Cycle 14 Abstract Catalog
Generated from Phase I Submissions
April 06, 2005

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10486
Title: A Cosmic String Lens Candidate
PI: Eric Agol
PI Institution: University of Washington

We propose two-band imaging observations with ACS of a cosmic string lens candidate, CSL-1, to look for a feature predicted by the cosmic string model: a low-surface brightness discontinuity in between the two galaxy images.

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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10487
Title: A Search for Debris Disks in the Coeval Beta Pictoris Moving Group
PI: David Ardila
PI Institution: The Johns Hopkins University

Resolved observations of debris disks present us with the opportunity of studying planetary evolution in other solar systems. We propose to search for debris disks in the Beta Pictoris moving group (8-20 Myrs, 10-50 pc away) , which provides a coeval sample of multiple spectral types, and it has already produced two magnificent resolved debris disks: AU Mic and Beta Pic. Such coeval sample will provide us with a snapshop of the crucial time in disk evolution in which the disk makes the transition from optically thick to optically thin, and it will be useful to study the stellar mass dependence of the disk evolution.

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Proposal Category: SNAP
Scientific Category: GALAXIES
ID: 10488
Title: The Most Massive Galaxies in the Universe: Color-Gradients and Texture
PI: Mariangela Bernardi
PI Institution: University of Pennsylvania

We are proposing an HST snapshot survey of 40 objects with velocity dispersion larger than 350 km/s, selected from the Sloan Digital Sky Survey and confirmed to be single massive galaxies by the ACS-HRC i-band imaging obtained during Cycle 13. This sample of the most massive galaxies in the Universe is interesting because these objects potentially harbor the most massive black holes, and because their existence places strong constraints on galaxy formation models. These objects are unusual for another reason than their abnormally large velocity dispersions: they appear to be bluer than expected from extrapolation of the color-velocity dispersion relation of normal early-

types to these large velocity dispersions. The bluer than expected colors indicate that the formation histories of these objects are likely to be rather different than for normal early-types. This difference is also expected to manifest as abnormal color-gradients. ACS-HRC imaging in one other band (i.e. the g-band) will allow us not simply to analyze color gradients in these objects but also to study their color texture and topology. This study will provide important information about the formation history of galaxies.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10489
Title: Imaging Extended UV H2 Emission Around T Tauri
PI: Alexander Brown
PI Institution: University of Colorado at Boulder

The interactions between the circumstellar disk, newly-forming star, and bipolar jet outflows play a central role in the process of star formation. These interactions control how disks evolve and dissipate, and, thereby, control the process of planetary system formation. We propose to image the UV molecular hydrogen (H2) emission around the pre-main-sequence binary star T Tauri using the ACS SBC (solar blind channel) MAMA detector, thus determining the spatial properties of the H2 emitting regions, and deriving important detailed observational information on the disk-star-jet interaction on scales of order 5 AU. These images will reveal the degree of collimation and opening angles of the innermost parts of the high velocity jets, the shock structure within the jet outflows, the size and morphology of the circumstellar disks, both in emission and in silhouette, and the conditions inside the polar cavities swept clear by Herbig-Haro flows. Fluorescent H2 emission lines dominate the UV spectrum of T Tau. Long-slit (1-D) STIS UV spectra of T Tau show H2 emission with a complex spatial structure extending many arcseconds from the star and the presence of significant shock structures. The H2 must be warm (approx. 2000 K) for the fluorescence to operate. The molecular emission originates in shocks and, perhaps, also from the surfaces of the inner regions of accretion disks.
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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 10490
Title: A Snapshot Survey of a Complete Sample of X-ray Luminous Galaxy Clusters from Redshift 0.3 to 0.7
PI: Megan Donahue
PI Institution: Michigan State University

We propose to extend a public, uniform imaging survey of a well-studied, complete, and homogeneous sample of X-ray clusters. The sample of 72 clusters spans the redshift range between 0.3-0.7 and almost 2 orders of magnitude of X-ray luminosity, with a median luminosity of 10^44 erg/s (0.5-2.0 keV). These snapshots will be used to obtain a fair census of the morphologies of cluster galaxies in the cores of intermediate redshift clusters, to detect radial and tangential arc candidates, to detect optical jet candidates, and to provide an approximate estimate of the shear signal of the clusters themselves and a potential assessment of the contribution of large scale structure to lensing shear.
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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 10491
Title: A Snapshot Survey of the most massive clusters of galaxies
PI: Harald Ebeling
PI Institution: University of Hawaii

We propose a snapshot survey of a sample of 124 high X-ray luminosity clusters in the redshift range 0.3-0.7. Similarly luminous clusters at these redshifts frequently exhibit strong gravitational lensing. The proposed observations will provide important constraints on the nature of the cluster mass distributions and a set of optically bright, lensed galaxies for further 8-10m spectroscopy. We acknowledge the broad community interest in this sample and waive our data rights for these observations.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10492
Title: A detailed study of the mass properties for the galaxy cluster RX J1347-1145
PI: Thomas Erben
PI Institution: Universitaet Bonn, Inst fur Astrophysik und Extraterrestris

We propose to obtain deep, multi-colour imaging for the galaxy cluster RX J1347-1145 at z=0.45. Together with our high-quality ground-based optical and X-ray data sets already at hand this observation will produce a precise mass determination of this most X-ray luminous cluster. The analysis will mainly be carried out by a newly developed and novel technique that combines weak and strong lensing information and which is able to break the mass-sheet degeneracy that hampered most previous lensing mass determinations. Within our extensive campaign to understand the mass properties of RX J1347-1145, the main goal of the ACS images will be a refined, high-resolution lensing mass reconstruction of the cluster core. This will be achieved by a substantially increased number density of background sources for a weak lensing analysis in combination with constraints from multiply lensed images that are identified with morphology and colour information. Both of these require the unique resolving power of ACS. RX J1347-1145 is an ideal candidate for elucidating the discrepant mass estimates obtained from traditional methods. It plays the same role at high redshift as A1689 at intermediate redshifts for which a similar analysis has been performed with ACS. Our results will therefore be an important ingredient in the use of galaxy clusters as cosmological probes.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10493
Title: A Survey for Supernovae in Massive High-Redshift Clusters
PI: Avishay Gal-Yam
PI Institution: California Institute of Technology

We propose to measure, to an unprecedented 30% accuracy, the SN-Ia rate in a sample of massive z=0.5-0.9 galaxy clusters. The SN-Ia rate is a poorly known observable, especially at high z, and in cluster environments. The SN rate and its redshift dependence can serve as powerful discrimiminants for a number of

key issues in astrophysics and cosmology. Our observations will: 1. Put clear constraints on the characteristic SN-Ia "delay time," the typical time between the formation of a stellar population and the explosion of some of its members as SNe-Ia. Such constraints can exclude entire categories of SN-Ia progenitor models, since different models predict different delays. 2. Help resolve the question of the dominant source of the high metallicity in the intracluster medium (ICM) - SNe-Ia, or core-collapse SNe from an early stellar population with a top-heavy IMF, perhaps those population III stars responsible for the early re-ionization of the Universe. Since clusters are excellent laboratories for studying enrichment (they generally have a simple star-formation history, and matter cannot leave their deep potentials), the results will be relevant for understanding metal enrichment in general, and the possible role of first generation stars in early Universal enrichment. 3. Reveal, via nuclear variability, the AGN fraction in clusters at this redshift, to be compared with the field AGN fraction. This will be valuable input for understanding black-hole demographics, AGN evolution, and ICM energetics. 4. Potentially discover intergalactic cluster SNe, which can trace the stripped stellar population at high z.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10494
Title: Imaging the mass structure of distant lens galaxies
PI: Leon Koopmans
PI Institution: Kapteyn Astronomical Institute

