

Cycle 17 Abstract catalog (based on Phase I submissions)
Generated on: Fri May 30 08:50:52 EDT 2008

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11554
Title: Luminosity Profiles of Extremely Massive Clusters in NGC 7252
PI: Nate Bastian
PI Institution: University of Cambridge

The galactic merger remnant NGC 7252 represents one of the most extreme post-starburst environments in the local universe. During the disk-disk merger (~400 Myr ago) this galaxy produced the largest young massive star cluster population known, including two clusters above 10^7 Msun, a factor of 100 more massive than typical globular clusters in the Milky Way. We propose ACS-HRC observations of 3 fields in NGC 7252 in order to explore the detailed properties, i.e. luminosity profiles, of these massive star clusters. These observations will be able to test massive cluster formation mechanisms (e.g. the cluster merger scenario) as well as the possible tidal erosion and truncation of the outer regions of the clusters by the galactic tidal field. These observations will compliment our large on-going study using archival HST data, of star cluster profiles outside the Local Group. The cluster population in NGC 7252 will extend our sample in cluster mass by an order of magnitude.

=====
Proposal Category: GO
Scientific Category: COOL STARS
ID: 11555
Title: Transition Region and Chromospheric Activity on Low Metallicity Arcturus Moving Group "Alien" Dwarfs
PI: Alexander Brown
PI Institution: University of Colorado at Boulder

How does low metallicity affect the heating and resultant temperature structure of the chromospheres, transition regions, and coronae of old solar-like dwarf stars? The Arcturus Moving Group is very likely a remnant of the merger of a dwarf galaxy with the Milky Way Galaxy in the distant (~ 7- 8 Gyr) past. This kinematically distinct group has members that are located very close to the Sun, allowing study of stellar activity on very old, low metallicity stars that typically would not be possible. We propose to obtain COS G140L spectra of four dwarf star members of the Arcturus Moving Group to measure the fluxes of their transition region and upper chromospheric emission lines and to investigate the effects of low metallicity on the outer atmospheric radiative losses and temperature structure. Our targets have metallicities of ~ 20% solar or less, spectral types F9 - M4, and are at distances less than 25 pc from the Sun. COS is the only UV spectrograph that is capable of registering the FUV spectra of these stars in a reasonable number of HST orbits.

=====
Proposal Category: GO

Scientific Category: SOLAR SYSTEM
ID: 11556
Title: Investigations of the Pluto System
PI: Marc Buie
PI Institution: Southwest Research Institute

We propose a set of high SNR observations of the Pluto system that will provide improved lightcurves, orbits, and photometric properties of Nix and Hydra. The key photometric result for Nix and Hydra will be a vastly improved lightcurve shape and rotation period to test if the objects are in synchronous rotation or not. A second goal of this program will be to retrieve a new epoch of albedo map for the surface of Pluto. These observations will also improve masses and in some case densities for the bodies in the Pluto system.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11557
Title: The Nature of low-ionization BAL QSOs
PI: Gabriela Canalizo
PI Institution: University of California - Riverside

The rare subclass of optically-selected QSOs known as low-ionization broad absorption line (LoBAL) QSOs show signs of high-velocity gas outflows and reddened continua indicative of dust obscuration. Recent studies show that galaxies hosting LoBAL QSOs tend to be ultraluminous infrared systems that are undergoing mergers, and that have dominant young (< 100 Myr) stellar populations. Such studies support the idea that LoBAL QSOs represent a short-lived phase early in the life of QSOs, when powerful AGN-driven winds are blowing away the dust and gas surrounding the QSO. If so, understanding LoBALs would be critical in the study of phenomena regulating black hole and galaxy evolution, such as AGN feedback and the early stages of nuclear accretion. These results, however, come from very small samples that may have serious selection biases. We are therefore taking a more aggressive approach by conducting a systematic multiwavelength study of a volume limited sample of LoBAL QSOs at $0.5 < z < 0.6$ drawn from SDSS. We propose to image their host galaxies in two bands using WFC3/UVIS and WFC3/IR to study the morphologies for signs of recent tidal interactions and to map their interaction and star forming histories. We will thus determine whether LoBAL QSOs are truly exclusively found in young merging systems that are likely to be in the early stages of nuclear accretion.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11558
Title: Planetary Nebulae, Globular Clusters and Binary Mergers
PI: Orsola De Marco
PI Institution: American Museum of Natural History

Four planetary nebulae (PNe) have been found within 130 of the 150 globular clusters (GCs) of our Galaxy. This might not seem like many, but stellar evolution predicts that the old populations of these clusters should contain

no PN at all

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11559
Title: Jovian Upheaval and its Impact on Vortices
PI: Imke de Pater
PI Institution: University of California - Berkeley

We propose observations of Jupiter with global coverage at high resolution to quantify changes in its atmosphere during and following the global upheaval. Only HST has the capability to obtain images with enough spatial resolution and contrast to extract velocity fields (we will use our newly developed technique to accomplish this), and with WFC3 we can image Jupiter in its entirety in a single exposure. We are in particular interested in the Red Oval BA: Will the Oval be long-lived, remain red, or turn white again, disappear? Both the merger of its precursors, and change in color has never before been witnessed. The Great Red Spot: This storm system appears to decrease in size and has become rounder, both as derived from its associated cloud deck, but also from its potential vorticity, a more powerful dynamical quantity. How will the GRS evolve? Will it swallow the new vortices detected in amateur images at this same latitude band? How will this effect the potential vorticity? In addition, we hope to understand Disturbances and stagnation points, both of which were detected during the present global upheaval: are these cyclonic regions, can they spawn anticyclones (as suggested by amateur images)?

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11560
Title: Cl0016+1609: the first (and the last) massive cluster of galaxies at $z>0.5$
PI: Harald Ebeling
PI Institution: University of Hawaii

We propose two-filter (F555W, F814W) ACS observations of the core of Cl0016+1609, arguably the most famous massive cluster at $z>0.5$. The most-studied such system at all wavelengths from X-ray to radio, Cl0016+1609 has no useful multi-passband ACS images to date. Complementing the only existing ACS data (a 2x2 mosaic in the F606W passband and a snapshot of the core in the F775W passband), the observations proposed here will provide resolved color information on both lensed background objects and cluster galaxies, thereby allowing us to measure accurately the cluster's dark-matter distribution on scales from tens to more than 500/h₅₀ kpc using both strong- and weak-gravitational lensing, and to study the color morphology of mergers and the star-formation history of galaxies in a high-density environment. Supported by an extensive groundbased imaging and spectroscopic campaign, as well as by deep Chandra X-ray observations, this observation completes our HST/ACS survey of the 12 most distant galaxy clusters detected in the MACS X-ray survey.

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11561
Title: An intensive COS spectroscopic study of the planetary debris disks around two warm white dwarfs
PI: Boris Gaensicke
PI Institution: The University of Warwick

It is very likely that the gas giants in our Solar system will survive the evolution of the Sun into a white dwarf, and the same is thought to be generally true for Jovian planets around solar-like stars if their initial orbits are wider than $\sim 3\text{AU}$. Despite this prediction, no unambiguous detection of a planet around a white dwarf has been announced so far. However, over the past few years, about a dozen white dwarfs have been identified which host metal-rich debris disks that are thought to stem from the tidal disruption of asteroids. In most cases the debris disks are observed in the form of an infrared flux excess, and offer relatively little diagnostic potential for the study of their structure. We have discovered three warm ($T \sim 20000\text{K}$) white dwarfs with metal-rich debris disks in a gaseous phase which display strong double-peaked CaII emission lines in the I-band and weak Fe 5169A emission. The line profiles can be modelled in terms of Keplerian disks with an extension of $\sim 1R_{\text{sun}}$ around the white dwarfs. Photospheric MgII 4481A absorption demonstrates that the white dwarfs are accreting from the debris disks. Besides these spectral features, the optical wavelength range is devoid of other useful metal transitions. Here, we propose an intensive spectroscopic ultraviolet study of these systems, which will provide (a) ~ 1000 photospheric absorption lines of 15 chemical elements, allowing an accurate abundance study of the material accreted from the debris disks, and (b) ~ 2 dozen additional emission lines of Mg, Cr, Ti, and Fe that will provide detailed insight into the dynamical, thermal, and density structure of these exo-planetary debris disks.

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11562
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. 2008, in preparation). 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 T00 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 C16, 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 17.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11563
Title: Galaxies at $z \sim 7-10$ in the Reionization Epoch: Luminosity Functions to $< 0.2L^*$ from Deep IR Imaging of the HUDF and HUDF05 Fields
PI: Garth Illingworth
PI Institution: University of California - Santa Cruz

The first generations of galaxies were assembled around redshifts $z \sim 7-10+$, just 500-800 Myr after recombination, in the heart of the reionization of the universe. We know very little about galaxies in this period. Despite great effort with HST and other telescopes, less than ~ 15 galaxies have been reliably detected so far at $z > 7$, contrasting with the ~ 1000 galaxies detected to date at $z \sim 6$, just 200-400 Myr later, near the end of the reionization epoch. WFC3 IR can dramatically change this situation, enabling derivation of the galaxy luminosity function and its shape at $z \sim 7-8$ to well below L^* , measurement of the UV luminosity density at $z \sim 7-8$ and $z \sim 8-9$, and estimates of the contribution of galaxies to reionization at these epochs, as well as characterization of their properties (sizes, structure, colors). A quantitative leap in our understanding of early galaxies, and the timescales of their buildup, requires a total sample of ~ 100 galaxies at $z \sim 7-8$ to ~ 29 AB mag. We can achieve this with 192 WFC3 IR orbits on three disjoint fields (minimizing cosmic variance): the HUDF and the two nearby deep fields of the HUDF05. Our program uses three WFC3 IR filters, and leverages over 600 orbits of existing ACS data, to identify, with low contamination, a large sample of over 100 objects at $z \sim 7-8$, a very useful sample of ~ 23 at $z \sim 8-9$, and limits at $z \sim 10$. By careful placement of the WFC3 IR and parallel ACS pointings, we also enhance the optical ACS imaging on the HUDF and a HUDF05 field. We stress (1) the need to go deep, which is paramount to define L^* , the shape, and the slope alpha of the luminosity function (LF) at these high redshifts; and (2) the far superior performance of our strategy, compared with the use of strong lensing clusters, in detecting significant samples of faint $z \sim 7-8$ galaxies to derive their luminosity function and UV ionizing flux. Our recent $z \sim 7.4$ NICMOS results show that wide-area IR surveys, even of GOODS-like depth, simply do not reach faint enough at $z \sim 7-9$ to meet the LF and UV flux objectives. In the spirit of the HDF and the HUDF, we will waive any proprietary period, and will also deliver the reduced data to STScI. The proposed data will provide a Legacy resource of great value for a wide range of archival science investigations of galaxies at redshifts $z \sim 2-9$. The data are likely to remain the deepest IR/optical images until JWST is launched, and will provide sources

for spectroscopic followup by JWST, ALMA and EVLA.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11564
Title: Optical and Ultraviolet Photometry of Isolated Neutron Stars
PI: David Kaplan
PI Institution: Massachusetts Institute of Technology

We propose ultraviolet and B-band observations of 5 nearby, thermally emitting neutron stars. These data will measure the Rayleigh-Jeans tails of their spectra, providing a vital complement to X-ray spectroscopy and helping to constrain atmospheric models, working toward the ultimate goal of unraveling the physics of neutron stars. With these data we will have good-quality optical and UV data for the full sample of these objects, allowing detailed comparisons between them. Finally, the data should allow us to measure proper motions for one or two objects, and will serve as the reference data for the remaining objects; such proper motions allow ages to be determined for these objects by tracing them back to likely birth locations.

=====
Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 11565
Title: A search for astrometric companions to very low-mass, Population II stars
PI: Sebastien Lepine
PI Institution: American Museum of Natural History

We propose to carry out a SNAPshot search for astrometric companions in a subsample of very low-mass, halo subdwarfs identified within 120 parsecs of the Sun. These ultra-cool M subdwarfs are local representatives of the lowest-mass H-burning objects from the Galactic Population II. The expected 3-4 astrometric doubles that will be discovered will be invaluable in that they will be the first systems from which gravitational masses of metal-poor stars at the bottom of the main sequence can be directly measured.

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11566
Title: Imaging Saturn's Equinoctal Auroras
PI: Jonathan Nichols
PI Institution: Boston University

Auroral emissions provide an indispensable diagnostic tool for the energetic processes occurring in planetary magnetospheres. In 2009 Saturn will reach equinox for the first time since the advent of high-sensitivity planetary ultraviolet (UV) auroral imaging, offering a unique, transient opportunity to observe both polar auroral regions simultaneously. The observations proposed here will not only provide the best images to date of Saturn's northern

auroras, they will address three fundamental issues: (1) Are Saturn's auroras similar in the north and south? This will reveal the nature of the processes that cause the northern auroras, and verify the multipole nature of Saturn's internal magnetic field. (2) Is the location of the northern auroral emission symmetric with to the south? This will indicate why the southern auroral oval is displaced a few degrees toward midnight from the spin pole. It will also reveal whether the oscillation observed in the location of the southern auroral oval is similarly observed in the north, illuminating the nature of near-planetary period oscillations observed throughout the magnetosphere and potentially providing a value for the elusive rotation period of the deep interior. (3) What is the influence of equinox on the magnetosphere? The unique orientation of the planetary spin axis at equinox will reveal whether the auroras are influenced by the direction of the interplanetary magnetic field, and whether the Sun's effect on Saturn's magnetosphere changes throughout the planet's seasons. The Hubble Space Telescope is the only instrument capable of providing global instantaneous coverage of Saturn's UV auroras, and since Saturn's orbital period is ~30 years, Cycle 17 is the only opportunity to make these observations.

=====

Proposal Category: SNAP
Scientific Category: HOT STARS
ID: 11567
Title: Boron Abundances in Rapidly Rotating Early-B Stars.
PI: Charles Proffitt
PI Institution: Computer Sciences Corporation

Models of rotation in early-B stars predict that rotationally driven mixing should deplete surface boron abundances during the main-sequence lifetime of many stars. However, recent work has shown that many boron depleted stars are intrinsically slow rotators for which models predict no depletion should have occurred, while observations of nitrogen in some more rapidly rotating stars show less mixing than the models predict. Boron can provide unique information on the earliest stages of mixing in B stars, but previous surveys have been biased towards narrow-lined stars because of the difficulty in measuring boron abundances in rapidly rotating stars. The two targets observed as part of our Cycle 13 SNAP program 10175, just before STIS failed, demonstrate that it is possible to make useful boron abundance measurements for early-B stars with $V_{\sin(i)}$ above 100 km/s. We propose to extend that survey to a large enough sample of stars to allow statistically significant tests of models of rotational mixing in early-B stars.

=====

Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11568
Title: A SNAPSHOT Survey of the Local Interstellar Medium: New NUV Observations of Stars with Archived FUV Observations
PI: Seth Redfield
PI Institution: University of Texas at Austin

We propose to obtain high-resolution STIS E230H SNAP observations of MgII and FeII interstellar absorption lines toward stars within 100 parsecs that

already have moderate or high-resolution far-UV (FUV), 900-1700 Å, observations available in the MAST Archive. Fundamental properties, such as temperature, turbulence, ionization, abundances, and depletions of gas in the local interstellar medium (LISM) can be measured by coupling such observations. Due to the wide spectral range of STIS, observations to study nearby stars also contain important data about the LISM embedded within their spectra. However, unlocking this information from the intrinsically broad and often saturated FUV absorption lines of low-mass ions, (DI, CII, NI, OI), requires first understanding the kinematic structure of the gas along the line of sight. This can be achieved with high resolution spectra of high-mass ions, (FeII, MgII), which have narrow absorption lines, and can resolve each individual velocity component (interstellar cloud). By obtaining short (~10 minute) E230H observations of FeII and MgII, for stars that already have moderate or high-resolution FUV spectra, we can increase the sample of LISM measurements, and thereby expand our knowledge of the physical properties of the gas in our galactic neighborhood. STIS is the only instrument capable of obtaining the required high resolution data now or in the foreseeable future.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11569
Title: Probing the Atomic and Molecular Inventory of a Beta-Pic Analog, the Young, Edge-On Debris Disk of HD32297
PI: Seth Redfield
PI Institution: University of Texas at Austin

Edge-on, optically thin, debris disks provide unique opportunities to probe physical properties of the disk itself. Using the host star as the background source, trace atomic and molecular disk species can be detected in absorption. Redfield (2007) found that the recently discovered edge-on system, HD32297, has the strongest NaI absorption feature of any known debris disk, 5 times the level observed toward beta Pic, the canonical edge-on debris disk. Roberge et al. (2006) compiled the only comprehensive chemical inventory of a debris disk, using beta Pic, and found that carbon was surprisingly overabundant, which has important implications for the physical structure and support of a stable gas disk. What is severely lacking are comparison observations to determine if such an abundance pattern is typical of debris disk systems. HD32297 represents the best opportunity to make such a comparative study and perform a comprehensive gas inventory of a debris disk, due to its high NaI column density. The UV is critical for this work due to the large number of strong transitions (almost 50 ions and molecules are accessible) that are located in, and often only in, the UV. These observations will provide a much needed comparison dataset for addressing the gas chemistry of debris disk systems that are at the critical stage, near the end of planet formation, and in the process of clearing their interplanetary environments.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11570
Title: Narrowing in on the Hubble Constant and Dark Energy
PI: Adam Riess

PI Institution: The Johns Hopkins University

A measurement of the Hubble constant to a precision of a few percent would be a powerful aid to the investigation of the nature of dark energy and a potent "end-to-end" test of the present cosmological model. In Cycle 15 we constructed a new, streamlined distance ladder utilizing high-quality type Ia supernova data and observations of Cepheids with HST in the near-IR to minimize the dominant sources of systematic uncertainty in past measurements of the Hubble constant and reduce its total uncertainty to a little under 5%. Here we propose to exploit this new route to reduce the remaining uncertainty by more than 30%, translating into an equal reduction in the uncertainty of the equation of state of dark energy. We propose three sets of observations to reach this goal: a mosaic of NGC 4258 with WFC3 in F160W to triple its sample of long period Cepheids, WFC3/F160W observations of the 6 ideal SN Ia hosts to triple their samples of Cepheids, and observations of NGC 5584 the host of a new SN Ia, SN 2007af, to discover and measure its Cepheids and begin expanding the small set of SN Ia luminosity calibrations. These observations would provide the bulk of a coordinated program aimed at making the measurement of the Hubble constant one of the leading constraints on dark energy.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11571
Title: A Fundamental Test of Accretion Physics with NGC 4203
PI: Joseph Shields
PI Institution: Ohio University

The rapid evolution of quasars indicates that supermassive black holes in galaxy nuclei spend most of their time in a relatively quiescent state. Studies of nearby galaxies demonstrate that many such black holes are accreting at a low rate, and appear as low-luminosity active galactic nuclei (LLAGNs). Theoretical arguments suggest that the mode of accretion onto a central black hole may be very different in LLAGNs as compared to high-luminosity systems. The LINER NGC 4203 provides an excellent opportunity to investigate quantitatively the accretion process in a LLAGN, and hence the typical accretion state for a supermassive black hole. Cycle 7 STIS data acquired at one position angle reveal double-peaked H-alpha emission in the nucleus that may trace an accretion disk, and spatially resolved emission that places an upper limit on black-hole mass. We propose observations with STIS to map the two-dimensional velocity field of the circumnuclear gas disk in the central regions of NGC 4203, in order to measure the black-hole mass. This parameter is essential for testing theoretical models of accretion, determining the mass accretion rate, and estimating the radiative efficiency for accreted matter. The results will be important for making sense of LLAGNs, and for translating their measured luminosity into accretion rates that trace the growth of black holes. This is a resubmission of a proposal that was approved for 5 orbits in Cycle 13 (GO-10191) but never carried out due to the failure of STIS.

=====

Proposal Category: GO

Scientific Category: EXTRA-SOLAR PLANETS
ID: 11572
Title: Charaterizing Atmospheric Sodium in the Transiting hot-
Jupiter HD189733b
PI: David Sing
PI Institution: CNRS, Institut d'Astrophysique de Paris

We propose STIS transit observations of the exoplanet HD189733b with the goal of measuring atmospheric atomic sodium. Our strategy is to repeat the observing methods used for HD209458b, which resulted in a successful exoplanetary atmospheric sodium detection. Initial ground-based measurements suggest that the sodium signature on HD189733 could be up to three times larger than HD209458b, making a robust 8? detection possible within a 12 orbit program observing three transits. Transit transmission spectra resulting from space-based measurements have the advantage of retaining absolute transit depths when features are measured, which will make it possible to provide an observational link between sodium and atmospheric haze detected with ACS. Such a link can break modeling degeneracies and providing stringent constraints on the overall atmospheric properties, making such atmospheric information as abundances and the temperature-pressure-altitude relation known. A successful measurement will also allow for comparative atmospheric exoplanetology, as an atmospheric feature will be measured with the same instrument in two separate planets.

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11573
Title: Investigating Post-Equinox Atmospheric Changes on Uranus
PI: Lawrence Sromovsky
PI Institution: University of Wisconsin - Madison

Uranus is now past its 7 December 2007 equinox. The large seasonal phase shift expected from its long radiative time constant implies that it should now be in the process of reversing its hemispheric asymmetries in cloud band structure and zonal circulation. Many changes already observed -- the development of the first visible-wavelength dark spot, discovered in Cycle 15, the fading of the south polar cap, and the development of a new northern bright band while the southern band fades -- may all be indicative of the expected reversal. We propose a detailed characterization of Uranus' current seasonal response with a 9-orbit program consisting of 3 orbits of WFC3 imaging of cloud bands and dark spots, and 6 orbits of NICMOS imaging using both broadband and narrowband filters capable of tracking bright discrete cloud features. Filters between 0.467 and 1.87 microns will provide vertical sensing depths scanning through the pressure range where the putative methane and deeper H₂S clouds might plausibly exist and provide strong constraints on their contributions and parent gas mixing ratios. These observations have unique combinations of spectral range and resolution with needed temporal sampling and spatial resolution not available from groundbased observations.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS

ID: 11574
Title: Physical Characteristics of the Massive Outflow in 3C 48
PI: Alan Stockton
PI Institution: University of Hawaii

Superwinds associated with the triggering of quasars are of current interest because such feedback effects may be connected with the initial formation of the black-hole-mass/bulge mass correlation. In the $z = 0.369$ compact-steep-spectrum quasar 3C48, ground-based IFU observations show the presence of a high-velocity, wide-solid-angle outflow of gas, apparently connected with the recent formation of the radio jet. The total mass of gas in this outflow is at least 10^9 solar masses, but it could be well over 10^{10} solar masses (i.e., similar to or greater than the total interstellar mass of the Milky Way) if most of the gas has densities like those seen in other quasar extended emission regions. To determine the physical state and energetics of the gas in the outflow, we request (1) high-spatial-resolution spectroscopy over a wide spectral range, including the near UV, and (2) medium-resolution spectroscopy of the strong [O III] 5007 line, which, when combined with unpublished archival data, will allow complete coverage of the velocity field of the high-velocity gas in the inner region.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11575
Title: The Stellar Origins of Supernovae
PI: Schuyler Van Dyk
PI Institution: Jet Propulsion Laboratory

Supernovae (SNe) have a profound effect on galaxies, and have been used recently as precise cosmological probes, resulting in the discovery of the accelerating Universe. They are clearly very important events deserving of intense study. Yet, even with nearly 4000 known SNe, we know relatively little about the stars which give rise to these powerful explosions. The main limitation has been the lack of spatial resolution in pre-SN imaging data. However, since 1999 our team has been at the vanguard of directly identifying SN progenitor stars in HST images. From this exciting new line of study, the emerging trend from 5 detections for Type II-Plateau SNe is that their progenitors appear to be relatively low mass (8 to 20 Msun) red supergiants, although more cases are needed. Nonetheless, the nature of the progenitors of Type Ib/c SNe, a subset of which are associated with the amazing gamma-ray bursts, remains ambiguous. Furthermore, we remain in the continually embarrassing situation that we still do not yet know which progenitor systems explode as Type Ia SNe, which are currently being used for precision cosmology. In Cycle 16 we have triggered on the Type Ic SN 2007gr so far. We propose to determine the identities of the progenitors of 4 SNe within 17 Mpc, which we expect to occur during Cycle 17, through ToO observations using ACS/HRC.

=====
Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11576

Title: Physical parameters of the upper atmosphere of the
extrasolar planet HD209458b
PI: Alfred Vidal-Madjar
PI Institution: CNRS, Institut d'Astrophysique de Paris

One of the most studied extrasolar planet, HD209458b, has revealed both its lower and upper atmosphere thanks to HST and Spitzer observatories. Through transmission spectroscopy technique, several atmospheric species were detected: NaI, HI, OI and CII. Using STIS archived transit absorption spectrum from 3000 to 8000 Angstrom, we obtained detailed constraints on the vertical profile of temperature, pressure and abundances (Sing et al 2008a, 2008b, Lecavelier et al. 2008b). By observing in the NUV, from 2300 to 3100 Angstrom, we expect to obtain new constraints on the physical conditions and the chemical composition of the upper atmosphere: temperature/pressure profile up to very high in the atmosphere, abundance and condensation altitudes of new species, and new insight in the atmospheric escape and ionization state at the upper levels. The observation of four HD209458b transits with a single E230M setting will give access to many NUV atomic lines addressing these issues. The proposed observations will probe, for the first time, in details the atmosphere of a hot Jupiter, thus bench marking follow up studies.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11577
Title: Opening New Windows on the Antennae with WFC3
PI: Brad Whitmore
PI Institution: Space Telescope Science Institute

We propose to use WFC3 to provide key observations of young star clusters in "The Antennae" (NGC4038/39). Of prime importance is the WFC3's ability to push the limiting UV magnitude FIVE mag deeper than our previous WFPC2 observations. This corresponds to pushing the limiting cluster mass from $\sim 10^5$ to $\sim 10^3$ solar masses for cluster ages $\sim 10^8$ yrs. In addition, the much wider field of view of the WFC3 IR channel will allow us to map out both colliding disks rather than just the Overlap Region between them. This will be especially important for finding the youngest clusters that are still embedded in their placental cocoons. The extensive set of narrow-band filters will provide an effective means for determining the properties of shocks, which are believed to be a primary triggering mechanism for star formation. We will also use ACS in parallel with WFC3 to observe portions of both the northern and southern tails at no additional orbital cost. Finally, one additional primary WFC3 orbit will be used to supplement existing HST observations of the star-forming "dwarf" galaxy at the end of the southern tail. Hence, when completed we will have full UBV + H_{alpha} coverage (or more for the main galaxy) of four different environments in the Antennae. In conjunction with the extensive multi-wavelength database we have collected (both HST and ground-based) these observations will provide answers to fundamental questions such as: How do these clusters form and evolve? How is star formation triggered? How do star clusters affect the local and global ISM, and the evolution of the galaxy as a whole? The Antennae galaxies are the nearest example of a major disk--disk merger, and hence may represent our best chance for understanding how mergers form tremendous numbers of clusters and stars,

both in the local universe and during galaxy assembly at high redshift.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11578
Title: The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?
PI: Alessandra Aloisi
PI Institution: Space Telescope Science Institute - ESA

A long standing question in astrophysics is the existence of young galaxies, in which stars are now forming for the first time, in the nearby (i.e., present-day) universe. Such galaxies would be the local analogs of primordial galaxies observed at high redshift. The most promising candidates have long been the most metal-poor systems, including dwarf irregulars (dIrrs) and blue compact dwarfs (BCDs). However, in many dIrrs and BCDs studied with HST an old (> 1 Gyr) underlying stellar population, as traced by red giant branch (RGB) stars, has been unambiguously detected. Even in I Zw 18, which is the most-metal poor prototype of the class and long the most controversial case, our group has recently succeeded in detecting an RGB. Nonetheless, there remains the possibility that the star formation histories of BCDs/dIrrs vary from galaxy to galaxy, and that truly young galaxies do exist in the local universe. A new test of these issues has only recently become possible with the identification of DDO 68 as an extremely metal-poor galaxy with an oxygen abundance equal to that of I Zw 18 ($12+(O/H)=7.21$). This galaxy is about a factor of 2-3 closer than I Zw 18, which yields the opportunity to avoid the many ambiguities that have plagued studies of I Zw 18. Also, DDO 68 resides in a void, making it more likely that star formation has been suppressed for a very long time. We propose to observe DDO 68 with ACS/WFC in F606W and F814W, plus F658N (H α) to correct the broad F606W for gas contamination, for a total of 7 orbits. We will use WFC3 in parallel with the same filters to study radial population gradients. Deep color-magnitude diagrams (CMDs) reaching the depth of one magnitude below the predicted RGB tip will be constructed and interpreted based on synthetic CMD fitting. These data will determine unambiguously whether DDO 68 has an underlying old (RGB) stellar population or is forming stars for the first time. Finding just a single nearby ``young'' galaxy would have profound cosmological implications.

=====
Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11579
Title: The Difference Between Neutral- and Ionized-Gas Metal Abundances in Local Star-Forming Galaxies with COS
PI: Alessandra Aloisi
PI Institution: Space Telescope Science Institute - ESA

The metallicity of galaxies and its evolution with redshift is of paramount importance for understanding galaxy formation. Abundances in the interstellar medium (ISM) are typically determined using emission-line spectroscopy of HII regions. However, since HII regions are associated with recent SF they may not have abundances typical for the galaxy as a whole. This is true in particular

for star-forming galaxies (SFGs), in which the bulk of the metals may be contained in the neutral gas. It is therefore important to directly probe the metal abundances in the neutral gas. This can be done using absorption lines in the Far UV. We have developed techniques to do this in SFGs, where the absorption is measured for sightlines toward bright SF regions within the galaxy itself. We have successfully applied this technique to a sample of galaxies observed with FUSE. The results have been very promising, suggesting in I Zw 18 that abundances in the neutral gas may be up to 0.5 dex lower than in the ionized gas. However, the interpretation of the FUSE data is complicated by the very large FUSE aperture (30 arcsec), the modest S/N, and the limited selection of species available in the FUSE bandpass. The advent of COS on HST now allows a significant advance in all of these areas. We therefore propose absorption line spectroscopy with G130M in the same sample for which we already have crude constraints from FUSE. We will obtain ACS/SBC images to select the few optimal sightlines to target in each galaxy. The results will be interpreted through line-profile fitting to determine the metal abundances constrained by the available lines. The results will provide important new insights into the metallicities of galaxies, and into outstanding problems at high redshift such as the observed offset between the metallicities of Lyman Break Galaxies and Damped Lyman Alpha systems.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11580
Title: Watching Young Planetary Nebulae Grow: "The Movie"
PI: Bruce Balick
PI Institution: University of Washington

The development of magneto-hydro gas dynamical models is the key to the understanding of both the physics (processes) and astronomy (initial conditions) of astrophysical nebulae of all sorts. The models are reaching their highest degree of accuracy when applied to and compared against pre Planetary Nebulae (pPNe) thanks to the simplicity, relative lack of extinction, and the detail of the imaging and kinematic data that have become available for these objects. The primary barrier to progress is inadequate kinematic data of pPNe against which the predictions models can be tested. Unlike PNe, pPNe do not emit emission lines for detailed Doppler measurements. Therefore it is essential to find another way to monitor the morphological evolution. Only HST can uncover the dynamics of the growth patterns by subtracting multi-epoch images spanning a decade or more. We have selected four pPNe with highly collimated outflows in different evolutionary stages for which high-quality first-epoch images were obtained from 1996 to 2002. All of them display regularly shaped thin rims, sharp edges, and symmetric pairs of knots or bowshocks that are ideal for our purposes. We will closely mimic many of the earlier exposures using ACS and to monitor changes in structures. The morphology and its evolution will be compared to 3-D MHD models with adaptive grids in order to build a far clearer picture of the nuclear geometry which shaped the outflows and constrained their propagation to the present. We shall also obtain R, J, and H images for use with a 3-D dust radiative transfer code LELUYA to model the dust distribution deep into the nuclear zones.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11581
Title: Searching for Pulsations from a Helium White Dwarf
Companion to a Millisecond Pulsar
PI: Lars Bildsten
PI Institution: University of California - Santa Barbara

The low mass white dwarf (WD) companion to the 3.26 ms pulsar PSR J1911-5958A offers an unprecedented opportunity for seismological study of the interior of a helium core WD. While much more massive carbon/oxygen core WDs are observed to pulsate in normal modes of oscillation called g-modes (known as ZZ Ceti stars), no helium core pulsator is known. By extrapolating the boundaries of the ZZ Ceti instability strip downward in surface gravity by a factor of 20 below any known pulsator, we find that the effective temperature of this WD makes it an excellent candidate to search for pulsation. Detection of g-mode pulsations in the lightcurve would have a transformative effect on the field of WD pulsations, as this would allow the first seismological study of the interior of a helium core WD, and the low gravity strongly constrains theories for the driving and amplitudes of pulsations. We show that with 3 orbits of HST, we will detect photometric variations with amplitudes of 1%, lower than typically seen in other hydrogen-dominated ZZ Ceti stars. A set of measured mode periods would also constrain the thickness of the presumed stably hydrogen burning shell, and help us determine its age more securely.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11582
Title: The spatial distribution of radiation in the complex ISM
of distant ultraluminous galaxies
PI: Andrew Blain
PI Institution: California Institute of Technology

A significant fraction of energy emitted by galaxies at redshifts when their stars were forming most vigorously, and when their blackholes were growing most powerfully emerges at far-infrared (IR) wavelengths. The fraction of this energy generated by the most extreme and luminous objects is also much larger than the equivalent fraction at optical wavelengths. Many of the most luminous far-IR sources have been located precisely and unambiguously using deep radio, Spitzer and optical observations, and have spectroscopic identifications using the largest ground-based telescopes. Surprisingly, however, the spectra of most of these heavily dust-enshrouded galaxies show prominent Lyman-alpha emission. We propose to observe five of the brightest examples at $z \sim 2-3$ in re-activated ACS ramp filters, to resolve the spatial distribution of this line emission on fine kpc scales, in order to contrast and compare with the underlying ultraviolet (UV) continuum. Precise spectroscopic redshifts and the unique rest-UV resolution of HST are both essential to reveal the escape and generation of Lyman-alpha photons in the dusty ISM of these extreme galaxies. There is no other way to trace the detailed spatial distribution of the most excited gas in a galactic wind, along with emission from less-massive star-forming galaxies in associated groups. The targets have available HST-

resolution ground-based near-IR A0 imaging and arcsec-scale images in CO from ground-based mm-wave interferometers, which provide context for spatial structure of evolved stars and the ISM. The interplay between restframe UV emission and the ISM in these galaxies has important consequences for understanding the origin of the prodigious luminosity of these systems, and for future observations with JWST and ALMA.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11583
Title: The Star Formation Rate In Nearby Elliptical Galaxies
PI: Joel Bregman
PI Institution: University of Michigan

Small amounts of star formation in normal elliptical galaxies are suggested by several results: some surprisingly young ages from optical line-index dating; cooling X-ray gas; and mid-IR dust emission. Previously, it was difficult to detect low levels of star formation, but UV imaging with WFPC3 will permit us to conclusively identify individual O/B stars in nearby normal ellipticals by their UV colors and magnitudes. This technique is orders of magnitude more sensitive than previous methods, allowing detections of star formation to levels of $1E-4$ Msolar/yr. Proof of concept is provided by a very long UV ACS observation of M87 that revealed many O/B stars. We propose observations of four normal ellipticals where recent star formation is likely. This will yield their star formation rates and the locations of such activity.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11584
Title: Resolving the Smallest Galaxies with ACS
PI: Kristin Chiboucas
PI Institution: University of Hawaii

An order of magnitude more dwarf galaxies are expected to inhabit the Local Group, based on currently accepted galaxy formation models, than have been observed. This discrepancy has been noted in environments ranging from the field to rich clusters, with evidence emerging that lower density regions contain fewer dwarfs per giant than higher density regions, in further contrast to model predictions. However, there is no complete census of the faintest dwarf galaxies in any environment. The discovery of the smallest and faintest dwarfs is hampered by the limitations in detecting such compact or low surface brightness galaxies, and this is compounded by the great difficulty in determining accurate distances to, or ascertaining group membership for, such faint objects. The M81 group provides a powerful means for establishing membership for faint galaxies in a low density region. With a distance modulus of 27.8, the tip of the red giant branch (TRGB) appears at $I \sim 24$, just within the reach of ground based surveys. We have completed a 65 square degree survey in the region around M81 with the CFHT/MegaCam. Half of our survey was completed before Cycle 16 and we were awarded time with WFPC2 to observe 15 new candidate dwarf galaxy group members in F606W and F814W bands in order to construct color-magnitude diagrams from which to

measure accurate TRGB distances and determine star formation and metallicity histories. The data obtained show that 8 - 9 of these objects are galaxies at the same distance as M81. In completing our survey, we have discovered an additional 8 candidate galaxies we propose to image with ACS in order to measure TRGB distances and establish membership. We also wish to re-observe our smallest candidate group member and a tidal dwarf candidate with deeper observations made possible with ACS. Once membership has been established for this second set of candidates, we will have a complete census of the dwarf galaxy population in the M81 group to $M_r \sim -10$, allowing us to obtain a firm measurement of the luminosity function faint-end slope, and, combined with previous HST data, to provide a complete inventory of the age and abundance properties for the collapsed core of the M81 group.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11585
Title: Tracing the distribution of gas and galaxies using three closely-spaced background QSOs
PI: Neil Crighton
PI Institution: University of Durham

The distribution of the gaseous intergalactic medium (IGM) around galaxies is fundamentally important to our understanding of galaxy evolution. Simulations suggest that 'feedback' - the return of gas and radiation to the IGM via active galactic nuclei or star-formation-driven winds - is an important part of galaxy formation and a possible way to enrich the IGM with metals. We propose to use COS to observe the IGM towards the brightest known group of three QSOs ($z=0.96$, 0.96 and 0.73) separated by a few arcminutes on the sky. Using far-UV spectra of the Lyman-alpha forest region at resolutions > 20000 , we will detect both the cooler photo-ionized IGM at $\sim 10,000$ K using narrow HI absorbers, and the warm-hot intergalactic medium (WHIM) at $\sim 100,000$ K using OVI and broad HI absorbers over a redshift range of $0 < z < 0.48$ (HI) and $0.17 < z < 0.73$ (OVI). The immediate objective is to compare the distribution of the WHIM and cooler IGM to the distribution of galaxies in the same field over redshifts from 0 to 0.6 , and scales from ~ 100 kpc to ~ 1 Mpc. In particular we will look for signs of feedback, such as metal-enriched WHIM gas close to galaxies. The three sight-lines with separations of ~ 400 kpc to ~ 1 Mpc will allow us to constrain the size and geometry of gas overdensities in the IGM, which is not possible with only one or two QSO sight-lines. The QSO separations are ideally suited for this purpose, as they are comparable to the expected size of IGM gas clouds. Using state-of-the art hydrodynamical simulations, which include gas cooling inflows, outflows, feedback, and the introduction of gas and metals in the IGM, we will construct mock spectra and galaxy distributions to compare with the observations. Taken together, our new HST observations, ground-based galaxy redshift survey, and simulations will enable us to investigate the nature and extent of the connection between the IGM and galaxies.

