for the <500 Myr-old star clusters within this system. With this information in hand, these clusters can be used as tracers of the gross galaxy interactions over time, and probes of the physics of star formation within the large-scale shock in particular.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12302

Title: Probing the Atmospheres of Cepheids with HST-COS: Pulsation Dependences, Plasma Dynamics and Heating Mechanisms
PI: Edward Guinan
PI Institution: Villanova University

Classical Cepheids, although well studied in terms of their cosmologically crucial Period-Luminosity Law, are proving themselves to be increasingly complex and astrophysically intriguing objects. The major aim of this proposal is to probe their stellar atmospheres and try to understand the mechanisms by which they are heated. Archival IUE UV spectra revealed the presence and variability of 10^4 - 10^5 K plasma emission lines, correlated to the pulsation period of the studied Cepheids, indicating that a pulsation-driven heating mechanism may be at work. However, the spectra were of low resolution and also contaminated by scattered light, precluding a more thorough analysis. We propose multiple observations of two selected Cepheids (beta Dor and delta Cep - the prototype of all Classical Cepheids) with HST-COS through the G130M and G160M gratings. The COS spectra will provide comprehensive and detailed diagnostics of the atmospheric plasmas around these Cepheids, and will give us 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 also allow possible phase-lags between the emission lines to be detailed, giving important additional information into the heating mechanism. Numerous emission lines are covered by the G130M and G160M wavelength range (~1150-1750A), including N V 1240, O I 1305, C IV 1550 and He II 1640. When combined with our approved and ongoing X-ray observations of Cepheids, the HST-COS data will allow us to construct an understanding of Cepheid atmospheric plasmas with temperature from tens of thousands up to millions of degrees - the most thorough atmospheric study to date for this important class of pulsating stars.

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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12303
Title: HST/COS FUV Spectroscopy of the Nearby Solar Twin 18 Scorpii: Exploring the Last Missing Spectral Region to Probe its Chromosphere and Transition Region and to Compare Them to the Sun's
PI: Edward Guinan
PI Institution: Villanova University

We propose to carry out FUV spectrophotometry with COS/HST for an in-depth study of the chromosphere & transition region (TR) of the solar twin 18 Sco. This 5th mag G2 V star is an important star as a nearly perfect match to the Sun and is known as the "Closest-ever Solar Twin" (Porto de Mello & da Silva 1997). 18 Sco has nearly identical physical properties (e.g. SpType, Mass, Teff, L, R, log g, [Fe/H], Ca II HK, Lx, rotation, etc.) to the Sun. Recent studies of Ca II HK emission from Lowell Observatory (J. Hall, priv. comm.) indicate Ca II emissions are close to the Sun's and undergo a solar-like ~7-11 yr magnetic activity cycle. The proposed observations (using two consecutive HST orbits) are a crucial part of our ongoing "Sun in Time" program of solar-type stars across the electromagnetic spectra. We are proposing to utilize the enhanced FUV sensitivity of HST/COS (with the G 130M/G 160M elements) to obtain high S/N medium resolution, FUV (1150-1750Å) spectrophotometry of the only remaining unexplored spectral region of this important star. The FUV region contains many crucial chromospheric and TR emission diagnostics including C III 1175A, Si III 1206A, Ly-a 1215A, N V 1240A, OI 1305A, C II 1335A, Si IV 1400A, C IV 1550A, He II 1640A, C I 1660A as well as many other weaker emissions. These line emissions originate from plasmas from 8,000 K to

300,000 K, and are vital for understanding the star's magnetically heated chromosphere and TR. We plan to analyze this spectrum to determine the physical properties of 18 Sco's corona, TR and chromosphere and, importantly, to compare these line strengths and ratios to the corresponding FUV line emissions of the Sun (e.g. SUSIM, SOLSTICE) at a similar magnetic activity phase. This study provides an important check on the magnetic behavior of our present Sun and solar like stars. For example, is our Sun "normal" for its age and mass? If confirmed as a precise match to our Sun (and the data obtained thus far look like it is), 18 Sco would be important for follow-up studies in asteroseismology, extrasolar planet searches, and could serve as a surrogate for the "Night-Time Sun." In addition, as noted by Turnbull (2004), 18 Sco is one of the most promising nearby candidates for hosting life based on analysis of the HabCat list of stars. In spite of extensive observations at many other wavelengths, the best yet solar twin - 18 Sco - has not been observed in the FUV region where the most powerful diagnostic emission lines are located. With the planned COS spectroscopy, we will at long last complete the spectral coverage of this important solar twin.
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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12304
Title: Metallicity distribution functions of 4 Local Group dwarf galaxies
PI: Jon Holtzman
PI Institution: New Mexico State University