The surface brightness distribution of extended gravitationally lensed arcs and Einstein rings contains super-resolved information about the lensed object, and, more excitingly, about the smooth and clumpy mass distribution of the lens galaxies. The source and lens information can non-parametrically be separated, resulting in a direct "gravitational-mass image" of the inner mass-distribution of cosmologically-distant galaxies (Koopmans 2005). With this goal in mind, we propose deep HST ACS-F555W/F814W and NICMOS-F160W imaging of 15 gravitational-lens systems with spatially resolved lensed sources, selected from the 17 new lens systems discovered by the Sloan Lens ACS Survey (Bolton et al. 2004). Each system has been selected from the SDSS and confirmed in a time-efficient HST-ACS snapshot program (cycle-13); they show highly-magnified arcs or Einstein rings, lensed by a massive early-type lens galaxy. High-fidelity multi-color HST images are required (not delivered by the 420-sec snapshot images) to isolate these lensed images (properly cleaned, dithered and extinction-corrected) from the lens galaxy surface brightness distribution, and apply our "gravitational-mass imaging" technique. The sample of galaxy mass distributions - determined through this method from the arcs and Einstein ring HST images - will be studied to: (i) measure the smooth mass distribution of the lens galaxies (Dark and luminous mass are separated using the HST images and the stellar M/L values derived from a joint stellar-dynamical analysis of each system); (ii) quantify statistically and individually the incidence of mass-substructure (with or without obvious luminous counter-parts such as dwarf galaxies). Since dark-matter substructure should be considerably more prevalent at higher redshift, both results provide a direct test of this prediction of the CDM hierarchical structure-formation model.
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Proposal Category: GO
Scientific Category: GALAXIES

ID: 10495
Title: The Nuclear Environment of the Galaxy Hosting the Largest Known Radio Outburst
PI: Brian McNamara
PI Institution: Ohio University

We propose to image the cD galaxy host of the most powerful radio outburst known in the Universe. The outburst was identified in a Chandra image of a z=0.216 galaxy cluster which revealed a pair of enormous cavities, each 200 kpc in diameter, embedded in its X-ray halo. The outburst began approximately 100 Myr ago and has expended 6x10^61 ergs. It is apparently powered by accretion onto the cD's billion solar mass nuclear black hole, which grew heavier by roughly 1/3 during the outburst. We intend to examine the morphology and nuclear environment of the host galaxy to understand the conditions that created this remarkable event.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10496
Title: Decelerating and Dustfree: Efficient Dark Energy Studies with Supernovae and Clusters
PI: Saul Perlmutter
PI Institution: University of California - Berkeley

We propose a novel HST approach to obtain a dramatically more useful "dust free" Type Ia supernovae (SNe Ia) dataset than available with the previous GOODS searches. Moreover, this approach provides a strikingly more efficient search-and-follow-up that is primarily pre-scheduled. The resulting dark energy measurements do not share the major systematic uncertainty at these redshifts, that of the extinction correction with a prior. By targeting massive galaxy clusters at z > 1 we obtain a five-times higher efficiency in detection of Type Ia supernovae in ellipticals, providing a well-understood host galaxy environment. These same deep cluster images then also yield fundamental calibrations required for future weak lensing and Sunyaev-Zel'dovich measurements of dark energy, as well as an entire program of cluster studies. The data will make possible a factor of two improvement on supernova constraints on dark energy time variation, and much larger improvement in systematic uncertainty. They will provide both a cluster dataset and a SN Ia dataset that will be a longstanding scientific resource.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10497
Title: Cepheid Calibrations of the Luminosity of Two Reliable Type Ia Supernovae and a Re-determination of the Hubble Constant
PI: Adam Riess
PI Institution: Space Telescope Science Institute

We propose to determine the luminosity of two type Ia supernovae (SNe Ia), 1995al in NGC 3021 and SN 2002fk in NGC 1309, by observing Cepheids in their spiral hosts. Modern CCD photometry yields an extremely tight Hubble diagram for SNe Ia with a precisely determined intercept (i.e., Delta H_0/H_0). Yet, the measurement of the true Hubble constant via SNe Ia is limited by the calibration derived from problematic and unreliable SN data. Most of the SNe

Ia calibrated by HST to date are significantly compromised by the systematics of photographic photometry, high reddening and SN peculiarity, and by the photometric anomolies associated with WFPC2. The extended reach of ACS now provides opportunities to more reliably calibrate SNe Ia and H_0. Our Cepheid calibration of a reliable SN Ia dataset, SN 1994ae, using ACS in Cycle 11 resulted in a 15% increase in H_0 from the value derived by the HST SN Ia Calibration Program. Yet, there remains a terribly small sample of reliable SN Ia data sets on which to base such a crucial cosmological result. SN 1995al and SN 2002fk are two of the best observed SNe Ia both with little reddening. They provide two opportunities to use ACS for placing the calibration of H_0 via SN Ia on firmer footing and potentially improve its precision.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10498
Title: Detecting the progenitors of core-collapse supernovae
PI: Stephen Smartt
PI Institution: The Queen's University of Belfast

Modern supernovae searches in the nearby Universe are discovering large numbers of SNe which have massive star progenitors (Types II, Ib and Ic). The extensive HST image archives within ~20Mpc enables their indvidual bright stellar content to be resolved. As massive, evolved stars are the most luminous single objects in a galaxy, the progenitos of core-collapse SNe should be directly detectable on pre-explosion images. Two recent highlights of our ongoing HST programme are that we have detected the first red supergiant progenitor of a normal type II supernova and shown that SN1993J came from a binary system by detecting the companion star at the position of the SN. We have detected a further two progenitor stars of normal type II-P supernovae, set mass limits on a further 7 and suggest that faint type II supernovae are unlikely to come from the collapse of very massive stars which form black holes. These discoveries are providing strong constraints on theoretical models of pre-supernova evolution and the origin of the supernova types. We request time to continue this successful project and require ACS observations of future SNe which are discovered in galaxies closer than 20Mpc which have pre-explosion HST archive images available. This will allow the SNe to be precisely positioned on the pre-explosion images. We have set a final goal for this project of determining masses and types, or setting restrictive mass-limits for 30 supernovae, before the demise of HST.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10499
Title: Life Before the Fall: Morphological Evolution of Galaxies in Groups Prior to Cluster Assembly at z=0.37
PI: Kim-Vy Tran
PI Institution: Eidgenossiche Technische Hochschule (ETH)

We propose to obtain a deep ACS/WFC mosaic of a protocluster comprised of 4 distinct galaxy groups that are gravitationally bound to each other at z=0.37. The galaxy groups have a total combined mass comparable to the Coma cluster and already have twice as many absorption line galaxies as the field. The SG1120 complex thus provides an unprecedented opportunity for determining whether "pre-processing" in the group environment is responsible for the bulk

of observed diffences between galaxies in nearby clusters and those in the field. High resolution imaging with HST is needed to morphologically classify the group members and measure their structural parameters. By combining the early-type fraction and morphology-density relation in SG1120 with results from our wide-field spectroscopic survey, we will test whether spectral and morphological transformation timescales are decoupled on group scales and isolate the environmental mechanisms responsible for such evolution. We will also measure the Fundamental Plane and M/L ratios of the early-type members to constrain their formation epoch and how their stellar populations have evolved. Observations of the multiple galaxy groups in SG1120 provide a unique dataset to the community and will aid our understanding of how galaxies evolve in the still poorly studied group regime.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10500
Title: Exploring the Bottom End of the White Dwarf Cooling Sequence in the Galactic Open Cluster NGC2158
PI: Luigi Bedin
PI Institution: European Southern Observatory - Germany

The recent discovery by our group of an unexpectedly bright and still unexplained peak in the white dwarf (WD) luminosity function (LF) of the metal rich, old open cluster NGC6791 casts serious doubts on our understanding of the physical process which rules the formation and the cooling of WDs. In order to investigate whether the same problem is present in other open clusters with different ages and metallicities, we propose deep ACS/HST observations reaching the bottom end of the WD LFs, for the first time in a young and so popolous Galactic open cluster: NGC2158.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10501
Title: Extending the Heritage: Clusters, Dust, and Star Formation in M51
PI: Rupali Chandar
PI Institution: Space Telescope Science Institute