=====

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11586

Title: Exceptional Galactic Halo Globular Clusters and the
Second Parameter
PI: Aaron Dotter
PI Institution: Dartmouth College

We propose to obtain deep ACS/WFC images of six globular clusters (five of which have no previous HST photometry) that reside in the Galactic halo where the second parameter effect is most pronounced. These globular clusters are among the least studied in the Galaxy and yet, from the perspective of the second parameter problem, the most intriguing. With the best available CMDs only reaching the vicinity of the main sequence turn off at present, the unique sensitivity and resolution of ACS will yield ages of unprecedented precision for these clusters. These data will provide us with new insight into the stellar populations present in the outer Galactic halo and the nature of the second parameter. The second parameter plays a critical role in our understanding of the formation and evolution of the Galaxy and the proposed observations will shed new light on this problem and these exceptional clusters.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11587
Title: Probing Population III Star Formation in a z=7 Galaxy
PI: Xiaohui Fan
PI Institution: University of Arizona

Population III (Pop III) stars, the first generation, metal-free stars in the Universe, have been a main focus of the studies of early galaxy formation and reionization. HeII 1640 emission originates from energetic ionizing photons beyond 54.4eV, and is an ideal tracer of massive Pop III star formation with strong far-UV radiation. HeII has not yet been detected directly in individual galaxies at $z < 6.3$, indicating a small contribution of Pop III star formation at those redshifts. We propose to use WFC3 narrow-band imaging to measure the flux of HeII emission in galaxy IOK-1 ($z=6.96$), the highest redshift spectroscopically confirmed galaxy to date. At this redshift, the HeII line is perfectly located in the WFC3 F130N filter passband. Our deep narrow-band imaging will detect a HeII flux down to 4×10^{-18} erg/s/cm² at the 5-sigma level, corresponding to a star formation rate from massive Pop III stars of $\sim 1 M_{\text{sun}}$ per year, a factor of ~ 5 improvement to the best ground-based results at lower redshift. Strong HeII emission, if detected, will provide the first direct evidence of significant Pop III formation in early galaxies at the end of the reionization epoch. We will also carry out short F125W broad-band observations to measure the rest-frame UV flux of this galaxy in order to constrain its total star formation rate and to provide continuum subtraction for narrow-band imaging.

=====
Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 11588
Title: Galaxy-Scale Strong Lenses from the CFHTLS survey
PI: Raphael Gavazzi

PI Institution: CNRS, Institut d'Astrophysique de Paris

We aim to investigate the origin and evolution of early-type galaxies using gravitational lensing, modeling the mass profiles of objects over a wide range of redshifts. The low redshift ($z = 0.2$) sample is already in place following the successful HST SLACS survey; we now propose to build up and analyse a sample of comparable size (~ 50 systems) at high redshift ($0.4 < z < 0.9$) using HST WFC3 SNAPSHOT observations of lens systems identified by the SL2S collaboration in the CFHT legacy survey.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11589
Title: Hypervelocity Stars as Unique Probes of the Galactic
Center and Outer Halo
PI: Oleg Gnedin
PI Institution: University of Michigan

We propose to obtain high-resolution images of 11 new hypervelocity stars in the Galactic halo in order to establish the first-epoch astrometric frame, as a part of a long-term program to measure precise proper motions in an absolute inertial frame. The origin of these recently discovered stars with extremely large positive radial velocities, in excess of the escape speed from the Galaxy, is consistent only with being ejected from the deep potential well of the massive black hole at the Galactic center. Reconstructing the full three-dimensional space motion of the hypervelocity stars, through astrometric proper motions, provides a unique opportunity to measure the shape and orientation of the triaxial dark matter halo. The hypervelocity stars allow determination of the Galactic potential out to 120 kpc, independently of and at larger distances than is afforded by tidal streams of satellite galaxies such as the Sagittarius dSph galaxy. Proper motions of the full set of hypervelocity stars will provide unique constraints on massive star formation in the environment of the Galactic center and on the history of stellar ejection by the supermassive black hole. We request one orbit with WFC3 for each of the 11 hypervelocity stars to establish their current positions relative to background galaxies. We request a repeated observation of these stars in Cycle 19, which will conclusively measure the astrometric proper motions.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11590
Title: Observing the IR Catastrophe in a Deflagration Type Ia
Supernova
PI: Saurabh Jha
PI Institution: Rutgers the State University of New Jersey

Our lack of understanding of Type Ia supernova (SN Ia) explosions limits our confidence in their use for cosmology. While there is broad agreement that these objects represent the explosions of white dwarfs, the details of the explosion mechanism are not well-understood. Recently, we have identified an

internally homogeneous subclass of SNe Ia whose photometric and spectroscopic peculiarities make them quite distinct from normal SNe Ia. Models suggest we may be seeing the result of an explosion with a subsonic burning front, called a deflagration. We propose to test SN Ia models by obtaining late-time photometry for SN 2008A, a recent, nearby example of this subclass, using ACS and WFC3 on HST. We will accurately measure the late-time photometric decline rate and spectral energy distribution (SED). These observations will allow us to test whether the ejecta contain the large amount of oxygen predicted by certain models. We also aim to detect major evolution of the SED expected due to the "IR catastrophe," a change in the dominant cooling mechanism in the ejecta, as generically predicted by models but only hinted at by current observations.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11591
Title: Are Low-Luminosity Galaxies Responsible for Cosmic Reionization?
PI: Jean-Paul Kneib
PI Institution: Laboratoire d'Astrophysique de Marseille

Our group has demonstrated that massive clusters, acting as powerful cosmic lenses, can constrain the abundance and properties of low-luminosity star-forming sources beyond $z \sim 6$; such sources are thought to be responsible for ending cosmic reionization. The large magnification possible in the critical regions of well-constrained clusters brings sources into view that lie at or beyond the limits of conventional exposures such as the UDF. We have shown that the combination of HST and Spitzer is particularly effective in delivering the physical properties of these distant sources, constraining their mass, age and past star formation history. Indirectly, we therefore gain a valuable glimpse to yet earlier epochs. Recognizing the result (and limitations) of blank field surveys, we propose a systematic search through 10 lensing clusters with ACS/F814W and WFC3/[F110W+F160W] (in conjunction with existing deep IRAC data). Our goal is to measure with great accuracy the luminosity function at $z \sim 7$ over a range of at least 3 magnitude, based on the identification of about 50 lensed galaxies at $6.5 < z < 8$. Our survey will mitigate cosmic variance and extend the search both to lower luminosities and, by virtue of the WFC3/IRAC combination, to higher redshift. Thanks to the lensing amplification spectroscopic follow-up will be possible and make our findings the most robust prior to the era of JWST and the ELTs.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11592
Title: Testing the Origin(s) of the Highly Ionized High-Velocity Clouds: A Survey of Galactic Halo Stars at $z > 3$ kpc
PI: Nicolas Lehner
PI Institution: University of Notre Dame

Cosmological simulation predicts that highly ionized gas plays an important role in the formation and evolution of galaxies and their interplay with the

intergalactic medium. The NASA HST and FUSE missions have revealed high-velocity CIV and OVI absorption along extragalactic sightlines through the Galactic halo. These highly ionized high-velocity clouds (HVCs) could cover 85% of the sky and have a detection rate higher than the HI HVCs. Two competing, equally exciting, theories may explain the origin of these highly ionized HVCs: 1) the "Galactic" theory, where the HVCs are the result of feedback processes and trace the disk-halo mass exchange, perhaps including the accretion of matter condensing from an extended corona; 2) the "Local Group" theory, where they are part of the local warm-hot intergalactic medium, representing some of the missing baryonic matter of the Universe. Only direct distance determinations can discriminate between these models. Our group has found that some of these highly ionized HVCs have a Galactic origin, based on STIS observations of one star at $z < 5.3$ kpc. We propose an HST FUV spectral survey to search for and characterize the high velocity NV, CIV, and SiIV interstellar absorption toward 24 stars at much larger distances than any previous searches ($4 < d < 21$ kpc, $3 < |z| < 13$ kpc). COS will provide atomic to highly ionized species (e.g., OI, CII, CIV, SiIV) that can be observed at sufficient resolution ($R \sim 22,000$) to not only detect these highly ionized HVCs but also to model their properties and understand their physics and origins. This survey is only possible because of the high sensitivity of COS in the FUV spectral range.

=====
Proposal Category: GO
Scientific Category: COOL STARS
ID: 11593
Title: Dynamical Masses of the Coolest Brown Dwarfs
PI: Michael Liu
PI Institution: University of Hawaii

T dwarfs are excellent laboratories to study the evolution and the atmospheric physics of both brown dwarfs and extrasolar planets. To date, only a single T dwarf binary has a dynamical mass determination, and more are sorely needed. The prospects of measuring more dynamical masses over the next decade are limited to 6 known short-period T dwarf binaries. We propose here to obtain Long-Term HST/ACS monitoring for the 3 of the 6 binaries which cannot be resolved with AO from the ground. Upon completion, our program will substantially increase the number of T dwarf dynamical mass measurements and thereby provide key benchmarks for testing theoretical models of ultracool objects.

=====
Proposal Category: SNAP
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11594
Title: A WFC3 Grism Survey for Lyman limit absorption at $z=2$
PI: John O'Meara
PI Institution: The Pennsylvania State University

We propose to conduct a spectroscopic survey of Lyman limit absorbers at redshifts $1.8 < z < 2.5$, using WFC3 and the G280 grism. This proposal intends to complete an approved Cycle 15 SNAP program (#10878) which was cut short due to the ACS failure. We have selected 64 quasars at $2.3 < z < 2.6$ from the

Sloan Digital Sky Survey Spectroscopic Quasar sample, for which no BAL signature is found at the QSO redshift and no strong metal absorption lines are present at $z > 2.3$ along the lines of sight. The survey has three main observational goals. First, we will determine the redshift frequency dn/dz of the LLS over the column density range $16.0 < \log(N_{\text{HI}}) < 20.3 \text{ cm}^{-2}$. Second, we will measure the column density frequency distribution $f(N)$ for the partial Lyman limit systems (PLLS) over the column density range $16.0 < \log(N_{\text{HI}}) < 17.5 \text{ cm}^{-2}$. Third, we will identify those sightlines which could provide a measurement of the primordial D/H ratio. By carrying out this survey, we can also help place meaningful constraints on two key quantities of cosmological relevance. First, we will estimate the amount of metals in the LLS using the $f(N)$, and ground based observations of metal line transitions. Second, by determining $f(N)$ of the PLLS, we can constrain the amplitude of the ionizing UV background at $z \sim 2$ to a greater precision. This survey is ideal for a snapshot observing program, because the on-object integration times are all well below 30 minutes, and follow-up observations from the ground require minimal telescope time due to the QSO sample being bright.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11595
Title: Turning out the Light: A WFC3 Program to Image $z > 2$
Damped Lyman Alpha Systems
PI: John O'Meara
PI Institution: The Pennsylvania State University

We propose to directly image the star-forming regions of $z > 2$ damped Ly α systems (DLAs) using the WFC3/UVIS camera on the Hubble Space Telescope. In contrast to all previous attempts to detect the galaxies giving rise to high redshift DLAs, we will use a novel technique that completely removes the glare of the background quasar. Specifically, we will target quasar sightlines with multiple DLAs and use the higher redshift DLA as a "blocking filter" (via Lyman limit absorption) to eliminate all FUV emission from the quasar. This will allow us to carry out a deep search for FUV emission from the lower redshift DLA, shortward of the Lyman limit of the higher redshift absorber. The unique filter set and high spatial resolution afforded by WFC3/UVIS will then enable us to directly image the lower redshift DLA and thus estimate its size, star-formation rate and impact parameter from the QSO sightline. We propose to observe a sample of 20 sightlines, selected primarily from the SDSS database, requiring a total of 40 HST orbits. The observations will allow us to determine the first FUV luminosity function of high redshift DLA galaxies and to correlate the DLA galaxy properties with the ISM characteristics inferred from standard absorption-line analysis to significantly improve our understanding of the general DLA population.

=====

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 11596
Title: Coronagraphic Imaging of Debris Disks Containing Gas
PI: Aki Roberge
PI Institution: NASA Goddard Space Flight Center

We recently found a new sample of edge-on debris disks using the Spitzer Space Telescope. These disks are particularly valuable because they have observable circumstellar gas as well as dust. They double the small number of debris disks that can be used to study gas-dust interactions in optically-thin disks, as well as the evolution of circumstellar gas during the terrestrial planet-forming phase. We propose HST-ACS coronagraphic imaging of the two closest disks from our sample, in order to image light scattered from the dust disks in a broad optical bandpass. These observations will provide a wealth of information about the disks, including their sizes, radial surface brightness profiles, and basic morphologies (ring-like or smooth disk). They may also reveal dust structures (e.g. clumps) that are often seen in optical images of debris disks and may be generated by the influence of unseen planets. This proposed program is a crucial step towards full characterization of the circumstellar material in two important debris disks.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11597
Title: Spectroscopy of IR-Selected Galaxy Clusters at $1 < z < 1.5$
PI: S. Stanford
PI Institution: University of California - Davis

We propose to obtain WFC3 G141 and G102 slitless spectroscopy of galaxy clusters at $1 < z < 1.5$ that were selected from the IRAC survey of the Bootes NDWFS field. Our IRAC survey contains the largest sample of spectroscopically confirmed clusters at $z > 1$. The WFC3 grism data will measure H-alpha to determine SFR, and fit models to the low resolution continua to determine stellar population histories for the brighter cluster members, and redshifts for the red galaxies too faint for ground-based optical spectroscopy.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11598
Title: How Galaxies Acquire their Gas: A Map of Multiphase Accretion and Feedback in Gaseous Galaxy Halos
PI: Jason Tumlinson
PI Institution: Yale University

We propose to address two of the biggest open questions in galaxy formation - how galaxies acquire their gas and how they return it to the IGM - with a concentrated COS survey of diffuse multiphase gas in the halos of SDSS galaxies at $z = 0.15 - 0.35$. Our chief science goal is to establish a basic set of observational facts about the physical state, metallicity, and kinematics of halo gas, including the sky covering fraction of hot and cold material, the metallicity of infall and outflow, and correlations with galaxy stellar mass, type, and color - all as a function of impact parameter from 10 - 150 kpc. Theory suggests that the bimodality of galaxy colors, the shape of the luminosity function, and the mass-metallicity relation are all influenced

at a fundamental level by accretion and feedback, yet these gas processes are poorly understood and cannot be predicted robustly from first principles. We lack even a basic observational assessment of the multiphase gaseous content of galaxy halos on 100 kpc scales, and we do not know how these processes vary with galaxy properties. This ignorance is presently one of the key impediments to understanding galaxy formation in general. We propose to use the high-resolution gratings G130M and G160M on the Cosmic Origins Spectrograph to obtain sensitive column density measurements of a comprehensive suite of multiphase ions in the spectra of 43 $z < 1$ QSOs lying behind 43 galaxies selected from the Sloan Digital Sky Survey. In aggregate, these sightlines will constitute a statistically sound map of the physical state and metallicity of gaseous halos, and subsets of the data with cuts on galaxy mass, color, and SFR will seek out predicted variations of gas properties with galaxy properties. Our interpretation of these data will be aided by state-of-the-art hydrodynamic simulations of accretion and feedback, in turn providing information to refine and test such models. We will also use Keck, MMT, and Magellan (as needed) to obtain optical spectra of the QSOs to measure cold gas with Mg II, and optical spectra of the galaxies to measure SFRs and to look for outflows. In addition to our other science goals, these observations will help place the Milky Way's population of multiphase, accreting High Velocity Clouds (HVCs) into a global context by identifying analogous structures around other galaxies. Our program is designed to make optimal use of the unique capabilities of COS to address our science goals and also generate a rich dataset of other absorption-line systems along a significant total pathlength through the IGM ($\Delta z \sim 20$).

=====

Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11599
Title: Distances of Planetary Nebulae from SNAPshots of Resolved Companions
PI: Richard Wade
PI Institution: The Pennsylvania State University

Reliable distances to individual planetary nebulae (PNe) in the Milky Way are needed to advance our understanding of their spatial distribution, birthrates, influence on Galactic chemistry, and the luminosities and evolutionary states of their central stars (CSPN). Few PNe have good distances, however. One of the best ways to remedy this problem is to find resolved physical companions to the CSPN and measure their distances by photometric main-sequence fitting. We have previously used HST to identify and measure probable companions to 10 CSPN, based on angular separations and statistical arguments only. We now propose to use HST to re-observe 48 PNe from that program for which additional companions are possibly present. We then can use the added criterion of common proper motion to confirm our original candidate companions and identify new ones in cases that could not confidently be studied before. We will image the region around each CSPN in the V and I bands, and in some cases in the B band. Field stars that appear close to the CSPN by chance will be revealed by their relative proper motion during the 13+ years since our original survey, leaving only genuine physical companions in our improved and enlarged sample. This study will increase the number of Galactic PNe with reliable distances by 50 percent and improve the distances to PNe with previously known companions.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11600
Title: Star formation, extinction and metallicity at $0.7 < z < 1.5$:
H-alpha fluxes and sizes from a grism survey of GOODS-N
PI: Benjamin Weiner
PI Institution: University of Arizona

The global star formation rate (SFR) is ~ 10 x higher at $z=1$ than today. This could be due to drastically elevated SFR in some fraction of galaxies, such as mergers with central bursts, or a higher SFR across the board. Either means that the conditions in $z=1$ star forming galaxies could be quite different from local objects. The next step beyond measuring the global SFR is to determine the dependence of SFR, obscuration, metallicity, and size of the star-forming region on galaxy mass and redshift. However, SFR indicators at $z=1$ typically apply local calibrations for UV, [O II] and far-IR, and do not agree with each other on a galaxy-by-galaxy basis. Extinction, metallicity, and dust properties cause uncontrolled offsets in SFR calibrations. The great missing link is Balmer H-alpha, the most sensitive probe of SFR. We propose a slitless WFC3/G141 IR grism survey of GOODS-N, at 2 orbits/pointing. It will detect $\text{H}\alpha + [\text{N II}]$ emission from $0.7 < z < 1.5$, to $L(\text{H}\alpha) = 1.7 \times 10^{41}$ erg/sec at $z=1$, measuring H-alpha fluxes and sizes for > 600 galaxies, and a small number of higher-redshift emitters. This will produce: an emission-line redshift survey unbiased by magnitude and color selection; star formation rates as a function of galaxy properties, e.g. stellar mass and morphology/mergers measured by ACS; comparisons of SFRs from H-alpha to UV and far-IR indicators; calibrations of line ratios of H-alpha to important nebular lines such as [O II] and H-beta, measuring variations in metallicity and extinction and their effect on SFR estimates; and the first measurement of scale lengths of the H-alpha emitting, star-forming region in a large sample of $z \sim 1$ sources.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11601
Title: UV spectroscopy of the hot bare stellar core H1504+65
PI: Klaus Werner
PI Institution: Universitat Tubingen, Institut fur Astronomie &
Astrophysik

H1504+65 is the hottest known white dwarf ($T_{\text{eff}} = 200,000$ K). It has an extraordinary surface composition. The surface is devoid of hydrogen and helium. It is mainly composed of carbon and oxygen (by equal amounts) and neon (2%). We obviously see the exposed core of a former red giant. The evolutionary history of this unique object is unknown. We have identified magnesium absorption lines in the soft X-ray photospheric Chandra spectrum, which suggests that H1504+65 may be an O-Ne-Mg white dwarf. We will test this hypothesis by abundance determinations of Mg and Na. If confirmed, then H1504+65 would be the most compelling case for the existence of single O-Ne-Mg white dwarfs.

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11602
Title: High-resolution imaging of three new UV-bright lensed arcs
PI: Sahar Allam
PI Institution: Fermi National Accelerator Laboratory (FNAL)

We have identified and spectroscopically confirmed three new strongly lensed, UV-bright star-forming galaxies at $z \sim 2$ that are similar to the well-studied gravitationally lensed Lyman Break Galaxy (LBG) MS1512-cB58, and are of comparable brightness to the '8 O'Clock Arc' (Allam et al. 2007) and 'Clone' systems (Lin et al. 2008). The 8 O'Clock Arc and Clone have already been awarded 20 orbits for deep WFPC2 and NICMOS imaging in five bands (HST cycle 16, Program 11167, PI: Allam). Adding these three recently discovered objects thus completes a unique set of the brightest known strongly lensed galaxies at $z \sim 2$, with magnitudes of $r \sim 20-21$, and they provide a new window into the detailed study of the properties of high redshift galaxies. We propose 21 orbits for deep WFC3 imaging in five bands (F475W, F606W, F814W, F110W, and F160W) in order to construct detailed lensing models, to probe the mass and light profiles of the lensing galaxies and their environments, and to constrain the spectral energy distributions, star formation histories, and morphologies of the lensed galaxies.

=====

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11603
Title: A Comprehensive Study of Dust Formation in Type II Supernovae with HST, Spitzer and Gemini
PI: Jennifer Andrews
PI Institution: Louisiana State University and A & M College

The recent discovery of three extremely bright Type II SNe, (2007it, 2007oc, 2007od) gives us a unique opportunity to combine observations with HST, Spitzer and Gemini to study the little understood dust formation process in Type II SNe. Priority 1 Spitzer Cycle 5 and band 1 Gemini 2008A time has already been approved for this project. Since late-time Type II SNe are faint and tend to be in crowded fields, we need the high sensitivity and high spatial resolution of ACS/HRC and NICMOS/NIC2 for these observations. This project is motivated by the recent detection of large amounts of dust in high redshift galaxies. The dust in these high- z galaxies must come from young, massive stars so Type II SNe could be potential sources. The mechanism and the efficiency of dust condensation in Type II SN ejecta are not well understood, largely due to the lack of observational data. We plan to produce a unique dataset, combining spectroscopy and imaging in the visible, near- and mid-IR covering the key phase, 400-700 days after maximum when dust is known to form in the SN ejecta. Therefore, we are proposing for coordinated HST/NOAO observations (HST ACS/HRC, NICMOS/NIC2 & Gemini/GMOS and TRCS) which will be combined with our Spitzer Cycle 5 data to study these new bright SNe. The results of this program will place strong constraints on the formation of dust seen in young high redshift ($z > 5$) galaxies.

=====
Proposal Category: SNAP
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11604
Title: The Nuclear Structure of OH Megamaser Galaxies
PI: David Axon
PI Institution: Rochester Institute of Technology

We propose a snapshot survey of a complete sample of 80 OH megamaser galaxies. Each galaxy will be imaged with the ACS/WFC through F814W and a linear ramp filter (FR656N or FR716N or FR782N or FR853N) allowing us to study both the spheroid and the gas morphology in H α + [N II]. We will use the 9% ramps FR647M (5370-7570 Å) centred at 7000 Å and FR914M (7570-10,719 Å) 8000 Å for continuum subtraction for the high and low z objects respectively. OH megamaser galaxies (OHMG) form an important class of ultraluminous IR-galaxies (ULIRGs) whose maser lines emit QSO-like luminosities. ULIRGs in general are associated with recent mergers but it is often unclear whether their power output is dominated by starbursts or a hidden QSO because of the high absorbing columns which hide their nuclei even at X-ray wavelengths. In contrast, OHMG exhibit strong evidence for the presence of an energetically important and recently triggered active nucleus. In particular it is clear that much of the gas must have already collapsed to form a nuclear disk which may be the progenitor of a circum-nuclear torus, a key element of the unified scheme of AGN. A great advantage of studying OHMG systems over the general ULIRG population, is that the circum-nuclear disks are effectively "fixed" at a inner, edge on, orientation, eliminating varying inclination as a nuisance parameter. We will use the HST observations in conjunction with existing maser and spectroscopic data to construct a detailed picture of the circum-nuclear regions of a hitherto relatively neglected class of galaxy that may hold the key to understanding the relationship between galaxy mergers, nuclear star-formation, and the growth of massive black holes and the triggering of nuclear activity.

=====
Proposal Category: GO
Scientific Category: COOL STARS
ID: 11605
Title: Obtaining the Missing Links in the Test of Very Low Mass Evolutionary Models with HST
PI: Travis Barman
PI Institution: Lowell Observatory

We are proposing for spatially resolved ACS+HRC observations of 11 very low mass binaries spanning late-M, L and T spectral types in order to obtain precise effective temperature measurements for each component. All of our targets are part of a program in which we are measuring dynamical masses of very low-mass binaries to an unprecedented precision of 10% (or better). However, without precise temperature measurements, the full scientific value of these mass measurements cannot be realized. Together, mass and temperature measurements will allow us to distinguish between brown dwarf evolutionary models that make different assumptions about the interior and atmospheric structure of these ultra-cool objects. While dynamical masses can be obtained

from the ground in the near-IR, obtaining precise temperatures require access to optical data which, for these sub-arcsecond binaries, can only be obtained from space with Hubble.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11606
Title: Dynamical Hypermassive Black Hole Masses
PI: Dan Batcheldor
PI Institution: Rochester Institute of Technology

We will use STIS spectra to derive the masses of 5 hypermassive black holes (HMBHs). From the observed scaling relations defined by less massive spheroids, these objects are expected to reside at the nuclei of host galaxies with stellar velocity dispersions greater than 320 km/s. These 5 targets have confirmed regular gas distributions on the scales of the black hole sphere of influence. It is essential that the sphere of influence is resolved for accurate determinations of black hole mass (0.1"). These scales cannot be effectively observed from the ground. Only two HMBHs have had their masses modeled so far; it is impossible to draw any general conclusions about the connections between HMBH mass and their massive host galaxies. With these 5 targets we will determine whether these HMBHs deviate from the scaling relations defined by less massive spheroids. A larger sample will allow us to firmly anchor the high mass end of the correlation between black hole mass and stellar velocity dispersion, and other scaling relations. Therefore we are also conducting a SNAPSHOT program with which we expect to detect a further 24 HMBH candidates for STIS observation in future Cycles. At the completion of this project we will have populated the high mass end of the scaling relations with the sample sizes enjoyed by less massive spheroids.

=====
Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 11607
Title: Ly-alpha propagation in the planet-forming region of a circumstellar disk
PI: Thomas Bethell
PI Institution: University of Michigan

We propose using STIS to spectrally image the radial profile of resonantly scattered Lyman-alpha from the protoplanetary disk of TW Hya. Recent HST results have demonstrated that strong Lyman-alpha emission dominates the FUV radiation field of TW Hya. This has significant consequences for the chemical equilibrium of key species such as water within the planet-forming zone. Exploratory radiative transfer modeling predicts that the dominant Lyman-alpha component should resonantly scatter from the atomic layers of such disks at levels easily detectable with STIS. Using careful PSF subtraction, S/N ratios greater than 5 should be obtainable between 6-25AU from the central star. A detection of extended, resonantly scattered Lyman-alpha will reveal new information about the disk properties that cannot be obtained directly from other methods of observation. This includes constraining the morphology of the upper layers of the gas disk and possibly revealing the existence of a

puffed-up inner disk. We will also be able to place limits on the Lyman-alpha flux driving chemistry in the disk interior.

=====

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 11608
Title: How Far Does H2 Go: Constraining FUV Variability in the Gaseous Inner Holes of Protoplanetary Disks
PI: Nuria Calvet
PI Institution: University of Michigan

By studying the innermost, planet-forming regions of circumstellar disks around low-mass pre-main sequence stars we can refine theories of planet formation and develop timescales for the evolution of disks and their planets. Spitzer infrared observations of T Tauri stars have given us an unprecedented look at dust evolution in young objects, particularly the transitional disks. However, despite this ground breaking progress in studying the dust in young disks, the relationship between the dust and gas properties in the inner disk remains essentially unknown. Using STIS on HST, we propose to quantify the variability of H2 emission originating within the inner holes of transitional disks and explore its implications on dust distribution and planet formation.

=====

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11609
Title: NGC 6266: The Smoking Gun of Intermediate-Mass Black Holes in Galactic Globular Clusters?
PI: Julio Chaname
PI Institution: Space Telescope Science Institute

The existence of intermediate-mass black holes (IMBHs) in star clusters has been predicted by a variety of theoretical arguments and, more recently, by several large, realistic sets of collisional N-body simulations. Establishing their presence or absence at the centers of globular clusters would profoundly impact our understanding of problems ranging from the formation and long-term dynamical evolution of stellar systems, to the nature of the seeds and the growth mechanisms of the supermassive black holes (BHs) that inhabit the centers of most large, luminous galaxies. Observationally, the unambiguous signature of a massive central BH would be the discovery of central, unresolved X-ray or radio emission that is not consistent with more common stellar-mass accreting objects or pulsars. Yet, due to the largely uncertain details of accretion modeling, a precise mass determination of a central BH must necessarily come from gas or stellar dynamics. This goal has not been achieved to date at the centers of Galactic globular clusters because of lack of adequate data as well as the use of too simplified methods of analysis. This situation can be overcome today through the combination of HST proper-motion measurements and state-of-the-art dynamical models specifically designed to take full advantage of this type of dataset and do so in a most general way, avoiding the many overly restrictive assumptions often applied to this kind of analysis. For the last few years, this team has been embarked in a large, comprehensive program to do just this for a large sample of Galactic

globular clusters with a range of core properties, both with steep as well as shallow-sloped surface brightness cusps. We have successfully obtained our own HST data for a number of clusters, and are analyzing multiple astrometric epochs for a larger sample from the HST Archives. In this proposal, we request two (2) HST orbits to obtain second epoch observations of NGC 6266, possibly the most important target of our sample not only because its photometric and structural properties are all consistent with current theoretical expectations for a cluster harboring an IMBH, but, more importantly, because it is the only Galactic globular cluster for which there exists a detection of radio emission coincident with the cluster's core and with a flux density that rules out an origin on less exotic inhabitants of globular clusters.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11610
Title: A Search for Pulsation in Young Brown Dwarfs
PI: Ann Marie Cody
PI Institution: California Institute of Technology

Brown dwarfs are a ubiquitous yet poorly understood product of the processes that take place in star formation regions. To date, observational methods to determine important properties such as mass and age are lacking. But better understanding of the physical characteristics of young brown dwarfs and very low mass stars is now within reach through the signature of variable lightcurves. In particular, pulsation in these objects is a newly suggested phenomenon that offers unprecedented opportunities to probe their interiors and evolution. We propose to use HST WFC3 to improve upon ground-based studies which suggest low-amplitude, short-period variability indicative of pulsation just below the statistical detection threshold. We will acquire precise time-series photometry on a sample of confirmed brown dwarfs in the young IC 348 cluster. With estimated masses and ages appropriate to the deuterium-burning stage, these objects are some of the most promising candidates in a potential new class of pulsators. We aim to fully characterize light-curve periodicities down to millimagnitude amplitudes, and ultimately use the results to provide fundamental constraints on the interiors and properties of brown dwarfs.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11611
Title: Are Narrow-Line Seyfert 1 Galaxies Viewed Pole-on?
PI: D. Crenshaw
PI Institution: Georgia State University Research Foundation

We will obtain spatially resolved spectra of 3 Narrow-Line Seyfert 1 galaxies (NLS1s) with the STIS G430M grating centered on the bright [O III] emission lines. We will measure the radial velocities of the [O III] lines across the narrow-line regions of these AGN and determine the inclinations of their torus/accretion-disk axes via our kinematic models. Our goal is to answer the following question: are NLS1s viewed pole-on? If so, then the narrow widths of their permitted lines may be due to geometric effects, rather than low black

hole masses and correspondingly high Eddington ratios as indicated by the currently popular paradigm for NLS1s.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11612
Title: Eta Carinae's Continuing Instability and Recovery - the
2009 Event
PI: Kris Davidson
PI Institution: University of Minnesota - Twin Cities

Eta Carinae is the only really observable example of structural recovery from a massive giant eruption, a "supernova imposter" event. Moreover it is the only well-observed star above 100 Msun, and its 5.5-year-recurrent spectroscopic events provide extraordinary clues to its surface instability. This truly unique combination of attributes makes it valuable for understanding the most massive stars. A fresh development arose a few years ago: The star has brightened much faster than before, and appears to have entered a rapid stage in its post-eruption recovery. A spectroscopic event will occur at 2009.0, soon after the planned HST servicing mission. Because of the recent secular trend, this event is expected to differ from its well-observed 2003.5 predecessor. The differences will be very important, because they offer clues to very-massive-star structural instabilities that can't be observed in any other known way. Some of the needed observations require HST's high spatial resolution and UV coverage. We propose an efficient, well-chosen set of STIS and ACS observations around the critical time. If the servicing mission is too late for the event, then a subset of the observations will still be merited.