We will measure metallicity distribution functions (MDFs) in four Local Group dwarf galaxies (Leo I, Leo II, Phoenix, and IC 1613) using a new medium band filter available with WFC3 that covers the Ca H and K lines -- the strongest metal absorption lines in the visible spectrum of cooler stars. In addition to the Ca filter (F390M), we will obtain broadband observations in several optical and near-IR filters. Together, these will yield metallicity measurements with an accuracy of about 0.2 dex for giants brighter than the red clump. Unlike broadband colors, our multiband metallicity measurements will be insensitive to age variations in the population and reddening uncertainties or variations. The photometric metallicities will allow us to construct MDFs with almost an order of magnitude more stars than has been obtained from the ground for Leo I and Leo II, and hence will provide more stringent constraints on the number of rarer, more metal-poor stars; these will provide the first measurements of the metallicity distribution function in Phoenix and IC1613. The four galaxies span a wide range of different star formation histories. The MDFs will constrain models of chemical evolution and improve the derivation of the star formation histories.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12305
Title: Monitoring the Aftermath of an Asteroid Impact Event
PI: David Jewitt
PI Institution: University of California - Los Angeles

Comet P/2010 A2 is of high scientific importance as the first likely case of a collisional disruption caught in the act. Its investigation will throw new light on the physics of impact disruption, with eventual applications to planetary science, the study of debris disks, and impact mitigation.
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Proposal Category: GO

Scientific Category: HOT STARS
ID: 12306
Title: The proper motion of SGR 0501+4516
PI: Andrew Levan
PI Institution: The University of Warwick

We propose to obtain two epochs of WFC3/IR imaging of the counterpart of the soft gamma-repeater, SGR 0501+4516 to measure its proper motion and hence identify its birth place and constrain its age in a model independent manner. Our ground based observations have already located the optical/IR counterpart, and provided proper motion limits of <70 mas/yr. The source has now faded significantly since its first discovery and is becoming too faint for detailed ground based study. Using the excellent point spread function, wide field of view, astrometric stability, and sensitivity of WFC3, we can now make use of HST to directly measure the proper motion of an SGR for the first time. The location of SGR 0501+4516 in the Galactic anti-centre direction, with a likely low distance (~1.5 kpc), coupled with moderate foreground extinction, and no issues of crowding makes it the only SGR source for which such observations are plausible with current technology. Our proposed observations (one in Cycle 18 and one in Cycle 19) with a baseline of ~2 years should constrain the proper motion to better than 3-4 milliarcseconds per year (3 sigma), corresponding to spatial velocities of less than 25 km/s, smaller than the velocities observed for many radio pulsars. Hence we can place the first direct constraints on the kick velocities given to magnetars at their birth, as well as testing models for their age and evolution, and informing estimates of their rate of creation.
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Proposal Category: SNAP
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 12307
Title: A public SNAPSHOT survey of gamma-ray burst host galaxies
PI: Andrew Levan
PI Institution: The University of Warwick

We propose to conduct a public infrared survey of the host galaxies of Swift selected gamma-ray bursts (GRBs) at z<3. By obtaining deep, diffraction limited imaging in the IR we will complete detections for the host galaxies, and in concert with our extensive ground based afterglow and host programmes will compile a detailed catalog of the properties of high-z galaxies selected by GRBs. In particular these observations will enable us to study the colours, luminosities and morphologies of the galaxies. This in turn informs studies of the nature of the progenitors and the role of GRBs as probes of star formation across cosmic history. Ultimately it provides a product of legacy value which will greatly complement further studies with next generation facilities such as ALMA and JWST.
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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 12308
Title: Cosmic Metallicity from ZnII-Selected QSO Absorption Line Systems Near Redshift z=1.2
PI: Eric Monier
PI Institution: State University of New York College at Brockport

We have searched nearly 15,000 strong intervening MgII systems in SDSS quasar spectra to measure spectral regions where weak, unsaturated metal lines are predicted to exist, with the aim of finding a representative sample of the strongest metal-line column density systems in the universe. These systems

are clearly damped Lyman-alpha (DLA) systems, which track cosmologically intervening neutral gas regions that fall along the sightlines to background quasars. We propose STIS G230L spectroscopy of seven strong-ZnII-selected systems from this sample in order to measure their Lyman-alpha absorption profiles and derive their HI column densities. Since Zn is not depleted onto grains, measurement of N(HI) allows a direct measurement of the metal abundance in such systems. We expect the results to be representative of the upper envelope of the distribution of neutral-gas-phase metallicities near redshift z=1.2. If these systems are high-N(HI) DLAs (e.g., 6E21 atoms/cm^2) they will have metallicities typical of those normally found in DLAs (e.g., one-tenth solar). However, if they are low-N(HI) DLAs (e.g., 2E20 atoms/cm^2), they will have supersolar metallicities. Since these DLAs are selected on the basis of their extreme metal-line properties, analysis of their metallicities and dust-to-gas ratios will lead to strong constraints on the range of properties exhibited by DLA systems.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 12309
Title: Calibration of the WFC3 Emission-Line Filters and Application of the Results to the Greatest Source of Uncertainties in Determining Abundances in Gaseous Nebulae
PI: C. O'Dell
PI Institution: Vanderbilt University