Strongly interacting systems in the Local Universe offer the opportunity to investigate the modality of star formation under dynamical conditions more typical of the intermediate redshift Universe (z~0.5-1), at an exquisite resolution unmatched by distant galaxies. M51 is one such system. Most recently, the Hubble Heritage program dedicated 24 HST orbits to obtain a 3X2 ACS mosaic of M51 in BVI, and Halpha. While this is designed to produce a lovely multi-color image of this photogenic target, its scientific return will be limited for star formation studies. Hence we propose to augment these observations by obtaining WFPC2 U band and NICMOS H band primary imaging (with NICMOS Paschen alpha in parallel) of selected pointings of this interacting galaxy system. At the modest cost of 14 additional orbits, we will: (1) accurately determine the ages of the young star cluster population; (2) secure the identification of 60-70 old globular clusters; (3) search for heavily dust enshrouded stellar clusters; (4) investigate the distribution of the cluster populations as a function of location (galactocentric, arms, interarms, etc.); and (5) both remove the effects of dust and determine its properties. In addition to our specific science goals, these observations lend themselves, on

their own or in synergy with data from GALEX and Spitzer, to a host of other investigations, including those on evolved diffuse stellar populations, galactic structure, and dust radiative transfer. We will thus release these data early to the community, by relinquishing part of the proprietary period.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10502
Title: ACS Imaging of the Uranus Aurora and Hydrogen Corona
PI: John Clarke
PI Institution: Boston University

ACS SBC UV observations of Uranus are proposed with dual purposes that can be achieved with a single set of observations. First, we propose to observe the very unusual auroral of Uranus for the first time since IUE and Voyager in the 1980's. The Uranus aurora are centered on the magnetic poles, corresponding to the 60 deg. tilted magnetic moment, closer to the equator than the rotational poles. The brighter auroral emission appears around the weaker magnetic pole. The auroral emissions are highly variable, as recorded with IUE, and the rotational phase of Uranus is not known. The observations will therefore cover the extent of a Uranus rotation (17.29 hours), and will be repeated one-half solar rotation later to allow for variations in the solar wind at Uranus. The high sensitivity of the ACS SBC at long wavelengths will increase the sensitivity to auroral H2 emissions, and observations in cycle 14 near solar minimum will limit the sky background and reflected solar emissions from the Uranus disc. Secondly, these images will measure the extended hydrogen corona of Uranus, first seen by the Voyager 2 UVS. We propose to model the distribution of the hydrogen corona to determine the source processes in the Uranus upper atmosphere, by comparison with model runs from an exospheric code.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10503
Title: The Star Formation Histories of Early Type Dwarf Galaxies in Low Density Environments: Clues from the Sculptor Group
PI: Gary Da Costa
PI Institution: Australian National University

We seek HST ACS/WFC time to conduct a detailed study of the stellar populations of 5 early-type (dE, dE/dIrr) dwarf galaxies in the nearby (~1.5 to 4 Mpc) Sculptor group. Four of these systems have been recently found to contain modest amounts of HI, and existing ground-based and HST snapshot data point to the potential presence of small populations of young (blue) stars in at least three of these systems. Consequently, they resemble the Local Group 'transition' objects Phoenix and LGS3. The relative number of such transition systems is thus substantially larger in the low density environment of the Scl group than for the Local Group. Detailed stellar populations studies will allow estimation of the star formation histories, via stellar population modelling of the color-magnitude diagrams, of the target dwarfs, which in turn will connect to gas consumption and retention rates. For the two nearer dwarfs we aim to reach below the horizontal branch (a first for any system beyond the Local Group) equivalent to a main sequence turnoff age of ~1 Gyr. The observations of these two systems will also allow detection of RR Lyrae

variables and thus direct confirmation of the presence of old populations. For the other three dwarfs will we cover the first 2.5 mags of the red giant branch, equivalent to the main sequence termination for a ~300 Myr population. The results will have implications for theories of galaxy formation and evolution, particularly with regard to the evolutionary relation between low luminosity dEs and dwarf irregulars.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10504
Title: Characterizing the Sources Responsible for Cosmic Reionization
PI: Richard Ellis
PI Institution: California Institute of Technology

Our group has demonstrated the role that massive clusters, acting as powerful cosmic lenses, can play in constraining the abundance and properties of low-luminosity star-forming sources beyond z~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, as well as those in imaging surveys being undertaken with IRAC onboard Spitzer. 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 the UDF exposure, we propose a systematic search through 6 lensing clusters with ACS and NICMOS for further z~6-7 sources in conjunction with existing deep IRAC data. Our survey will mitigate cosmic variance and extend the search both to lower luminosities and, by virtue of the NICMOS/IRAC combination, to higher redshift. The goal is to count and characterize representative sources at z~6-10 and to delineate the redshift range of activity for the planning of future observations.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10505
Title: The Onset of Star Formation in the Universe: Constraints from Nearby Isolated Dwarf Galaxies.
PI: Carme Gallart
PI Institution: Instituto de Astrofisica de Canarias

The details of the early star formation histories of tiny dwarf galaxies can shed light on the role in galaxy formation of the reionization which occured at high redshift. Isolated dwarfs are ideal probes since their evolution is not complicated by environmental effects owing to the vicinity of the Milky Way and M31. In addition, dwarf galaxies are the most common type of galaxies, and potentially the building blocks of larger galaxies. Since we can date the oldest stars in them, their study represents a complementary approach to the study of the formation and evolution of galaxies through high-z observations. We propose to use the ACS to obtain a homogeneus dataset of high-quality photometry, down to the old (13 Gyr) main-sequence turnoffs, for a representative sample of 5 isolated Local Group dwarf galaxies. These data are essential to unambiguously determine their early star formation histories, through comparison with synthetic color-magnitude diagrams, and using the

constraints provided by their variable stars. Parallel WFPC2 observations of their halos will allow us to reveal the actual nature of their stellar population gradients, providing important aditional constraints on their evolution. The proposed observations are being complemented with ground-based spectroscopy, to obtain metallicity and kinematic information. The observations requested here, which must reach M_I=+3.5 (I=27.5-28.2) with S/N=10 in crowded systems, can only be achieved with HST using ACS, and won't be possible with planned ground- or space-based facilities such as JWST. For these reasons they were identified in the HST Treasury Workshop as key targets for HST in its final years. Based on deep WFPC2 observations and ACS image simulations, our team has designed an observational strategy which carefully considers the optimal filter combination, the necessary photometry depth and the effects of stellar crowding.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10506
Title: Coordinated observations of Saturn's auroral dynamic morphology and Cassini plasma measurements
PI: Jean-Claude Gerard
PI Institution: Universite de Liege

Planetary FUV aurora is the most spectacular signature of the electrodynamical coupling between the solar wind, the planet's magnetic field, and its atmosphere. Saturn's magnetosphere has similarities both with the Earth's magnetosphere, which is 'open' to solar wind interaction and Jupiter's relatively 'closed' case with its large internal sources of plasma. HST observations of Saturn's aurora have shown a much more complex and dynamic morphology than anticipated: a frequent 'spiral' structure, a changing size of the oval in response to variations of the solar wind dynamics pressure, and large brightness changes in a few ten of minutes following compression of the magnetosphere by the solar wind. In addition, the global morphology and some spots move at 70% of the planetary co-rotation, while some other features appear nearly fixed in local time. Recently, ideas have emerged to account for Saturn's aurora specificities, although many aspects are still not understood due to the paucity of observational data. Electric current models suggest that the main oval is located at the limit between closed and open magnetic field lines, near the magnetopause. The availability of Cassini in Saturn's magnetic environment now offers a unique opportunity for collaborative science. We thus propose to test the relationship between the aurora and conditions at Saturn's magnetopause (MP) boundary. We plan to image the FUV aurora with ACS at times of inbound Cassini crossing of the MP from the upstream solar wind/magnetosheath region into the middle magnetosphere during an inbound segment of a Cassini's orbit. FUV images will also reveal whether the main oval changes its size over the interval, possibly indicating evidence for changes in the amount of open flux in the system. These HST images of the aurora simultaneous with in situ measurements of the plasma characteristics and electrodynamics inside the magnetosphere are critical to obtain key observational tests and constraints to future ideas and models of Saturn's auroral precipitation and magnetospheric processes involved.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10507
Title: High resolution imaging of Jupiter's diffuse auroral

emissions inside and outside the main oval during solar minimum.
PI: Denis Grodent
PI Institution: Universite de Liege