=====
Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 11613
Title: GHOSTS: Stellar Outskirts of Massive Spiral Galaxies
PI: Roelof de Jong
PI Institution: Space Telescope Science Institute

We propose to continue our highly successful GHOSTS HST survey of the resolved stellar populations of nearby, massive disk galaxies using SNAPs. These observations provide star counts and color-magnitude diagrams 2-3 magnitudes below the tip of the Red Giant Branch of the outer disk and halo of each galaxy. We will measure the metallicity distribution functions and stellar density profiles from star counts down to very low average surface brightnesses, equivalent to ~32 V-mag per square arcsec. This proposal will substantially improve our unique sampling of galaxy outskirts. Our targets cover a range in galaxy mass, luminosity, inclination, and morphology. As function of these galaxy properties this survey provides: - the most extensive, systematic measurement of radial light profiles and axial ratios of the diffuse stellar halos and outer disks of spiral galaxies; - a comprehensive analysis of halo metallicity distributions as function of galaxy type and position within the galaxy; - an unprecedented study of the stellar metallicity and age distribution in the outer disk regions where

the disk truncations occur; - the first comparative study of globular clusters and their field stellar populations. We will use these fossil records of the galaxy assembly process to test halo formation models within the hierarchical galaxy formation scheme.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11614
Title: Follow up Investigation on a Possible Third Member of the Sirius System
PI: Sergio Dieterich
PI Institution: Georgia State University Research Foundation

We propose to follow up on a detection of a faint point source 0.6 arcseconds away from Sirius B. The possible discovery was made while analysing NICMOS images taken in an effort to characterize the multiplicity function of the solar neighborhood. The data are consistent with a brown dwarf of early T spectral type if we assume this source is at the distance of Sirius. We discuss several arguments for the reality of this detection, and propose an observing strategy optimized for bright targets in order to test for common proper motion and obtain better photometry. If confirmed, this discovery would put an end to the century-long debate on the multiplicity of the Sirius system. This would also be the closest brown dwarf known. The PI is a doctoral student working on a thesis on low mass stars and brown dwarfs.

=====

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11615
Title: HUNTING FOR OPTICAL COMPANIONS TO BINARY MSPS IN GLOBULAR CLUSTERS
PI: Francesco Ferraro
PI Institution: Universita di Bologna

Here we present a proposal which exploits the re-newed potential of HST after the Service Mission 4 for probing the population of binary Millisecond Pulsars (MSPs) in Globular Clusters. In particular we intend to: (1) extend the search for optical counterparts in Terzan 5, by pushing the performance of the WFC3 IR channel to sample the entire MS extension down to $M=0.1 M_{\odot}$; (2) perform a deep multi-band search of MSP companions with the WFC3, in 3 clusters (namely NGC6440, M28 and M5), where recent radio observations have found particularly interesting objects; (3) derive an accurate radial velocity (with STIS) of the puzzling optical companion COM6266B recently discovered by our group, to firmly assess its cluster membership. This program is the result of a large collaboration among the three major groups (lead by Freire, Ransom and Possenti) which are performing extensive MSP search in GCs in the radio bands, and our group which has a large experience in performing accurate stellar photometry in crowded environments. This collaboration has produced a number of outstanding discoveries. In fact, three of the 6 optical counterparts to binary MSP companions known to date in GCs have been discovered by our group. The observations here proposed would easily double/triple the existing sample of known MSP companions, allowing the first

meaningful approach to the study of the formation, evolution and recycling process of pulsar in GCs. Moreover, since most of binary MSPs in GCs are thought to form via stellar interactions in the high density core regions, the determination of the nature of the companion and the incidence of this collisionally induced population has a significant impact on our knowledge of the cluster dynamics. Even more interesting, the study of the optical companions to NSs in GCs allows one to derive tighter constraints (than those obtainable for NS binaries in the Galactic field) on the system properties. This has, in turn, an intrinsic importance for fundamental physics, since it offers the opportunity of measuring the mass of the NS and hence constraining the equation of state of matter at the nuclear equilibrium density.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11616
Title: The Disks, Accretion, and Outflows (DAO) of T Tau stars
PI: Gregory Herczeg
PI Institution: California Institute of Technology

Classical T Tauri stars undergo magnetospheric accretion, power outflows, and possess the physical and chemical conditions in their disks to give rise to planet formation. Existing high resolution FUV spectra verify that this spectral region offers unique diagnostics of these processes, which have the potential to significantly advance our understanding of the interaction of a star and its accretion disk. To date the limited results are intriguing, with dramatic differences in kinematic structure in lines ranging from C IV to H2 among the few stars that have been observed. We propose to use HST/COS to survey the disks, outflows, and accretion (the DAO) of 26 CTTS and 6 WTTS in the FUV at high spectral resolution. A survey of this size is essential to establish how properties of accretion shocks, winds and disk irradiation depend on disk accretion rate. Specifically, our goals are to (1) measure the radiation from and understand the physical properties of the gas very near the accretion shock as a function of accretion rate using emission line profiles of hot lines (C IV, Si IV, N V, and He II); (2) measure the opacity, velocity, and temperature at the base of the outflow to constrain outflow models using wind absorption features; and (3) characterize the radiation incident on disks and protoplanetary atmospheres using H2 line and continuum emission and reconstructed bright Ly-alpha line emission.

=====

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11617
Title: HAT-P-1: A Direct Glimpse into the Atmosphere of a Hot Jupiter
PI: Matthew Holman
PI Institution: Smithsonian Institution Astrophysical Observatory

The HATNet project has discovered a transiting planet that is an extremely valuable target for reflected light observations (Bakos et al. 2006). HAT-P-1b, with mass $M_p=0.53 \pm 0.04 M_{Jup}$, and radius $R_p=1.20 \pm 0.05 R_{Jup}$ (Winn et al. 2007), has a density comparable to that of HD 209458b. However,

HAT-P-1b's $P=4.46536$ day orbital period is longer than that of HD 209458b. It is expected that the cloud composition and particulate size distribution of HAT-P-1b will differ from that of HD 209458b, due to the larger semimajor axis and lower effective temperature of HAT-P-1b. The resulting geometric albedo for HAT-P-1b should be larger than that of HD-209458b. Furthermore, HAT-P-1 orbits one component of a wide binary (ADS 16402A and ADS 16402B are G0V stars with 11.2" at 1.39 pc), making this an ideal target for ultra-precise differential photometry. Therefore, we propose ACS/HRC slitless grism photometry near times of its secondary eclipse to make the first detection of reflected light from an extrasolar planet. Note: this program was awarded DD time in Cycle 15 but the observations were not executed before the ACS failed. Holman and Bakos are co-PIs on this proposal.

=====

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 11618
Title: WFC3 Observations of VeLLOs and the Youngest Star Forming Environments
PI: Tracy Huard
PI Institution: University of Maryland

The Cores-to-Disks Spitzer Legacy team has discovered a number of extremely low luminosity sources embedded deep within nearby (< 300 pc) cores previously thought to be starless. With substellar masses, these low luminosity sources represent either the youngest low-mass protostars yet detected or the first embedded brown dwarfs. In either case, they represent a new observed class of sources referred to as VeLLOs (Very Low Luminosity Objects). We propose WFC3 F160W observations of a small sample of these sources, to be combined with deep ground-based observations at Ks, to address a broad set of issues concerning VeLLOs and the environments within which they are forming. First, the morphology of their outflow cavities will be traced, yielding estimates of the inclinations and opening angles of the cavities and the evolutionary stages of the VeLLOs. Second, our observations will reveal background stars seen through the densest regions of cores harboring these VeLLOs. The color-excesses of the background stars will yield the highest angular resolution extinction maps necessary to directly probe the inner density structure of these cores, found very soon after the onset of collapse, which would constrain the initial conditions of collapse within these isolated environments. In addition, we will construct similar maps of the dense pre-protostellar core L694-2 and the protostellar core B335. These maps will provide a snapshot of the evolution of the inner density structure of a core prior to low-mass star formation and soon thereafter, for comparison with the inner density structure of cores that have formed VeLLOs. Finally, these extinction maps will enable us to determine the core "centers", or positions of peak column densities. Comparison of these centers with the positions of the VeLLOs may yield insight regarding potential differences between the formation of low-mass stars and brown dwarfs.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11619

Title: Definitive ISM Abundances through Low-mass X-ray Binaries
as Lighthouses
PI: Adam Jensen
PI Institution: NASA Goddard Space Flight Center

We propose UV observations of two low-mass X-ray binaries with existing archival Chandra spectra. The Chandra spectra exhibit absorption edges of oxygen, neon, and iron caused by material in the interstellar medium. These absorption edges probe these elements in all of their existing phases--various ionization states, atomic or molecular gas, and solid state forms. Our proposed observations will be used to measure gas-phase column densities of atomic hydrogen, oxygen, iron, and other elements in these lines of sight. We will use the atomic hydrogen column densities (and estimates of the ionized and molecular hydrogen column densities) to turn the elemental column densities derived through the X-ray data into rare measurements of total interstellar abundances for these elements, avoiding assumptions about dust composition or abundance proxies such as the Sun or other stars. Our measurements of the gas-phase column densities of oxygen and iron will be used to refine and interpret the X-ray results, including deriving interstellar dust-phase abundances of these two elements in the most direct manner possible.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11620
Title: A Quasar Light Echo in the Local Universe?
PI: William Keel
PI Institution: University of Alabama

The time history and duty cycle of individual AGN is an important part of their evolution and the growth history of massive black holes, but almost unconstrained on scales between galaxy-interaction timescales (hundreds of Myr) and the scales of years probed by variability measurements. We propose a detailed study of an object which seems to be a large-scale light echo from a QSO-level episode in a nearby galaxy. The Galaxy Zoo morphological survey of SDSS objects has uncovered a peculiar emission-line structure whose spectrum matches the narrow-line region of AGN, despite lying at least 20 kpc from a galaxy whose activity is currently very weak. This is best explained if the nucleus has faded dramatically on time scales of several tens of thousands of years. We propose a suite of imaging and spectroscopic observations to probe its properties, and the time history of this episode of nuclear activity, measuring time scales hitherto unavailable.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11621
Title: SDSS J1507: The First Halo CV or the First CV Born With a
Brown Dwarf Donor?
PI: Christian Knigge
PI Institution: University of Southampton

The eclipsing cataclysmic variable (CV) SDSS J1507 has an orbital period well below the period minimum obeyed by other CVs. Furthermore, it contains a cool, pulsating primary white dwarf (WD) and a sub-stellar brown-dwarf (BD) companion. We have now discovered that J1507 is also a high proper motion star, with a transverse velocity much higher than other CVs. These characteristics can all be reconciled if the system is the first Galactic halo CV to be discovered. However, there is one possible alternative explanation, according to which the system formed only recently from a detached WD-BD binary system. Here, we propose a definitive test of these two scenarios by using time-resolved, FUV + NUV spectroscopy to determine the metallicity of the system. The outcome of this test will have an immediate impact on our understanding of the Galactic CV population and of close binary evolution more generally. We will also measure the wavelength-dependence of the WD pulsation amplitudes in J1507 and determine high precision binary parameters based on a combination of spectroscopic modelling and eclipse analysis. As a result, J1507 will become the benchmark for theoretical studies of CV evolution and the first proper calibrator for models of pulsations in accreting WDs.

=====

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11622
Title: A Search for Water and Methane on a Neptune-Mass
Transiting Planet
PI: Heather Knutson
PI Institution: Harvard University

GJ 436b is the only known Neptune-mass transiting exoplanet. Like Neptune, more than 80% of the mass is ice and rock, surrounded by a thin H/He envelope of only 1-3 earth masses. The similarities end there, however, as GJ 436b orbits a mere 0.03 A.U. from its M dwarf primary and has a toasty 700 K atmosphere. Although it is much warmer than the gas giant planets in the solar system, GJ 436b is the coolest transiting planet discovered to date. As a result, we expect most of the carbon in GJ 436b's atmosphere to exist in the form of methane instead of the carbon monoxide found in the atmospheres of the hotter, more massive transiting planets. We propose to test this prediction by searching for the signature of water and methane absorption in this unusual planet's atmosphere as seen in the wavelength dependence of the transit depth from 1.4-2.5 micron. This wavelength range includes strong absorption bands from both water and methane, and will also allow us to place limits on the presence of clouds and atmospheric hazes if present. Using the technique of transit timing, these observations (which span four transits) will also allow us to search for additional planetary companions with masses as small as that of Mars. A second planet would provide a natural explanation for GJ 436b's ability to maintain a significant orbital eccentricity, despite the fact that the circularization time scale for this system is significantly shorter than its current age.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11623
Title: Shaping the pre-supernova circumstellar environment

PI: Gloria Koenigsberger
PI Institution: Universidad Nacional Autonoma de Mexico (UNAM)

Recent discoveries of very luminous supernovae associated with luminous blue variable-type objects (LBV's) raise the interesting possibility that an LBV phase may be the prelude to core collapse. Alternatively, the LBV events may be occurring in binary systems where the LBV phase is reached by one of the stars shortly before its more evolved companion becomes a supernova. The Small Magellanic Cloud binary system HD 5980 is believed to consist precisely of such two objects: a massive hydrogen-poor Wolf-Rayet star in orbit around an even more massive variable star that recently underwent an LBV-type eruption. The wind velocity and the mass-loss rate of the LBV-component have changed remarkably over the past ~ 40 years, providing a glimpse of the detailed information of how a binary LBV-type star may shape the circumstellar environment into which the eventual supernova ejecta will collide. One process that is shaping the CSM around HD 5980 is the interaction between the slow wind ejected during eruption and the fast wind that was subsequently "turned on". In order to model the evolution of this interaction region, an accurate determination of the mass-loss rate and the wind velocity of HD 5980 is required. Because the optical emission lines are contaminated by other sources, only the P Cygni profiles observable in the UV spectral region provide unambiguous values for the current wind speed and mass-loss rate. In this proposal we are requesting 2 HST orbits to observe HD 5980 with STIS in order to obtain one FUV MAMA spectrum from which we will determine the current wind velocity and mass-loss rate of the LBV-type star. These data will also allow a more detailed analysis of the atmospheric structure of the LBV-type object in its quiescent state and, combined with ground-based observations, an analysis of the emission arising in the wind-wind collision region may be performed. Although HD5980 may be unique in our Galactic vicinity, it may be typical of massive star systems formed in low-metallicity regions in distant galaxies and thus, an understanding of HD5980 can provide further insight into the energetic phenomena present in the more distant, low-metallicity star-forming regions.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11624
Title: Black hole superkicks: Imaging the site of a
gravitational wave recoil event
PI: Stefanie Komossa
PI Institution: Max-Planck-Institut fur extraterrestrische Physik

Recent numerical relativity simulations of coalescing, binary supermassive black holes (SMBHs) predict kick velocities as large as several thousand km/s due to anisotropic emission of gravitational waves. We have recently discovered the best candidate to date for such a recoiling SMBH, the quasar SDSS0927+2943. It shows an exceptional optical emission-line spectrum with two sets of emission lines; one set of very narrow emission lines, and a second set of broad Balmer and broad high-ionization forbidden lines which are blueshifted by 2650 km/s relative to the narrow emission lines. This is the predicted spectroscopic signature of a SMBH recoiling from the core of its host galaxy, carrying with it the broad-line gas while leaving behind the bulk

of the narrow-line gas. We apply for HST imaging in two filters for two orbits each in order to confirm the recoil model by detecting the host galaxy of the SMBH and measuring the angular offset of the recoiling SMBH from the host galaxy core; and determining, if possible, the morphology of the host galaxy in order to constrain its merger history. Confirmation of the SMBH ejection model for SDSSJ0927+2943 with HST will show decisively that kicks large enough to remove SMBHs completely from their host galaxies do occur, a result that would have profound implications for models of SMBH evolution and galaxy assembly and for numerical relativity.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11625
Title: Beyond the classical paradigm of stellar winds:
Investigating clumping, rotation and the weak wind
problem in SMC O stars
PI: Thierry Lanz
PI Institution: University of Maryland

SMC O stars provide an unrivaled opportunity to probe star formation, evolution, and the feedback of massive stars in an environment similar to the epoch of the peak in star formation history. Two recent breakthroughs in the study of hot, massive stars have important consequences for understanding the chemical enrichment and buildup of stellar mass in the Universe. The first is the realization that rotation plays a major role in influencing the evolution of massive stars and their feedback on the surrounding environment. The second is a drastic downward revision of the mass loss rates of massive stars coming from an improved description of their winds. STIS spectroscopy of SMC O stars combined with state-of-the-art NLTE analyses has shed new light on these two topics. A majority of SMC O stars reveal CNO-cycle processed material brought at their surface by rotational mixing. Secondly, the FUV wind lines of early O stars provide strong indications of the clumped nature of their wind. Moreover, we first drew attention to some late-O dwarfs showing extremely weak wind signatures. Consequently, we have derived mass loss rates from STIS spectroscopy that are significantly lower than the current theoretical predictions used in evolutionary models. Because of the limited size of the current sample (and some clear bias toward stars with sharp-lined spectra), these results must however be viewed as tentative. Thanks to the high efficiency of COS in the FUV range, we propose now to obtain high-resolution FUV spectra with COS of a larger sample of SMC O stars to study systematically rotation and wind properties of massive stars at low metallicity. The analysis of the FUV wind lines will be based on our 2D extension of CMFGEN to model axi-symmetric rotating winds.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11626
Title: Searching for the Upper Mass Limit in NGC 3603, the
Nearest Giant H II Region
PI: Philip Massey
PI Institution: Lowell Observatory

What is the mass of the highest mass star? 100Mo? 150Mo? 200Mo? Or higher? Theory gives us little guidance as to what physics sets the upper mass limit, presuming one exists. Is it due to limitations in the highest masses that can coalesce? Or is it due to stability issues in such a behemoth? Observationally, the upper mass limit is poorly constrained at present, with the strongest evidence coming from the K-band luminosity function of the Arches cluster near the Galactic Center. Here we propose to investigate this question by determining the Initial Mass Function of NGC 3603, the nearest giant H II region. This cluster is known to contain a wealth of O3 and hydrogen-rich Wolf-Rayets, the most luminous and massive of stars. By constructing an accurate H-R diagram for the cluster, we will construct a present day mass function using newly computed high mass evolutionary tracks, and convert this to an initial mass function using the inferred ages. This will allow us to see whether or not there is a true deficit of high mass stars, evidence of an upper mass cutoff. At the same time we are likely to establish good masses for the highest mass stars ever determined. We have laid the groundwork for this project using the Magellan 6.5-m telescope and the excellent seeing found on Las Campanas, plus analysis of archival ACS/HRS frames, but we now need to obtain spectra of the stars unobservable from the ground. This can only be done with HST and a reburbished STIS.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11627
Title: Resolving the puzzling nature of the ultra-compact binary V407 Vul
PI: Gijs Nelemans
PI Institution: Katholieke Universiteit Nijmegen

Recently, three variable stars have been identified as likely accreting binary systems with ultra-short orbital periods of 10 minutes or less. This makes them the closest binaries known as well as strong sources of gravitational wave emission. These objects have thus been identified as crucial calibration sources for the LISA mission. V407 Vul displays a 9.5 minute period at optical and X-ray wavelengths. Several different binary geometries have been proposed to explain this variable star with all but one scenario identifying the 9.5 minute period with the binary orbital period. Our time-resolved spectroscopy and photometry from the ground revealed that the optical light is dominated by a stationary G9 star which would be inconsistent with the mass donor star of a compact binary. We propose ACS/HRC imaging in order to confirm the tentative 0.03" mis-alignment we have picked up between this G9 star and the underlying variable. Confirmation of a spatial separation between the variable and this field star would conclusively rule out that the G star is part of a low-inclination binary and thus verify it as a LISA source. In addition, we propose UV imaging that will allow us to determine the NUV luminosity of the variable star and thereby reliably infer the distance and the nature (and thus the gravitational wave signal) of the ultra-compact binary, as either mass transfer or magnetic interaction powers the X-ray source. Only HST imaging can provide rigorous proof for an ultra-compact binary interpretation for V407 Vul and thus validate it as LISA verification source

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11628
Title: Globular Cluster Candidates for Hosting a Central Black Hole
PI: Eva Noyola
PI Institution: Max-Planck-Institut für extraterrestrische Physik

We are continuing our study of the dynamical properties of globular clusters and we propose to obtain surface brightness profiles for high concentration clusters. Our results to date show that the distribution of central surface brightness slopes do not conform to standard models. This has important implications for how they form and evolve, and suggest the possible presence of central intermediate-mass black holes. From our previous archival proposals (AR-9542 and AR-10315), we find that many high concentration globular clusters do not have flat cores or steep central cusps, instead they show weak cusps. Numerical simulations suggest that clusters with weak cusps may harbor intermediate-mass black holes and we have one confirmation of this connection with omega Centauri. This cluster shows a shallow cusp in its surface brightness profile, while kinematical measurements suggest the presence of a black hole in its center. Our goal is to extend these studies to a sample containing 85% of the Galactic globular clusters with concentrations higher than 1.7 and look for objects departing from isothermal behavior. The ACS globular cluster survey (GO-10775) provides enough objects to have an excellent coverage of a wide range of galactic clusters, but it contains only a couple of the ones with high concentration. The proposed sample consists of clusters whose light profile can only be adequately measured from space-based imaging. This would take us close to completeness for the high concentration cases and therefore provide a more complete list of candidates for containing a central black hole. The dataset will also be combined with our existing kinematic measurements and enhanced with future kinematic studies to perform detailed dynamical modeling.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11629
Title: Far-UV Phase-resolved Spectroscopy of PSR B0656+14
PI: George Pavlov
PI Institution: The Pennsylvania State University

X-ray observations of the brightest middle-aged pulsar PSR B0656+14 have shown a Wien tail of thermal emission from the neutron star surface in soft X-rays and magnetospheric emission at higher X-ray energies. Optical/near-UV observations of this pulsar have shown that its emission is predominantly magnetospheric in this range and indicated that the Rayleigh-Jeans thermal component could dominate in the far-UV. This hypothesis has been confirmed by our STIS/FUV observation, which, however, was too short to separate and study the thermal emission (only 2 of 8 allocated orbits were executed before the STIS failure). Using the superior sensitivity of COS/FUV, we will perform phase-resolved spectroscopy and wavelength-resolved timing of the pulsar radiation in the 1105-1900 Å band. The results of this observation, combined

with the optical-UV and X-ray data, will allow us to firmly separate the thermal and magnetospheric components and infer the temperature and radius of the neutron star, which is important for understanding the thermal evolution of neutron stars and constraining the composition and equation of state of their superdense interiors.

=====
Proposal Category: SNAP
Scientific Category: SOLAR SYSTEM
ID: 11630
Title: Monitoring Active Atmospheres on Uranus and Neptune
PI: Kathy Rages
PI Institution: SETI Institute

We propose Snapshot observations of Uranus and Neptune to monitor changes in their atmospheres on time scales of weeks and months, as we have been doing for the past seven years. Previous Hubble Space Telescope observations (including previous Snapshot programs 8634, 10170, 10534, and 11156), together with near-IR images obtained using adaptive optics on the Keck Telescope, reveal both planets to be dynamic worlds which change on time scales ranging from hours to (terrestrial) years. Uranus equinox occurred in December 2007, and the northern hemisphere is becoming fully visible for the first time since the early 1960s. HST observations during the past several years (Hammel et al. 2005, Icarus 175, 284 and references therein) have revealed strongly wavelength-dependent latitudinal structure, the presence of numerous visible-wavelength cloud features in the northern hemisphere, at least one very long-lived discrete cloud in the southern hemisphere, and in 2006 the first clearly defined dark spot seen on Uranus. Long-term ground-based observations (Lockwood and Jerzekiewicz, 2006, Icarus 180, 442; Hammel and Lockwood 2007, Icarus 186, 291) reveal seasonal brightness changes that seem to demand the appearance of a bright northern polar cap within the next few years. Recent HST and Keck observations of Neptune (Sromovsky et al. 2003, Icarus 163, 256 and references therein) show a general increase in activity at south temperate latitudes until 2004, when Neptune returned to a rather Voyager-like appearance with discrete bright spots rather than active latitude bands. Further Snapshot observations of these two dynamic planets will elucidate the nature of long-term changes in their zonal atmospheric bands and clarify the processes of formation, evolution, and dissipation of discrete albedo features.

=====
Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 11631
Title: Binary brown dwarfs and the L/T transition
PI: Iain Reid
PI Institution: Space Telescope Science Institute

Brown dwarfs traverse spectral types M, L and T as their atmospheric structure evolves and they cool into oblivion. This SNAPSHOT program aims to obtain high-resolution NICMOS Camera 1 images of 45 nearby late-L and early-T dwarfs to investigate the nature of the L/T transition. Recent analyses have suggested that a substantial proportion of late-L and early-T dwarfs are

binaries, comprised of an L dwarf primary and T dwarf secondary. NIC1 observations will let us quantify this suggestion by expanding coverage to a much larger sample, and permitting comparison of the L/T binary fraction against "normal" ultracool dwarfs. Only eight L/T binaries are currently known, including several that are poorly resolved: we anticipate at least doubling the number of resolved systems. The photometric characteristics of additional resolved systems will be crucial to constraining theoretical models of these late-type ultracool dwarfs. Finally, our data will also be eminently suited to searching for extremely low luminosity companions, potentially even reaching the Y dwarf régime.

=====
Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11632
Title: The Gaseous Corona of M31
PI: R. Rich
PI Institution: University of California - Los Angeles

We propose to obtain ultraviolet spectroscopy of the halo of M31, to probe for a hot corona on scales of 30-40 pc from the galaxy. We seek to obtain absorption line spectra of O I, Mg II, Si II, C IV, and Si IV toward bright QSOs located behind the galaxy. One of the sightlines falls on the projection of Ibata's giant stream. All background sources have been vetted with GALEX photometry and are therefore bright enough for observation. If hot gas is detected with this initial study, we will endeavor to use a grid of background sources to map the structure and kinematics of this gas in detail. M31 is the nearest major spiral galaxy for which such a study can be undertaken, other than our own Milky Way. Recent studies find a substantial population of HI high velocity clouds at distances from M31 of up to 50 kpc, and there is well documented evidence of disrupted satellites and tidal streams. These observations will shed light on the hot gaseous halo of M31, but also will help in interpreting QSO sightlines at high redshift.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11633
Title: A Precision White Dwarf Cooling Age for NGC 6397
PI: R. Rich
PI Institution: University of California - Los Angeles

We propose to obtain second epoch imaging of the globular cluster NGC 6397, which has the deepest ACS/WFC dataset (126 orbits in Cycle 13) ever obtained in a globular cluster. These additional 14 orbits would enable the construction of a proper motion - cleaned white dwarf cooling sequence reaching fainter than the observed truncation point of the white dwarf luminosity function; a byproduct will be absolute proper motions (relative to the extragalactic reference frame) of the rich spheroidal field population. Our data shows the long sought "blue hook", a feature in the WD cooling sequence predicted in theoretical white dwarf models; the improved photometry and statistics afforded by the second epoch observations are needed to confirm the blue hook and to test other aspects of white dwarf cooling models that

contribute to a 0.5 Gyr or greater uncertainty in the age. The proposed observations will provide formal constraints on the age and formation timescale of NGC 6397 that will be smaller than 1 Gyr and place the cluster's formation epoch relative to the end of reionization. The final proper motion-purified white dwarf sequence will be a powerful constraint for white dwarf cooling models and atmospheres, the basis for white dwarf-based globular cluster age determinations, and also constrain the fraction of binary white dwarfs.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11634
Title: Probing the collimation of pristine post-AGB jets with STIS
PI: Carmen Sanchez Contreras
PI Institution: Instituto de Estructura de la Materia

The shaping of planetary and protoplanetary nebulae (PNe and PPNe) is probably the most exciting yet least understood problem in the late evolution of ~1-8 solar mass stars. An increasing number of astronomers believe that fast jet-like winds ejected in the PPN phase are responsible for carving out the diverse shapes in the dense envelopes of the Asymptotic Giant Branch (AGB) stars. To date, the properties of these post-AGB jets have not been characterized and, indeed, their launching/collimation mechanism is still subject to controversial debate. This is due to the lack of the direct observations probing the spatio-kinematic structure of post-AGB winds in the stellar vicinity (~10e16cm), which is only possible with HST+STIS. Recently, STIS observations have allowed us for the first time the DIRECT study of the structure and kinematics of the elusive post-AGB winds in one PPN, He3-1475 (Sanchez Contreras & Sahai 2001). Those winds have been discovered through H-alpha blue-shifted absorption features in the inner 0.3"-0.7" of the nebula. These STIS observations have revealed an ultra-fast collimated outflow relatively unaffected by the interaction with the AGB wind that is totally hidden in ground-based spectroscopic observations and HST images. The discovery of the pristine ultra-fast (~2300km/s) jet in He3-1475 is the first observational confirmation of the presence of collimated outflows as close as ~10e16cm from the central star. Most importantly, the spatio-kinematic structure of the ultra-fast jet clearly rules out hydrodynamical collimation alone and favors magnetic wind collimation. Therefore, STIS observations provide a unique method of probing the structure, kinematics, and collimation mechanism of the elusive post-AGB winds. We now propose similar observations for a sample of bipolar PPNe with ongoing post-AGB ejections in order to investigate the frequency of jets like those in He3-1475 in other PPNe and elucidate their nature and collimation mechanism. The observational characterization of these winds is indispensable for understanding this violent and important phase of post-AGB evolution.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11635
Title: In Search of SNIb/Ic Wolf-Rayet Progenitors and

Comparison with Red Supergiants (SNII Progenitors) in the
Giant ScI Spiral M101

PI: Michael Shara
PI Institution: American Museum of Natural History

We propose to test two of the clearest predictions of the theory of evolution of massive-star evolution: 1) The formation of Wolf-Rayet stars depends strongly on these stars' metallicity (Z), with relatively fewer WR stars forming at lower Z, and 2) Wolf-Rayet stars die as Type Ib or Ic supernovae. To carry out these tests we propose a deep, narrowband imaging survey of the massive star populations in the ScI spiral galaxy M101. Just as important, we will test the hypothesis that Superclusters like 30 Doradus are always richly populated with WR stars, and by implication that these complexes are responsible for the spectral signatures of starburst galaxies. Our previous HST survey of the HII regions in the ScIII galaxy NGC 2403 suggested that the distribution of WR stars and RSG is a sensitive diagnostic of the recent star-forming history of these large complexes: young cores of O and WR stars are surrounded by older halos containing RSG. Theory predicts that this must change with metallicity; relatively fewer WR stars form at lower Z. A key goal of our proposal is to directly test this paradigm in a single galaxy, M101 being the ideal target. The abundance gradient across M101 (a factor of 20) suggests that relatively many more WR will be found in the inner parts of this galaxy than in the outer "suburbs". Second, we note that WR stars are predicted to end their lives as core-collapse or pair-instability supernovae. The WR population in M101 may be abundant enough for one to erupt as a Type Ib or Ic supernova within a generation. The clear a priori identification of a WR progenitor would be a major legacy of HST. Third, we will also determine if "superclusters", heavily populated by WR stars, are common in M101. It is widely claimed that such Superclusters produce the integrated spectral signatures of Starburst galaxies. We will be able to directly measure the numbers and emission-line luminosities of thousands of Wolf Rayet stars located in hundreds of M101 Superclusters, and correlate those numbers against the Supercluster sizes and luminosities. It is likely (but far from certain) that Supercluster sizes and emission-line luminosities are driven by their Wolf-Rayet star content. Our sample will be the largest and best-ever Supercluster/Wolf Rayet sample, an excellent local proxy for characterizing starburst galaxies' Superclusters.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11636
Title: First Resolved Imaging of Escaping Lyman Continuum
PI: Brian Siana
PI Institution: Jet Propulsion Laboratory

The emission from star-forming galaxies appears to be responsible for reionization of the universe at $z > 6$. However, the models that attempt to describe the detailed impact of high-redshift galaxies on the surrounding inter-galactic medium (IGM) are strongly dependent upon several uncertain parameters. Perhaps the most uncertain is the fraction of HI-ionizing photons produced by young stars that escape into the IGM. Most attempts to measure this "escape fraction" have produced null results. Recently, a small subset

of $z \sim 3$ Lyman Break Galaxies (LBGs) has been found exhibiting large escape fractions. It remains unclear however, what differentiates them from other LBGs. Several models attempt to explain how such a large fraction of ionizing continuum can escape through the HI and dust in the ISM (eg. "chimneys" created by SNe winds, globular cluster formation, etc.), each producing unique signatures which can be observed with resolved imaging of the escaping Lyman continuum. To date, there are only six LBGs with individual detections of escaping Lyman continuum at any redshift. We propose a single deep, high resolution WFC3/UVIS image of the ionizing continuum (F336W) and the rest-frame UV/optical (F606W/F814W/F160W) of five of these six LBGs with large escape fractions. These LBGs have a high surface density and large escape fractions, and lie at the optimal redshift for Lyman continuum imaging with UVIS filters, making our sample especially suitable for follow-up. With these data we will discern the mechanisms responsible for producing large escape fractions, and therefore gain insight into the process of reionization.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11637
Title: A Closeup View of a Twin of SN 1987A Before Explosion
PI: Nathan Smith
PI Institution: University of California - Berkeley

Last year we reported the discovery of a ring nebula called SBW1 around a blue supergiant star in our Galaxy. In almost every respect, it is a true "twin" of the equatorial ring nebula around SN 1987A: it has an identical physical radius of 0.2pc, a similar expansion speed and age, it is located in a massive HII region, the central star is an early B supergiant with the same luminosity as SN1987A's progenitor, and the ring's structure in our ground-based H-alpha images looks almost identical to early HST images of SN1987A's ring. The detailed density structure of SN1987A's ring on scales smaller than the limiting resolution of HST has become a pressing question, because the forward shock of the supernova is now colliding with that ring, causing it to brighten by 3 orders of magnitude and giving rise to a series of "hotspots" around the ring. HST/WFC3 images of SBW1 will provide a snapshot of an SN1987A-like ring before the supernova explodes, and will provide a detailed view of the important density inhomogeneities in the ring with a physical spatial resolution 10 times better than HST images of SN1987A (because SBW1 is 10 times closer to us). STIS spectra will allow us to directly measure the radial density structure of the ring. Both the overall radial density profile and the detailed structures of the clumps that give rise to the "hotspots" are critical factors in modeling the rapid evolution of SN1987A, and our proposed study of SBW1 will provide extremely valuable input for those models.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11638
Title: Illuminating the HI Structure of a Proto-cluster Region at $z=2.84$
PI: Charles Steidel
PI Institution: California Institute of Technology

We propose very deep intermediate-band Lyman alpha imaging in the field of a newly-discovered proto-cluster region surrounding the extremely luminous QSO HS1549+19 at $z=2.844$. The large structure, initially discovered in a spectroscopic survey of galaxies in fields surrounding the brightest QSOs at $z=2.5-2.8$, represents an ideal laboratory for studying the response of the intergalactic medium to a source of ionizing photons that exceeds the UV background by factors >1000 . Within a single pointing of WFC3-UVIS there are already more than 45 known Lyman alpha emitters, most of which are already spectroscopically confirmed, and at least 3 of which are giant 'Lyman alpha blobs'. Many of the objects have properties similar to those expected from the process of fluorescence, in which Lyman alpha emission is induced by the UV radiation field of the QSO in any HI gas that dense enough to remain partially self-shielded. Fortunately, the F467M filter (Stromgren "b") in WFC3-UVIS is a perfect match to Lyman alpha at $z=2.844$. In combination with an equally deep broad-band continuum image, the observations will allow the construction of a Lyman alpha map tracing dense gas throughout the inner parts of a proto-cluster region at sub-kpc resolution. The ability to measure the spatial sub-structure and surface brightness distribution of Ly α emission, relative to known protocluster galaxies and AGN, will illuminate the 'cosmic web' in a dense region caught in a violent stage of formation.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11639
Title: Catching Accreting WDs Moving into Their Instability Strip(s)
PI: Paula Szkody
PI Institution: University of Washington

Our past HST studies of the temperatures of 9 accreting, pulsating white dwarfs in cataclysmic variables show that 3 are in the normal instability strip for single white dwarfs, but the other 6 are much hotter (15,000-16,500K). This dual strip has been proposed to be due to mass differences in the white dwarfs related to evolutionary history and driven by the ionization of different elements in their respective driving regions. In 2007, GW Lib (the brightest and best studied of the 6 hot accreting pulsators) and V455 And (the brightest and best studied of the 3 cool accreting pulsators) underwent rare large amplitude dwarf nova outbursts (known to heat the white dwarf) and their pulsations disappeared. We propose COS observations to: a) take advantage of the unprecedented opportunity to view the change in pulsation modes due to cooling of the white dwarf envelope and b) determine the masses of the white dwarfs to test the dual strip theory. In addition, a nova that had its outburst 22 yrs ago has begun non-radial pulsations as it returns to quiescence. We will use COS to determine its temperature in relation to the instability strip for the pulsating white dwarfs in dwarf novae.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11640
Title: Lyman Alpha Imaging of Two Quasar Host Galaxies at $z>6$

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

We propose to image the Lyman Alpha emission line in two of the highest redshift quasar host galaxies (redshifts $z=6.31$ and 6.42) to map the amount and extent of star formation in the hosts and in their immediate environment. These observations are now possible for the first time, as UVIS on WFC3 (coincidentally) provides narrow-band filters at the right wavelengths. Circumstantial evidence (based on NIR, radio/millimeter and molecular gas measurements) suggests that these quasar hosts are undergoing intense ~ 1000 Msun/yr bursts of star formation over scales of ~ 5 kpc ($0.6''$). Our program will provide (continuum-subtracted) images of the Lyman Alpha emission in the host which will in turn directly constrain the extent and magnitude of star formation in the host. In the case of the host galaxy of J1148+5251 ($z=6.42$) the Lyman Alpha emission will be compared to resolved imaging of the molecular gas phase (CO and [CII]) which in turn will yield critical constraints on the structure of the host galaxy and the conditions of the interstellar medium. The observations should also be sensitive enough to reveal potential companion galaxies (if the quasars are residing in major overdensities at these redshifts) and infall signatures in the immediate vicinity of the quasar. The narrow-band filters of UVIS/WFC3 provide the unique opportunity to study host/bulge formation at the end of cosmic reionization (less than 1Gyr after the Big Bang).