The WFC3 is arguably the most powerful camera that has been used on the HST. This capability arises in part from the uniquely complete set of narrow-band filters that were incorporated for making images of nebulae in emission-lines. Turning these oft-times beautiful images into scientifically useful information requires accurate flux calibration of the filters, which is the first subject of this proposal. The present plan is that WFC3 calibration will be done from pre-launch properties of the filters and observations of stars. The WFC3 filters transmission profiles were measured pre-launch in a different optical configuration and temperature than applies within the WFC3, thus rendering uncertain any flux calibrations tied to those pre-launch measurements. We propose to perform a “ground-truth” calibration of the WFC3 narrow-band filters using NGC 6720 as a reference source, in much the same manner that the PI did when calibrating similar filters in the WFPC2 and the ACS. These new calibrations will then be used to address the t^2 problem in Gaseous Nebulae. This is the source of uncertainties in the relative abundances of factors 1.1 to 10 and undermines efforts to trace the abundance variations within our Galaxy and other galaxies. The t^2 problem remains unresolved after four decades and the NGC 6720 images used for the filter calibration may resolve the problem if they show that regions of small-scale temperature fluctuations arise from low-temperature shadow-zones behind knots that are known to exist within the nebula or from high-temperature shocks that have been posited. Unlike the case of the Orion Nebula, where we have addressed this problem with fewer diagnostic filters, the geometry of NGC 6720 is ideally favorable for seeing these temperature variations and identifying their cause.
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Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 12310
Title: LARS - The Lyman Alpha Reference Sample
PI: Goran Ostlin
PI Institution: Stockholm University

Lyman-alpha (Lya) is intrinsically the strongest recombination line in HII nebulae, reprocessing around 1/3 of the ionizing energy. This fact, combined with a rest wavelength that makes it convenient for high redshift studies have made Lya the dominant spectral probe of galaxy formation and evolution in the distant universe. At the same time, our understanding of emission and escape from galaxies is extremely patchy, for two reasons: 1) The resonant nature of Lya makes radiative transfer effects very important, and 2) with a rest wavelength pretty far out in the ultra violet (UV), detailed studies of local galaxies are difficult and require space instrumentation. In contrast to the thousands of galaxies in the nearby universe that have been studied at high spatial resolution (through ground based telescopes and yet a little further with HST) in optical broad bands and emission lines like H-alpha, only six (sic

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Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 12311
Title: Multiple Stellar Populations in Galactic Globular Clusters
PI: Giampaolo Piotto
PI Institution: Universita di Padova

This is a proposal to bring the unique new properties of WFC3 to bear on the most exciting recent development in stellar populations: multiple generations of stars in globular clusters. From our vantage point in the midst of these developments, we feel that the present-day situation merits a concentration on increasing the depth of knowledge in clusters that are already known to have multiple populations, rather than merely increasing the list of clusters with perplexing peculiarities. We are therefore proposing to look for a clear splitting of the main sequence (and other sequences) of 47 Tuc, M4, M22, NGC 1851, and NGC 6752, and quantify them. The main-sequence study will cast particular light on the question of helium enrichment. Coupling the requested F275W data with F814W images available from the archive will allow us to follow the multiple sequences in the color magnitude diagram from the main sequence to the horizontal branch and asymptotic giant branch, and therefore constrain the effects of enhanced He and CNO on their evolution.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 12312
Title: Hubble Investigation of 103P/Hartley 2 in Support of NASA's DIXI Mission
PI: Harold Weaver
PI Institution: The Johns Hopkins University Applied Physics Laboratory

Comet 103P/Hartley 2 is a small but highly active comet that will pass unusually close to the Earth (0.12 AU) during the fall of 2010, when it will also be visited by NASA's DIXI spacecraft. We propose a 15-orbit spectroscopic observing campaign with Hubble, comprised of three 5-orbit visits spanning a 2-month period, to measure the abundances of several key volatiles (CO, CO2, S2) and their possible seasonal variations. CO has not yet been detected in 103P, and Hubble may be the only facility capable of doing it. Hubble is also uniquely capable of providing confirmation of DIXI's measurements of the CO2 abundance. The DIXI flyby is an exceptional opportunity to study the nature of comets, and Hubble will contribute important and unique data to the international campaign supporting this mission.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 12313
Title: An in-depth study of dark matter in the massive cluster
                     merger MACSJ0358.8-2955
PI: Harald Ebeling
PI Institution: University of Hawaii