The analysis of HST-STIS FUV images has greatly and quickly advanced our knowledge of the magnetospheric mechanisms producing the auroral emissions on the giant planets. However, these studies were limited to the brightest emissions and very little has been said about the fainter emissions, mainly because of the lower S/N. We propose to image the faint auroral emissions on Jupiter which could not be observed with STIS. We will take full advantage of ACS/SBC's higher sensitivity to observe the diffuse auroral FUV emissions appearing poleward and directly equatorward of Jupiter's main auroral oval in the northern hemisphere. This proposal has the potential to reveal new magnetosphere-ionosphere coupling mechanisms especially those involving solar wind interactions with a giant planet.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10508
Title: Orbits, Masses, and Densities of Three Transneptunian Binaries
PI: William Grundy
PI Institution: Lowell Observatory

The subset of transneptunian objects (TNOs) having natural satellites offers unique opportunities for physical studies of these distant relics from the outer parts of the protoplanetary nebula. HST/ACS is ideally suited to determining orbits of TNO satellites, resulting in the system masses. In conjunction with thermal emission observations by Spitzer, which provides sizes, we can determine the densities of TNOs. Densities offer a powerful window into their bulk compositions and interior structures.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10509
Title: The Cluster Lens SDSS 1004+4112: Constraining World Models With its Multiply-Imaged Quasar and Galaxies
PI: Christopher Kochanek
PI Institution: The Ohio State University Research Foundation

We will use deep ACS imaging of the giant (15 arcsec) four-image z_s=1.734 lensed quasar SDSS 1004+4112, and its z_l=0.68 lensing galaxy cluster, to identify many additional multiply-imaged background galaxies. Combining the existing single orbit ACS I-band image with ground based data, we have definitely identified two multiply imaged galaxies with estimated redshifts of 2.6 and 4.3, about 15 probable images of background galaxies, and a point source in the core of the central cD galaxy, which is likely to be the faint, fifth image of the quasar. The new data will provide accurate photometric redshifts, confirm that the candidate fifth image has the same spectral energy distribution as the other quasar images, allow secure identification of additional multiply-lensed galaxies for improving the mass model, and permit identification of faint cluster members. Due to the high lens redshift and the broad redshift distribution of the lensed background sources, we should be able to use the source-redshift scaling of the Einstein radius that depends on

(d_ls/d_os), to derive a direct, geometric estimate of Omega_Lambda. The deeper images will also allow a weak lensing analysis to extend the mass distribution to larger radii. Unlike any other cluster lenses, the time delay between the lensed quasar images (already measured for the A--B images, and measurable for the others over the next few years), breaks the so-called kappa-degeneracies that complicate weak-lensing analyses.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10510
Title: Morphology of massive early-type galaxies at z>1.2: constraining galaxy formation models
PI: Marcella Longhetti
PI Institution: Osservatorio Astronomico di Brera, Milano

We ask for NICMOS-NIC2 H-band imaging of a sample of 10 massive early-type galaxies spectroscopically identified at 1.2<z6500A, would map the mass distribution of the bulk of their stellar
content. The targets have been revealed by our group on the basis of near-IR spectroscopy obtained in the framework of a spectroscopic survey of a complete sample of bright EROs (Ks<18.5). Optical and near-IR photometry is available for all the targets, and low resolution near-IR spectra have allowed their identification and redshift measurement. Spectroscopic and photometric data in our hands show that they have already assembled stellar masses greater than 3 10^11 solar masses, and that the mean age of their stellar population is estimated older than 2-3 Gyr for 6 of them and about 1 Gyr for the other 4 galaxies. Thus, they are among the most luminous and massive evolved galaxies detected so far at z>1. Other data are needed to infer how they have assembled such high stellar masses, i.e. to trace back their evolution. The requested observations would allow us to reveal signs of past interaction/merger event. A smooth r^{1/m} profile, coupled with no other signs of interaction/merger (disturbed morphology), would place the possible merger event of formation 1-2 Gyr before their redshift z \approx 1.5, i.e. at z > 2-3. On the other hand, if signs of recent merger events will be found, the last merger event forming the local massive spheroids will be constrained at 1.5 < z < 2. Thus, the requested HST observations will allow for the first time to see how massive early-type galaxies at z \approx 1.5 look like, constraining in any case the redshift of the possible merging event of their formation.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10511
Title: An Edge-on Disk around a Brown Dwarf?
PI: Kevin Luhman
PI Institution: Smithsonian Institution Astrophysical Observatory

We have recently discovered a young brown dwarf in the Taurus star-forming region that exhibits several characteristics (very faint for its spectral type, forbidden emission lines, anomalous near-IR colors) that are often observed in stars occulted by edge-on circumstellar disks. We propose to determine if an edge-on disk is indeed present by obtaining high-resolution images of this brown dwarf with ACS/HRC on HST. If the disk is detected, we will constrain its physical properties, particularly its diameter, by fitting the images with the predictions of our models of brown dwarfs occulted by

circumstellar disks. These observations could potentially provide the first direct measurement of the size of a disk around a brown dwarf, which would comprise a fundamental test of models for the formation of these objects (e.g., embryo ejection).
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Proposal Category: SNAP
Scientific Category: SOLAR SYSTEM
ID: 10512
Title: Search for Binaries Among Faint Jupiter Trojan Asteroids
PI: William Merline
PI Institution: Southwest Research Institute

We propose an ambitious SNAPSHOT program to survey faint Jupiter Trojan asteroids for binary companions. We target 150 objects, with the expectation of acquiring data on about 50%. These objects span Vmag = 17.5-19.5, a range inaccessible with ground-based adaptive optics. We now have a significant sample from our survey of brighter Trojans to suggest that the binary fraction is similar to that which we find among brighter main-belt asteroids, roughly 2%. However, our observations suggest a higher binary fraction for smaller main-belt asteroids, probably the result of a different formation mechanism (evident also from the physical characteristics of the binaries). Because the collision environment among the Trojans is similar to that of the Main Belt, while the composition is likely to be very different, sampling the binary fraction among the fainter Trojans should help us understand the collisional and binary formation mechanisms at work in various populations, including the Kuiper Belt, and help us evaluate theories for the origin of the Trojans. Calibration of and constraints on models of binary production and collisional evolution can only be done using these large-scale, real-life physical systems that we are beginning now to find and utilize.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10513
Title: The very late phases of a thermonuclear supernova
PI: Peter Milne
PI Institution: University of Arizona

A better understanding of the physics of Type Ia supernovae (SNe) is important for their use as cosmological standard candles. Late time observations of the SN light curves are poorly studied - but offers a unique way to probe the explosion models. Combining state of the art models of 3-D explosions with sophisticated spectral modeling, we can test these models against observations in a way not earlier possible. In particular, the broad band light curves are sensitive to the degree of clumping and the timing of the `infra-red catastrophe', factors which depend on the explosion mechanism (deflagration vs. delayed detonation). Further, these observations can probe the degree of positron trapping in the ejecta, important for both the SN ejecta and for the production of free positrons in the galaxy. Because of its small distance, favorable galaxy location and excellent ground based follow-up - SN 2003hv offers a unique opportunity to obtain the best late light curves to date. Observations in several optical and IR bands will enable us to distinguish between different model predictions.
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Proposal Category: SNAP