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11641
Title: Super star clusters in the starburst core of M82
PI: Mark Westmoquette
PI Institution: University College London (UCL)

M82 is the archetype starburst galaxy and the nearest (3.6 Mpc) analogue to the star-forming galaxies identified at high- z . No other galaxy affords the opportunity to study an active starburst at such high spatial resolution, and with such a wealth of complimentary data available in the literature. In our cycle 10 STIS programme, we carried out the first spectroscopic study of a cluster in the core of the M82 starburst. Intriguingly, we found this young (6.5 Myr) cluster to be surrounded by a compact (4.5 pc), high-pressure HII region, whose evolution appears to have been significantly affected by the high ambient pressures found in this region of the starburst. We therefore propose to obtain spatially resolved STIS spectroscopy of a sample of star clusters within the starburst core, distributed over a range of ambient conditions. Together with measuring accurate ages, masses, sizes, and extinctions of the star clusters, we will also measure the properties of their immediate environments (gas dynamics, pressures/densities, excitations). Only with the spatial resolution of STIS can we isolate individual clusters in the crowded starburst core of M82, where the background is also bright and highly variable. The data from this proposal will uniquely chart relationships between SSCs and the ISM in their immediate vicinities. By so doing, they will provide the first systematic measurements of how SSCs transmit their power to their surroundings, and ultimately to the starburst-powered galactic wind.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11642
Title: FUV/X-ray absorption and emission line spectroscopy of
the Galactic corona
PI: Yangsen Yao
PI Institution: Massachusetts Institute of Technology

The Galactic corona is believed to play an essential role in the ``ecosystem'' of the Galaxy. But the extent and ionization state as well as the physical properties of the corona are yet to be determined. We request COS/HST observations to sample the intervening gas through the line absorptions of CIV, NV, SiIV, OI, SII, SiIII, and FeII along the LMC X-3 sight line, toward which we have already detected OVI, OVII, and NeIX absorption lines and NVII, OVII, OVIII, and NeIX emission lines with FUSE, Chandra, and Suzaku observations. We have developed a software tool to jointly analyze the far-UV/X-ray absorption and emission spectra. The requested observations will not only allow us to rigorously test our preliminary results based on the existing observations, but also enable us to examine various models (e.g., diffuse hot gas vs. conductive layers) and to constrain the spatial and thermal properties of the hot gas over a broad temperature range. The results will provide a unique calibration of our understanding of the corona.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11643
Title: A Timeline for Early-Type Galaxy Formation: Mapping the
Evolution of Star Formation, Globular Clusters, Dust, and
Black Holes
PI: Ann Zabludoff
PI Institution: University of Arizona

While considerable effort has been devoted to statistical studies of the origin of the red sequence of galaxies, there has been relatively little direct exploration of galaxies transforming from late to early types. Such galaxies are identified by their post-starburst spectra, bulge-dominated, tidally-disturbed morphologies, and current lack of gas. We are constructing the first detailed timeline of their evolution onto the red sequence, pinpointing when star formation ends, nuclear activity ceases, globular clusters form, and the bulk of the merging progenitors' dust disappears. Here we propose to obtain HST and Chandra imaging of nine galaxies, whose wide range of post-starburst ages we have precisely dated with a new UV-optical technique and for which we were awarded Spitzer time. We will address 1) whether the black hole-bulge mass relation arises from nuclear feedback, 2) whether the bimodality of globular cluster colors is due to young clusters produced in galaxy mergers, and 3) what happens to the dust when late types merge to form an early type.

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM

ID: 11644
Title: A dynamical-compositional survey of the Kuiper belt: a new window into the formation of the outer solar system
PI: Michael Brown
PI Institution: California Institute of Technology

The eight planets overwhelmingly dominate the solar system by mass, but their small numbers, coupled with their stochastic pasts, make it impossible to construct a unique formation history from the dynamical or compositional characteristics of them alone. In contrast, the huge numbers of small bodies scattered throughout and even beyond the planets, while insignificant by mass, provide an almost unlimited number of probes of the statistical conditions, history, and interactions in the solar system. To date, attempts to understand the formation and evolution of the Kuiper belt have largely been dynamical simulations where a hypothesized starting condition is evolved under the gravitational influence of the early giant planets and an attempt is made to reproduce the current observed populations. With little compositional information known for the real Kuiper belt, the test particles in the simulation are free to have any formation location and history as long as they end at the correct point. Allowing compositional information to guide and constrain the formation, thermal, and collisional histories of these objects would add an entire new dimension to our understanding of the evolution of the outer solar system. While ground based compositional studies have hit their flux limits already with only a few objects sampled, we propose to exploit the new capabilities of WFC3 to perform the first ever large-scale dynamical-compositional study of Kuiper belt objects (KBOs) and their progeny to study the the chemical, dynamical, and collisional history of the region of the giant planets. The sensitivity of the WFC3 observations will allow us to go up to two magnitudes deeper than our ground based studies, allowing us the capability of optimally selecting a target list for a large survey rather than simply taking the few objects that can be measured, as we have had to do to date. We have carefully constructed a sample of 120 objects which provides both overall breadth, for a general understanding of these objects, plus a large enough number of objects in the individual dynamical subclass to allow detailed comparison between and within these groups. These objects will likely define the core Kuiper belt compositional sample for years to come. While we have many specific results anticipated to come from this survey, as with any project where the field is rich, our current knowledge level is low, and a new instrument suddenly appears which can exploit vastly larger segments of the population, the potential for discovery -- both anticipated and not -- is extraordinary.

=====
Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11645
Title: HST COS Observations of the Atmosphere and Airglow/Aurora of Enceladus
PI: John Clarke
PI Institution: Boston University

Recent observations from several instruments on the Cassini spacecraft have revealed plumes of dust and water from the southern polar region, and clearly

shown that Enceladus contributes large amounts of plasma to Saturn's magnetosphere. This implies a global thin atmosphere containing water and likely other species, and a local region with orders of magnitude higher density near the plumes. While water and dust have been identified from the plumes, the presence of many other species in the atmosphere is possible and not yet ruled out. The identification of all significant species in the atmosphere of Enceladus is of key importance to speculation about the source of the water plumes, and the implications for any form of life at or below the surface. In addition, modeling suggests that Enceladus' mass loading region may be comparable in extent to Io's, and interacts strongly with Saturn's corotating magnetic field and plasma. We have recently concluded a search for an auroral footprint of Enceladus in HST images, which set a low upper limit implying that the magnetospheric interaction is concentrated near Enceladus, rather than being communicated along field lines to Saturn's ionosphere. The next step will be to observe the interaction at the satellite, and to learn whatever we can about the physics of the release of the atmospheric gas. We propose here an exploratory set of spectral observations with HST COS to measure the solar reflection spectrum over a broad range of UV wavelengths for atmospheric absorption signatures. This will at the same time measure the emission spectrum of the atmosphere from both the leading and trailing hemispheres ? Enceladus orbit apart, as was done in HST STIS observations of Io to study its interaction at Jupiter. The higher sensitivity of COS will be needed to study the much smaller and relatively weakly-interacting Enceladus, and the outcome of these observations will determine the nature of future studies of the atmosphere of Enceladus and its plasma interaction with the Saturnian magnetosphere.

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11646
Title: Light Echoes as Probes of Supernova Type Ia Environments
PI: Arlin Crofts
PI Institution: Columbia University in the City of New York

Environmental factors of Type Ia supernovae are key in understanding their nature, lightcurve evolution, and utility as cosmological standard candles. The progenitor ages (and many other properties) are bimodal, differing by roughly an order of magnitude. Is this reflected as well in the differences in their immediate surroundings in terms of gas and dust? The most powerful and direct way to address this issue is by imaging the reflected light from the dust itself via a light echo. In order for this approach to work, however, one must start imaging the vicinity of the supernova frequently and soon after the explosion is seen. We propose to maintain the imaging sequences crucial for understanding the three-dimensional dust distribution of two recent and key Type Ia supernovae, in a timely manner that will prevent otherwise significant holes in our knowledge. These observations are likely to be important in determining if the interstellar versus the circumstellar environments are more important in determining the appearance of Type Ia explosions, and thereby offer a clue as to the poorly-understood mass-loss history of SN Ia progenitors.

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11647
Title: A Deep Exploration of Classes of Long Period Variable
Stars in M31
PI: Arlin Crotts
PI Institution: Columbia University in the City of New York

We propose a thrifty but information-packed investigation with WFC3/IR F160W and F110W providing crucial information about Long Period Variables in M31, at a level of detail that has recently allowed the discovery of new variable star classes in the Magellanic Clouds, a very different stellar population. These observations are buttressed by an extensive map of the same fields with ACS and WFPC2 exposures in F555W and F814W, and a massive ground-based imaging patrol producing well-sampled light curves for more than 400,000 variable stars. Our primary goal is to collect sufficient NIR data in order to analyze and classify the huge number of long-period variables in our catalog (see below) through Period-Luminosity (P/L) diagrams. We will produce accurate P/L diagrams for both the bulge and a progression of locations throughout the disk of M31. These diagrams will be similar in quality to those currently in the Magellanic Clouds, with their lower metallicity, radically different star formation history, and larger spread in distance to the variables. M31 offers an excellent chance to study more typical disk populations, in a manner which might be extended to more distant galaxies where such variables are still visible, probing a much more evenly spread progenitor age distribution than cepheids (and perhaps useful as a distance scale alternative or cross-check). Our data will also provide a massive and unique color-magnitude dataset; we expect that this study will produce several important results, among them a better understanding of P/L and P/L-color relations for pulsating variables which are essential to the extragalactic distance ladder. We will view these variables at a common distance over a range of metallicities (eliminating the distance-error vs. metallicity ambiguity between the LMC and SMC), allow further insight into possible faint-variable mass-loss for higher metallicities, and in general produce a sample more typical of giant disk galaxies predominant in many studies.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11648
Title: WFC3 spectroscopy of an X-ray luminous galaxy cluster at $z > 2$
PI: Emanuele Daddi
PI Institution: Commissariat a l'Energie Atomique (CEA)

We propose to obtain deep WFC3+G141 grism observations to spectroscopically confirm a remarkable $z > 2$ cluster of galaxy candidate. Over a 1000 arcmin² field imaged with Spitzer's IRAC we have discovered a compact (<30'' diameter) concentration of extremely red galaxies with a factor of >40 overdensity over the adjacent field. Among these galaxies for which we can derive meaningful photometric redshifts, 17 are consistent with $z_{\text{phot}} = 2-2.5$, making it very likely that the concentration is a real cluster at such high redshift. This is further supported by a 3.5 sigma detection of extended X-Ray emission on XMM-

Newton data, by a likely color-magnitude sequence of red galaxies, and by the presence of a giant galaxy consistent with a BCG at the cluster redshift. The general faintness of the red galaxies in all optical bands and their high redshifts prevent confirmation of this cluster with ordinary optical spectroscopy. The WFC3 camera with G141 grism provides the only way to confirm this record high-z cluster and measure its redshift from spectral breaks typical of old stellar populations. Our deep integrations will reveal redshifts for at least 19 ultra-red galaxies in the area and of a similar number of bluer galaxies at the cluster redshift. Knowledge of the cluster redshift based on the HST spectra will allow us to reach important scientific aims: find the most distant X-ray emitting evolved galaxy cluster, determine membership of the other galaxies from photometric SED analysis, study their stellar population properties, characterize the color-magnitude relation with constraints on the formation redshift. The proposed observations will establish a first $z > 2$ benchmark for cluster-field comparisons of galaxy formation at this highest redshift and will firmly establish the progenitors of local rich Abell clusters.

=====

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11649
Title: Elucidating the mystery of the Io footprint time variations
PI: Jean-Claude Gerard
PI Institution: Universite de Liege

The Io UV footprint (IFP) is an auroral emission on Jupiter consisting of one or more spots resulting from the electromagnetic interaction between Io and the Jovian magnetosphere. Recent UV HST observations of the Jovian aurora raised new issues and put previous interpretations under question. Dedicated STIS Time-tag observations based on only 3 HST orbits will help us to directly answer the following questions and test new hypothesis on the physics driving their associated phenomenon. The proposed observations will determine whether the previously observed short timescale (~2 min) variations of the IFP are periodic or burst events. If the (quasi-)periodicity is established, these constraints will help us to understand the origin of these variations. These observations will also clarify the conditions of occurrence of the unexpected quasi-simultaneous variations of the southern multiple spots of the IFP. Moreover, we propose to observe the emergence of the southern leading (or precursor) spot and the possible evolution of its brightness. These two elements might validate or exclude the recently proposed idea that cross-hemisphere electron beams or strong non-linearities of the electromagnetic interaction explain the presence of the leading and secondary spots.

=====

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11650
Title: Mutual Orbits, Colors, Masses, and Bulk Densities of 3 Cold Classical Transneptunian Binaries
PI: William Grundy
PI Institution: Lowell Observatory

Many transneptunian objects (TNOs) have been found to be binary or multiple systems. As in other astrophysical settings, transneptunian binaries (TNBs) offer uniquely valuable information. Their mutual orbits allow the direct determination of their system masses, perhaps the most fundamental physical quantity of any astronomical object. Their frequency of occurrence and dynamical characteristics provide clues to formation conditions and evolution scenarios affecting both the binaries and their single neighbors. Combining masses with sizes, bulk densities can be measured. Densities constrain bulk composition and internal structure, key clues to TNO origins and evolution over time. Several TNB bulk densities have been determined, hinting at interesting trends. But none of them belongs to the Cold Classical sub-population, the one group of TNOs with demonstrably distinct physical characteristics. Two top-priority Spitzer programs will soon observe and measure the sizes of 3 Cold Classical TNBs. This proposal seeks to determine the mutual orbits and thus masses of these systems, enabling computation of their densities.

=====

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11651
Title: Is the atmosphere of the hottest known transiting exoplanet evaporating?
PI: Carole Haswell
PI Institution: Open University

WASP-12 is the hottest and the largest currently known transiting exoplanet. It has the shortest orbital period and is the closest to its host star. Previous spectacular HST observations revealed that the atmosphere of HD 209458b appears to be evaporating away, though this interpretation has recently been questioned. We propose ultraviolet observations of WASP-12 to learn whether it is in a state of hydrodynamic 'blow-off' as the work on HD 209458b would suggest. We will obtain a precise radius for the planet, free from systematic errors caused by the earth's atmosphere. We will use our data to hone models of exoplanet atmospheres.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11652
Title: Throughput Calibration of the 52x0.2E1 Aperture
PI: Sara Heap
PI Institution: NASA Goddard Space Flight Center

The Next Generation Spectral Library (NGSL) is a library of low-dispersion STIS spectra extending from ~0.2-1.0 microns. So far, 378 stars with a wide range in metallicity have been observed. Despite their high S/N>100, many NGSL spectra have 5-10% systematic errors in their spectral energy distributions, which can be traced to throughput variations in the 52x0.2E1 aperture caused by vignetting of a wavelength-dependent asymmetric PSF. We propose to obtain STIS spectra of the HST standard star, BD+75D325, at several positions in the 52x0.2E1 aperture, which will enable us to calibrate the NGSL spectra

properly.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11653
Title: SAINTS - Supernova 1987A INTensive Survey
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 21. HST is the essential tool for resolving SN1987A'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 Australia Telescope, HST, VLT, Spitzer, and Chandra observations to understand the several emission mechanisms at work. Photons from the shocked ring will excite previously invisible gas outside the ring, revealing the true extent of the mass loss that preceded the explosion of Sanduleak -69 202. This will help test ideas for the progenitor of SN 1987A. 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. Questions about SN 1987A remain unanswered. 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.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11654
Title: UV Studies of a Core Collapse Supernova
PI: Robert Kirshner
PI Institution: Harvard University

Observations of the UV spectrum of core collapse SNe hold unique information about nucleosynthesis, the mass loss history, shock physics and dust formation in the explosion on massive stars. This proposal aims at a detailed study of a bright core collapse SN, discovered by any of the many ongoing surveys, either a Type IIP, IIIn or Ibc 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 use the UV continuum as a diagnostic of non-thermal emission from the shock. The overall goal of our team is to achieve a better understanding of these objects by combining HST data with complementary ground-based observations. We have used HST to obtain UV spectra from the explosion to the nebular phase. Over the past decade, we have conducted studies of nearby SNe with HST, and we have published an extensive series of papers. When Nature provides a bright candidate, HST should be ready to respond.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS

ID: 11655
Title: Dynamics of the Galactic bulge/bar
PI: Konrad Kuijken
PI Institution: Universiteit Leiden

We request second-epoch ACS observations of four star fields in the Galactic bar. These will allow us to measure proper motions for tens of thousands of stars well below the turnoff, to construct a dynamical model for the bulge/bar (in combination with data already in hand from other HST fields, and from VLT spectroscopy), and hence to take a unique look at the internal dynamical structure of the central regions of our Galaxy. By relating the kinematics with stellar population we can elucidate the formation history of the bulge and bar, and their relation to the surrounding Galactic disk. This is a resubmission of an approved Cycle 15 proposal that was hit by the ACS malfunction.

=====

Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 11656
Title: A Comprehensive Survey of Neptune's Small Moons and Faint Rings
PI: Mark Showalter
PI Institution: SETI Institute

We will use the High Resolution Channel of ACS to study the inner rings, arcs and moons of Neptune with a sensitivity that exceeds that achieved by any previous observations, including Voyager 2 during its 1989 flyby. Our study will reveal any inner moons down to V magnitude 25.5, corresponding to a radius ~ 15 km (assuming 9% albedo), to address a peculiar, apparent truncation in the size distribution of inner moons and to look for the "shepherds" and source bodies for Neptune's dusty rings. (For comparison, the radius of Neptune's smallest known regular moon, Naiad, is ~ 33 km.) Monitoring of the arcs at fine resolution and sensitivity will reveal their ongoing evolution more clearly and will enable us to assess the role of Galatea, whose resonant perturbations are widely believed to confine the arcs. Our study will also reveal any broad, faint rings with optical depth $\sim 10^{-6}$, comparable to those now known to encircle all of the other giant planets.

=====

Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11657
Title: The population of compact planetary nebulae in the Galactic Disk
PI: Letizia Stanghellini
PI Institution: National Optical Astronomy Observatories, AURA

We propose to secure narrow- and broad-band images of compact planetary nebulae (PNe) in the Galactic Disk to study the missing link of the early phases of post-AGB evolution. Ejected AGB envelopes become PNe when the gas is ionized. PNe expand, and, when large enough, can be studied in detail from the ground. In the interim, only the HST capabilities can resolve their size,

morphology, and central stars. Our proposed observations will be the basis for a systematic study of the onset of morphology. Dust properties of the proposed targets will be available through approved Spitzer/IRS spectra, and so will the abundances of the alpha-elements. We will be able thus to explore the interconnection of morphology, dust grains, stellar evolution, and populations. The target selection is suitable to explore the nebular and stellar properties across the Galactic Disk, and to set constraints on the Galactic evolutionary models through the analysis of metallicity and population gradients.

=====
Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11658
Title: Probing the Outer Regions of M31 with QSO Absorption Lines
PI: David Turnshek
PI Institution: University of Pittsburgh

We propose HST-COS spectroscopy of 10 quasars behind M31. Absorption lines due to MgII, FeII, CIV, and a variety of other lines will be searched for and measured. Six quasars lie between 1 and 4.2 Holmberg radii near the major axis on the southwest side, where confusion with Milky Way gas is minimized. Two lie even farther out on the southwest side of the major axis. One lies within 1 Holmberg radius. Two of the 10 pass through M31's high velocity clouds seen in a detailed 21 cm emission map. Exposure time estimates were based on SDSS magnitudes and available GALEX magnitudes. Thus, using the most well-studied external spiral galaxy in the sky, our observations will permit us to check, better than ever before, the standard picture that quasar metal-line absorption systems such as MgII and CIV arise in an extended gaseous halo/disk of a galaxy well beyond its observable optical radius. The observations will yield insights into the nature of the gas and its connection to the very extended stellar components of M31 that have recently been studied. Notably the observations have the potential of extending M31's rotation curve to very large galactocentric distances, thereby placing new constraints on M31's dark matter halo. Finally, we also request that the coordinated parallel orbits be allocated to this program so that we may image the resolved stellar content of M31's halo and outer disk (see Special Requirements).

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11659
Title: Probing the Interior of SN1006
PI: P. Winkler
PI Institution: Middlebury College

The remnant of SN 1006 is unique among all supernova remnants in having 3 identified background UV sources that can be used to probe cold, otherwise unseen ejecta within the remnant shell. We propose high-resolution spectra from COS to obtain spectra of all three of these. The brightest of these, the Schweizer-Middleditch star (the only one with extensive previous high-quality UV spectra) shows Si II absorption with an extremely unusual asymmetric

profile with a sharp edge on the red end, indicating the velocity of material just entering the reverse shock. Our new spectrum can be compared with STIS observations from 1999 to measure definitively the velocity change as the reverse shock eats its way into ever-more-slowly-expanding ejecta. One may well ask, however, if this profile is truly representative, and we seek to answer that with a spectrum of a background quasar at a similar distance of the SM star from the projected center, but in a different direction. And by investigating the detailed structure of these two sources and a second quasar, we can probe small-scale structure in the ejecta. No object other than SN1006 offers a similar opportunity to probe the distribution of ejecta within the remnant of a Type Ia supernova.

=====

Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 11660
Title: Investigation Jet Rotation in Young Stars via High Resolution UV Spectra
PI: Francesca Bacciotti
PI Institution: Osservatorio Astrofisico di Arcetri

In recent years we have successfully harnessed the high resolution of STIS in the optical to reveal asymmetries in Doppler shifts transverse to the flow direction in 8 T Tauri jets (Bacciotti ea 2002; Woitas ea 2005; Coffey ea 2004; 2007). We interpret the findings, just 100 AU above the disk, as signatures of jet rotation. The significance of these results is considerable. They form the only existing observational indications supporting the theory that jets extract angular momentum from star-disk systems. Furthermore, they hold the potential to discriminate between the main model contenders: X-wind and Disk-wind (Ferreira ea 2006). Although our results are encouraging, it is evident that we are only marginally resolving the effects of rotation because of the limiting resolution (spatially and spectrally) of STIS in the optical. Therefore, in Cycle 12 we proposed to extend this study into the near-ultraviolet (NUV), giving double the spatial and spectral resolution (proposal ID 9807). Unfortunately, only 3 targets in our survey were observed before the failure of STIS (Coffey ea 2007). Nevertheless, the results were very exciting. Agreement was found between the optical and NUV results in terms of the magnitude and sense of the Doppler shift gradient across the jet. Furthermore, the NUV lines indicated that the observed high velocity gas was launched from about 0.2-0.5 AU, compared to the lower velocity gas traced in optical lines which originates from as far as 2 AU. This puts a strong constraint on MHD launch models, and indeed holds the potential to differentiate between them. Given that the strength of a rotation argument lies in the survey nature of the findings, we need to resume this program in order to see if the same rotation signatures are commonly seen in the NUV, as they are in the optical. Furthermore, the higher spatial and spectral resolution of STIS in the NUV will allow us to more accurately quantify the variation in toroidal velocity as a function of distance from the jet axis. This study will provide an invaluable statistical argument to support the fact that we are indeed observing jet rotation. Such a conclusion is critical to providing observational backing to the widely accepted but untested theory of magnetocentrifugal ejection.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11661
Title: The Black Hole Mass - Bulge Luminosity Relationship for
the Nearest Reverberation-Mapped AGNs
PI: Misty Bentz
PI Institution: University of California - Irvine

We propose to obtain WFC3 host galaxy images of the eight nearest AGNs with masses from reverberation mapping, and one star as a PSF model. These images will allow us to determine with unprecedented accuracy the bulge luminosities of the host galaxies, a goal which is not achievable from the ground due to the blurring of the very bright PSF component under typical, and even very good, seeing conditions. High-resolution ACS images of the host galaxies of more luminous AGNs reveal that the black hole mass-bulge luminosity and black hole mass-bulge mass relationships for AGNs are not well constrained and arise from what appear to be fundamentally flawed data sets. With the addition of the images proposed here to our current sample of ACS images, we will be able to extend our determinations of the black hole mass-bulge luminosity and black hole mass-bulge mass relationships for AGNs by an order of magnitude and test our preliminary results for these fundamentally important relationships against those previously determined for quiescent galaxies.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11662
Title: Improving the Radius-Luminosity Relationship for Broad-
Lined AGNs with a New Reverberation Sample
PI: Misty Bentz
PI Institution: University of California - Irvine

The radius-luminosity (R-L) relationship is currently the fundamental basis for all techniques used to estimate black hole masses in AGNs, in both the nearby and distant universe. However, the current R-L relationship is based on 34 objects that cover a limited range in black hole mass and luminosity. To improve our understanding of black hole growth and evolution, the R-L relationship must be extended to cover a broader range of black hole masses using the technique known as reverberation mapping. To this end, we have been awarded an unprecedented 64 nights on the Lick Observatory 3-m telescope between March 24 and May 31, 2008, to spectroscopically monitor 12 AGNs in order to measure their black hole masses. To properly determine the luminosities of these 12 AGNs, we must correct them for their host-galaxy starlight contributions using high-resolution images. Previous work by Bentz et al. (2006) has shown that the starlight correction to AGN luminosity measurements is an essential component to interpreting the R-L relationship. The correction will be substantial for each of the 12 sources we will monitor, as the AGNs are relatively faint and embedded in nearby, bright galaxies. Starlight corrections are not possible with ground-based images, as the PSF and bulge contributions become indistinguishable under typical seeing conditions, and adaptive optics are not yet operational in the spectral range where the corrections are needed. In addition, spectral decompositions are

very model-dependent and are limited by the degree of accuracy to which we understand emission processes and stellar populations in galaxies. Without correcting for starlight, we will be unable to apply the results of our Spring 2008 campaign to the body of knowledge from previous reverberation mapping work. Therefore, we propose to obtain high resolution, high dynamic range images of the host galaxies of the 12 AGNs in our ground-based monitoring sample, as well as one white dwarf which will be used as a PSF model.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11663
Title: Formation and Evolution of Massive Galaxies in the
Richest Environments at $1.5 < z < 2.0$
PI: Mark Brodwin
PI Institution: National Optical Astronomy Observatories, AURA

We propose to image seven $1.5 < z < 2$ clusters and groups from the IRAC Shallow Cluster Survey with WFC3 and ACS in order to study the formation and evolution of massive galaxies in the richest environments in the Universe in this important redshift range. We will measure the evolution of the sizes and morphologies of massive cluster galaxies, as a function of redshift, richness, radius and local density. In combination with allocated Keck spectroscopy, we will directly measure the dry merger fraction in these clusters, as well as the evolution of Brightest Cluster Galaxies (BCGs) over this redshift range where clear model predictions can be confronted. Finally we will measure both the epoch of formation of the stellar populations and the assembly history of that stellar mass, the two key parameters in the modern galaxy formation paradigm.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11664
Title: The WFC3 Galactic Bulge Treasury Program: Populations,
Formation History, and Planets
PI: Thomas Brown
PI Institution: Space Telescope Science Institute

Exploiting the full power of the Wide Field Camera 3 (WFC3), we propose deep panchromatic imaging of four fields in the Galactic bulge. These data will enable a sensitive dissection of its stellar populations, using a new set of reddening-free photometric indices we have constructed from broad-band filters across UV, optical, and near-IR wavelengths. These indices will provide accurate temperatures and metallicities for hundreds of thousands of individual bulge stars. Proper motions of these stars derived from multi-epoch observations will allow separation of pure bulge samples from foreground disk contamination. Our catalogs of proper motions and panchromatic photometry will support a wide range of bulge studies. Using these photometric and astrometric tools, we will reconstruct the detailed star-formation history as a function of position within the bulge, and thus differentiate between rapid- and extended-formation scenarios. We will also measure the dependence of the stellar mass function on metallicity, revealing how the characteristic mass of

star formation varies with chemistry. Our sample of bulge stars with accurate metallicities will include 12 candidate hosts of extrasolar planets. Planet frequency is correlated with metallicity in the solar neighborhood; our measurements will extend this knowledge to a remote environment with a very distinct chemistry. Our proposal also includes observations of six well-studied globular and open star clusters; these observations will serve to calibrate our photometric indices, provide empirical population templates, and transform the theoretical isochrone libraries into the WFC3 filter system. Besides enabling our own program, these products will provide powerful new tools for a host of other stellar-population investigations with HST/WFC3. We will deliver all of the products from this Treasury Program to the community in a timely fashion.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11665
Title: The Formation Mechanisms of Extreme Horizontal Branch Stars
PI: Thomas Brown
PI Institution: Space Telescope Science Institute

Blue hook stars are a class of hot (~35,000 K) subluminoous extreme horizontal branch (EHB) stars that have been recently discovered using HST ultraviolet images of the massive globular clusters omega Cen and NGC 2808. These stars occupy a region of the HR diagram that is unexplained by canonical stellar evolution theory. Using new theoretical evolutionary and atmospheric models, we have shown that the blue hook stars are very likely the progeny of stars that undergo extensive internal mixing during a late helium core flash on the white dwarf cooling curve. This "flash mixing" produces an enormous enhancement of the surface helium and carbon abundances (relative to the abundance pattern that existed on the main sequence), which suppresses the observed flux in the far-UV. Because stars born with a high helium abundance are more likely to evolve into hot horizontal branch stars, flash mixing is more likely to occur in those massive clusters capable of helium self-enrichment. However, a high initial helium abundance, by itself, is not sufficient to explain the presence of a blue hook population - flash mixing of the envelope is also required. We propose far-UV spectroscopy of normal and subluminoous EHB stars in NGC 2808 that will unambiguously test this new formation mechanism. These observations will easily detect the helium and carbon enhancements predicted by flash mixing and will therefore determine if flash mixing represents a new evolutionary channel for populating the hot end of the EHB. More generally, our observations will help to clarify the role of helium self-enrichment in producing blue horizontal branch morphologies and multiple main sequences in massive globular clusters. Finally, these results will provide new insight into the origin and abundance anomalies of the hot helium-rich subdwarf B and O stars in the Galactic field.

=====
Proposal Category: GO
Scientific Category: COOL STARS
ID: 11666
Title: Chilly Pairs: A Search for the Latest-type Brown Dwarf

Binaries and the Prototype Y Dwarf
PI: Adam Burgasser
PI Institution: Massachusetts Institute of Technology

We propose to use HST/NICMOS to image a sample of 27 of the nearest (< 20 pc) and lowest luminosity T-type brown dwarfs in order to identify and characterize new very low mass binary systems. Only 3 late-type T dwarf binaries have been found to date, despite that fact that these systems are critical benchmarks for evolutionary and atmospheric models at the lowest masses. They are also the most likely systems to harbor Y dwarf companions, an as yet unpopulated putative class of very cold ($T < 600$ K) brown dwarfs. Our proposed program will more than double the number of T5-T9 dwarfs imaged at high resolution, with an anticipated yield of ~ 5 new binaries with initial characterization of component spectral types. We will be able to probe separations sufficient to identify systems suitable for astrometric orbit and dynamical mass measurements. We also expect one of our discoveries to contain the first Y-type brown dwarf. Our proposed program complements and augments ongoing ground-based adaptive optics surveys and provides pathway science for JWST.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11667
Title: Detailed Probing of a 3000 km/s Ly-alpha + Metal Line
Absorption Complex Near Two Galaxies at $z=0.67$
PI: Christopher Churchill
PI Institution: New Mexico State University

At intermediate redshifts, Ly-alpha absorbers cluster around rich metal-line systems [those with numerous low and high ionization species (Bahcall et al.)], and at $z=3$, higher ionization clouds reside at the velocity extremes of clustered Ly-alpha lines, a signature of the physics of collapse and layered gas structures (Songaila & Cowie). These extraordinary HI environments provide unique astrophysical laboratories for probing relatively high overdensity IGM structures and for placing powerful constraints on our understanding of the intergalactic medium and extended galaxy halos in the context of structure evolution, galactic stellar feedback chemical enrichment to large galactocentric distances, and the cosmic baryon budget. We have undertaken a comprehensive study of the remarkable 1400 km/s velocity width, optically thin Ly-alpha only complex (five components) at $z=0.67$ within 1600 km/s of the Lyman limit $z=0.66$ metal-line system toward TON 153 (Churchill et al.). We have collected FOS, STIS, and HIRES quasar spectra covering the Lyman series, OVI, CIV, and MgII absorption, an F702W/WFPC-2 image, and set of ground based narrow-band SDSS filter images of the quasar field. Two galaxies aligned in velocity with the $z=0.67$ Ly-alpha complex and $z=0.66$ metal-line system lie within 100 kpc of the quasar sightline; the absorption is not consistent with our standard model of extended "halo" gas for either galaxy, which suggests that a large scale structure (i.e., filament) may extend between these galaxies. We propose to obtain G160M/1600 and G185M/1921+1941 (S/N >10) COS spectra of the $z=1.01$ quasar TON 153 to obtain detailed kinematic, chemical, and ionization conditions of this extraordinary absorber/galaxy system (total velocity spread 3000 km/s). The propose

observations will provide an unprecedented first high resolution examination of the full Lyman series and MgII, CIV, and OVI metal lines arising in galaxy halos or a possible large scale structure (i.e., filament) associated with thoroughly studied galaxies. We aim to discern if the HI extends between the galaxies and test for multiphase absorption signatures suggestive of a galactic feedback or large scale collapsing structure.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11668
Title: Cosmo-chronometry and Elemental Abundance Distribution of the Ancient Star HE1523-0901
PI: Anna Frebel
PI Institution: University of Texas at Austin

We propose to obtain near-UV HST/STIS spectroscopy of the extremely metal-poor, highly r-process-enhanced halo star HE 1523-0901, in order to produce the most complete abundance distribution of the heaviest stable elements, including platinum, osmium, and lead. These HST abundance data will then be used to estimate the initial abundances of the long-lived radioactive elements thorium and uranium, and by comparison with their observed abundances, enable an accurate age determination of this ancient star. The use of radioactive chronometers in stars provides an independent lower limit on the age of the Galaxy, which can be compared with alternative limits set by globular clusters and by analysis from WMAP. Our proposed observations of HE1523-0901 will also provide significant new information about the early chemical history of the Galaxy, specifically, the nature of the first generations of stars and the types of nucleosynthetic processes that occurred at the onset of Galactic chemical evolution.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11669
Title: The Origins of Short Gamma-Ray Bursts
PI: Andrew Fruchter
PI Institution: Space Telescope Science Institute

During the past decade extraordinary progress has been made in determining the origin of long-duration gamma-ray bursts. It has been conclusively shown that these objects derive from the deaths of massive stars. Nonetheless, the origin of their observational cousins, short-duration gamma-ray bursts (SGRBs) remains a mystery. While SGRBs are widely thought to result from the inspiral of compact binaries, this is a conjecture. SGRBs have been found in elliptical galaxies, Abell Clusters, star-forming dwarfs and even an edge-on spiral. Whether they primarily result from an old population, a young population, or rapid evolution of binaries in globular clusters remains open. Here we propose to employ two related sets of observations which may dramatically advance our understanding of short bursts. The first is a variant of a technique that we pioneered and used to great effect in elucidating the origins of long-duration bursts. We will examine a statistical sample of hosts and measure the degree to which SGRB locations

trace the red or blue light of their hosts, and thus old or young stellar populations. This will allow us to study the demographics of the SGRB population in a manner largely free of the distance dependent selection effects which have so far bedeviled this field. In the second line of attack we will use two targets of opportunity to obtain extremely precise positions of up to two nearby bursts -- one on a star-forming galaxy and the other on a elliptical. Observation of the star-formation galaxy could link at least some bursts directly to a young population; however, a discovery in later images of a globular cluster at the site of the explosion in an elliptical would provide revolutionary evidence that SGRBs are formed from compact binaries.