We propose multi-passband observations with HST/ACS (F435W, F606W, and F814W) and moderately deep X-ray observations with Chandra/ACIS-I of the massive cluster merger MACSJ0358.8-2955 at z=0.434. The combination of existing HST/ACS and Chandra/ACIS-I snapshots shows strong evidence for a segregation of luminous and dark matter in a linear cluster merger, making this system a prime candidate for a quantitative study of the properties of dark matter. We have already identified and spectroscopically confirmed two sets of strongly lensed multiple-image systems. The resulting tentative model of the mass distribution shows a highly elongated critical line and further supports a linear, post-collision geometry that may enable a third, independent measurement of the self-interaction cross section of dark matter from cluster mergers. The colour and morphological information provided by the proposed HST/ACS observations will allow us to unambiguously identify additional multiple-image systems to refine our mass model, and to obtain further independent constraints on the mass profile from a weak-lensing analysis. The proposed Chandra/ACIS-I will provide complementary information on the intra-cluster gas, most importantly an accurate mapping of its distribution, but also spatially resolved gas temperatures. In combination with groundbased spectroscopy (underway), these observations will permit us to reconstruct the three-dimensional geometry and dynamics of this merger and to perform an independent test of the results on the existence and properties of dark matter obtained for the Bullet Cluster and MACSJ0025.4-1222.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 12314
Title: Mapping Brown Dwarfs: The Evolution of Cloud Properties
                     Through the L–T Transition
PI: Daniel Apai
PI Institution: Space Telescope Science Institute

Ultracool L and T dwarf bridge the gap between cool stars and giant planets and therefore provide an important laboratory for both probing stellar atmospheres and devising future observations of cool, large-separation giant exoplanets. A key challenge of ultracool atmospheres is the understanding of the transition from dusty L-type atmospheres to clearer T-type atmospheres, dominated by methane and water absorption bands. It is clear that understanding cloud formation and evolution is crucial to understanding the L/T transition, and hence giant exoplanet atmospheres. Numerous diverse models have been proposed to explain the atmospheric evolution, from multi-condensate clouds to growing holes and sudden collapse of the cloud layers with decresing temperature. As yet, those models remain weakly constrained by observations. We propose to use the unparalleled sensitivity and stability of WFC3 on HST to tackle this question. We will obtain time series of G141 grism spectra of six L/T dwarfs, including two resolved binaries and two unresvolved L/T dwarfs. We will measure the level of rotational variability as a function of wavelength to derive the one-dimensional spectral maps of their cloud covers. Those maps will address the following questions: How heterogenous is the cloud cloud cover as a function of spectral type? and, What are the spectral properties and diversity of clouds across the photosphere of the targets? The proposed

observations will provide a unique, statistically constraining data set on cloud distribution, properties, and evolution as a function of spectral type. These new constraints will allow direct comparison to the models and will drive the development of new models with realistic treatment of the cloud layers. With typical rotation periods of 3 hours, we can cover two rotation periods within 6 HST orbits. We propose to obtain simultaneous IRAC [4.5] observations of the two unresolved T dwarfs. The Spitzer data will enhance our ability to identify absorbers in individual clouds within their complex atmospheres and will probe non-equilibrium CO chemistry and vertical mixing. Combined, these observations will provide the first spatially and spectrally resolved maps of ultracool dwarf photospheres across the L/T transition.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 12315
Title: Winds, accretion and activity: Deciphering the FUV lines in TW Hya
PI: Hans Guenther
PI Institution: Smithsonian Institution Astrophysical Observatory

Classical T Tauri stars (CTTS) show strong, broad and asymmetric FUV emission lines. Neither the width, nor the line profile is understood. Likely, different mechanisms influence the line profile; the best candidates are accretion, winds and stellar activity. We propose to monitor the CIV 1548/1550 Ang doublet in the nearby, bright CTTS TW Hya and to correlate it with i) the cool wind, as seen in COS NUV MgII line profiles, ii) the photometric period from joint ground-based monitoring, iii) the accretion rate as determined from the UV continuum and iv) the Ha line profile from independent ground-based observations. We request 10 orbits distributed over a few weeks to cover the typical time scales of stellar rotation, accretion and winds. With this data we can identify the FUV emission region, test for the presence of a hot wind, identify its properties, and characterize the variability of the accretion region.
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