Scientific Category: SOLAR SYSTEM
ID: 10514
Title: Kuiper Belt Binaries: Probes of Early Solar System Evolution
PI: Keith Noll
PI Institution: Space Telescope Science Institute

Binaries in the Kuiper Belt are a scientific windfall: in them we have relatively fragile test particles which can be used as tracers of the early dynamical evolution of the outer Solar System. We propose a Snapshot program using the ACS/HRC that has a potential discovery efficiency an order of magnitude higher than the HST observations that have already discovered the majority of known transneptunian binaries. By more than doubling the number of observed objects in dynamically hot and cold subpopulations we will be able to answer, with statistical significance, the question of whether these groups differ in the abundance of binaries as a result of their particular dynamical paths into the Kuiper Belt. Today's Kuiper Belt bears the imprints of the final stages of giant-planet building and migration; binaries may offer some of the best preserved evidence of that long-ago era.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10515
Title: The Unique Star Cluster System of M85
PI: Eric Peng
PI Institution: Dominion Astrophysical Observatory

Even with its long history as one of the pillars of modern astronomy, the study of star clusters has continued to reveal new and surprising things. Over the past decade, numerous programs with HST have shown that extragalactic star clusters powerfully probe the processes of galactic formation, evolution, and destruction. The diversity of star cluster systems is a testament to the rich variation in galaxy properties. During the course of the ACS Virgo Cluster Survey, we have discovered that the early-type galaxy M85 has a system of star clusters unlike any other galaxy studied to date. Hundreds of star clusters in M85 are fainter and more extended than typical globular clusters, and have no local analog. We propose deep optical-infrared imaging with ACS and NICMOS to obtain ages, metallicities, luminosities, and sizes of unprecedented precision to characterize these new star clusters and unravel the evolutionary state of M85 that gave rise to them.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10516
Title: Host Galaxies of Reverberation-Mapped AGNs
PI: Bradley Peterson
PI Institution: The Ohio State University Research Foundation

We propose to obtain unsaturated ACS high-resolution images of four reverberation-mapped active galactic nuclei in order to remove the point-like nuclear light from each image, thus yielding a "nucleus-free" image of the host galaxy. This will allow investigation of host galaxy properties: our particular interest is determination of the host-galaxy starlight contribution to the reverberation-mapping observations. This is necessary (1) for accurate determination of the relationship between the AGN nuclear continuum flux and

the size of the broad Balmer-line emitting regions of AGNs, which is important because this relationship is used in estimating black hole masses for large samples of QSOs, and (2) for accurate determination of the bolometric luminosity of the AGN proper. In a Cycle 12 SNAP program, we obtained images of 14 of the 36 reverberation-mapped AGNs for this purpose. This additional request is to complete this program through observations of the four important remaining sources.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10517
Title: Imaging Astrometrically-Discovered Brown Dwarfs
PI: Steven Pravdo
PI Institution: Jet Propulsion Laboratory

We propose to image the astrometrically discovered companions of three M-dwarfs with NICMOS to more tightly constrain their masses and determine their stellar or sub-stellar natures. Each of these systems has been observed with a sensitive ground-based adaptive optics system and no companions have been detected. NICMOS results will eliminate an ambiguity in the astrometric mass measurements that arises because a companion that contributes significantly to the visible light reduces the motion of the center of light and mimics a small motion of the center of mass. In addition the astrometric measurements made with NICMOS will fix the scale of the system, distinguishing among possible orbits. Finally the color photometry will constrain the spectral types to within a couple of subtypes. When we measure the masses of astrophysical objects, we test and assist the development of the theoretical mass models. Models are based upon parameters such as age and metallicity. Determining the correct mass thus deepens our understanding of the fundamental physics of stars and substellar objects
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10518
Title: Dark matter and the missing images of cx2201-3201
PI: Paul Schechter
PI Institution: Massachusetts Institute of Technology

The galaxy lensing the z=3.9 quasar cx2201-3201 is a bulgeless edge-on spiral. Models for the disk that contain more than 20% of the mass predict four images, but only two are seen in ground-based images. We request 3 orbits to obtain high resolution optical and infrared images. If the missing images are indeed absent, more than 80% of the mass inside the Einstein radius must be in an unseen spherical component.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10519
Title: Testing the Stellar Coalescence and Accretion Disk Theories of Massive Star Formation with NICMOS
PI: Janet Simpson
PI Institution: NASA Ames Research Center

The importance of massive stars cannot be underestimated - they produce most

of the heavy elements in the universe and dominate the evolution of the interstellar medium in their vicinity. In spite of their significance, our understanding of their formation is meager. Both accretion through disks, analogous to the process of low-mass star formation, and coalescence of low-mass stars through collisions in the dense cores of stellar clusters have been suggested. Possibly both mechanisms occur. High spatial resolution polarization measurements of the closest massive young stellar objects (YSOs) will enable us to search for evidence of disk accretion or coalescence in the form of patterns indicative of light scattered off a coherent disk or off a disk disrupted by an infalling star, respectively. Here we propose to use 2 micron polarimetry with NICMOS to identify the presence of accretion disks around massive YSOs or to characterize their environments as possibly disrupted from a close stellar encounter. There are only a few sources that meet the stringent selection criteria for this investigation (even with HST), which we will examine here. High spatial resolution is required, but even more important, the point spread function (PSF) must be stable with time. Furthermore, the PSF must put minimal flux into large spatial scales, something that cannot be achieved with adaptive optics. This combination of high Strehl ratio and stable PSF can only be achieved from space.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10520
Title: Resolving the Complex Star Formation History of the Leo I Dwarf Spheroidal Galaxy
PI: Tammy Smecker-Hane
PI Institution: University of California - Irvine

Determining the star formation histories (SFHs) and chemical evolution of nearby galaxies gives us powerful constrains on the physical processes that regulate galaxy evolution. The SFHs can be measured most accurately by comparing the observed densities of stars in color-magnitude diagrams (CMDs) to predictions from stellar evolutionary models. WFPC2 imaging of the Leo I dSph shows it is unique because its stellar population is relatively young. Approximately 68% of its stars formed between 1 and 7 Gyr ago and only 12% of its stars formed >~ 10 Gyr ago. We propose to vastly improve the derived SFH of Leo I by exploiting ACS/WFC's higher quantum efficiency at bluer wavelengths, higher spatial resolution, and larger field-of-view. The figure of merit for our proposed observations, defined as the age resolution times the number of stars detected, will be a factor of 12 higher than existing WFPC2 observations. To surmount the degeneracy of age and metallicity in the CMD, we have independently measured the metallicity distribution of its stars using spectroscopy. Simultaneously modeling the metallicity distribution and CMD, we will firmly constrain the evolution of the Leo I dSph, a unique example of an isolated dwarf galaxy that has not been influenced by interactions with the Milky Way or M31.