=====
Proposal Category: SNAP
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11670
Title: The Host Environments of Type Ia Supernovae in the SDSS Survey
PI: Peter Garnavich
PI Institution: University of Notre Dame

The Sloan Digital Sky Survey Supernova Survey has discovered nearly 500 type Ia supernovae and created a large, unique, and uniform sample of these cosmological tools. As part of a comprehensive study of the supernova hosts, we propose to obtain Hubble ACS images of a large fraction of these galaxies. Integrated colors and spectra will be measured from the ground, but we require high resolution HST imaging to provide accurate morphologies and color information at the site of the explosion. This information is essential in determining the systematic effects of population age on type Ia supernova luminosities and improving their reliability in measuring dark energy. Recent studies suggest two populations of type Ia supernovae: a class that explodes promptly after star-formation and one that is delayed by billions of years. Measuring the star-formation rate at the site of the supernova from colors in the HST images may be the best way to differentiate between these classes.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11671
Title: Kinematic Reconstruction of the Origin and IMF of the Massive Young Clusters at the Galactic Center
PI: Andrea Ghez
PI Institution: University of California - Los Angeles

We propose to exploit the wide field capabilities of Wide Field Camera 3 to study star formation at the Galactic center. By studying young stars located in the most the physically extreme region of our Galaxy, we can test star formation theories, which suggest that such environments should favor high mass stars and, in extreme cases, should suppress star formation entirely. Specifically, we will measure the proper motions and photometry of stars over the full extent of the three massive young clusters that have been identified at the Galactic Center (Arches, Quintuplet, and the Young Nuclear Star Cluster). These observations are a factor of ~2000 more efficient than what can be done with ground-based adaptive optics. Our goals are two-fold. First,

we hope to establish the initial sites of star formation in order to obtain an accurate estimate of the conditions that led to the stellar populations within these clusters. Answering this question for the Young Nuclear Star Cluster is particularly important as it establishes whether or not star formation can indeed proceed within 0.1 pc of our Galaxy's supermassive black hole. Second, we will measure the IMF in the Arches and Quintuplet, where dynamical evolution is less severe, using proper motions to determine membership and to reveal the tidal radius. Probing how the properties of the emergent stellar populations within our Galaxy may be affected by the physical environment in which they arise is an important first step to understanding how they might vary as a function of cosmic time and thereby affect our models of galaxy formation and evolution.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11672
Title: Microlensing of the Broad Line Region in the Most
Anomalous Lensed Quasar
PI: Charles Keeton
PI Institution: Rutgers the State University of New Jersey

The gravitationally lensed quasar SDSS J0924+0219 has highly anomalous flux ratios: image D is more than a factor of 10 fainter than expected if the lens galaxy has a smooth mass distribution. From previous HST spectra (Keeton et al. 2006) and photometric variability (Morgan et al. 2006) we know the anomalous continuum flux ratios are caused by microlensing by stars in the lens galaxy. However, with existing data we do not know whether the anomalous emission line flux ratios are caused by microlensing by stars or millilensing by dark matter clumps. With just four orbits we can measure spectra at two more epochs and determine unambiguously whether the quasar's broad line region (BLR) is microlensed. If the emission line flux ratios vary, that would prove the BLR is microlensed and make SDSS0924 only the second known quasar with microlensing of an optical broad emission line. In this case we would be able to constrain the BLR size and relative densities of stars and dark matter in the lens galaxy. Conversely, if the emission line flux ratios do not vary, that would prove the BLR is millilensed rather than microlensed, and make SDSS0924 the first lens known to have both microlensing (of the continuum) and millilensing (of the BLR). This would usher in a new and rich field of multiscale lensing. The conclusions about small-scale structure in galaxies and quasars will be exciting in either case. This experiment is infeasible with ground-based telescopes, but with HST it is easy and fast to make this powerful test of small-scale structure in SDSS0924.

=====
Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11673
Title: Dynamics in the atmosphere of the evaporating planet
HD189733b
PI: Alain Lecavelier des Etangs
PI Institution: CNRS, Institut d'Astrophysique de Paris

With HST/STIS, we detected and characterized the upper atmosphere of the extrasolar planet HD209458b, showing that the planet must be evaporating at a rate of $\sim 10^{10}$ g/s in a "blow-off" mechanism. More recently, using ACS we concluded that HD189733b is also evaporating. However, because of the low resolution of the ACS prism spectroscopy, the escape rate and mechanism are still to be determined. This is one of the prime objectives of the present proposal. COS observations of the absorption line profile with 15 km/s resolution will allow us to probe the dynamics of the escaping gas, and therefore to determine the escape rate. Simultaneous observations of the transit depth and spectral shape in several important lines (not only HI, but also OI, CII and possibly NI) will constrain the escape mechanism and allow us to distinguish between several scenarios. The results will enlighten the physical phenomena at work in the exosphere of these extrasolar planets, and provide new constraints for the modeling of the evaporation of hot-Jupiters.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11674
Title: A STIS NUV Search for Shocked-Interstellar and
Circumstellar Gas towards the Debris Disk System, HD
61005
PI: Holly Maness
PI Institution: University of California - Berkeley

Circumstellar debris disks provide the principle window for investigating planet formation and evolution on timescales of 10-100 Myr. Unlike their younger counterparts, debris disks no longer contain primordial material. The dust observed in these objects is instead produced by collisional erosion of larger parent bodies in the developing planetary system. Currently, only five confirmed debris disks have detected circumstellar gas, studied primarily through UV absorption spectroscopy. The exact production mechanisms for this replenished gas are presently poorly constrained. However, the few objects studied so far have revealed a wide range of intriguing properties, including a stable Keplerian gas disk maintained by its high carbon abundance (Beta Pic), and a rapidly expelled population of gas produced in collisions between unstable planetesimals (Sigma Her). To add to this important set of observations, we propose to obtain NUV STIS spectroscopy of the debris disk host, HD 61005, a nearly edge-on debris disk notable for its swept asymmetric morphology. These observations allow the likely detection of circumstellar gas, making HD 61005 the first solar-type debris disk host with gas detected in this way. Thus, the proposed observations provide the unique opportunity to study gas in a debris disk analogous to our early solar system. In addition to potentially detecting circumstellar gas associated with this system, HD 61005 offers the possibility of tracing interstellar bow-shocked gas. HD 61005 is a unique debris disk in terms of its significant interaction with the interstellar medium. The proposed observations will, therefore, be the first to directly probe the interaction between a debris disk and its surrounding interstellar material. STIS is ideally suited for this experiment, providing sensitive NUV spectra with the required balance between spectral resolution and wavelength coverage.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11675
Title: Stellar Forensics: A post-explosion view of the
progenitors of core-collapse supernovae
PI: Justyn Maund
PI Institution: University of Texas at Austin

Recent studies have used high spatial resolution HST observations of SN sites to 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 ACS/HRC of the sites of six core-collapse SNe. In this program we aim to: 1) confirm our identifications, that were made with HST pre-explosion images, of the red supergiant progenitors of four Type IIP SNe (1999ev, 2003gd, 2004A and 2005cs), by observing if the objects identified as the progenitors are now missing; 2) place precise constraints on the progenitor of the Type Ic SN 2007gr by studying its host cluster; and 3) confirm our identification of an LBV-like outburst of an unstable WR star as belonging to the progenitor of a Type Ib-n core-collapse SN (2006jc), using broad and narrow-band imaging to search for emission line stars in its locality. The deep imaging will also allow to probe the stellar populations in the immediate vicinities of these SNe, that were previously obscured by the progenitors and the bright SNe. HST provides the unique combination of high-resolution optical imaging at very faint magnitudes that will facilitate this study.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11676
Title: A Deep ACS Study of the Spiral Outflow from the Extreme
Carbon Star, CRL3068
PI: Mark Morris
PI Institution: University of California - Los Angeles

At optical wavelengths, the extreme carbon star, AFGL3068, exhibits a remarkable spiral morphology in its dense, outflowing, circumstellar envelope, showing at least 5 windings of its externally illuminated dust shell around the invisible central star. Near-IR imaging with the Keck Telescope shows that this is a binary system with ~ 100 AU separation, so the spiral structure seen in the circumstellar outflow is apparently caused by the binary interaction. We propose to obtain relatively deep images of this spiral dust structure with the F475W and F606W filters in order to: 1) image more distant windings of the spiral structure, if they are present, and thereby explore the history of the mass loss rate, and 2) refine the details of the spiral density distribution of dust, for comparison with our existing dynamical & radiative transfer models of gas flow within a binary system containing a star undergoing spherical mass loss. With the proposed imaging in two filters, we will also have the color information for comparison with our models of the external illumination of the dusty envelope by Galactic starlight. Comparable

dust "arcs" have been observed in a variety of other post-AGB stars, planetary and preplanetary nebulae, but none is as highly organized, as continuous, nor as clearly defined as the dust structure in AFGL3068. By understanding this favorable case, we hope to gain insights into this whole class of objects.

=====

Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11677
Title: Is 47 Tuc Young? Measuring its White Dwarf Cooling Age
and Completing a Hubble Legacy
PI: Harvey Richer
PI Institution: University of British Columbia

With this proposal we will firmly establish the age of 47 Tuc from its cooling white dwarfs. 47 Tuc is the nearest and least reddened of the metal-rich disk globular clusters. It is also the template used for studying the giant branches of nearby resolved galaxies. In addition, the age sensitive magnitude spread between the main sequence turnoff and horizontal branch is identical for 47 Tuc, two bulge globular clusters and the bulge field population. A precise relative age constraint for 47 Tuc, compared to the halo clusters M4 and NGC 6397, both of which we recently dated via white dwarf cooling, would therefore constrain when the bulge formed relative to the old halo globular clusters. Of particular interest is that with the higher quality ACS data on NGC 6397, we are now capable with the technique of white dwarf cooling of determining ages to an accuracy of ± 0.4 Gyrs at the 95% confidence level. Ages derived from the cluster turnoff are not currently capable of reaching this precision. The important role that 47 Tuc plays in galaxy formation studies, and as the metal-rich template for the globular clusters, makes the case for a white dwarf cooling age for this metal-rich cluster compelling. Several recent analyses have suggested that 47 Tuc is more than 2 Gyrs younger than the Galactic halo. Others have suggested an age similar to that of the most metal poor globular clusters. The current situation is clearly uncertain and obviously a new approach to age dating this important cluster is required. With the observations of 47 Tuc, this project will complete a legacy for HST. It will be the third globular cluster observed for white dwarf cooling; the three covering almost the full metallicity range of the cluster system. Unless JWST has its proposed bluer filters (700 and 900 nm) this science will not be possible perhaps for decades until a large optical telescope is again in space. Ages for globular clusters from the main sequence turnoff are less precise than those from white dwarf cooling making the science with the current proposal truly urgent.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11678
Title: Resolved H alpha star formation in two lensed galaxies at $z=0.9$
PI: Jane Rigby
PI Institution: Carnegie Institution of Washington

We propose to obtain H alpha narrow-band imaging for two galaxies at $z=0.912$

that have been gravitationally lensed by the galaxy cluster Abell 2390. H alpha falls squarely into the F126N filter at this redshift, and both galaxies fit in a single WFC3 field of view. Because these two galaxies are magnified by factors of 6.7 (+0.4) and 12.6 (+0.8), WFC3 IR pixels probe spatial scales of 150 and 80 pc. (Without lensing, the WFC3 pixels probe 1 kpc scales at these redshifts.) Thus, these two galaxies provide a rare chance to examine, in detail and at high S/N, the spatial distribution of star formation in galaxies at z=1. The H alpha map, when compared to the existing [O II] 3727 ground-based map and rest-UV WFPC2 images, will map out the extinction in these galaxies, and can be used to test integrated diagnostics of star formation rate obtained with Spitzer.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11679
Title: Probing The Globular Cluster / Low Mass X-ray Binary
Connection in Early-type Galaxies At Low X-ray
Luminosities
PI: Craig Sarazin
PI Institution: The University of Virginia

Combined high-resolution images from Hubble and Chandra (CXO) have revolutionized our understanding of extragalactic low-mass X-ray binaries (LMXBs) and globular clusters (GCs), yet their connection in early-type galaxies has remained unstudied at the luminosities of the Galactic LMXBs in GCs. NGC 3379 and NGC 4278 are the first prototypical elliptical galaxies with complete, deep CXO observations enabling the study of LMXBs at lower luminosities. We propose completing mosaic ACS observations of both galaxies (5 fields per galaxy) that will provide the most comprehensive view into the connection between GCs and LMXBs in early-type galaxies. We will detect ~860 and ~270 GCs in all of NGC 4278 and NGC 3379, respectively. These two galaxies will have among the greatest number of detected GC-LMXBs to date (~130 & 50) and will include the faintest GC-LMXBs in a normal early-type galaxy. We will measure the fraction of GCs which contain LMXBs, as a function of X-ray luminosity, galactocentric distance, color, and GC half-light radius. Using the radial profiles of optical light, GCs, and LMXBs, we will determine the percentage of field LMXBs which may have originated in GCs. We will use the measured GC properties over the entire extent of both galaxies to constrain theories of GC formation and evolution. This is a resubmission of an approved Cycle 15 program (10835) which was only partially completed.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11680
Title: The Main Sequence Luminosity Function of Low-Mass
Globular Clusters
PI: Graeme Smith
PI Institution: University of California - Santa Cruz

Theoretical work indicates that the dynamical evolution of globular clusters of low mass and low central concentration is strongly determined by mass-loss

processes, such as stellar evaporation and tidal stripping, that can eventually lead to cluster dissolution. In fact, mass loss and cluster disruption is now considered to be a viable explanation for the form of the faint end of the Milky Way globular cluster luminosity function. A clear observational demonstration of the prevalence of cluster mass-loss would have ramifications not only for the dynamical evolution of individual globular clusters and their internal stellar mass distributions, but also for the relationships between halo field and cluster stars and the properties of globular cluster systems in galaxies. Our previous WFPC2 imaging of the low-mass diffuse halo cluster Palomar 5 revealed a main sequence deficient in stars compared to other low-concentration globular clusters of much higher mass, consistent with there having been a considerable loss of stars from this system. But is Pal 5 typical of low-mass, low-concentration halo clusters? We propose to place the mass-loss scenario on a firm observational footing (or otherwise) by using WFC3 imaging to measure the main-sequence stellar mass functions of two of the lowest-mass lowest-concentration globular clusters in the Milky Way, AM-4 and Palomar 13, in order to search for analogous evidence of stellar depletion.

=====

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11681
Title: A Search for Ultraviolet Emission Filaments in Cool Core Clusters
PI: William Sparks
PI Institution: Space Telescope Science Institute

We propose to use ACS SBC imaging to seek ultraviolet CIV emission filaments in clusters of galaxies exhibiting strong cool-core X-ray emission and optical line emission filaments. These short observations are crafted to test thermal conduction models for the filament excitation, and can significantly impact our understanding of the overall physical processes dominant in the galaxy cluster ISM.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11682
Title: An HST/STIS spectroscopic investigation:
. is Kelu-1 AB a brown dwarf - brown dwarf binary?
PI: Micaela Stumpf
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

We propose to obtain resolved HST/STIS spectroscopy for the benchmark binary brown dwarf Kelu-1 AB. Dynamical masses are being obtained by monitoring the orbital motion using ground-based telescopes with adaptive optics. The main goal of this program is to study the Li I resonance line at 670.8 nm and investigate if only one or even both components bear lithium. This observation will be compared to model predictions of lithium depletion as a function of age and mass, and including our model independent ground-based mass estimations, hence will provide an observational test to the theory of substellar objects. Spin-offs will be the measurement of the strength of H-

alpha emission, an indicator of chromospheric activity in cool atmospheres, and comparing the shape of the optical continuum with model spectra with different dust opacities. Thus our program will be an important step towards the understanding of brown dwarf atmospheres and to establish precise models for their formation and evolution.

=====
Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11683
Title: Intracluster star formation and galaxy transformation:
ESO 137-001 in A3627
PI: Ming Sun
PI Institution: Michigan State University

ESO137-001 is a small starburst galaxy in the nearby massive cluster A3627. A 70 kpc long X-ray tail behind ESO 137-001 has been revealed by both Chandra and XMM data, which makes it the only known late-type galaxy with an X-ray tail in a Coma-like cluster. Our SOAR observations also reveal a 40 kpc H α tail in the position of the X-ray tail, as well as ~ 30 intracluster HII regions in or around the tail. We propose HST observations of this unique galaxy to resolve the distorted galactic structures in transformation, and to search for young star clusters in or around the tail, and to understand star formation in the galaxy and in the intracluster space. The results will be of general interest to galaxy transformation in clusters (e.g., 'Butcher-Oemler' galaxies at $z>0.3$), starburst induced by ICM pressure, and intracluster star formation.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11684
Title: The First Proper Motion Measurement for M31: Dynamics and Mass of the Local Group
PI: Roeland van der Marel
PI Institution: Space Telescope Science Institute

We propose to determine the proper motion of the Andromeda galaxy M31, which has been sought for almost a century without success. While challenging, this measurement has now become possible due to the availability of existing deep ACS/WFC images of several M31 fields. The requested second epoch images will yield the average shift of the M31 stars with respect to compact galaxies in the background. From detailed astrometric analysis we find that these galaxies provide an average positional accuracy (per galaxy per half-orbit exposure) of 0.04 pixels. Given the measured number of galaxies (~ 100), the requested number of exposures (18), and the 4.5-6.5 year time baselines, this will yield a proper motion random error of only 40 km/s at the distance of M31. Our observing strategy uses six different fields (three primary and three coordinated parallel) with two different instruments (ACS and WFC3) to provide a maximum handle on possible systematic effects. This fundamental measurement will be sufficiently accurate to: (a) discriminate between different histories for the dynamics of the Local Group; (b) constrain the mass distribution of the Local Group; (c) determine the details of the expected future merger

between M31 and the Milky Way; (d) infer the past interaction history between M31 and M33; (e) constrain the internal proper motion kinematics of the M31 spheroid, outer disk, and tidal stream; and (f) obtain a pilot estimate of the M31 distance through the method of rotational parallax. Our team is well positioned to make this project a success, given that we have already obtained the first epoch data, explored the kinematics of the target fields through Keck spectroscopy, developed the software for the astrometric analysis, and published the most stringent indirect constraints on the M31 proper motion.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11685
Title: Supermassive Neutron Stars or Odd binaries: Searching for Companions to Pulsars NGC 6440B and Terzan 5J
PI: Marten van Kerkwijk
PI Institution: University of Toronto

Recent sensitive pulsar searches of globular clusters uncovered four pulsars with very high inferred masses, between 1.7 and 2.7 solar masses. These strongly constrain the behaviour of matter in the ultra-dense interiors of neutron stars, since for most models such massive neutron stars could not exist. All four masses are inferred from the measured advance of periastron with time, under the assumption that it is due to General Relativity only. Here, we propose to test whether part of the observed periastron advance could be induced by the quadrupole moment of a suitably large, rotationally distorted companion. We infer the radii such companions need to have and show that they would be relatively bright, easily detectable with HST. For one pulsar, M 5B, we find a plausible candidate counterpart in archival data. We propose to use 2 orbits with WFC3 to search for suitably large counterparts to two of the other systems, including the one with the highest inferred mass.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11686
Title: The Cosmological Impact of AGN Outflows: Measuring Absolute Abundances and Kinetic Luminosities
PI: Nahum Arav
PI Institution: Virginia Tech

AGN outflows are increasingly invoked as a major contributor to the formation and evolution of supermassive black holes, their host galaxies, the surrounding IGM, and cluster cooling flows. Our HST/COS proposal will determine reliable absolute chemical abundances in six AGN outflows, which influences several of the processes mentioned above. To date there is only one such determination, done by our team on Mrk 279 using 16 HST/STIS orbits and 100 ksec of FUSE time. The advent of COS and its high sensitivity allows us to choose among fainter objects at redshifts high enough to preclude the need for FUSE. This will allow us to determine the absolute abundances for six AGN (all fainter than Mrk 279) using only 40 HST COS orbits. This will put abundances studies in AGN on a firm footing, an elusive goal for the past four decades. In addition, prior FUSE observations of four of these targets indicate that it

is probable that the COS observations will detect troughs from excited levels of C III. These will allow us to measure the distances of the outflows and thereby determine their kinetic luminosity, a major goal in AGN feedback research. We will use our state of the art column density extraction methods and velocity-dependent photoionization models to determine the abundances and kinetic luminosity. Previous AGN outflow projects suffered from the constraints of deciding what science we could do using ONE of the handful of bright targets that were observable. With COS we can choose the best sample for our experiment. As an added bonus, most of the spectral range of our targets has not been observed previously, greatly increasing the discovery phase space.

=====
Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 11687
Title: SNAPing Coronal Iron
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

This is a Snapshot Survey to explore two forbidden lines of highly ionized iron in late-type coronal sources. Fe XII 1349 (T~ 2 MK) and Fe XXI 1354 (T~ 10 MK) -- well known to Solar Physics -- have been detected in about a dozen cool stars, mainly with HST/STIS. The UV coronal forbidden lines are important because they can be observed with velocity resolution of better than 15 km/s, whereas even the state-of-the-art X-ray spectrometers on Chandra can manage only 300 km/s in the kilovolt band where lines of highly ionized iron more commonly are found. The kinematic properties of hot coronal plasmas, which are of great interest to theorists and modelers, thus only are accessible in the UV at present. The bad news is that the UV coronal forbidden lines are faint, and were captured only in very deep observations with STIS. The good news is that 3rd-generation Cosmic Origins Spectrograph, slated for installation in HST by SM4, in a mere 25 minute exposure with its G130M-1291 mode can duplicate the sensitivity of a landmark 25-orbit STIS E140M observation of AD Leo, easily the deepest such exposure of a late-type star so far. Our goal is to build up understanding of the properties of Fe XII and Fe XXI in additional objects beyond the current limited sample: how the lineshapes depend on activity, whether large scale velocity shifts can be detected, and whether the dynamical content of the lines can be inverted to map the spatial morphology of the stellar corona (as in "Doppler Imaging"). In other words, we want to bring to bear in the coronal venue all the powerful tricks of spectroscopic remote sensing, well in advance of the time that this will be possible exploiting the corona's native X-ray radiation. The 1290-1430 band captured by side A of G130M-1291 also contains a wide range of key plasma diagnostics that form at temperatures from below 10,000 K (neutral lines of CNO), to above 200,000 K (semi-permitted O V 1371), including the important bright multiplets of C II at 1335 and Si IV at 1400; yielding a diagnostic gold mine for the subcoronal atmosphere. Because of the broad value of the SNAP spectra, beyond the coronal iron project, we waive the normal proprietary rights.

=====
Proposal Category: GO

Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11688
Title: Exploring the Bottom End of the White Dwarf Cooling
Sequence in the Open Cluster NGC6819
PI: Luigi Bedin
PI Institution: Space Telescope Science Institute

The recent discovery by our group of an unexpectedly bright end of the white-dwarf (WD) luminosity function (LF) of the metal-rich, old open cluster NGC 6791 casts serious doubts on our understanding of the physical process which rules the formation and the cooling of WDs. It is clear at this point that the theory badly needs more observations. Here we propose WFC3/UVIS and ACS/WFC HST observations reaching the bottom end of the WD LF, for the first time in a solar-metallicity, 2.5-Gyr-old, populous open cluster: NGC 6819.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11689
Title: Direct Observations of Dark Matter from a Second Bullet:
The Spectacular Abell 2744
PI: Renato Dupke
PI Institution: University of Michigan

Vigorous cluster mergers provide a unique opportunity to directly "see" dark matter and to probe its properties through the analysis of the segregation of the baryonic and non-baryonic components. This is accomplished through detailed comparison of the mass distributions as traced by X-ray emitting gas and by gravitational lensing. This condition is rare and so far only one cluster has met these requirements, the so-called "bullet" cluster, producing exciting results and placing constraints to the properties of dark matter. These constraints have a broad impact on models for formation of structure and on galaxy evolution. This multi-wavelength analysis has the potential confront alternative gravity models such as MOND. Therefore, it is crucial to find new "bullet clusters" to corroborate and improve previous measurements. This is the most direct way to constrain dark matter properties and A2744 is ideal for corroborating this study since it maximizes all the requirements for this analysis. Here, we propose to carry out such analysis through combined ACS and Chandra observations of the cluster merger Abell 2744.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11690
Title: EG And: Providing the Missing Link Required for Modelling
Red Giant Mass-loss
PI: Brian Espey
PI Institution: University of Dublin, Trinity College

For the majority of red giant stars the basic mass-loss processes at work are unknown. Indeed, for stars of spectral types between K0 III and M5-M6 III, much remains unknown about the regions above the visible photosphere and the transportation of the processed material outwards to the ISM. Eclipsing

symbiotic binary systems, consisting of an evolved giant in orbit with a white dwarf, provide an opportunity to take advantage of the finite size of the hot component to probe different levels of the chromosphere and wind acceleration region in absorption. This provides spatially resolved thermal, ionisation and dynamic information on the wind which can then be compared against predictions of hydrodynamical stellar atmosphere codes. The symbiotic binary EG And can be considered as a rosetta stone for understanding the winds of these objects. The system is ideal on a number of counts for utilising the ultraviolet eclipse of the white dwarf (WD) component to probe, layer-by-layer, the thermal and dynamic conditions at the very base of the wind and chromosphere of the RG. This information is vital for constraining, testing and calibrating the new generation of cool giant wind+chromosphere models and is not possible to obtain for isolated RGs. This team has studied the UV eclipses of this system in depth and detail, however in order to definitively constrain the wind acceleration profile and identify the location of the temperature rise just above the photosphere we require 4 STIS E140M observations of EG And at specific orbital phases. We are also requesting a E230M observation of an isolated spectral standard, corresponding to the RG in the binary, which will help place the EG And results into the context of the general RG population from analysis of the MgII wind diagnostic lines.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11691
Title: Using Massive Star Clusters in Merger Remnants To Provide Reference Colors of Intermediate-Age Stellar Populations
PI: Paul Goudfrooij
PI Institution: Space Telescope Science Institute

Much current research in cosmology and galaxy formation relies on an accurate interpretation of colors of galaxies in terms of their evolutionary state, i.e., in terms of ages and metallicities. One particularly important topic is the ability to identify early-type galaxies at "intermediate" ages (~ 500 Myr - 5 Gyr), i.e., the period between the end of star formation and ~ half the age of the universe. Currently, integrated-light studies must rely on population synthesis models which rest upon spectral libraries of stars in the solar neighborhood. These models have a difficult time correctly incorporating short-lived evolutionary phases such as thermally pulsing AGB stars, which produce up to 80% of the flux in the near-IR in this age range. Furthermore, intermediate-age star clusters in the Local Group do not represent proper templates against which to calibrate population synthesis models in this age range, because their masses are too low to render the effect of stochastic fluctuations due to the number of bright RGB and AGB stars negligible. As a consequence, current population synthesis models have trouble reconciling the evolutionary state of high-redshift galaxies from optical versus near-IR colors. We propose a simple and effective solution to this issue, namely obtaining high-quality EMPIRICAL colors of massive globular clusters in galaxy merger remnants which span this important age range. These colors should serve as relevant references, both to identify intermediate-age objects in the local and distant universe and as calibrators for population synthesis modellers.

=====

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11692
Title: The LMC as a QSO Absorption Line System
PI: J. Howk
PI Institution: University of Notre Dame

We propose to obtain high resolution, high signal-to-noise observations of QSOs behind the Large Magellanic Clouds. These QSOs are situated beyond the star forming disk of the galaxy, giving us the opportunity to study the distribution of metals and energy in regions lacking significant star formation. In particular, we will derive the metallicities and study the ionization characteristics of LMC gas at impact parameters 3-17 kpc. We will compare our results with high-z QSO absorption line systems.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11693
Title: Follow-up Observations of Debris Disks around Two Solar-Type Stars
PI: John Krist
PI Institution: Jet Propulsion Laboratory

Circumstellar debris disks offer direct views into the structure of extrasolar planetary systems. Their constituent dust, seen in scattered light and thermal emission, is created by the collisions of asteroidal and cometary parent bodies. The distribution of this dust provides information on the location of the parent bodies, and can be strongly affected by planetary perturbations. Dynamical signatures of planets can include asymmetries, warps, central clearings, and radial gaps in a disk, and thus are key features to search for in resolved images. Following up recent Spitzer measurements, we have now detected two new, nearby debris disks in scattered light. Our initial ACS F606W coronagraphic images show faint ringlike structures around the solar-type stars HD 10647 (F9V) and HD 207129 (G0V); both are also spatially resolved in Spitzer/MIPS 70 micron images. The HD 10647 disk, seen close to edge-on, represents the first disk ever imaged in scattered light around a star known to have a radial velocity planet. The inclined ring around HD 207129 is the faintest disk ever imaged in scattered light, and seems in the MIPS image to be asymmetric like the eccentric ring around Fomalhaut. We propose to obtain deep ACS coronagraphic images of these two disks. Our goals are to get definitive measurements of the dust spatial distributions (including disk asymmetries and sharpness of the ring edges), and measure the overall F606W-F814W color of each disk in order to constrain the dust properties. The results will be a definitive exploration of the Kuiper belts of two nearby, Sun-like stars.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11694
Title: Mapping the Interaction between High-Redshift Galaxies and the Intergalactic Environment

PI: David Law
PI Institution: California Institute of Technology

With the commissioning of the high-throughput large-area camera WFC3/IR, it is possible for the first time to undertake an efficient survey of the rest-frame optical morphologies of galaxies at the peak epoch of star formation in the universe. We therefore propose deep WFC3/IR imaging of over 320 spectroscopically confirmed galaxies between redshift $1.6 < z < 3.4$ in well-studied fields which lie along the line of sight to bright background QSOs. The spectra of these bright QSOs probe the IGM in the vicinity of each of the foreground galaxies along the line of sight, providing detailed information on the physical state of the gas at large galactocentric radii. In combination with our densely sampled UV/IR spectroscopy, stellar population models, and kinematic data in these fields, WFC3/IR imaging data will permit us to construct a comprehensive picture of the structure, dynamics, and star formation properties of a large population of galaxies in the early universe and their effect upon their cosmological environment.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11695
Title: Searching for the Bottom of the Initial Mass Function
PI: Kevin Luhman
PI Institution: The Pennsylvania State University

The measurement of the minimum mass of the IMF would provide a fundamental test of theories of star and planet formation. In a Cycle 13 program, we used ACS and ground-based near-IR imaging and spectroscopy to measure the IMF down to a completeness limit of $10 M_{\text{Jup}}$ ($i \sim 24$) in a $800'' \times 1000''$ area in the southern subcluster of the Chamaeleon I star-forming region (2 Myr, 160 pc). There is no sign of a low-mass cutoff in this IMF measurement. To provide a better constraint on the minimum mass of the IMF, we propose to obtain ACS images of this field again and use the two ACS epochs to identify substellar cluster members down to the detection limit of the data ($i \sim 27$) via their proper motions. In this way, we will improve the completeness limit of our IMF measurement to $3 M_{\text{Jup}}$. In addition, to improve the number statistics of our measurement of the substellar IMF in Chamaeleon I, we propose to double the number of objects in the IMF sample by performing ACS imaging of a second field toward the northern subcluster.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11696
Title: Infrared Survey of Star Formation Across Cosmic Time
PI: Matthew Malkan
PI Institution: University of California - Los Angeles

We propose to use the unique power of WFC3 slitless spectroscopy to measure the evolution of cosmic star formation from the end of the reionization epoch at $z > 6$ to the close of the galaxy-building era at $z \sim 0.3$. Pure parallel observations with the grisms have proven to be efficient for identifying line

emission from galaxies across a broad range of redshifts. The G102 grism on WFC3 was designed to extend this capability to search for Ly-alpha emission from the first galaxies. Using up to 250 orbits of pure parallel WFC3 spectroscopy, we will observe about 40 deep (4-5 orbit) fields with the combination of G102 and G141, and about 20 shallow (2-3 orbit) fields with G141 alone. Our primary science goals at the highest redshifts are: (1) Detect Ly α in ~ 100 galaxies with $z > 5.6$ and measure the evolution of the Ly α luminosity function, independent of cosmic variance; 2) Determine the connection between emission-line selected and continuum-break selected galaxies at these high redshifts, and 3) Search for the proposed signature of neutral hydrogen absorption at re-ionization. At intermediate redshifts we will (4) Detect more than 1000 galaxies in H α at $0.5 < z < 1.8$ to measure the evolution of the extinction-corrected star formation density across the peak epoch of star formation. This is over an order-of-magnitude improvement in the current statistics, from the NICMOS Parallel grism survey. (5) Trace "cosmic downsizing" from $0.5 < z < 2.2$; and (6) Estimate the evolution in reddening and metallicity in star-forming galaxies and measure the evolution of the Seyfert population. For hundreds of spectra we will be able to measure one or even two line pair ratios -- in particular, the Balmer decrement and [OII]/[OIII] are sensitive to gas reddening and metallicity. As a bonus, the G102 grism offers the possibility of detecting Ly α emission at $z = 7-8.8$. To identify single-line Ly α emitters, we will exploit the wide $0.8-1.9 \mu\text{m}$ wavelength coverage of the combined G102+G141 spectra. All [OII] and [OIII] interlopers detected in G102 will be reliably separated from true LAEs by the detection of at least one strong line in the G141 spectrum, without the need for any ancillary data. We waive all proprietary rights to our data and will make high-level data products available through the ST/ECF.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11697
Title: Proper Motion Survey of Classical and SDSS Local Group Dwarf Galaxies
PI: Slawomir Piatek
PI Institution: New Jersey Institute of Technology

Using the superior resolution of HST, we propose to continue our proper motion survey of Galactic dwarf galaxies. The target galaxies include one classical dwarf, Leo II, and six that were recently identified in the Sloan Digital Sky Survey data: Bootes I, Canes Venatici I, Canes Venatici II, Coma Berenices, Leo IV, and Ursa Major II. We will observe a total of 16 fields, each centered on a spectroscopically-confirmed QSO. Using QSOs as standards of rest in measuring absolute proper motions has proven to be the most accurate and most efficient method. HST is our only option to quickly determine the space motions of the SDSS dwarfs because suitable ground-based imaging is only a few years old and such data need several decades to produce a proper motion. The two most distant galaxies in our sample will require time baselines of four years to achieve our goal of a 30-50 km/s uncertainty in the tangential velocity; given this and the finite lifetime of HST, it is imperative that first-epoch observations be taken in this cycle. The SDSS dwarfs have dramatically lower surface brightnesses and luminosities than the classical dwarfs. Proper motions are crucial for determining orbits of the galaxies and

knowing the orbits will allow us to test theories for the formation and evolution of these galaxies and, more generally, for the formation of the Local Group.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11698
Title: The Structure and Dynamics of Virgo's Multi-Phase
Intracluster Medium
PI: Mary Putman
PI Institution: University of Michigan

The dynamical flows of the intracluster medium (ICM) are largely unknown. We propose to map the spatial and kinematic distribution of the warm ICM of the nearby Virgo cluster using the Cosmic Origins Spectrograph. 15 sightlines at a range of impact parameters within the virial radius of the cluster (0.2 - 1.7 Mpc) will be probed for Lyman-alpha absorption and the data compared to blind HI, dust and x-ray surveys to create a multi-phase map of the cluster's ICM. Absorption line sightlines are commonly 40-100 kpc from a galaxy, allowing the flow of baryons between galaxies and the ICM to be assessed. The velocity distribution of the absorbers will be directly compared to simulations and used to constrain the turbulent motions of the ICM. This proposal will result in the first map of a cluster's warm ICM and provide important tests for our theoretical understanding of cluster formation and the treatment of gas cooling in cosmological simulations.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11699
Title: On the evolutionary status of extremely hot helium stars
- are the O(He) stars successors of the R CrB stars?
PI: Thomas Rauch
PI Institution: Universitat Tubingen, Institut fur Astronomie &
Astrophysik

We propose UV spectroscopy of the four unique post-AGB stars of spectral type O(He) in order to understand the origin of their peculiar surface abundances. These stars are the only known amongst the hottest post-AGB stars (effective temperatures > 100,000 K) whose atmospheres are composed of almost pure helium. This chemistry markedly differs from that of the hydrogen-deficient post-AGB evolutionary sequence with objects which have carbon dominated atmospheres (PG1159 stars and Wolf-Rayet central stars). While PG1159 and Wolf-Rayet stars are the result of a late helium-shell flash, this scenario cannot explain the O(He) stars. Instead, they are possibly double-degenerate mergers. We speculate that the four O(He) stars represent evolved RCrB stars, which also have helium-dominated atmospheres. We aim to determine the C, N, O, and Si abundances precisely, in order to proof this evolutionary link.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE

ID: 11700
Title: Bright Galaxies at $z > 7.5$ with a WFC3 Pure Parallel Survey
PI: Michele Trenti
PI Institution: Space Telescope Science Institute

The epoch of reionization represents a special moment in the history of the Universe as it is during this era that the first galaxies and star clusters are formed. Reionization also profoundly affects the environment where subsequent generations of galaxies evolve. Our overarching goal is to test the hypothesis that galaxies are responsible for reionizing neutral hydrogen. To do so we propose to carry out a pure parallel WFC3 survey to constrain the bright end of the redshift $z > 7.5$ galaxy luminosity function on a total area of 176 arcmin² of sky. Extrapolating the evolution of the luminosity function from $z \sim 6$, we expect to detect about 20 Lyman Break Galaxies brighter than M_* at $z \sim 8$ significantly improving the current sample of only a few galaxies known at these redshifts. Finding significantly fewer objects than predicted on the basis of extrapolation from $z = 6$ would set strong limits to the brightness of M_* , highlighting a fast evolution of the luminosity function with the possible implication that galaxies alone cannot reionize the Universe. Our observations will find the best candidates for spectroscopic confirmation, that is bright $z > 7.5$ objects, which would be missed by small area deeper surveys. The random pointing nature of the program is ideal to beat cosmic variance, especially severe for luminous massive galaxies, which are strongly clustered. In fact our survey geometry of 38 independent fields will constrain the luminosity function like a contiguous single field survey with two times more area at the same depth. Lyman Break Galaxies at $z > 7.5$ down to $m_{AB} = 26.85$ (5 σ) in F125W will be selected as F098M dropouts, using three to five orbits visits that include a total of four filters (F606W, F098M, F125W, F160W) optimized to remove low-redshift interlopers and cool stars. Our data will be highly complementary to a deep field search for high- z galaxies aimed at probing the faint end of the luminosity function, allowing us to disentangle the degeneracy between faint end slope and M_* in a Schechter function fit of the luminosity function. We waive proprietary rights for the data. In addition, we commit to release the coordinates and properties of our $z > 7.5$ candidates within one month from the acquisition of each field.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11701
Title: The "jackpot" in technicolor: photometric redshift and mass to light decomposition of a double Einstein Ring
PI: Tommaso Treu
PI Institution: University of California - Santa Barbara

The structure, formation and evolution of early-type galaxies is still largely an open problem in cosmology: how does the Universe evolve from large linear scales dominated by dark matter to the non-linear scales of galaxies, where baryons and dark matter both play important, interacting, roles? To understand the complex physical processes involved in their formation scenario, it is critically important to understand the relative distribution of luminous and dark matter at galactic scales. Over the last four years, using HST, the SLACS collaboration has discovered some 100 new gravitational lenses and developed a

toolbox to tackle these issues by combining new non-parametric strong lensing techniques, stellar dynamics, and weak gravitational lensing. Among the 100 new lenses, we discovered the first double Einstein Ring, the so-called "jackpot". The presence of two rings at different radii provides qualitatively new insights into the distribution of luminous and dark matter at 10 kpc scales. Via a joint lensing and dynamical analysis, this system has the potential to deliver the most precise measurements on galactic scales of the inner slope of dark matter halos, of the total mass profile, and of the stellar mass to light ratio. Unfortunately, the precision is currently limited by the lack of a redshift for the outer ring, in spite of ultradeep spectroscopy at the 10m Keck Telescope. We propose to obtain F336W and F438W WFC3 images of the system, which in combination with our existing F606W, F814W and F160W images will allow us to obtain a photo-z for the outer ring, precise enough to fully realize the potential of this system. The multicolor HST images will also be used to derive a stellar mass-to-light and constrain the initial mass function by comparison with the lens and dynamical measurement.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11702
Title: Search for Very High-z Galaxies with WFC3 Pure Parallel
PI: Hao-Jing Yan
PI Institution: Carnegie Institution of Washington

WFC3 will provide an unprecedented probe to the early universe beyond the current redshift frontier. Here we propose a pure parallel program using this new instrument to search for Lyman-break galaxies at $6.5 < z < 8.8$ and to probe the epoch of reionization, a hallmark event in the history of the early universe. We request 200 orbits, spreading over 30 ~ 50 high Galactic latitude visits ($|b| > 20 \text{deg}$) that last for 4 orbits and longer, resulting a total survey area of about 140~230 square arcminute. Based on our understanding of the new HST parallel observation scheduling process, we believe that the total number of long-duration pure parallel visits in Cycle 17 should be sufficient to accommodate our program. We waive all proprietary rights to our data, and will also make the enhanced data products public in a timely manner. (1) We will use both the UVIS and the IR channels, and do not need to seek optical data from elsewhere. (2) Our program will likely triple the size of the probable candidate samples at $z \sim 7$ and $z \sim 8$, and will complement other targeted programs aiming at the similar redshift range. (3) Being a pure parallel program, our survey will only make very limited demand on the scarce HST resources. More importantly, as the pure parallel pointings will be at random sight-lines, our program will be least affected by the bias due to the large scale structure ("cosmic variance"). (4) We aim at the most luminous LBG population, and will address the bright-end of the luminosity function at $z \sim 8$ and $z \sim 7$. We will constrain the value of L^* in particular, which is critical for understanding the star formation process and the stellar mass assembly history in the first few hundred million years of the universe. (5) The candidates from our survey, 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. (6) 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.

=====
Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11703
Title: The Nature of the Black Hole in a NGC 4472 Globular Cluster and the Origin of Its Broad [OIII] Emission
PI: Stephen Zepf
PI Institution: Michigan State University

We propose to use STIS to obtain optical spectroscopy at high spatial resolution of the black hole-hosting globular cluster RZ2109 in the Virgo elliptical NGC 4472. This is motivated by our very recent discovery broad [OIII] 4959, 5007 emission with a width of several thousand km/s in this globular cluster. The STIS spectroscopy will enable us to determine if the very broad [OIII] emission is due to material driven at high velocity from the central accreting black hole across the globular cluster, or if the velocity widths are due to gravitational motions very close to the central black hole. In the former case, the [OIII] emission should extend over a few-tenths of an arcsecond and be spatially resolved by HST and STIS, while in the latter case, the emission lines will be unresolved. Distinguishing between these two possibilities will allow us to - 1) determine whether the black hole is of intermediate mass or a stellar mass, and thereby whether the black hole mass - sigma relation extends to globular cluster masses, 2) test models of black hole formation and evolution in dense stellar systems, and 3) address the nature of accretion in the high luminosity black-hole X-ray source, and constrain the feedback processes from luminous black holes into their surrounding medium in dense stellar systems.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11704
Title: The Ages of Globular Clusters and the Population II Distance Scale
PI: Brian Chaboyer
PI Institution: Dartmouth College

Globular clusters are the oldest objects in the universe whose age can be accurately determined. The dominant error in globular cluster age determinations is the uncertain Population II distance scale. We propose to use FGS 1r to obtain parallaxes with an accuracy of 0.2 milliarcsecond for 9 main sequence stars with $[Fe/H] < -1.5$. This will determine the absolute magnitude of these stars with accuracies of 0.04 to 0.06mag. This data will be used to determine the distance to 24 metal-poor globular clusters using main sequence fitting. These distances (with errors of 0.05 mag) will be used to determine the ages of globular clusters using the luminosity of the subgiant branch as an age indicator. This will yield absolute ages with an accuracy 5%, about a factor of two improvement over current estimates. Coupled with

existing parallaxes for more metal-rich stars, we will be able to accurately determine the age for globular clusters over a wide range of metallicities in order to study the early formation history of the Milky Way and provide an independent estimate of the age of the universe. The Hipparcos database contains only 1 star with $[Fe/H] < -1.4$ and an absolute magnitude error less than 0.18 mag which is suitable for use in main sequence fitting. Previous attempts at main sequence fitting to metal-poor globular clusters have had to rely on theoretical calibrations of the color of the main sequence. Our HST parallax program will remove this source of possible systematic error and yield distances to metal-poor globular clusters which are significantly more accurate than possible with the current parallax data. The HST parallax data will have errors which are 10 times smaller than the current parallax data. Using the HST parallaxes, we will obtain main sequence fitting distances to 11 globular clusters which contain over 500 RR Lyrae stars. This will allow us to calibrate the absolute magnitude of RR Lyrae stars, a commonly used Population II distance indicator.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11705
Title: Physical Properties of Quasar Outflows: From BALs to mini-BALs
PI: Frederick Hamann
PI Institution: University of Florida

Accretion disk outflows are important components of quasar environments. They might play a major role in facilitating accretion, regulating star formation in the host galaxies and distributing metals to the surrounding gas. They reveal themselves most conspicuously via broad absorption lines (BALs), but they appear even more frequently in other guises such as the weaker and narrower "mini-BALs." How are these diverse outflow features related? Are mini-BALs really just "mini" versions of the BALs, or do they represent a fundamentally different type of outflow, with different degrees of ionization, column densities, mass loss rates, physical origins, etc.? We propose HST-COS spectroscopy to make the first quantitative assessment of the outflow physical conditions across the full range of weak/narrow mini-BALs to strong/broad BALs. Our strategy is to measure key diagnostic lines (SVI, OVI, CIII, SIV, PV, etc.) at 930A - 1130A (rest-frame) in a sample of 7 outflow quasars with known mini-BALs through weak BALs. We will then 1) combine the COS data with ground-based spectra of the same quasars to include more lines (CIV, SiIV) at longer wavelengths, and 2) include in our analysis a nearly identical UV/optical dataset obtained previously for a sample of quasars with strong BALs. Our study of this combined dataset will be an essential next step toward a more global understanding of quasar outflows.

=====
Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11706
Title: The Parallax of the Planet Host Star XO-3
PI: Christopher Johns-Krull
PI Institution: Rice University

We will use HST+FGS to measure the parallax of the transiting planet host star X0-3. The resulting accurate distance measurement will provide the most accurate radius determination to date for this massive extrasolar planet (X0-3b), allowing us to critically test current giant extrasolar planet structure models. These observations will also constrain the amount of heating that may be produced inside X0-3b by tides raised on the planet as it moves through its 3.2 d eccentric ($e \sim 0.22$) orbit.

=====
Proposal Category: GO
Scientific Category: HOT STARS
ID: 11707
Title: Detecting Isolated Black Holes through Astrometric
Microlensing
PI: Kailash Sahu
PI Institution: Space Telescope Science Institute

This proposal aims to make the first detection of isolated stellar-mass black holes (BHs) in the Milky Way, and to determine their masses. Until now, the only directly measured BH masses have come from radial-velocity measurements of X-ray binaries. Our proposed method uses the astrometric shifts that occur when a Galactic-bulge microlensing event is caused by a BH lens. Out of the hundreds of bulge microlensing events found annually by the OGLE and MOA surveys, a few are found to have very long durations (>200 days). It is generally believed that the majority of these long-duration events are caused by lenses that are isolated BHs. To test this hypothesis, we will carry out high-precision astrometry of 5 long-duration events, using the ACS/HRC camera. The expected astrometric signal from a BH lens is >1.4 mas, at least 7 times the demonstrated astrometric precision attainable with the HRC. This proposal will thus potentially lead to the first unambiguous detection of isolated stellar-mass BHs, and the first direct mass measurement for isolated stellar-mass BHs through any technique. Detection of several BHs will provide information on the frequency of BHs in the Galaxy, with implications for the slope of the IMF at high masses, the minimum mass of progenitors that produce BHs, and constraints on theoretical models of BH formation.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11708
Title: Determining the Sub-stellar IMF in the Most Massive Young
Milky Way Cluster, Westerlund 1
PI: Morten Andersen
PI Institution: California Institute of Technology

Despite over 50 years of active research, a key question in galactic astronomy remains unanswered: is the initial mass function (IMF) of stars and sub-stellar objects universal, or does it depend on initial conditions? The answer has profound consequences for the evolution of galaxies as well as a predictive theory of star formation. Work to date suggests that certain environments (high densities, e.g. Elmegreen 2004; low metallicity, e.g. Larson 2005) should produce a top-heavy IMF, and there are hints from

unresolved star-bursts that this might be the case. Yet, there is no clear evidence for an IMF that differs from that characterizing the Galactic field stars in a resolved stellar population down to one solar mass. Westerlund 1 is the most massive young star cluster known in the Milky Way. With an estimated mass of $5 \times 10^4 M_{\text{sun}}$, an age of 3-5 Myr, and located at a distance of 3-4 kpc, it presents a unique opportunity to test whether the IMF in such a cluster deviates from the norm well down into the brown dwarf regime. We propose WFC3 near-IR imaging to probe the IMF down to 40 Jupiter masses. The data will enable use to: 1) provide a stringent test of the universality of the IMF under conditions approximating those of star-bursts; 2) search for primordial or dynamic mass segregation in the clusters; and 3) assess whether the cluster is likely to remain bound (as a massive open cluster) or disperse into the field. We will obtain images in the F125W, F160W, and F139M filters. The F139M filter covers a strong water absorption feature and the color F125W/F139M is a powerful temperature diagnostic in the range 2800-4000 K. This information will enable us to: a) confirm membership for low mass stars suspected on the basis of their position in the color-magnitude diagram; b) place the members in the HR diagram; and c) estimate the masses and ages of cluster members for low-mass stars and sub-stellar objects. This new capability offered with the WFC3 (through a novel combination of filter complement, high spatial resolution, and large field of view) will enable us to make a fundamental test of whether the IMF is universal on a unique resolved stellar population, as well as assess the clusters structure, dynamics, and ultimate fate.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11709
Title: Stretching the diversity of cosmic explosions: The supernovae of gamma-ray bursts
PI: David Bersier
PI Institution: Liverpool John Moores University

While the association between gamma-ray bursts (GRBs) and massive stars is robust, there is a large diversity of properties among supernovae (SNe) associated with GRBs. The converse is also true: Several recent events show that there is a large brightness range among high energy transients associated with SNe. As part of a comprehensive program, we propose to use HST in order to search for and characterize the SNe associated with GRB. HST offers the means to cleanly separate the light curve of the GRB afterglow from the supernova, and to remove the contamination from the host galaxy, opening a clear path to the fundamental parameters of the SN, and thence to the progenitor. From these observations, we will determine the absolute magnitude at maximum, the shape of the spectral energy distribution, and any change over time of the energy distribution. We will also measure the rate of decay of the exponential tail. Merged with the ground-based data that we will obtain for each event, we will be able to compare our data set to models and constrain the energy of the explosion, the mass of the ejecta and the mass of Nickel synthesized during the explosion. These results will shed light on the apparent variety of supernovae associated with gamma-ray bursts and X-ray flashes, and on the relation between these SNe and other, more common, types of core-collapse explosions.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11710
Title: The Extreme Globular Cluster System of Abell 1689: The
Ultimate Test of Universal Formation Efficiency
PI: John Blakeslee
PI Institution: Dominion Astrophysical Observatory

The stellar masses of the most luminous galaxies poorly represent the masses of the halos in which they reside. However, recent studies of the very rich globular cluster (GC) populations in the centers of galaxy clusters point toward an apparently linear scaling of the number of GCs with the total core mass of the galaxy cluster. Thus, unlike for the stars in cD galaxies, GC formation in these systems appears to have proceeded with a roughly universal mass conversion efficiency. GCs are also distinct in that their spatial distributions are more extended than the starlight, and recent simulations suggest that they follow the mass density profile of the merged dark matter halos that formed stars at high redshift. To provide a definitive test of the universal efficiency hypothesis requires measuring the number of GCs in the most massive galaxy clusters, where the number should be a factor of 5 or more greater than seen in M87. Likewise, the relationship between GCs and mass density can only be tested in systems where the total mass and mass density are well-determined. Fortunately, the imaging power of HST brings the GC population of Abell 1689, the most extreme high-mass lensing cluster, into range. Estimates of the size of the A1689 GC population from available data suggest an unprecedented 100,000 GCs, but this number is based on the tip of the iceberg and is extremely uncertain. We propose to obtain the first accurate measurement of the number of GCs and their density profile in this extraordinary system - the most massive and most distant GC system ever studied - and thus make the ultimate test of the universal GC formation hypothesis. Our deep I-band image will also provide a stringent "null-detection" test of several known $z > 7$ galaxy candidates and improve the mass model of the system by increasing the number of usable lensed background galaxies. Finally, we will take deep multi-band parallel observations with WFC3/IR to help in quantifying the abundance of rare faint red objects.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11711
Title: A Definitive Distance to the Coma Core Ellipticals
PI: John Blakeslee
PI Institution: Dominion Astrophysical Observatory

As the richest galaxy cluster in the local universe ($cz < 10,000$ km/s), the Coma cluster continues to serve as the standard of comparison for numerous studies of galaxy properties and scaling relations in clusters. The central importance of Coma has been recognized with two recent HST large programs: a Treasury survey to study the dwarf galaxy population by imaging 82 different ACS/WFC pointings, and a program to measure Cepheid distances to two spiral galaxies projected within the Coma core region. An accurate distance to the

Coma core is essential for comparing the galaxy luminosities and sizes to nearby galaxies in Virgo and Fornax, while an accurate peculiar velocity is needed for correctly tying to more distant clusters. However, experience dictates that Cepheid distances to clusters must be carefully verified against accurate measurements to the dominant early-type population, especially for such an unprecedented effort as the Coma Cepheid search (the completion of which remains uncertain). We propose to measure highly accurate (3-4% internal error per galaxy) SBF distances to the two giant Coma core ellipticals. The reliability of the SBF method with the ACS/WFC has been repeatedly demonstrated, and it is so efficient that it requires only 3% of the number of orbits dedicated to the two current large Coma programs. The precise ACS SBF Coma core distance will also provide a good constraint on the Coma peculiar velocity, thus improving the accuracy of comparisons to distant clusters. It is unclear whether WFC3/IR will deliver similarly accurate SBF distances, as important SBF calibration work must first be carried out for that instrument. Finally, our program will answer some longstanding puzzles surrounding the rich globular cluster population in the core of this archetypal galaxy cluster.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11712
Title: Calibration of Surface Brightness Fluctuations for WFC3/IR
PI: John Blakeslee
PI Institution: Dominion Astrophysical Observatory

We aim to characterize galaxy surface brightness fluctuations (SBF), and calibrate the SBF distance method, in the F110W and F160W filters of the Wide Field Camera 3 IR channel. Because of the very high throughput of F110W and the good match of F160W to the standard H band, we anticipate that both of these filters will be popular choices for galaxy observations with WFC3/IR. The SBF signal is typically an order of magnitude brighter in the near-IR than in the optical, and the characteristics (sensitivity, FOV, cosmetics) of the WFC3/IR channel will be enormously more efficient for SBF measurements than previously available near-IR cameras. As a result, our proposed SBF calibration will allow accurate distance derivation whenever an early-type or bulge-dominated galaxy is observed out to a distance of 150 Mpc or more (i.e., out to the Hubble flow) in the calibrated passbands. For individual galaxy observations, an accurate distance is useful for establishing absolute luminosities, black hole masses, linear sizes, etc. Eventually, once a large number of galaxies have been observed across the sky with WFC3/IR, this SBF calibration will enable accurate mapping of the total mass density distribution in the local universe using the data available in the HST archive. The proposed observations will have additional important scientific value; in particular, we highlight their usefulness for understanding the nature of multimodal globular cluster color distributions in giant elliptical galaxies.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 11713
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 two visits during Cycle 17, using the repaired ACS (or WFC3) in order to continue the mapping of the circumstellar dust and to accomplish the other goals listed above.

=====
Proposal Category: SNAP
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11714
Title: Snapshot Survey for Planetary Nebulae in Local Group
Globular Clusters
PI: Howard Bond
PI Institution: Space Telescope Science Institute

Planetary nebulae (PNe) in globular clusters (GCs) raise a number of interesting issues related to stellar and galactic evolution. The number of PNe known in Milky Way GCs, four, is surprisingly low if one assumes that all stars pass through a PN stage. However, it is likely that the remnants of stars now evolving in Galactic GCs leave the AGB so slowly that any ejected nebula dissipates long before the star becomes hot enough to ionize it. Thus there should not be ANY PNe in Milky Way GCs--but there are four

=====
Proposal Category: GO
Scientific Category: COOL STARS
ID: 11715
Title: The Luminous Galactic Cepheid RS Puppis: A Geometric
Distance from its Nested Light Echoes
PI: Howard Bond
PI Institution: Space Telescope Science Institute

RS Puppis is one of the most luminous Cepheids in the Milky Way (P = 41.4 days) and an analog of the bright Cepheids used to measure extragalactic distances. An accurate distance would help anchor the zero-point of the bright

end of the period-luminosity relation, but at a distance of about 2 kpc it is too far away for a trigonometric parallax with existing instrumentation. RS Pup is unique in being surrounded by a reflection nebula, whose brightness varies as pulses of light from the Cepheid propagate outwards. Members of our team have used ground-based imaging of the nebula to derive phase lags in the light variations of individual features in the nebula, and have inferred a seemingly very precise geometric distance to the star. However, there is an unavoidable ambiguity involving the cycle counts, which was resolved by assuming that the features lie in the plane of the sky. If this assumption is incorrect, a large systematic error would be introduced into the distance measurement. We show that polarimetric imaging using the high spatial resolution of ACS/WFC and its ability to image close to the star can resolve this ambiguity and yield a reliable geometric distance to RS Pup. We will also obtain a wide-field multicolor image of the nebula, in order to study its morphology and the mass-loss history of the Cepheid.

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11716
Title: In Search of the Lost Remnant of M31 RV: Shedding Light
on the New Class of Luminous Red Transients
PI: Howard Bond
PI Institution: Space Telescope Science Institute

M31 RV is a luminous red variable star that appeared in the bulge of M31 in 1988. During its outburst, which lasted a few months, it was one of the brightest stars in the Local Group. Unlike a classical nova, it was extremely cool during the eruption, and it never became optically thin or exposed a hot, blue source. There has been renewed interest in M31 RV recently, because of its remarkable similarities to V838 Mon, a luminous Galactic variable star that underwent a similar rapid expansion to become a red supergiant, and which is currently illuminating a spectacular light echo, extensively observed by HST. The outburst mechanism for this new class of luminous transients remains unknown, and is one of the major current challenges to our understanding of stellar physics. Bond and Siegel have examined WFPC2 frames of the site of M31 RV, obtained fortuitously in 1999 as parallel observations during spectroscopic studies of the nucleus of M31. The explosion site shows only a pure old population of red giants, with no obvious remnant of M31 RV. I propose now to obtain second-epoch images of the site, in the same filters, to determine whether there is an object in the field that has faded or varied, and if so what its brightness and color is. This information may provide new constraints on proposed outburst mechanisms, such as stellar mergers or collisions, and could lead to a spectroscopic observation in a future HST cycle.

=====

Proposal Category: GO
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11717
Title: Unraveling the Mysterious Origin of GRB 070125
PI: S Cenko
PI Institution: California Institute of Technology

We propose a modest (2 WFC3 orbits) HST program to ascertain the origin of the mysterious gamma-ray burst GRB 070125. With a duration of 60 s and a high local (i.e. parsec scale) circum-burst density, GRB 070125 resembles a canonical (i.e. massive-star progenitor) long-duration event. However, we have strong evidence that GRB 070125 exploded in the halo of its host galaxy, far away from the bulk of massive star formation. The UV detection of a compact, star-forming cluster would confirm our original hypothesis that GRB 070125 exploded in a tidal tail formed by galaxy interactions (analogous to the Tadpole and Antenna galaxies) at $z = 1.54$. Alternatively, the absence of ongoing star formation and the presence of an old stellar population would require a novel explosion process unassociated with massive stars. While the former would open a new path to study star formation and galaxy interactions at high redshift, the latter would require a re-thinking of one of the fundamental tenets of GRB astronomy: the 1:1 mapping between duration and progenitor system.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11718
Title: The Stellar Halos of Dwarf Galaxies
PI: Julianne Dalcanton
PI Institution: University of Washington

The metal-poor stellar halo is the oldest extended structure in the Galaxy. Such halos are thought to form through hierarchical merging, and contain stars pulled from accreted subhalos. The diffuse stellar halo therefore stores information about the properties of the accreted galaxies (i.e., their orbits, stellar masses, and metallicities). It is therefore unsurprising that stellar halos have become a popular probe of the early epoch of galaxy formation. Almost all current work on stellar halos has focused on massive galaxies, however. We propose to extend the work on stellar halos to much lower mass scales, by studying the halos of faint dwarf galaxies. By taking halo studies into the dwarf galaxy regime, we can probe exceptionally small mass scales for the accreted halos. At these mass scales the effects of reionization and supernova feedback have the largest impact on the galaxy population. Stellar halos of dwarf galaxies are therefore a sensitive probe of the key processes needed to resolve the lack of substructure observed at low masses. We are requesting two far-field ACS pointings for the three closest isolated nearby dwarf irregular galaxies whose inner halos have already been mapped with the ACS Nearby Galaxy Survey Treasury. These outer fields will allow us to trace the halo out to roughly half the virial radius, further than any previous study. We will use the resulting distribution of halo stars (1) to unambiguously measure the structure of the stellar halo, with minimal contamination from the main galaxy; (2) to constrain the flattening of the stellar halo; (3) to measure the metallicity of halo stars as a function of radius; (4) to correlate any changes in halo profile with changes in metallicity. The resulting data will constrain models of halo accretion and the epoch of reionization.

=====

Proposal Category: SNAP

Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11719
Title: A Calibration Database for Stellar Models of Asymptotic
Giant Branch Stars
PI: Julianne Dalcanton
PI Institution: University of Washington

Studies of galaxy formation and evolution rely increasingly on the interpretation and modeling of near-infrared observations. At these wavelengths, the brightest stars are intermediate mass asymptotic giant branch (AGB) stars. These stars can contribute nearly 50% of the integrated luminosity at near infrared and even optical wavelengths, particularly for the younger stellar populations characteristic of high-redshift galaxies ($z > 1$). AGB stars are also significant sources of dust and heavy elements. Accurate modeling of AGB stars is therefore of the utmost importance. The primary limitation facing current models is the lack of useful calibration data. Current models are tuned to match the properties of the AGB population in the Magellanic Clouds, and thus have only been calibrated in a very narrow range of sub-solar metallicities. Preliminary observations already suggest that the models are overestimating AGB lifetimes by factors of 2-3 at lower metallicities. At higher (solar) metallicities, there are no appropriate observations for calibrating the models. We propose a WFC3/IR SNAP survey of nearby galaxies to create a large database of AGB populations spanning the full range of metallicities and star formation histories. Because of their intrinsically red colors and dusty circumstellar envelopes, tracking the numbers and bolometric fluxes of AGB stars requires the NIR observations we propose here. The resulting observations of nearby galaxies with deep ACS imaging offer the opportunity to obtain large (100-1000's) complete samples of AGB stars at a single distance, in systems with well-constrained star formation histories and metallicities.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11720
Title: Detailed analysis of carbon atmosphere white dwarfs
PI: Patrick Dufour
PI Institution: University of Arizona

We propose to obtain UV spectra for the newly discovered white dwarf stars with a carbon-dominated atmosphere. Model calculations show that these stars emit most of their light in the UV part of the electromagnetic spectrum and that an accurate determination of the flux in this region is crucial for an accurate determination of the atmospheric parameters. It will also provide a unique opportunity to test the atomic data and broadening theory in stellar conditions never met before. This will play a primordial role in our path to understand the origin of these objects as well to obtain a better understanding of the evolution of stars in general. The principal objective we hope to achieve with these observations are 1) obtain accurate surface gravity/mass for these stars, 2) constrain/determine the abundance of other elements (O, He, Mg, Ne etc.), especially oxygen, 3) verify the accuracy of the various theoretical atomic data used in the model calculations, 4) understand the origin and evolution of carbon atmosphere white dwarfs, in

particular whether progenitor stars as massive as 10.5 solar masses can produce white dwarfs, rather than supernovae. We propose to observe 5 objects chosen carefully to cover the range of observed properties among carbon atmosphere white dwarfs (effective temperature, surface gravity, abundance of hydrogen/helium and magnetic field).

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11721
Title: Verifying the Utility of Type Ia Supernovae as
Cosmological Probes: Evolution and Dispersion in the
Ultraviolet Spectra
PI: Richard Ellis
PI Institution: California Institute of Technology

The study of distant type Ia supernova (SNe Ia) offers the most practical and immediate discriminator between popular models of dark energy. Yet fundamental questions remain over possible redshift-dependent trends in their observed and intrinsic properties. High quality Keck spectroscopy of a representative sample of 36 intermediate redshift SNe Ia has revealed a surprising, and unexplained, diversity in their rest-frame UV fluxes. One possible explanation is hitherto undiscovered variations in the progenitor metallicity. Unfortunately, this result cannot be compared to local UV data as only two representative SNe Ia have been studied near maximum light. Taking advantage of two new 'rolling searches' and the restoration of STIS, we propose a non-disruptive T00 campaign to create an equivalent comparison local sample. This will allow us to address possible evolution in the mean UV spectrum and its diversity, an essential precursor to the study of SNe beyond $z \sim 1$.

=====
Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11722
Title: Imaging the Distribution of Iron in a Type Ia Supernova
PI: Robert Fesen
PI Institution: Dartmouth College

We know Type Ia supernovae are thermonuclear explosions of CO white dwarfs, but we don't know the specifics of how the nuclear burning proceeds from the core outward to the surface once it starts. Thermonuclear instability in a WD core is thought to start off as a subsonic, turbulent deflagration wave or "burning" wave but then may, at some point, transition into a supernova blast or detonation wave. In such a "delayed detonation" model, differences between normal and subluminous Type Ia SNe reflect differences in the amount of burning that has occurred in the pre-detonation phase. More burning helps to pre-expand the WD before passage of the detonation wave which then lowers the density of the outer layers and, in turn, results in a different element production and internal structure. Directly imaging the 2D chemical distribution of ejecta from a Type Ia SN is actually possible in the case of the subluminous Type Ia SN 1885 which occurred on the near-side of M31's central bulge. The entire 123 year old remnant -- core to outer edge -- is visible via strong near-UV, Ca and Fe line absorptions, and remarkably, is

still in near free expansion. This means that elemental stratification seen today is likely to accurately reflect the explosive nucleosynthesis physics. We propose ACS WFC images of SN 1885 to take advantage of this extraordinary situation: Having a young, nearby Type Ia SN remnant visible in silhouette against a galaxy-size light table. The proposed observations will reveal the Fe ejecta distribution, density structure, sphericity, and ionization state as a function of expansion velocity, thereby testing SN Ia explosion models with direct Fe-rich ejecta mapping data.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11723
Title: Imaging the Crab Nebula-Like Supernova Remnant 3C 58
PI: Robert Fesen
PI Institution: Dartmouth College

The Galactic supernova remnant 3C 58 shares several important properties with the Crab Nebula. It possesses a young, rapidly spinning pulsar and an associated compact optical/IR synchrotron wind nebula. This makes 3C 58, along with the Crab and PSR B0540-69 in the LMC, only the third such PWN detected in the optical and IR. Also like the Crab, 3C58 has been associated with a historically reported 'guest star', in this case, the apparent SN of 1181 CE. Its optical nebulosity contains an unusually large fraction of shocked circumstellar material, with the remnant's high-velocity, N-rich ejecta knots exhibiting a strong bi-polar expansion asymmetry. Despite having a relatively extensive optical nebula, it is the only young and nearby Galactic SNR that has not yet been imaged by HST. However, some recent deep, high-resolution Gemini images show a surprising amount of fine-scale filament detail, revealing some peculiar optical emission morphologies. Here we propose a WFC3 imaging survey of 3C 58 in order to investigate: 1) the optical luminosity and emission efficiency of the remnant's young, 65.7 ms pulsar PSR J0205+6449 thereby providing a rare testing of pulsar emission models, 2) the effect of the remnant's expanding synchrotron nebula on the formation of Rayleigh-Taylor instabilities in its optical filaments like that observed so far only in the Crab through HST imaging, and 3) the fine-scale structure of 3C 58's slow moving circumstellar and high-velocity SN ejecta and the morphological and distribution differences between them.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11724
Title: Direct Age Determination of the Local Group dE Galaxies
NGC 147 and NGC 185
PI: Marla Geha
PI Institution: Yale University

The origin of dwarf elliptical (dE) galaxies remains a mystery and the dE galaxies of the Local Group provide the best opportunity to study this galaxy class in detail. We propose to obtain ACS photometry of main sequence turnoff stars in the M31 dE satellites NGC 147 and NGC 185. Because these galaxies have little to no stars younger than 1 Gyr, resolving the main sequence

turnoff is required to directly quantify their star formation histories. NGC 147 and NGC 185 are the only two dEs for which a clean measurement is feasible with the HST. This proposal was accepted in Cycle 15, but little data were taken before the failure of ACS. The main sequence turnoffs of NGC 147 and NGC 185 are expected to be at an apparent magnitude of $V=29$; we request F606W/F814W imaging one half magnitude fainter than this limit (three magnitudes fainter than the deepest previous dE observations). Quantifying the ratio of old to intermediate-age stars will allow us to discriminate between competing models of dE formation. On-going Keck/DEIMOS spectroscopy of several hundred red giant stars in each of these two dE galaxies, coupled with dynamical modeling and spectral synthesis, will complement the ACS measurement by providing information on chemical abundance patterns, dark matter content and internal dynamics. The proposed ACS data will be the first to directly quantify the onset and duration of star formation episodes in dE galaxies, and will thereby form the cornerstone in what promises to be the most comprehensive study of this class of galaxies.