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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10521
Title: ACS Imaging of a Unique Spitzer Field: Morphology of mid-IR Variable Sources
PI: Jason Surace
PI Institution: California Institute of Technology

We propose to observe the IRAC Dark Field, an extragalactic field 15 arcminutes in diameter near the north ecliptic pole, using 50 orbits of ACS imaging at I-band. This field is extraordinarily deep and is uniquely suited to detecting variable objects in the mid-infrared. The high spatial resolution ACS imaging will be used to derive morphological information about the galaxies in the field, which will then be correlated with mid-infrared variable objects (specifically AGN and supernovae) we have discovered. This field is the dark current calibration target for the Spitzer Space Telescope, the infrared counterpart to HST. Because the field is observed frequently as part of routine operations, it is now similar in size and depth to the infrared component of the GOODS program, and is confusion-limited in the mid-infrared. More importantly, due to the periodicity of the observations, the Spitzer observations are sensitive to variability on week timescales, ultimately spanning a baseline of five years, and are the only mid-infrared dataset that will ever have this capability at this depth. By complementing our wide range of lower resolution imaging at optical and infrared wavelengths, we hope to exploit one of HST's most unique capabilities - unparalleled spatial resolution in the optical. While our specific interest lies in analysis of variable sources, we will request no proprietary period on the ACS data so that it may be used by the community to complement the publicly available Spitzer data.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10522
Title: Calibrating Star Formation: The Link between Feedback and Galaxy Evolution
PI: Daniela Calzetti
PI Institution: Space Telescope Science Institute

Stellar feedback - the return of mass and energy from star formation to the interstellar medium - is one of the primary engines of galaxy evolution. Yet, the theoretical foundation of mechanical feedback is, to date, unconstrained by observations. We propose to investigate this fundamental aspect of star formation on a sample of three local actively star-forming galaxies, He2-10, NGC4449, and Holmberg II. The three galaxies have been selected to occupy an unexplored, yet crucial for quantifying mechanical feedback, niche in the two-parameter space of star formation intensity and galaxy mass. ACS/WFC and WFPC2 narrow-band observations in the light of H-beta, [OIII], H-alpha, and [NII] will be obtained for all three galaxies, in order to: (1) discriminate the feedback-induced shock fronts from the photoionization regions; (2) map the shocks inside and around the starburst regions; and (3) measure the energy budget of the star-formation-produced shocks. These observations, complemented by existing data, will yield: (1) the efficiency of the feedback, i.e. the fraction of the star formation's mechanical energy that is transported out of the starburst volume rather than confined or radiated away; (2) the dependence of this efficiency on the two fundamental parameters of star formation intensity and stellar mass. The high angular resolution of HST is crucial for separating the spatially narrow shock fronts (~5 pc, ~0.25" at 4 Mpc) from the more extended photoionization fronts. The legacy from this project will be the most complete quantitative measurement of the energetics associated with feedback processes. We will secure the first milestone for placing feedback mechanisms on a solid physical ground, and for understanding quantitatively their role on the energetics, structure, and star formation history of galaxies at all redshifts.

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Proposal Category: SNAP
Scientific Category: GALAXIES
ID: 10523
Title: The Halo Shape and Metallicity of Massive Spiral Galaxies
PI: Roelof de Jong
PI Institution: Space Telescope Science Institute

We propose to resolve the stellar populations of the halos of seven nearby, massive disk galaxies using a SNAP survey with WFC/ACS. These observations will provide star counts and color-magnitude diagrams 2-3 magnitudes below the tip of the Red Giant Branch along the two principal axes and one intermediate axis 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 ~31 V-mag per square arcsec. This proposal will create a unique sampling of galaxy halo properties, as our targets cover a range in galaxy mass, luminosity, inclination, and morphology. As function of these galaxy properties this survey will provide: - the first 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.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10524
Title: Blue Stragglers: a key stellar population to probe internal cluster dynamics
PI: Francesco R. Ferraro
PI Institution: Universita degli Studi di Bologna, Italy

This proposal is part of a coordinated project devoted to understand the interplay of globular cluster (GC) dynamics and the formation and evolution of blue straggler stars (BSS). By using a combination of HST and ground-based observations we are constructing complete BSS surveys in a sample of GCs; complete BSS surveys require mid-UV HST observations in the center and wide field CCD ground based observations under excellent seeing conditions of the exterior. Up to now only four clusters have been surveyed in this way and the results are surprising: in three GCs (M3, 47 Tuc, NGC 6752) we have discovered that the BSS radial distribution is bimodal, highly peaked in the cluster center, rapidly decreasing at intermediate radii and rising again at large radii (Ferraro et al. 1997, 2004, Sabbi et al. 2004), conversely BSS population in Omega Centauri does not show any signature of the segregation which would be expected for a class of objects arising from either stellar interactions or binarity (Ferraro et al. 2005). These observational facts are opening a new prospective in the study of the formation processes and evolution of BSS in GCs. By using extensive simulations, we demonstrated that the spatial distribution of BSS observed in 47 Tuc can be only reproduced if a sizable fraction of BSS is generated (via mass transfer in primordial binaries) in the peripheral region of the cluster (Mapelli et al 2004), thus excluding a purely collisional formation scenario. Here we propose mid-UV

imaging of a few clusters suspected of harboring a large population of central BSS and a few known to have many BSS the external region. These are good candidates for determining accurate BSS radial distributions. The modest amount of time proposed here will go far to determine the ubiquity of BSS bimodality and to constrain models of dynamical evolution. Since we believe the proposed observations would be useful to the entire stellar community (for multifold purposes) we waive the propretary period.

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Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 10525
Title: Characterizing the Near-UV Environment of M Dwarfs: Implications for Extrasolar Planetary Searches and Astrobiology
PI: Suzanne Hawley
PI Institution: University of Washington

We propose SNAP observations with the ACS HRC PR200L prism, designed to measure the near ultraviolet emission in a sample of 107 nearby M dwarfs. The sample spans the mass range from 0.1 - 0.6 solar masses (temperature range 2200K - 4000K) where the UV energy distributions vary widely between active and inactive stars. The strength and distribution of this UV emission can have critical consequences for the atmospheres of attendant planets. Our proposed observations will provide desperately needed constraints on models of the habitability zone and the atmospheres of possible terrestrial planets orbiting M dwarf hosts, and will be used to sharpen TPF target selection. In addition, the NUV data will be used in conjunction with existing optical, FUV and X-ray data to constrain a new generation of M dwarf atmospheric models, and to explore unanswered questions regarding the dynamo generation and magnetic heating in these low-mass stars.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10526
Title: Dynamics of the Polarization Structure of the Crab Nebula
PI: J. Hester
PI Institution: Arizona State University

The Crab Nebula is not a free expansion SNR. Rather, it is a pulsar wind nebula expanding from the inside out into a larger remnant of freely expanding ejecta. At the heart of this object is the Crab Pulsar and the region where the pulsar's highly nonisotropic wind interacts with the larger synchtron nebula. HST and Chandra monitoring has shown this to be one of the most intricately structured and highly dynamical objects ever observed. In Cycle 12 we demonstrated our ability to use the polarization capabilities of the ACS to isolate physically discrete features within the Crab Synchrotron Nebula and accurately measure their polarization characteristics. These data provide a unique look at the physical structure in the heart of the Crab, adding a new dimension to past observations. Polarization provides extensive information about field geometries, the degree of disorder in the field, and particle pitch angle distributions. But one image of the Crab is like a single image of waves at the beach. It necessarily misses the point. In the Crab, the name of the game is "dynamics". In this proposal we request time to monitor changes in the polarization structure of the Crab. This program will allow us to follow the changing polarization of features including relativistically

moving wisps in the Crab Nebula. This is the only place in the sky where a dynamic relativistic plasma can be observed in sufficient detail to make such measurements possible, and the HST/ACS is the only instrument that we are likely to see in our careers capable of making the measurement. These observations will be an important addition to the already rich observational legacy of HST for what is arguably the most important single object in astrophysics.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10527
Title: Imaging Scattered Light from Debris Disks Discovered by the Spitzer Space Telescope Around 20 Sun-like Stars
PI: Dean Hines
PI Institution: Space Science Institute