=====

Proposal Category: GO
Scientific Category: HOT STARS
ID: 11725
Title: Eclipsing Binaries in the Local Group: III -
Unprecedented Accuracy in Distance Determination to M33
and Calibration of the Cosmic Distance Scale
PI: Edward Guinan
PI Institution: Villanova University

The Great Spiral Galaxy in Triangulum (M33) is a crucial calibrator for the Cosmic Distance Scale, and thus for determining the age and evolution of the Universe. M33 is viewed face-on, has a simple geometry, large and diverse stellar populations, and morphologies similar to our Galaxy and other more distant galaxies used for distance determinations. Yet currently the M33 distance ($d \sim 830 \pm 120$ kpc) still has measurement dispersions of 10-15%. Moreover, the distance to M33 derived from Cepheids, RR Lyrae stars, H2O masers, RGB stars, and EBs is currently discrepant by ~15% (Bonanos et al. 2006). In our work on the LMC and M31 distances we have demonstrated that double-line eclipsing binaries serve as excellent "standard candles." Distances derived from eclipsing binaries are basically geometric and essentially free from many assumptions and uncertainties that plague other less direct methods, such as metallicity differences and calibration zeropoints. The absolute radii of the component stars of eclipsing binaries can be determined to better than a few percent from the time-tested analyses of their light and radial velocity curves. With accurate determinations of radii, temperatures, and ISM absorption it is possible to determine reliable distances. In Cycle 15 we extended our program of using eclipsing binaries as standard candles to M33 using ACS/SBS and WFPC/2 spectrophotometry of a well suited ~19th mag 07+07 eclipsing binary system. Although insightful, ACS/SBC data alone do not provide sufficient accuracy for the unambiguous determination of individual temperatures, $[Fe/H]$, and ISM extinction, which are central to distance determination. We propose a 4 orbit follow-up spectrophotometry with the newly installed HST/COS G140L and the repaired HST/STIS G230L and G430L to obtain the single missing key element of this program. These quantities, when combined with the results from existing light and radial velocity curves for

the target (cf. Bonanos et al. 2006), yield stellar masses, radii, luminosities and, most importantly, the distance. Based on our previous experience, we expect to reduce the uncertainty of the M33 distance to less than 5%, thereby leading to a resolution of the currently irreconcilable distances to M33 derived by different methods, and a firm calibration of the Cosmic Distance Scale and the zeropoint of the Hubble Constant (H_0).

=====

Proposal Category: GO
Scientific Category: COOL STARS
ID: 11726
Title: Mysteries of the North Star: HST/COS confirmation of real-time evolution and upper atmospheric heating in Polaris
PI: Edward Guinan
PI Institution: Villanova University

The major aims of this proposal are twofold: to confirm and understand the recently observed apparent evolutionary changes of the bright (3.97-day) Cepheid Polaris – and – to further study the recent discovery of hot plasmas (up to 1MK) well above the photospheric temperature of the Cepheid itself. This study will have a major impact on understanding the evolution, structure, heating and dynamics of Cepheid (and related Hybrid Star) atmospheres. In our study – the Secret Lives of Cepheids – Polaris is noteworthy for its well-documented increase in pulsation period (+3.51 sec/year) and decrease in light amplitude over the last 100-150 years, almost ceasing pulsations in the early 1990s. Moreover, our studies of photoelectric photometry and historic visual observations have shown evidence that Polaris may have increased in brightness by almost 0.2-mag over the past century (and possibly by more than 1-mag since Ptolemy). In addition, a study of the IUE database indicates a possible increase in photospheric temperature (which the FUV region is very sensitive to) between 1978/79 and 1991/93, pointing to a change of $\sim 35 \pm 12$ K. More recently, FUSE and Chandra observations of Polaris indicate the presence of C III 977/1176A and O VI 1032/1038A emissions, as well as possible soft X-ray emission, respectively. The source of these hot plasmas could be related to pulsations (shock heating) and/or magnetic activity. To further investigate the evolutionary changes and upper atmospheric emissions of Polaris, we propose for HST/COS medium resolution spectrometry covering the wavelength range ~ 1150 – 2100 Å. This wavelength range covers both the high energy emission lines (< 1600 Å) along with the rise in continuum of the F-supergiant photosphere (> 1600 Å). HST/COS is the only instrument capable of carrying out the necessary FUV observations to achieve our scientific goals for Polaris – providing a better understanding of the evolution and heating mechanisms of Cepheids.

=====

Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11727
Title: UV spectroscopy of Local Lyman Break Galaxy Analogs: New Clues to Galaxy Formation in the Early Universe
PI: Timothy Heckman
PI Institution: The Johns Hopkins University

Much of our information about galaxy evolution and the interaction between galaxies and the IGM at high- z has been provided by the Lyman Break Galaxies (LBGs). However, it is difficult to investigate these faint and distant objects in detail. To address this, we have used the GALEX All-Sky Imaging Survey and the SDSS to identify for the first time a rare population of low-redshift galaxies with properties remarkably similar to the high-redshift LBGs. These local "Lyman Break Analogs" (LBAs) resemble LBGs in terms of morphology, size, UV luminosity, star formation rate, UV surface brightness, stellar mass, velocity dispersion, metallicity, and dust content. We are assembling a wide range of data on these objects with the goal of using them as local laboratories for better understanding the relevant astrophysical processes in LBGs. These data include HST imaging (95 orbits in Cy15 and 16), Spitzer photometry and spectroscopy, Chandra and XMM X-ray imaging and spectroscopy, and near-IR integral field spectroscopy (VLT, Keck, and Gemini). In this proposal we are requesting the most important missing puzzle piece: far-UV spectra with a signal-to-noise and spectral resolution significantly better than available for typical LBGs. We will use these spectra to study the LBA's galactic winds, probe the processes that regulate the escape of Ly- α and Lyman continuum radiation, determine chemical abundances for the stars and gas, and constrain the form of the high-end of the Initial Mass Function. Adding these new COS data will give us vital information about these extraordinary sites of star formation in the local universe. In so-doing it will also shed new light on the processes that led to the formation of stars, the building of galaxies, and the enrichment and heating of the IGM in the early universe.

=====
Proposal Category: GO
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11728
Title: The Impact of Starbursts on the Gaseous Halos of Galaxies
PI: Timothy Heckman
PI Institution: The Johns Hopkins University

Perhaps the most important (yet uncertain) aspects of galaxy evolution are the processes by which galaxies accrete gas and by which the resulting star formation and black hole growth affects this accreting gas. It is believed that both the form of the accretion and the nature of the feedback change as a function of the galaxy mass. At low mass the gas comes in cold and the feedback is provided by massive stars. At high mass, the gas comes in hot, and the feedback is from an AGN. The changeover occurs near the mass where the galaxy population transitions from star-forming galaxies to red and dead ones. The population of red and dead galaxies is building with cosmic time, and it is believed that feedback plays an important role in this process: shutting down star formation by heating and/or expelling the reservoir of cold halo gas. To investigate these ideas, we propose to use COS far-UV spectra of background QSOs to measure the properties of the halo gas in a sample of galaxies near the transition mass that have undergone starbursts within the past 100 Myr to 1 Gyr. The galactic wind associated with the starburst is predicted to have affected the properties of the gaseous halo. To test this, we will compare the properties of the halos of the post-starburst galaxies to those of a control sample of galaxies matched in mass and QSO impact

parameter. Do the halos of the post-starburst galaxies show a higher incidence rate of Ly-Alpha and metal absorption-lines? Are the kinematics of the halo gas more disturbed in the post-starbursts? Has the wind affected the ionization state and/or the metallicity of the halo? These data will provide fresh new insights into the role of feedback from massive stars on the evolution of galaxies, and may also offer clues about the properties of the QSO metal absorption-line systems at high-redshift .

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11729
Title: Photometric Metallicity Calibration with WFC3 Specialty Filters
PI: Jon Holtzman
PI Institution: New Mexico State University

The community has chosen to include several filters in the WFC3 filter complement that have been designed to allow fairly precise estimates of stellar metallicities, and many science programs are enabled by this capability. Since these filters do not exactly match those used for this purpose on the ground, however, the mapping of stellar colors to stellar metallicities needs to be calibrated. We propose to achieve this calibration through observations of five stellar clusters with well known metallicities. We will calibrate several different filter calibrations which will allow future users to determine what filter combination best meets their science needs.

=====
Proposal Category: SNAP
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11730
Title: Continued Proper Motions of the Magellanic Clouds: Orbits, Internal Kinematics, and Distance
PI: Nitya Kallivayalil
PI Institution: Massachusetts Institute of Technology

In Cycles 11 and 13 we obtained two epochs of ACS/HRC data for fields in the Magellanic Clouds centered on background quasars. We used these data to determine the proper motions of the LMC and SMC to better than 5% and 15% respectively. The results had a number of unexpected implications for the Milky Way-LMC-SMC system and received considerable attention in the literature and in the press. The implied three-dimensional velocities are larger than previously believed and close to the escape velocity in a standard 10^{12} solar mass Milky Way dark halo. Our orbit calculations suggest the Clouds may not be bound to the Milky Way or may just be on their first passage, both of which are unexpected in view of traditional interpretations of the Magellanic Stream. Alternatively, the Milky Way dark halo may be a factor two more massive than previously believed, which would be surprising in view of other observational constraints. Also, the relative velocity between the LMC and SMC was larger than expected, leaving open the possibility that the Clouds may not be bound to each other. To further verify and refine our results we requested an additional epoch data in Cycle 16 which is being executed with WFPC2/PC due

to the failure of ACS. A detailed analysis of one LMC field shows that the field proper motion using all three epochs of data is consistent within 1-sigma with the two-epoch data, thus verifying that there are no major systematic effects in our previous measurements. The random errors, however, are only smaller by a factor of 1.4 because of the relatively large errors in the WFPC2 data. A prediction for a fourth epoch with measurement errors similar to epochs 1 and 2 shows that the uncertainties will improve by a factor of 3. This will allow us to better address whether the Clouds are indeed bound to each other and to the Milky Way. It will also allow us to constrain the internal motions of various populations within the Clouds, and to determine a distance to the LMC using rotational parallax. Continuation of this highly successful program is therefore likely to provide important additional insights. Execution in SNAPSHOT mode guarantees maximally efficient use of HST resources.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11731
Title: Studying Cepheid Systematics in M81: H-band Observations
PI: C. Kochanek
PI Institution: The Ohio State University Research Foundation

The local value of the Hubble Constant remains one of the most important constraints in cosmology, but improving on the 10% accuracy of the HST Key Project is challenging. No improvements will be convincing until the metallicity dependence is well constrained and blending effects are fully understood. M81 and its dwarf companion Holmberg IX are superb laboratories for studying Cepheid systematics because they contain large numbers of bright Cepheids with a good spread in metallicity lying at a common, relatively close distance. We have identified 180 $12 < P < 70$ day Cepheids in these two galaxies using the Large Binocular Telescope (compared to 30 in total by the KP), and will expand the sample further in 2008-2009. We will use 10 orbits with WFC3/IR to obtain H-band images of 100 Cepheids in M81 to add to the ACS/BVI calibrations we will obtain from archival data and 1 orbit with WFC3/UVIS to add B-band data for Holmberg IX. Four band BVIH photometry will allow us to flux calibrate, estimate extinction, measure metallicity effects and then check the results in detail. We can also examine blending effects on WFC3/IR data in a relatively nearby galaxy before it is applied to more distant galaxies. Our M81 sample is three times larger than the next best sample, that of NGC4258, and suffers less from blending because M81 is at half the distance, so it is an excellent laboratory for studying Cepheid systematics even if it lacks as precise a geometric distance as NGC4258.

=====
Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11732
Title: The Temperature Profiles of Quasar Accretion Disks
PI: C. Kochanek
PI Institution: The Ohio State University Research Foundation

We can now routinely measure the size of quasar accretion disks using

gravitational microlensing of lensed quasars. At optical wavelengths we observe a size and scaling with black hole mass roughly consistent with thin disk theory but the sizes are larger than expected from the observed optical fluxes. One solution would be to use a flatter temperature profile, which we can study by measuring the wavelength dependence of the disk size over the largest possible wavelength baseline. Thus, to understand the size discrepancy and to probe closer to the inner edge of the disk we need to extend our measurements to UV wavelengths, and this can only be done with HST. For example, in the UV we should see significant changes in the optical/UV size ratio with black hole mass. We propose monitoring 5 lenses spanning a broad range of black hole masses with well-sampled ground based light curves, optical disk size measurements and known GALEX UV fluxes during Cycles 17 and 18 to expand from our current sample of two lenses. We would obtain 5 observations of each target in each Cycle, similar to our successful strategy for the first two targets.

=====

Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 11733
Title: WPVS 007: the little AGN that could
PI: Karen Leighly
PI Institution: University of Oklahoma Norman Campus

Outflows are important components of AGN, potentially removing angular momentum, enriching the intergalactic medium, and potentially playing a key role in the evolution of galaxies. Yet their astrophysics is poorly understood. We propose an FUV observation of the Seyfert-luminosity AGN WPVS 007 ($M_V = -19.7$, $z = 0.02882$) using COS, coordinated with a short Chandra observation. Observed to have a miniBAL with maximum velocity $v_{\max} \sim 1000$ km/s in a 1996 HST observation, it was discovered to have developed an additional BAL flow by the time of the FUSE observation in 2003. The BAL flow has maximum velocity of at least 6,000 km/s, and the unambiguous presence of PV indicates that it is very optically thick. In addition, it was found to have normal X-ray flux during the ROSAT All Sky Survey, but in subsequent observations from 1993 to 2003 it was observed to be X-ray weak, suggesting that the X-rays were absorbed by the emerging BAL. Our proposed observations will contribute to our understanding of outflows in three key areas. First, an observed relationship between v_{\max} and luminosity that is plausibly related to the acceleration mechanism is violated in WPVS 007; thus WPVS 007 presents a challenge to outflow models. Second, the observed evolution of the BAL flow may be related to the small black hole mass and correspondingly compact emission and absorption regions; thus, WPVS 007 offers the rare opportunity to observe evolution of the outflow on human time scales. Finally, while WPVS 007 has been observed to be X-ray weak since 1993, a recent long Swift observation revealed the first detection of hard X-ray emission. The proposed observations will reveal whether this emergence of hard X-rays is accompanied by a decrease in the UV absorption, and thus test the relationship between X-ray and UV absorbers in BALQSOs.

=====

Proposal Category: GO
Scientific Category: COSMOLOGY

ID: 11734
Title: The hosts of high redshift gamma-ray bursts
PI: Andrew Levan
PI Institution: The University of Warwick

Gamma-ray bursts are the most luminous explosive events known, acting as beacons to the high redshift universe. Long duration GRBs have their origin in the collapse of massive stars and thus select star forming galaxies across a wide range of redshift. Due to their bright afterglows we can study the details of GRB host galaxies via absorption spectroscopy, providing redshifts, column densities and metallicities for galaxies far too faint to be accessible directly with current technology. We have already obtained deep ground based observations for many hosts and here propose ACS/WFC and WFC3 observations of the fields of bursts at $z > 3$ which are undetected in deep ground based images. These observations will study the hosts in emission, providing luminosities and morphologies and will enable the construction of a sample of high- z galaxies with more detailed physical properties than has ever been possible before.

=====
Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 11735
Title: The LSD project: dynamics, merging and stellar populations of a sample of well-studied LBGs at $z \sim 3$
PI: Filippo Mannucci
PI Institution: INAF - IRA, Firenze

A large observational effort with the ground-based ESO/VLT telescopes allowed us to obtain deep, spatially-resolved, near-IR spectra of complete sample of 11 Lyman-Break Galaxies at $z \sim 3.1$. These observations were used to obtain, for the first time, the metallicity and the dynamical properties of a sample of objects that, albeit small, is representative of the total population of the LBGs. We propose to use HST to obtain high-resolution optical and near-IR images of this sample of LBGs in order to study the broad-band morphology and the stellar light distribution of these galaxies. These images, exploiting the superior spatial resolution of HST images and the low-background : 1- will allow a precise measure of the dynamical mass from the velocity field derived with spectroscopy; 2- will permit a comparison of the distribution of star formation (from the line emission) with the underlying stellar population, and, 3- will be used to check if the complex velocity field and the multiple line-emitting regions detected in most targets can be ascribed to on-going mergers. This accurate study will shed light on a number of unsolved problems still affecting the knowledge of the LBGs.

=====
Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11736
Title: The Nearest Cold Interstellar Cloud
PI: David Meyer
PI Institution: Northwestern University

Optical observations of interstellar Na I absorption have recently discovered that a cold (20 K) diffuse cloud stretching over 10 degrees across the constellation Leo is nearby ($d < 45$ pc) and thus, deep inside the Local Bubble of hot, tenuous gas surrounding the Sun out to distances of ~ 100 pc. Assuming thermal pressure equilibrium under these conditions leads to an extremely thin, sheetlike geometry for the cold Leo cloud. Such a cold cloud could also be the overpressured interface between colliding flows of warm gas in the Local Bubble. The keys to evaluating the gas pressure and other physical characteristics of the cold Leo cloud lie in the ultraviolet with its rich diversity of interstellar diagnostic transitions. Due in part to a lack of bright UV background sources, there has been no previous UV absorption line study of this cloud. We have identified 3 stars exhibiting Na I absorption from the cold Leo cloud that are suitable for such a study with STIS onboard HST. The main goals of our proposed observations are to: (1) determine the cloud's gas pressure through measurements of its C I fine-structure excitation, (2) assess the dust contribution to the cloud heating by measuring the depletion-sensitive Cr/Zn gas-phase abundance ratio, and (3) evaluate the cloud cooling rate and electron density through measurements of its C II fine-structure excitation.

=====

Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11737
Title: The Distance Dependence of the Interstellar N/O Abundance Ratio: A Gould Belt Influence?
PI: David Meyer
PI Institution: Northwestern University

The degree of elemental abundance homogeneity in the interstellar medium is a function of the enrichment and mixing processes that govern Galactic chemical evolution. Observations of young stars and the interstellar gas within ~ 500 pc of the Sun have revealed a local ISM that is so well-mixed it is having an impact on ideas regarding the formation of extrasolar planets. However, the situation just beyond the local ISM is not so clear. Sensitive UV absorption line measurements have recently revealed a pattern of inhomogeneities in the interstellar O, N, and Kr gas-phase abundances at distances of ~ 500 pc and beyond that appear nucleosynthetic in origin rather than due to dust depletion. In particular, based on a sample of 13 sightlines, Knauth et al. (2006) have found that the nearby stars ($d < 500$ pc) exhibit a mean interstellar N/O abundance ratio that is significantly higher (0.18 dex) than that toward the more distant stars. Interestingly, all of their sightlines lie in the sky vicinity of the Gould Belt of OB associations, molecular clouds, and diffuse gas encircling the Sun at a distance of ~ 400 pc. Is it possible that mixing processes have not yet smoothed out the recent ISM enrichment by massive stars in the young Belt region? By measuring the interstellar N/O ratios in a strategic new sample of sightlines with STIS, we propose to test the apparent N/O homogeneity inside the Gould Belt and determine if the apparent decline in the N/O ratio with distance is robust and associated with the Belt region.

=====

Proposal Category: GO

Scientific Category: COSMOLOGY
ID: 11738
Title: SPIDERWEBS AND FLIES: OBSERVING MASSIVE GALAXY FORMATION
IN ACTION
PI: George Miley
PI Institution: Sterrewacht Leiden

Distant luminous radio galaxies are among the brightest known galaxies in the early Universe, pinpoint likely progenitors of dominant cluster galaxies and are unique laboratories for studying massive galaxy formation. Spectacular images with the ACS and NICMOS of one such object, the "Spiderweb Galaxy" at $z = 2.2$, show in exquisite detail, hierarchical merging occurring 11 Gyr ago. By imaging 3 additional Spiderweb-like galaxies we wish to study this potentially crucial phase of massive galaxy evolution, when hierarchical merging, galaxy downsizing and AGN feedback are all likely to be occurring. Properties of the complete sample of Spiderweb galaxies will be used to (i) constrain models for the formation and evolution of the most massive galaxies that dominate rich clusters and (ii) investigate the nature of chain and tadpole galaxies, a fundamental but poorly understood constituent of the early Universe. We shall image rest-frame UV and optical continuum emission from 3 radio galaxies with $2.4 < z < 3.8$ that appear clumpy and large in shallow WFPC/PC observations. The new observations will typically reach ~ 2 magnitudes fainter over 20-40 times larger area than previously. Photometric and morphological parameters will be measured for satellite galaxies ("flies") in the clumpy massive hosts and for galaxies in ~ 1.5 Mpc x 1.5 Mpc regions of surrounding protoclusters. Locations, sizes, elongations, clumpiness, masses, and star formation rates of the merging satellite and protocluster galaxies will be compared with new state of the art simulations. Combination of ACS and WFC3 images will help disentangle the properties of the young and old populations. Specific goals include: (i) investigating star formation histories of the satellite galaxies and the extended emission, (ii) studying "downsizing" and merging scenarios and (iii) measuring the statistics of linear galaxies and relating them to models for the formation of massive galaxies and to the properties of the important but enigmatic class of chain/tadpole galaxies in the HUDF.

=====
Proposal Category: GO
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11739
Title: Multiple Stellar Generations in the Unique Globular
Clusters NGC 6388 and NGC 6441
PI: Giampaolo Piotto
PI Institution: Universita di Padova

Over the last few years HST observations have resulted in one of the most exciting and unexpected developments in stellar population studies: the discovery of multiple generations of stars in several globular clusters. The finding of multiple main sequences in the massive clusters NGC 2808 and Omega Centauri, and multiple subgiant branches in NGC 1851, M54, and NGC 6388 has challenged the long-held paradigm that globular clusters are simple stellar populations. Even more surprising, given the spectroscopic and photometric constraints, the only viable explanation for the main sequence splitting

appears to be Helium enrichment, up to an astonishingly high $Y=0.4$. The conditions under which certain globulars experience the formation of multiple stellar generations remain mysterious, and even more so the helium-enrichment phenomenon. Such an enrichment has important implications for chemical-enrichment, star-formation, and stellar-evolution scenarios, in star clusters and likely elsewhere. To properly constrain the multiple main sequence phenomenon, it is important to determine its extent among GCs: is it limited to Omega Cen and NGC2808, or is it more common? We propose deep WFC3 optical/IR imaging of NGC 6388 and 6441, the two globular clusters that are most likely to host multiple, helium-enriched populations. Our simulations of WFC3 performance suggest that we will be able to detect even the main sequence splittings caused by small He differences ($\Delta Y < 0.03$).

=====

Proposal Category: GO
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11740
Title: A Complete Optical and NIR Atmospheric Transmission
Spectrum of the Exoplanet HD189733b
PI: Frederic Pont
PI Institution: University of Bern

The hot Jupiter HD189733b offers the best exoplanet in which to perform atmospheric studies through transit spectroscopy. Here we propose STIS and Nicmos spectra to help construct a full exoplanetary transit transmission spectrum that extends over the entire optical and near-infrared range. Such a spectrum will link existing observed atmospheric features such as haze, water, and methane, providing a coherent understanding of all these reported features. With a spectrum covering many observed absorption features, the absolute pressure scale and abundances can be determined linking observed features to the actual atmospheric properties of the exoplanet.

=====

Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11741
Title: Probing Warm-Hot Intergalactic Gas at $0.5 < z < 1.3$ with a Blind Survey for O VI, Ne VIII, Mg X, and Si XII Absorption Systems
PI: Todd Tripp
PI Institution: University of Massachusetts

Currently we can only account for half of the baryons (or less) expected to be found in the nearby universe based on D/H and CMB observations. This "missing baryons problem" is one of the highest-priority challenges in observational extragalactic astronomy. Cosmological simulations suggest that the baryons are hidden in low-density, shock-heated intergalactic gas in the $\log T = 5 - 7$ range, but intensive UV and X-ray surveys using O VI, O VII, and O VIII absorption lines have not yet confirmed this prediction. We propose to use COS to carry out a sensitive survey for Ne VIII and Mg X absorption in the spectra of nine QSOs at $z(\text{QSO}) > 0.89$. For the three highest-redshift QSOs, we will also search for Si XII. This survey will provide more robust constraints on the quantity of baryons in warm-hot intergalactic gas at $0.5 <$

$z < 1.3$, and the data will provide rich constraints on the metal enrichment, physical conditions, and nature of a wide variety of QSO absorbers in addition to the warm-hot systems. By comparing the results to other surveys at lower redshifts (with STIS, FUSE, and from the COS GTO programs), the project will also enable the first study of how these absorbers evolve with redshift at $z < 1$. By combining the program with follow-up galaxy redshift surveys, we will also push the study of galaxy-absorber relationships to higher redshifts, with an emphasis on the distribution of the WHIM with respect to the large-scale matter distribution of the universe..

=====
Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11742
Title: Probing HeII Reionization with GALEX-selected Quasar
Sightlines and HST/COS
PI: Gabor Worseck
PI Institution: Astrophysikalisches Institut Potsdam

We propose spectroscopic observations with COS of eight $z \sim 3$ QSOs that we found to be bright in the far ultraviolet. Our aim is to study intergalactic absorption caused by the onset of the He II Lyman forest. Several lines of evidence suggest that helium reionization occurred at $z \sim 3$. Understanding this process is critical for a complete picture of the intergalactic medium and its evolution; it also gives clues to hydrogen reionization at $z > 6$. The only direct means of assessing He II reionization is through far-UV observations of the He II Lyman alpha forest. Only 6 sightlines are known to date where this is feasible, despite extensive surveys. Our programme is designed to double the number of available sightlines. To this effect, we cross-correlated all known $z > 2.73$ quasars with UV source lists from the GALEX satellite. The selected quasars were all significantly detected in the far UV by GALEX, and their UV colors are similar to those of already known quasars with transparent sightlines. Spectra obtained with COS will allow us to compile the first comprehensive sample of He II absorption spectra probing similar redshifts, enabling a systematic investigation of the He II reionization epoch and the spectral shape of the UV background.

=====
Proposal Category: AR
Scientific Category: COOL STARS
ID: 11743
Title: Ironing Out the Wrinkles
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

This is a Calibration Archival proposal to develop, implement, and test enhancements to the pipeline wavelength scales of STIS echelle spectra, to take full advantage of the extremely high performance of which the instrument is capable. The motivation is a recent extensive investigation--The Deep Lamp Project--which identified systematic wavelength distortions in all 44 primary and secondary settings of the four STIS echelle modes: E140M, E140H, E230M, and E230H. The method was to process deep exposures of the onboard Pt/Cr-Ne calibration source as if they were science images, and measure deviations of

the lamp lines from their laboratory wavelengths. An approach has been developed to correct the distortions post facto, but it would be preferable to implement a more robust dispersion model in the pipeline itself. The proposed study will examine a more extensive set of WAVECALs than in the exploratory Deep Lamp effort, and will benefit from a new laboratory line list specifically for the STIS lamps. Ironing out the wrinkles in the STIS wavelength scales will impact many diverse science investigations, especially the Legacy Archival project "StarCAT."

=====

Proposal Category: AR
Scientific Category: EXTRA-SOLAR PLANETS
ID: 11744
Title: 3D Transit Spectroscopy for Extrasolar Planets
PI: Travis Barman
PI Institution: Lowell Observatory

This proposal outlines steps for improving our ability to model the atmospheres of extrasolar planets -- in particular modeling the transmission of stellar host flux through the upper atmospheres of hot-Jupiters. Hubble will soon be in a position to detect atmospheric metals and molecules through observations using the new Cosmic Origins Spectrograph and the soon to be repaired STIS and ACS. In order to make more realistic predictions of the transmission spectrum, we propose to construct multi-dimensional radiative transfer models for two important regions of the atmosphere probed by transit spectroscopy -- the upper photosphere and the extended, low-pressure, exosphere.

=====

Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11745
Title: Spectral models of singly ionized iron-peak species for HST science
PI: Manuel Bautista
PI Institution: Virginia Polytechnic and State University

Several of the most important astronomical topics today that involve UV and optical astronomical spectroscopy require detailed understanding of singly iron-peak species (Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu). Yet, our present knowledge of the atomic physics and spectra is lagging behind the avalanche of high quality spectra arising from these ions. We have started a systematic study of each of these species which is aimed to provide complete radiative models containing radiative rates and collision strengths. The proposed calculations will reach a new level of completeness and accuracy, as needed for modern astronomical applications, because of the sum of recent theoretical developments that allow for more accurate representations of the atomic species and unprecedented computational power. The spectral models will be incorporated into the widely used photoionization modeling codes CLOUDY and XSTAR for use of the astronomical community. The data will also be made widely available to the community.

=====

Proposal Category: AR
Scientific Category: COOL STARS
ID: 11746
Title: A Definitive HST/FGS Parallax for the Hyades
PI: George Benedict
PI Institution: University of Texas at Austin

We propose to obtain from the archive the forty orbits of GTO FGS fringe tracking data secured by the HST Astrometry Science team using FGS 3. These data contain FGS observations of a total of 7 science targets (confirmed members of the Hyades open cluster) and 36 reference stars. These data were previously analyzed and resulted in a parallax for the Hyades published in 1997. Since that time Benedict, McArthur, and Harrison have significantly changed and improved the processing pipeline and the methodology employed to derive parallaxes from HST FGS data. Our expected parallax precision will be nearly three times better than what was previously obtained. These should yield single star absolute magnitudes with errors of 0.04 mag or better, aiding studies of cluster shape and intrinsic main sequence width. Given the importance of the Hyades as a rung in the distance scale ladder, it would be valuable to obtain a definitive, independent parallax for the Hyades and confirm that HIPPARCOS got that one right. A weighted average of the HIPPARCOS and HST parallaxes could provide a valuable test metric for upcoming space astrometry missions such as SIM and/or GAIA.

=====

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11747
Title: Shapelets analysis of the COSMOS field
PI: Joel Berge
PI Institution: Jet Propulsion Laboratory

We propose a next-generation weak gravitational lensing analysis of the Hubble Space Telescope COSMOS field with shapelets, an advanced shear measurement method. Shapelets have been shown to perform as well as or better than other methods on ground-based images, and are expected to be a premier tool for upcoming space-based weak lensing surveys. COSMOS ACS/WFC images are ideal to optimize our shapelets pipeline for space-based images. In particular, they will allow us to optimize the control on systematic errors by using the unique ability of shapelets to provide several shear estimators from high-resolution imaging. We will also improve the galaxy fitting procedure used by shapelets by introducing a technical innovation based on wavelets. We will then create an improved shear catalog of the COSMOS field. Combined with new, more accurate photometric redshifts, this will allow us to significantly improve the weak lensing analysis of this field. Most importantly, the robust control of systematic errors that shapelets provide will allow us to measure the weak lensing three-point correlation function, thus improving on previous constraints on cosmological parameters.

=====

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11748

Title: Structural Properties of Star Clusters in M33
PI: Rupali Chandar
PI Institution: University of Toledo

We propose to study the mass-radius relationship of star clusters in M33, from the vast amount of archival HST data that has accumulated on this nearby galaxy. These data, taken for a large variety of programs, can be assembled to provide a comprehensive, high resolution view of (nearly) the entire disk of M33, which will allow us to study the detailed properties of at least ~500 clusters, and possibly many more. The clusters span ages from a few millions of years to more than 10 billion years, and are close enough that with HST we can measure a full suite of structural parameters, including half-light, core, and tidal radii, cluster density and more. Our immediate goal is to determine the initial mass-radius relation of these star clusters, and how this changes over time. Determining these relations for a relatively complete sample of star clusters in a single galaxy will enable us to address many questions on the dynamical state and evolution of star clusters in general. We aim in particular to study the evolution of the cluster mass function over time, in order to establish whether or not the mass function depends on cluster density, as has been recently shown for old globular cluster systems in the Milky Way and Sombrero galaxies. We will thus determine directly whether the mass-radius relation and the mass function of the M33 cluster system evolve together, as expected if evaporation due to internal, two-body relaxation is the dominant process responsible for evolving the cluster mass function. Due to its proximity, rich cluster system, and available datasets, M33 is possibly the best galaxy to accomplish these goals.

=====
Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 11749
Title: Constraining the co-evolution of black hole growth and star formation at the lowest levels of galactic nuclear activity
PI: Anca Constantin
PI Institution: Smithsonian Institution Astrophysical Observatory

We propose to investigate at the highest possible angular resolution the nuclear excitation structure in > 150 nearby actively line-emitting galaxies, based on novel measurements of HST-STIS archival spectra. This sample offers the highest number statistics ever achieved for ~10 parsec resolution scrutiny of the power source of the ambiguous (and ubiquitous) $z \approx 0$ sources that are labeled as AGN yet do not present the usual hallmarks of an accretion-powered system. The data will be used to quantify line flux ratio gradients and isolate the spectrum from the central few tens of parsecs, allowing a more sensitive search for accretion signatures. We will be able to quantitatively test the validity of a potential H II \rightarrow Seyfert/Transition Object \rightarrow LINER evolutionary sequence, and offer crucial constraints for the true incidence of accretion activity at $z \approx 0$.

=====
Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE

ID: 11750
Title: The Stellar Metallicities of a Large Sample of Dwarf Galaxies: Constraints on Formation Models
PI: Julianne Dalcanton
PI Institution: University of Washington

The properties of dwarf galaxies fall into two broad classes. At one extreme are dwarf irregulars, which have blue colors and irregular morphologies. They are actively star forming, with high gas mass fractions and current star formation rates that are comparable to or higher than their past average. At the other extreme are dwarf spheroidal and dwarf elliptical galaxies, which have smooth morphologies and redder colors. They are devoid of gas, have no current star formation, and are preferentially found in denser environments. For decades, scientists have debated the origin of these two distinct classes, postulating that dwarf spheroidals and dwarf ellipticals are either former dwarf irregulars whose star formation was truncated by environmental processes (e.g. ram pressure or tidal stripping) or that they are a distinct class of galaxies with a unique evolutionary history. Given that the suppression of dwarf galaxies' star formation is central to reconciling the paucity of dwarfs with predictions of Lambda CDM, discriminating amongst these models transcends squabbles about the origin of dwarf galaxy morphologies. A recent paper has claimed a definitive answer to these questions, based in large part on their finding that, at the same luminosity, the old stars in dwarf irregulars have systematically lower metallicities than those in dwarf spheroidals. These metallicities were estimated from the colors of red giant branch (RGB) stars, which become redder with increasing metallicity for old stellar populations. However, these authors neglected that when younger stellar populations are present, the color of the RGB becomes bluer and is contaminated with evolving AGB and core helium-burning stars. The resulting bluer colors lead to the false impression of lower metallicities if a purely old age is incorrectly assumed. The observed offset of young dIrr galaxies to lower inferred metallicities may reflect exactly this mistake. We propose to reanalyze a large sample of dwarf galaxies with high quality multi-color ACS imaging. We will rederive the metallicity distribution of the old stellar population, after correcting for the presence of young stars on the RGB. We will then analyze the resulting trends in metallicity as a function of galaxy mass, luminosity, morphology, and environment. Because this analysis will be carried out as a function of position within each galaxy, we will be able to examine radial trends in metallicity as well.

=====
Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11751
Title: Simulations of COS intergalactic HI and metal absorbers
PI: Romeel Dave
PI Institution: University of Arizona

We will use advanced cosmological hydrodynamic simulations, including a well-constrained dynamical prescription for enriching the IGM via galactic outflows, to study how quasar absorption line data from COS can optimally inform our understanding of the cosmic gas and metal distribution at $0 < z < 1.5$. We will specifically focus on (1) quantifying tracers of the Warm-Hot

Intergalactic Medium (WHIM), thought to harbor the so-called missing baryons; (2) understanding what the wide suite of COS-observable absorption lines tells us about the multi-phase nature of gas in filaments and around galaxies; and (3) testing and constraining predicted cosmic metal distribution using statistics of HI and metal absorbers. To do so we will run quarter-billion particle simulations including a sophisticated chemical enrichment model and non-equilibrium ionization, extract artificial COS spectra, and present line statistics for comparison with upcoming COS observations. We will also make our simulated spectra publicly available through our SLACR website, including physical information along the line of sight, to facilitate improved interpretation of COS data. This proposal will provide a state of the art, user-friendly platform for understanding COS observations of enriched baryons in the low-redshift Cosmic Web.