We propose to use the high contrast capability of the NICMOS coronagraph to image a sample of newly discovered circumstellar disks associated with sun-like stars. These systems were identified by their strong thermal infrared emission with the Spitzer Space Telescope as part of the Spitzer Legacy Science program titled, "The Formation and Evolution of Planetary Systems (FEPS)." Modelling of the thermal excess emission in the form of spectral energy distributions alone cannot distinguish between narrowly confined high opacity disks and broadly distributed, low opacity disks. However, our proposed NICMOS observations can, by imaging the light scattered from this material. Even non-detections will place severe constraints on the disk geometry, ruling out models with high optical depth. Unlike previous disk imaging programs, our program contains a well defined sample of solar mass stars covering a range of ages from ~10Myrs to a few Gyrs, allowing us to study the evolution of disks from primordial to debris for the first time. These results will greatly improve our understanding of debris disks around Sun-like stars at stellar ages nearly 10x older than any previous investigation. Thus we will have fit a crucial piece into the puzzle concerning the formation and evolution of our own solar system.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10528
Title: Ram Pressure Stripping and Dense Cloud Ablation in the Virgo Spiral NGC 4402
PI: Jeffrey Kenney
PI Institution: Yale University

We propose to image in BVI with HST ACS the highly inclined Virgo cluster spiral galaxy NGC 4402, which is an outstanding example of a galaxy undergoing stripping of its ISM by an ICM-ISM interaction. Ground-based images at 0.5" resolution appear to show active dust stripping, triggered star formation, and ablation of dense molecular clouds by the ICM wind. The near side of NGC 4402 contains the leading edge of interaction, giving us a relatively unobscured view of the processes which occur as the ICM wind impacts the ISM. High resolution HST B-I images of dust in NGC 4402 can reveal the fate of giant molecular clouds during a stripping event, including whether clouds above some size get left behind as the rest of the ISM is stripped from around them, how decoupled clouds become ablated by the ICM wind, and how the survival time varies with cloud mass. We will identify and estimate the ages of stars and

star clusters in the stripped outer disk and halo, and from the spatial distributions of the younger objects, constrain the stripping history of the galaxy. Its proximity, orientation, stage of evolution, and direction of travel through the ICM make NGC 4402 an outstanding subject for a detailed HST study of ICM-ISM stripping. An in-depth study of this galaxy will provide new insight into the physical processes of ISM-ICM interactions and give us greater understanding of cluster galaxy evolution, both in Virgo and at higher redshifts.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10529
Title: A Deep H-band Probe of the Globular Cluster Mass function
PI: Arunav Kundu
PI Institution: Michigan State University

We propose to obtain deep NICMOS H-band data for the globular clusters in the inner region of M87 and coordinated parallel ACS WFC g and z band observations of a second field which has very deep archival NICMOS data. Therefore, our proposed deep NICMOS observation overlaps corresponding deep archival optical data in the inner regions, and the parallel ACS observations overlap deep NICMOS images in the outer field. The combination of the sensitivity of the near infrared to the mass of old stellar systems such as the globular clusters in M87 and the ability of the optical to isolate the metal-rich and metal-poor subcomponents of the globular cluster system will allow us to probe the mass function, and the possible variation with metallicity, to unprecedented depths. These observations are critical to linking the commonly observed cluster luminosity function to the usually derived mass function in theoretical calculations of globular cluster and globular cluster system formation and evolution models. The multiple pointings will allow us to probe the radial variations in globular cluster properties and test the predictions of cluster formation and dynamical destruction models. Because of its extremely rich globular cluster system (~15,000 clusters) M87 is one of the only galaxies in which such a study can be conducted with a statistically significant number of candidate clusters (approximately 300 globular clusters in this study) with efficient use of HST time.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10530
Title: Probing Evolution And Reionization Spectroscopically (PEARS)
PI: Sangeeta Malhotra
PI Institution: Space Telescope Science Institute

While imaging with HST has gone deep enough to probe the highest redshifts, e.g. the GOODS survey and the Ultra Deep Field, spectroscopic identifications have not kept up. We propose an ACS grism survey to get slitless spectra of all sources in a wide survey region (8 ACS fields) up to z =27.0 magnitude, and an ultradeep field in the HUDF reaching sources up to z =28 magnitude. The PEARS survey will: (1) Find and spectrocopically confirm all galaxies between z=4-7. (2) Probe the reionization epoch by robustly determining the luminosity function of galaxies and low luminosity AGNs at z = 4 - 6. With known redshifts, we can get a local measure of star formation and ionization rate in case reionization is inhomogeneous. (3) Study galaxy formation and evolution

by finding galaxies in a contiguous redshift range between 4 < z < 7, and black hole evolution through a census of low-luminosity AGNs. (4) Get a robust census of galaxies with old stellar populations at 1 < z < 2.5, invaluable for checking consistency with heirarchical models of galaxy formation. Fitting these galaxies' spectra will yield age and metallicity estimates. (5) Study star-formation and galaxy assembly at its peak at 1< z < 2 by identifying emission lines in star-forming galaxies, old populations showing the 4000A break, and any combination of the two. (6) Constrain faint white dwarfs in the Galactic halo and thus measure their contribution to the dark matter halo. (7) Derive spectro-photometric redshifts by using the grism spectra along with broadband data. This will be the deepest unbiased spectroscopy yet, and will enhance the value of the multiwavelength data in UDF and the GOODS fields to the astronomical community. To this end we will deliver reduced spectra to the HST archives.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10531
Title: The most distant X-ray cluster at z = 1.4: morphologies, color-magnitude relation and Fundamental Plane
PI: Chris Mullis
PI Institution: University of Michigan

We have been engaged in a serendipitous search for very distant clusters based on extended X-ray sources in archival XMM-Newton observations, followed up by R and z snapshot imaging with VLT-FORS2. Very recent VLT-FORS2 spectroscopy of the best high-z candidate (reddest R-z galaxy overdensity) has unambiguously confirmed the presence of a massive cluster at z = 1.392 (11 secure redshifts), a record-breaking distance to date, which bears a crucial leverage on the evolution and formation of the most massive galaxies and clusters. We propose here to obtain deep NICMOS images in the H band and ACS images in the z band of the z = 1.4 cluster. The high resolution and sensitivity will allow us to study morphologies, measure lengthscales and surface photometry of the cluster members. We will analyse the color-magnitude relation and, in combination with velocity dispersions from VLT-FORS2 spectroscopy, we will extend the study of the Fundamental Plane to the highest possible limit. Tracing these scaling relations in clusters to an unprecedented look-back time will enable us to put strong constraints on the formation epoch of cluster galaxies.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10532
Title: Kinematics and morphology of the most massive field disk galaxies at z>1
PI: Kai Noeske
PI Institution: University of California - Santa Cruz

We propose to obtain 1 orbit NIC-2 images of a sample of the 15 most massive galaxies found at $1 < z < 1.3$. These were culled from over 20,000 Keck spectra collected as part of DEEP and are unique among high redshift massive galaxy samples in being kinematically selected. We intend to test whether these potentially very young galaxies are likely precursors to massive local disks, assuming no further merging. NIC-2 images provide rest-frame optical morphologies that will show whether they are normal disky systems or instead

more disturbed looking objects with multiple subcomponents, mergers, peculiar structure, etc. NIC-2 provides near-IR resolutions sufficient to enable measurements of bulges and disks subcomponents. The near-IR will fill a critical gap in the broad-band SED photometry of the galaxy and its subcomponents to estimate mean stellar ages and stellar masses and to assess whether old stellar bulges and disks are in place at that time. Finally, this sample will yield the first statistically significant results on the $z > 1$ evolution of the Tully-Fisher relation for massive galaxies.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10533
Title: The IMF in NGC6611: the environmental influence on the formation of low-mass stars and brown dwarfs
PI: Joana Oliveira
PI Institution: University of Keele