=====
Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 11752
Title: Modeling the Broad Lines of Nearby LLAGNs with known
Central Masses
PI: Nick Devereux
PI Institution: Embry-Riddle Aeronautical University

We will be using archival STIS and FOS spectroscopy to identify and model the broad emission lines for 14 nearby, low luminosity AGNs (LLAGNs) whose the central mass distributions have been determined from gas kinematics. Since the 2-D gravitational field strength is already known for these galaxies, the relationship between velocity and radius may be established, given a kinematic model for the broad emission line gas. We will investigate various kinematic models for the broad line gas including inflow, rotating accretion disks and the atmospheres of stars orbiting close to the AGN. These low luminosity AGNs are unable to sustain outflows which greatly simplifies the modeling. We have already demonstrated in a recent publication (Devereux & Shearer 2007) that our new analysis technique has the potential to yield the size of the broad line region, the mass inflow rate, the volume filling factor, and the radial density profile for the broad line gas. Additionally, archival WFPC2 and ACS UV imaging will allow us to measure, or set a limit, on the ionization provided by the AGN, for half of the galaxies in our sample. We have a Cycle 17 GO proposal (# 106) pending to image the remainder with the SBC of ACS. Our recently published results indicate that the broad line region in M81 is very large ~ 1 pc which may explain why the AGN is unable to sustain the ionization seen there. We wish to explore this discrepancy for the other galaxies in our sample. However, regardless of whether or not our GO proposal is accepted, this archival proposal will allow us to find the broad line region size for 14 nearby low luminosity AGNs and the relationship between broad line region size and ionization for 6 of these.

=====
Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11753
Title: Compact binaries in the core-collapsed globular cluster
NGC6397

PI: Jonathan Grindlay
PI Institution: Harvard University

We propose to carry out archival analysis of the 126-orbit dataset (GO-10424) for the WFPC2 data on the core of the globular cluster NGC 6397. As the closest core collapse cluster, this represents the best possible data to study the nature and distributions of compact binaries in the cluster. The initial task will be to derive the optical and particularly U-band variability of Chandra X-ray binaries (CVs, ABs and MSP candidates) in the cluster core, as well as a deep search for the optical counterpart of the quiescent LMXB in the cluster. The analysis will then allow the deepest search for binary periods on known and newly identified optical counterparts to the Chandra sources now found in our deepest-ever Chandra survey of NGC 6397. For comparison, a generalized binary period search will be conducted vs. radius in the cluster. This will enable the compact binary content of this cluster (primarily CVs vs. ABs) to be measured and the dynamical history of binary production vs. destruction through core collapse to be constrained.

=====

Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 11754
Title: Planetary Perturbations of Circumstellar Debris Disks
PI: Joseph Hahn
PI Institution: Space Science Institute

Circumstellar debris disks are of considerable astronomical interest, particularly since they provide insight into the formation and evolution of planet-forming systems. These dusty disks are the byproducts of collisions among unseen planetesimals, which are themselves the seeds of planets. So it is of no surprise that some debris disks (beta Pictoris, Fomalhaut, HR 4796, and others) appear to be perturbed by planets orbiting within. The signatures of planetary perturbations include: central gaps, warps and radial offsets, and other asymmetries in the disk. The following proposes to develop a model of a circumstellar debris disk that is perturbed by an unseen planetary system. This research effort will then apply this model to Hubble Space Telescope observations of several perturbed debris disks, which will then allow us to measure or else constrain the masses and orbits of any unseen planets that might be lurking within.

=====

Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11755
Title: Constraining the Star-Formation and Metal-Enrichment Histories of Galaxies with the Next Generation Spectral Library
PI: Sara Heap
PI Institution: NASA Goddard Space Flight Center

Hubble's Next Generation Spectral Library (NGSL) comprises intermediate-resolution (R~1000) STIS spectra of 378 stars having a wide range in metallicity and age. Unique features of the NGSL include its broad wavelength

coverage (1,800-10,100 Å) and high-S/N, absolute spectrophotometry. When incorporated in modern stellar population synthesis codes, the NGSL should enable us to constrain simultaneously the star-formation history and metal-enrichment history of galaxies over a wide redshift interval ($z= 0-2$). In AR10659, we laid the foundation for tracing the spectral evolution of galaxies by putting the NGSL in order. We now propose to derive the atmospheric and fundamental parameters of the program stars, generate integrated spectra of stellar populations of different metallicities and initial mass functions, and derive spectral diagnostics of the age, metallicity and E(B-V) of stellar populations.

=====
Proposal Category: AR
Scientific Category: HOT STARS
ID: 11756
Title: Advancing Spectroscopy of Hot Stars
PI: D. Hillier
PI Institution: University of Pittsburgh

Much of our current knowledge about stars comes from detailed studies of their spectra. Unfortunately to interpret their spectra requires detailed atmospheric models. To facilitate the study of massive star spectra we will significantly enhance and further develop the radiative transfer code, CMFGEN, which is publicly available at my web-page (www.pitt.edu/~hillier). This code has been successfully used to model OB stars, Wolf-Rayet (W-R) stars, Luminous Blue variables, A supergiants, [W-R] central-stars of planetary nebulae, and supernovae, and has been used to make available to the community theoretical UV fluxes for both O stars and W-R stars. Massive stars play an important role in starbursts and galaxies --- dynamically, energetically, and chemically. Mass loss from massive stars significantly affects the elemental abundance ratios in starbursts and plays a major role in the origin and recycling of the elements in the ISM of galaxies. Massive stars are thought to play a key role in the metal enrichment of the early Universe, are responsible for reionization, and are also thought to be responsible for one class of gamma-ray bursters. Understanding massive stars, their radiation, their mass-loss rates, and having reliable parameters is thus crucial to many different areas of astrophysics. CMFGEN has made a significant contribution to the analysis of massive stars; the proposed enhancements will allow CMFGEN to continue to be an invaluable tool to expand our astrophysical knowledge.

=====
Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11757
Title: Toward a Better Understanding of ISM Turbulence through the Study of Velocity Profiles over a Large Dynamic Range
PI: Edward Jenkins
PI Institution: Princeton University

We plan to study turbulence in the diffuse interstellar medium (ISM) by analyzing the shapes of absorption features arising from various atomic species that appear in the archival UV spectra of 102 early-type stars in the Milky Way, recorded by the highest resolution mode (E140H) of the STIS

spectrograph. Our objective is to consider 12 different lines that cover a wide range of line strengths, so that we can piece them together to create a composite velocity profile over a large span in equivalent hydrogen column densities. We intend to study separately neutral, singly-ionized and doubly ionized atoms. The statistical properties of the velocity distribution functions should yield insights on the dynamical effects arising from turbulence in the ISM and, moreover, allow comparisons to be made with the predictions from theoretical models arising numerical simulations of turbulence created by different investigators. We plan to use a specific analysis approach called the Velocity Coordinate Spectrum developed by Lazarian and Pogosyan to interpret the data.

=====
Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11758
Title: Simulated HST Observations of Elliptical Galaxies in
Formation
PI: Patrik Jonsson
PI Institution: University of California - Santa Cruz

We propose to generate simulated HST observations of galaxies at redshifts above 2, which are likely to be undergoing rapid merging and have high star-formation rates, using hydrodynamic simulations and radiation-transfer calculations to include the effects of dust. Simulations of galaxies forming at these redshifts must include multiple mergers and accretion of gas from infalling structure. Detailed galaxy simulations will be developed, with initial conditions informed by large-scale cosmological simulations. Such simulations are the most effective way of generating large numbers of such merging systems. When these new hydrodynamic simulations are combined with our radiation transfer code Sunrise, it will be possible to generate realistic images and spectra of the simulated galaxies, not only at HST wavelengths but from far-UV to submillimeter. The simulated HST images and the other data will be used to develop better algorithms for identification of galaxies undergoing mergers.

=====
Proposal Category: AR
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11759
Title: Comprehensive Theoretical UV-optical Diagnostics for STIS
and COS
PI: Lisa Kewley
PI Institution: University of Hawaii

Observing the metallicity and star formation history of galaxies since the earliest times in the universe is crucial to understanding galaxy formation and evolution. The star formation history of galaxies has been studied extensively but our understanding of the chemical history of star-forming galaxies is lacking. STIS and COS will provide UV-optical spectra for thousands of star-forming galaxies. These spectra will include many emission and absorption lines suitable for chemical abundance analysis, but consistent UV-optical abundance diagnostics do not currently exist. We propose to

exploit the recent major advances in theoretical stellar atmospheres, stellar population synthesis, and photoionization models to create the first consistent theoretical suite of UV-optical emission and absorption diagnostics for use with STIS (and where possible COS) spectra of HII regions, and star-forming galaxies. The model suite, IDL tools, and diagnostics that we develop will be useful for numerous applications and will be made available to the entire astronomical community on our Mappings On-Line website. In combination with STIS/COS spectroscopy, the abundance diagnostics that we develop will provide an in-depth understanding of the nucleogenic state of the Galaxy through C, N, and O. In addition, these diagnostics will pave the way for UV absorption and optical emission-line abundances to be used consistently in cosmic metallicity history research, for the first time.

=====

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11760
Title: Studying Cepheid Systematics In M81: Archival BVI Data
PI: C. Kochanek
PI Institution: The Ohio State University Research Foundation

The local value of the Hubble Constant remains one of the most important constraints in cosmology, but improving on the 10% accuracy of the HST Key Project is challenging. No improvements will be convincing until the metallicity dependence is well constrained and blending effects are fully understood. M81 and its dwarf companion Holmberg IX are superb laboratories for studying Cepheid systematics because they contain large numbers of bright Cepheids with a good spread in metallicity lying at a common, relatively close distance. We have identified 180 $12 < P < 70$ day Cepheids in these two galaxies using the Large Binocular Telescope (compared to 30 in total by the KP), and will expand the sample further in 2008-2009. We will use archival BVI ACS images of M81 and Holmberg IX to flux calibrate these Cepheids and then measure or limit the metallicity dependence. Three band photometry allows us to flux calibrate, estimate extinction, measure metallicity effects and check for additional systematic effects, particularly blending. A separate proposal aims to expand the study to H-band. Our M81 sample is three times larger than the next best sample, that of NGC4258, and suffers less from blending because M81 is at half the distance, so it is an excellent laboratory for studying Cepheid systematics even if it lacks as precise a geometric distance as NGC4258.

=====

Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 11761
Title: The Dynamical Legacy of Star Formation in the Orion Nebula Cluster
PI: Adam Kraus
PI Institution: California Institute of Technology

We propose an archival study of astrometry in the Orion Nebula Cluster, analyzing data from four previous surveys of the ONC core with WFPC2 and ACS/WFC. This program will allow us to measure precise proper motions of

individual cluster members, characterizing the intra-cluster velocity distribution and directly studying the dynamical signatures of star formation and early cluster evolution. Our astrometric uncertainties (~ 1 mas at each epoch) will allow us to calculate individual stellar velocities to unprecedented precision (~ 0.2 mas/yr; 0.4 km/s), and since these velocities are parallel to the projected spatial distribution of cluster members, we can directly relate these stellar velocities to spatial substructure within the cluster. We will also conduct a wider-field survey exploiting observations of the cluster halo from the two ACS/WFC surveys, which covered ten times the area (400 square arcminutes) but with a shorter time baseline. Finally, both components of our survey will allow us to probe other topics in small-scale star formation physics by searching for high-velocity stars ejected from decaying multiple systems, expanding our knowledge of multiplicity in dense environments, and testing the membership of candidate cluster members based on kinematic membership tests.

=====

Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11762
Title: A Statistical Survey of Lyman Limit Systems at $z < 2$
PI: Nicolas Lehner
PI Institution: University of Notre Dame

Lyman limit systems (LLS) are a key for understanding the transfer of ionizing radiation in the universe, the interactions between the galaxies and their environments, and the distribution of metals in the universe. Yet, they are the least understood and studied class of QSO absorbers both observationally and theoretically. This is especially true at $z < 2$ (i.e. looking back over 75% of cosmic time), where they can only be observed in the UV. Progress toward a better understanding of these systems and improved theoretical models has been limited by the small statistical samples and few detailed analyses. We propose to use the 516 low resolution FOS and STIS spectra from the HST archive to determine the statistical properties of the $z < 2$ LLS. Our analysis will span a total redshift path of ~ 200 and yield over 110 Lyman thick absorbers ($17.2 \leq \log N(\text{HI}) < 20.3$) at $z < 2$, increasing their number by at least a factor of 7 over the current largest sample. We will undertake for the first time a systematic search for partial LLS ($16.5 \leq \log N(\text{HI}) < 17.2$) at $z < 2$. The main goals of our survey are 1) to determine the redshift density and the column density frequency distribution of the LLS, and 2) to compare the partial LLS and LLS statistics to those of indirect tracers of high column density absorbers such as MgII systems. Currently, uncertainties in dN/dz and $f[N(\text{HI})]$ are among the greatest sources of uncertainty for inferring the shape and intensity of the UV background radiation field and constraining cosmological models. We will make high level data products available to the community, including co-added and calibrated spectra, and line identifications.

=====

Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 11763
Title: Merging Supermassive Black Holes: Observational consequences of Gravitational-Radiation Recoils, Spin

and Gas Dynamics
PI: Carlos Lousto
PI Institution: Rochester Institute of Technology

The merger of binary supermassive black holes (SMBHs) and the possibly substantial kick that follows will have a major effect on both circumstellar disks surrounding each SMBH as well as the circumbinary disk surrounding the system. These phenomena may play a crucial role in interpreting a number of objects observed with HST, including binary active galactic nuclei (AGN) and "naked" quasars displaced from the centers of their host galaxies. Recent scientific breakthroughs (in large part by our group) in solving the Einstein's field equations in strong field gravity have enabled computational astrophysicists to study these dynamical effects in great detail. One of the most important discoveries is that the merger of spinning black holes can yield recoil velocities from gravitational radiation up to 4000 km/s. Several candidate recoiling SMBHs may have been observed, but uncertainties in the theoretical predictions for observing such systems limit the ability to confirm detections. In this proposal we describe a plan to simulate in full general relativity the mergers of SMBHs embedded in accretion disks, determining how these extremely large kicks influence the resulting observational signatures observable by HST. These effects should include, but may not be limited to, periodic emission from the initial binary system, bimodal emission from disks with induced eccentricities, and highly red/blueshifted broad line emission relative to narrow line emission from the portion of the disk carried away by the recoiling SMBH after the merger.

=====

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11764
Title: The Faint-End Slope of the Rest-Frame Optical Luminosity Function at $z \sim 2-3$
PI: Danilo Marchesini
PI Institution: Yale 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 luminosity function (LF) is one of the most fundamental of all cosmological observables, and it is one of most basic descriptors of a galaxy population. As the redshift range $z \sim 2-3$ represents a key epoch in the buildup and evolution of galaxies, probes of the LF at these redshifts provide important constraints on the processes at work in galaxy formation and evolution. While currently there are strong constraints on the bright end of the LF in this epoch, the faint end is less well-known, suffering from small number statistics and field-to-field variations, especially for red galaxies. Moreover, the uncertainties on the faint-end slope propagate in the estimates of the number and luminosity densities. In particular, the relative contributions of red and blue galaxies to the global densities are very sensitive to the adopted faint-end slopes. We here propose to use HST archival data to constrain the faint end of the rest-frame optical LFs at $2 < z < 3$ by exploiting the ultra-deep optical and near-IR data available in the two GOODS fields over a total surveyed area of ~ 73 square arcmin. We expect to increase the number of galaxies with $0.08L^* < L < 0.4L^*$ by a factor of ~ 5 . Moreover, we

will push the determination of the LFs about 2-3 mag deeper, allowing us to probe the rest-frame optical LFs down to $\sim 0.01 L^*$ at $z \sim 3$. This analysis will ultimately result in the most accurate rest-frame optical LFs of galaxies at $z \sim 2-3$.

=====

Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 11765
Title: Curating and cataloging the Carina Nebula mosaic
PI: Max Mutchler
PI Institution: Space Telescope Science Institute

We will enable new and deeper analyses of this prototypical nearby star-formation region, especially the largest structures which require fully assembled mosaics. We will deliver a legacy ACS dataset, including WFPC2 parallel observations, expertly and uniformly prepared beyond the capabilities of any existing or currently planned automated pipelines, and we will do this at a small fraction of the cost of similar ACS legacy datasets. The dataset will become a High-Level Science Product (HLSP), and will be ingested into the Hubble archive (MAST) and also conform to, and by be fully accessible by, NVO, etc.

=====

Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 11766
Title: Measuring the size distribution of small Kuiper-belt objects using FGS
PI: Eran Ofek
PI Institution: California Institute of Technology

The measurement of the size distribution of small Kuiper belt objects (KBO) is a powerful tool for testing models of the origin of KBOs, their effective strength and their collisional evolution, as well as models of the origin of the solar system. However, objects smaller than about 10 km in radius are too faint to be directly observed. For the past 14 years, the HST/Fine Guidance Sensors (FGS) have been collecting a large number of photometric measurements of guide stars with 40 Hz time resolution. We propose to use this unique data set to look for occultations of stars by KBOs. We show that this archival proposal will be about two orders of magnitude more powerful than any ongoing search for KBO occultations, and we expect to find between 0.1 to 40 events. Therefore, HST/FGS is in a unique position to detect, for the first time, small KBOs ($150 \text{ m} < r < 1 \text{ km}$) and measure their size distribution.

=====

Proposal Category: AR
Scientific Category: COOL STARS
ID: 11767
Title: DRAFTS-- A Deep Rapid Archival Flare Transient Search
PI: Rachel Osten
PI Institution: University of Maryland

We propose to use the archival database from the SWEEPS project (Sahu et al. 2006a) to quantify the incidence of stellar flaring among Galactic dwarfs. The long time series (continuous 7 days viewing) coupled with short individual exposures (~5 minutes in V and I) occupies a unique niche in the parameter space of optical transient studies. Time-series data are available for ~230,000 stars down to V=29.5 (mass of ~0.25 Msun); the resultant mass function shows that there are more than 100,000 M stars which can be used to look for flares. Due to their dependence on the presence and dynamics of interacting magnetic fields, stellar flares are a diagnostic of transient magnetic activity, in addition to more commonly used persistent indicators, and thus provide a complementary diagnostic of the presence and action of large-scale magnetic fields. Recent results from deep optical fast transient searches indicate the prevalence of stellar flaring and bolster support for a better quantification of the stellar flare rate. The stellar flare rate is also an important input to astrobiological studies on the effects of stellar flares on exoplanets in M dwarf planet-hosting systems. We will use this data to determine the stellar flare rate as a function of mass, temperature, and apparent magnitude in stars of intermediate-old age and compare to the decline of magnetic activity seen in younger stellar populations.

=====

Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11768
Title: Internal kinematics of the Orion Nebula Cluster
PI: Imants Platais
PI Institution: The Johns Hopkins University

The Orion Nebula Cluster (ONC) is the best-ever studied rich system of very young stars and other objects, and has already provided crucial clues about protoplanetary disks and the very early stages of star formation, ranging from the most massive stars down to brown dwarfs. One of the last unsolved mysteries of the ONC is its dynamical status: it is unclear whether the ONC is bound or unbound. The key to this quest is a reliable and precise measurement of the internal velocity dispersion via proper motions. We propose to derive this dispersion with only a 15% uncertainty which then will enable: 1) to settle the issue on the dynamical stability of ONC; 2) to examine the radial dependence of the internal velocity dispersion; 3) to explore its dependency on stellar mass. This will provide the foundation upon which the next generation of dynamical models of systems, like the ONC, can be built. Our group has the world's best archival images of the ONC spanning more than 40 years. The combination of HST ACS/WFC and WFPC2 images with our superb and deep ground-based collection of plates and CCD images is the key condition to reach the required 0.1 mas/yr precision level - at least three times better than the current estimates for stars fainter than V=12. This appears to be the most rational way to extract the invaluable astrometric information from the HST Orion Treasury Program and other extensive HST datasets.

=====

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11769
Title: Mitigating Image Persistence in WFC3 NIR Observations to

Allow Weak Lensing Shape Measurements

PI: Jason Rhodes
PI Institution: Jet Propulsion Laboratory

Weak gravitational lensing, the slight distortion of the shapes of background galaxies by foreground dark matter, has become an important tool in precision cosmology. With the addition of the of the near infrared (NIR) WFC3 channel later this year, there will be NIR surveys in which weak lensing will be a primary or secondary science goal. We have identified an important instrumental systematic effect, image persistence, or ghosting, that is present in HgCdTe NIR detectors such as WFC3. This effect will cause non-negligible shape distortions that mimic a weak lensing signal and prevent precise weak lensing measurements. We have outlined a mitigation strategy that entails quantifying the effect and then removing the effect from the data as the first stage in image processing. We have all the necessary tools, including two HgCdTe detectors in our labs undergoing persistence characterization, an existing image simulation pipeline, and well-tested weak lensing shape measurement software. Using science and calibration imaging data taken during the normal course of Cycle 17 operations, we will develop a model of persistence in WFC3, produce a removal algorithm, and deliver the results to STScI for dissemination to the community. We will also monitor WFC3 over the course of Cycle 17 to see if the persistence worsens due to charged particle radiation damage.

=====
Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11770
Title: The Mass of the Milky Way: Orbits for the Leo I and Leo II dwarf Galaxies (Archival Studies of Leo I)
PI: R. Rich
PI Institution: University of California - Los Angeles

Constraining the mass of the Galaxy at large radii remains a difficult problem. Available data are still rather scarce, and orbits of even a few objects at large radii can have a large impact. We propose to obtain proper motions for the Galaxy's two most remote satellites, Leo I and Leo II, which orbit the Galaxy at about 200 kpc. Together with the radial velocities of these galaxies, which are well known, the proper motions allow space velocities to be constructed: these can remove significant uncertainty in the Galactic mass models, and in particular settle the vexed question of whether or not Leo I is gravitationally bound to the Galaxy. The proper motion of Leo I as derived from archival ACS and WFPC2 data is addressed in this proposal, while a companion (approved Cycle 16) WFPC2 imaging proposal addresses the orbit of Leo II.

=====
Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 11771
Title: Where do Black Holes get their kicks?
PI: Andrew Robinson
PI Institution: Rochester Institute of Technology

Our present understanding of galaxy evolution suggests that supermassive black holes (SMBH) commonly form binary systems in the cores of large galaxies. It is expected that the SMBH binary will ultimately undergo rapid coalescence in an enormous outburst of gravitational waves. Anisotropic emission of the gravitational radiation can impart a large recoil velocity to the merged SMBH, which may even exceed the escape velocity of the host galaxy. As SMBH are the engines of active galactic nuclei (AGN), the aftermath of SMBH coalescence may be observable as a displacement of the AGN from the centre of its host galaxy. Recent n-body simulations suggest that even if the SMBH fails to escape its host, it will undergo long-lived oscillations in the core of the galaxy after the initial large amplitude oscillations have been damped by dynamical friction. This implies that if binary coalescence is an important SMBH growth mechanism, the AGN should commonly be displaced from the center of the host galaxy. We therefore propose to search for such displacements using archival images of nearby Seyfert galaxies. Our aims are (1) to verify the displacements indicated by previous 2-D spectroscopy and spectroastrometric measurements. In doing so, will we explore and test a variety of techniques for accurately determining the center of the host galaxy bulge and quantify the associated uncertainties. (2) Measure AGN – galaxy center offsets in a larger sample of nearby Seyferts in order statistically quantify the occurrence of significant offsets and hence set limits on the frequency of possible binary SMBH mergers. (3) Search for relationships between displacement magnitude and direction and key properties of the AGN (including SBMH mass and radio source position angle) and host galaxy (e.g., hubble type, morphology evidence for past mergers). A null result would be equally important, since this would imply that binary SMBH do not occur in Seyfert hosts (mainly early-type spirals), or that they do not coalesce.

=====

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 11772
Title: The Galaxy Major Merger Rate at $z>3$: Constraints on Galaxy Evolution and the LCDM Paradigm
PI: Russell Ryan
PI Institution: Arizona State University

We propose to determine the highest redshift portion ($3 < z < 6.8$) of the galaxy merger rate from the BVi'-band dropout galaxies identified in the Great Observatories Origins Deep Survey (GOODS) and the Hubble Ultra-Deep Field (HUDF). By adopting methods widely discussed in the literature, we can construct a robust sample of merging galaxies while correcting for a variety of selection biases and completeness issues, which are inherent to any flux-limited survey. Contrary to other schemes for identifying merging galaxies, this approach will best utilize the deep, high resolution imaging available only through HST. Our Archival proposal focuses on two primary science goals: (1) Identify the dynamically-close, merging pairs at $z>3$. While galaxy merging is widely regarded as the primary mechanism of galaxy evolution, there are currently no merger studies at $z>3$. When our results are combined with the wealth of published data at $z<1$ and our work at $0.5 < z < 2.5$, we will have determined the galaxy merger history for ~93% of the age of the Universe. (2) Compare the observed redshift evolution to galaxy formation and cosmological

models. In particular, the galaxy merger rate depends on the equation of state of the dark energy component in the standard LCDM cosmology. However, the role of the cosmological model cannot be uniquely determined from low redshift observations alone, owing to considerable degeneracies in this modeling. Only these deep fields observed with HST can provide the angular resolution, depth, and statistics needed to study high redshift galaxy merging.

=====
Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 11773
Title: Spectroscopic Archive Legacy Survey of the Cosmic Web
PI: J. Shull
PI Institution: University of Colorado at Boulder

We propose a one-year HST (and FUSE) Legacy Archive Program on the low-redshift IGM, associated galaxies, and interstellar high-velocity clouds (HVCs). We will produce a uniformly reduced, carefully analyzed set of spectra of extragalactic sources (AGN), based on observations made through 2004. These data are the highest quality, low-z quasar absorption-line (QAL) spectra, needed to guide plans for COS spectrographic research on the intergalactic medium (IGM) and Galactic HVCs. A comprehensive QAL database will provide the following benefits to the astronomical community: (1) Joint analysis of HST and FUSE absorbers in the low-z IGM and HVCs; (2) Measurements of the IGM baryon content, metallicity, and ionization state; (3) Probes of the thermal phases of IGM and HVC gas; (4) IGM signposts (Ly-alpha, Ly-beta, O~VI) for future UV and X-ray surveys of the cosmic web. Our survey will also assist in designing an HST Community Treasury Project, to survey quasar absorbers and intervening galaxy halos with COS.

=====
Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11774
Title: Shock Destruction of Dust in Supernova Remnants
PI: J. Shull
PI Institution: University of Colorado at Boulder

In this AR-Theory program, we propose to carry out a series of investigations of grain injection, transport, and destruction using hydrodynamical models of reverse-shocked SN ejecta. In a young supernova remnant (SNR) such as Cas A or SN 1987A the outer blast wave strikes surrounding circumstellar matter, and reverse shocks propagate inward toward the interior debris, which may contain large amounts of newly formed dust. Our major theoretical goals are to determine how much dust is destroyed in shocked SNR ejecta, as they are decelerated by the reverse shocks, and to study how these ejecta are lighted up in optical, X-ray, and IR line emission. Numerical codes will be used to study grain destruction in metal-enriched ejecta and to interpret the morphologies, proper motions, and emissivities of these fast-moving ejecta, observed by Hubble in many young SNRs. We intend to undertake the following tasks: (1) Compile the latest gas-grain data (sputtering yields vs projectile energy for H, He, and heavy ions); (2) Incorporate gas-grain and grain-grain

interactions with radiative cooling rates (X-ray, optical, IR line emission) of sputtered atoms and ions; (3) Compute adaptive-mesh hydrodynamical models of ejecta-shock interactions; (4) Use these ejecta models to compute grain destruction, grain heating, plasma cooling, and spectral diagnostics in metal-enriched environments; (5) Apply our results to specific SNRs (Cas A, SN 1987A, G292, etc) to interpret ejecta morphologies, proper motions, and emissivities; (6) assess the net efficiency of supernova dust injection.

=====
Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11775
Title: Determining the Phase of Carbon in the Interstellar Medium
PI: Ulysses Sofia
PI Institution: Whitman College

This purpose of this program is to better understand the ISM and its extinction effects by greatly increasing the high-quality sample of carbon abundance measurements from the neutral ISM. Carbon is an abundant element that exists in several phases in the interstellar medium: dust, gaseous atoms/ions and gaseous molecules. The phase distribution of this element is a fundamental characteristic of interstellar clouds that governs their physics. Yet the abundance of carbon has been measured in only 13 neutral interstellar sight lines, 7 of which have known extinction characteristics. The HST archive contains a wealth of data on interstellar carbon that has not yet been tapped. We propose to use archival STIS measurements of the interstellar C II 1334 A absorption to significantly increase the sample of interstellar carbon abundance measurements. Nineteen of our proposed 23 sight lines have extinction curves determined for them; this will nearly quadruple the number of sight lines with both measured C abundances and derived extinction curves. The enhanced sample of measurements will allow us to gain insight into both the gas and dust-phases of the interstellar medium, perhaps solve the problem of the carbon crisis, and illuminate the role of carbon-based grains as extinction carriers.

=====
Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 11776
Title: Accurate Photodissociation of UV-Irradiated Molecular Gas
PI: Phillip Stancil
PI Institution: University of Georgia Research Foundation, Inc.

With the upcoming servicing of the HST and the installation of COS, a large number of molecular absorption and emission features will be observable in the visible and ultraviolet. These observations, and analysis of past ones, are expected to give new insights into our understanding of the evolution of a range of astronomical sources and the chemistry occurring in these environments. In particular, molecules are primarily destroyed in diffuse and translucent regions via photodissociation (PD) due to incident UV and optical radiation. The majority of astrochemical/spectral modeling codes available today use pre-computed exponentially-attenuated photorates based on dust

scattering/absorption for an "average" interstellar cloud. Since there is clearly a large scatter in the dust properties and local radiation field for various environments in the Galaxy and beyond, the adoption of such pre-computed photorates can lead to considerable errors in predicted abundances. We propose here to significantly improve current modeling capabilities by computing new rovibrationally-resolved PD cross sections for C₂, CN, and CS; constructing a publicly available database of available PD cross sections; implementing the PD cross sections into the spectral simulation code Cloudy for explicit computation of local photorates; and testing of the Cloudy implementation in diffuse and translucent cloud simulations and with photodissociation region benchmark models. The successful completion of the goals from this proposal will be important for obtaining accurate molecular abundances from HST observations of diffuse clouds, translucent clouds, and other UV-irradiated molecular regions and in inferring local grain properties.

=====

Proposal Category: AR
Scientific Category: ISM IN EXTERNAL GALAXIES
ID: 11777
Title: Toward Understanding the Fundamental Structure of
Superwinds: An Archival Study of Clouds in M82's Wind
PI: David Strickland
PI Institution: The Johns Hopkins University

Outflows from starburst galaxies are now viewed as an important aspect of galaxy formation and evolution. Much of what we know about superwinds comes from optical emission and UV/optical absorption line studies, yet the physical structures within winds that are responsible for these tracers - clouds - are not well understood even in the local Universe. Important issues such as typical cloud sizes, how they are accelerated, and whether they are being destroyed in the wind are not known. In 2006 the Hubble Heritage team obtained a deep and wide-field mosaic of ACS imaging of M82, the nearest brightest starburst galaxy with a superwind, in B, V, I and H-alpha filters. This is and will be the best dataset for studying superwind clouds for the foreseeable future. We will numerically identify clouds in the ACS images, and determine the cloud size and flux distributions as a function of position within the wind. We will combine this with existing information on electron density, extinction and wind velocity as a function of distance along wind to determine e.g, cloud masses, and mass-flow rates and thus the effective cloud lifetimes. We will also study the relationship between the H-alpha clouds and (a) dust clouds visible in these images, and (b) the soft X-ray emission. This study will provide us with data of unprecedented quality on the physical nature of the one of the fundamental constituents of galactic winds.

=====

Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 11778
Title: An archival search for faint Kuiper Belt Objects
PI: David Trilling
PI Institution: University of Arizona

The Kuiper Belt is a ring of rocky and icy debris that surrounds the planetary realm of our Solar System. Residents of the Kuiper Belt are referred to as Kuiper Belt Objects (KBOs). KBOs and the Kuiper Belt are remnants from the era of planet formation in our Solar System, 4.5-billion years ago. The location of a change in slope at the faint end of the KBO magnitude distribution can be used as a proxy measurement for the dynamical age of the outer Solar System, and three recent studies have found significantly different values, implying very different histories for the outer Solar System. We propose here an Archive project to harvest 50--100 $R < 27$ KBOs from a number of existing ACS/WFC datasets. We will derive the KBO magnitude distribution and magnitude of change in slope (if any) from a large number of faint KBOs. We will measure the number and magnitude distributions of KBOs as functions of latitude, longitude, and KBO inclination. Dynamically hot and cold KBO populations may have different magnitude distributions, alluding to differing evolutionary histories. With these results we will constrain the dynamical history of the outer Solar System.

=====

Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11779
Title: Intermediate Mass Black Holes in Globular Clusters
PI: Stefan Umbreit
PI Institution: Northwestern University

Although predicted by theory more than 30 years ago, the possible existence and properties of intermediate-mass black holes (IMBHs) could not be probed by observations up until very recently. IMBHs are expected theoretically to form at the centers of dense star clusters through various dynamical processes and indeed the most promising observational signatures for IMBHs are in the cores of dense globular clusters (GCs), where the evidence now comes from both the stellar velocity distribution and the surface brightness profile near the cluster center. However, interpretation of the data and, in particular, constraints on central IMBH masses, require the use of detailed cluster dynamical models. Here we propose to model GCs that harbor IMBHs with our state-of-the-art Monte Carlo cluster code. This Monte Carlo code is orders of magnitude faster than other, "direct summation" N-Body codes, and now incorporates all relevant physical processes, including both stellar dynamics and stellar evolution, thereby allowing us for the first time to make detailed and direct comparisons with observations. By directly comparing our predicted velocity dispersion and surface brightness profiles with observations, we will be able to place strong constraints on the masses of a central IMBH. In particular, with our detailed dynamical models we should be able to unambiguously prove or disprove the presence of a 40,000 solar mass IMBH at the center of omega Cen, suggested by recent HST data of Noyola et al. (2008).

=====

Proposal Category: AR
Scientific Category: RESOLVED STELLAR POPULATIONS
ID: 11780
Title: Dynamical Evolution of Young Clusters in Merging Galaxies
PI: Enrico Vesperini

PI Institution: Drexel University

We propose to study the dynamical evolution of young star clusters in merging galaxies. HST observations have shown that the high luminosities and the compact sizes of these young clusters are those expected for globular clusters at young ages but the evolution of young clusters in the galactic environment typical of merging galaxies has not been explored and can not be inferred from existing simulations of the evolution of clusters in isolated galaxies. In order to establish the relationship between these clusters and old globular clusters and to understand whether these objects will indeed survive and evolve to form a population of globular clusters with properties similar to those of old globulars in elliptical galaxies, we plan to study their dynamical evolution and, in particular, to explore the effects of the complex time-variation of the tidal field of the merging galaxies on their early evolution. Our study will be aimed at determining the fate and survival fraction of these young clusters, their internal properties at the end of the galaxy merger, and the global properties of the surviving cluster population. The proposed research will be based on detailed N-body simulations, using state-of-the-art hardware (several special-purpose GRAPE-6 computers will be available for this project) and software capable of modeling in detail both the internal evolution of individual clusters and the larger-scale physics of the galaxy merger.

=====
Proposal Category: AR
Scientific Category: UNRESOLVED STELLAR POPULATIONS AND GALAXY STRUCTURE
ID: 11781
Title: A Database of Young Star Clusters for Five Hundred Galaxies
PI: Brad Whitmore
PI Institution: Space Telescope Science Institute

We propose to use the source lists developed as part of the Hubble Legacy Archive (HLA: Data Release 1 - February 8, 2008) to obtain a large (N ~50 galaxies for multi-wavelength, N ~500 galaxies for ACS F814W), uniform (ACS + WFPC2 + NICMOS: DA0phot used for object detection) database of super star clusters in nearby star-forming galaxies in order to address two fundamental astronomical questions: 1) To what degree is the cluster luminosity (and mass) function of star clusters universal ? 2) What fraction of super star clusters are "missing" in optical studies (i.e., are hidden by dust)? This database will also support comparisons with new Monte-Carlo simulations that have independently been developed in the past few years by co-I Larsen and PI Whitmore, and will be used to test the Whitmore, Chandar, Fall (2007) framework designed to understand the demographics of star clusters in all star forming galaxies. The catalogs will increase the number of galaxies with measured mass and luminosity functions by an order of magnitude, and will provide a powerful new tool for comparative studies, both ours and the community's.