We propose to use HST with ACS and NICMOS to survey the central area of the young (2 Myr) cluster NGC6611 in the Eagle Nebula, with the goal of constructing the low-mass and substellar Initial Mass Function (IMF). We plan to obtain deep images in I (F775W) and Z (F850LP) with ACS/WFC, and deep images in J (F110W) and H (F160W) for 25 NICMOS/NIC2 fields within the 202" x 202" ACS/WFC field. Using a proven technique based on the use of IZJH color-magnitude and color-color diagrams to identify and determine the masses of the low-mass pre-main sequence cluster members, we are thus able to construct the IMF down to masses of 0.02-0.03 Msun. With an intense ionizing radiation field but a relatively low density, NGC6611 provides a unique laboratory in which to test the importance of photoevaporation and density on the formation of low-mass stars and brown dwarfs, through comparison with the IMFs determined for the different environments in the Orion Nebular Cluster, Taurus and IC348. This will not only offer substantial new insight into the physics of star formation, but also have important ramifications for estimating the global star formation rates at high redshift, the efficiency of galactic chemical evolution and the contribution of sub-stellar mass objects to the baryonic dark matter content of the Universe.
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Proposal Category: SNAP
Scientific Category: SOLAR SYSTEM
ID: 10534
Title: 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, months, and years. Uranus is rapidly approaching equinox in 2007, with another 4 degrees of latitude becoming visible every year. Recent HST observations during this epoch (including 6818: Hammel, Lockwood, and Rages; 8680: Hammel, Rages, Lockwood, and Marley; 8634: Rages, Hammel, Lockwood, Marley, and McKay; and 10170: Rages, Hammel, Lockwood, and Marley) have revealed strongly wavelength-dependent latitudinal structure and the presence of numerous visible-wavelength cloud features in the northern hemisphere. Long-term ground-based observations (Lockwood and Thompson 1999) show seasonal brightness changes whose origins are not well understood. Recent near-IR images of Neptune obtained using adaptive optics on the Keck Telesccope together with images

from our Cycle 9 Snapshot program (8634) show a general increase in activity at south temperate latitudes as well as the possible development of another Great Dark Spot. 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.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10535
Title: High Temperature Accretion Flows and Reprocessing in X-ray Binaries: The ADC Source 4U 1822-371
PI: Edward Robinson
PI Institution: University of Texas at Austin

The eclipsing low-mass X-ray binary 4U 1822-371 is the ideal system in which to observe hot accretion and the effects of strong irradiation. Its orbital period is 5.57~hr and its orbital inclination is high enough that flux from the neutron star is blocked by the edge-on accretion disk in the system. Because the neutron star is hidden its Accretion Disk Corona is visible. These ADCs are present in most if not all low-mass X-ray binaries but are generally not visible. 4U 1822-371 provides a unique opportunity to study an ADC and disk irradiation because the eclipse by the secondary star allows their geometry and flux to be mapped. We will perform a multiwavelength light curve synthesis and eclipse analysis of 4U 1822-371. The scientific goal is to map the geometry and flux from its ADC and from its irradiated accretion disk. The crucial and irreplaceable role of HST is to provide the UV data needed to disentangle the ADC from the irradiated accretion disk. We will obtain time-resolved, objective-prism UV spectroscopy of 4U 1822-371 using the ACS/SBC with the PR130L prism covering most of its orbit and all of the eclipse. This combination will yield excellent orbital light curves in the UV continuum and in the integrated line fluxes.
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Proposal Category: SNAP
Scientific Category: COOL STARS
ID: 10536
Title: What Are Stalled Preplanetary Nebulae? An ACS SNAPshot Survey
PI: Raghvendra Sahai
PI Institution: Jet Propulsion Laboratory

Essentially all planetary nebulae (PNs) are aspherical, whereas the mass-loss envelopes of AGB stars are strikingly spherical. Our previous SNAPshot surveys of a morphologically unbiased sample of pre-planetary nebulae (PPNs) -- objects in transition between the AGB and PN evolutionary phases -- show that roughly half our observed targets are resolved, with bipolar or multipolar morphologies. Spectroscopic observations of our sample confirm that these objects have not yet evolved into planetary nebulae. Thus, the transformation from spherical to aspherical geometries has already fully developed by the time these dying stars have become PPNs. Although our current studies have yielded exciting results, they are limited in two important ways -- (1) the number of well-resolved objects is still small (18), and the variety of morphologies observed relatively multitudinous, hence no clear trends can yet be established between morphology and other source properties (e.g., near-IR, far-IR colors, stellar spectral type, envelope mass), and (2) the current

samples are strongly biased towards small PPNs, as inferred from their low 60-to-25 micron flux ratios [R(60/25)<1]. However, the prototype of objects with R(60/25)>1, the Frosty Leo Nebula, has a puzzlingly large post-AGB age (almost 10^4 yr) and a fairly cool central star, very different from the expectations of single-star stellar evolutionary models. A proposed, but still speculative, hypothesis for such objects is that the slow evolution of the central star is due to backflow of material onto the mass-losing star, retarding its evolution towards the PN phase. This hypothesis has significant consequences for both stellar and nebular evolution. We therefore propose a survey of PPNs with R(60/25)>1 which is heavily weighted towards the discovery of such "stalled PPNs". Supporting kinematic observations using long-slit optical spectroscopy (with the Keck), millimeter and radio interferometric observations (with OVRO, VLA & VLBA) are being undertaken. The results from this survey (together with our previous work) will allow us to draw general conclusions about the complex mass-outflow processes affecting late stellar evolution, and will provide crucial input for theories of post-AGB stellar evolution. Our survey will produce an archival legacy of long-standing value for future studies of dying stars.

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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10537
Title: Caught in the Act with HST -- Active Jet Sculpting in the Young Preplanetary Nebulae IRAS 22036+5306
PI: Raghvendra Sahai
PI Institution: Jet Propulsion Laboratory

We have discovered an extended, highly-structured and bipolar nebula surrounding the post-AGB object IRAS22036+5306 (I22036), in a Cycle 10 WFPC2 imaging survey of very young pre-planetary nebulae (PPNs). Young PPNs like I22036, objects in rapid transition between the AGB and Planetary Nebulae (PN) phases, retain direct signatures, in the spatial character of their outflows, of the physical mechanisms which transform slowly expanding, round circumstellar AGB envelopes into highly aspherical PNs with fast-expanding elongated lobes along one or more axes. I22036 shows intriguing evidence for the presence of jets in the HST images, and VLA A-array maps show OH maser emission in a linear structure along the nebular axis. Our ground-based echelle H-alpha spectra show high-velocity blue-shifted absorption in a very broad (~2000 km/s) line profile, and mm-wave CO J=1-0 interferometric data show a bipolar molecular outflow. There are very few young PPNs like I22036 which show clear morphological & kinematical evidence of the presence of jets and their working surfaces, making it unquestionably a key object for understanding how jets can sculpt out bipolar lobes in a progenitor AGB star wind. Using ground-based long-slit spectroscopy with the Keck/ESI, we have partially spatially resolved the H-alpha emission in this object. We now propose to image I22036 in F658N, F631N, F606W and F814W in order to identify accurately the location and structure of the shocked gas, and its relation to the jets and their working surfaces. An important goal is to determine whether we can characterise the forward and reverse shocks near the heads of the knotty jets. The proposed HST imaging will help us to understand the spatio-kinematic structure of the outflowing gas in the bipolar lobes, and allow us to study the relationships between the important dynamical components of this nebula. Supporting ground-based observations such as Zeeman measurements of polarised OH masers with the VLBA to search for magnetic fields in I22036 are being pursued for testing magnetic-collimation models for jets in PPNs.

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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10538
Title: Near-IR Spectrophotometry of 2MASSWJ 1207334-393254B - An Extra-Solar Planetary Mass Companion to a Young Brown Dwarf
PI: Glenn Schneider
PI Institution: University of Arizona

We propose to obtain "short" wavelength near-IR diagnostic and characterizing spectra of the very high probability candidate extra-solar giant planet (EGP) companion to 2MASSWJ 1207334-393254 (2M1207), a young brown dwarf and TW Hydrae Association member. Recent NICMOS camera 1 multi-band photometric imaging of the companion candidate, 0.77" (54 AU projected) from 2M1207 - initially detected at longer wavelengths with VLT/NACO - implicate an object of several Jupiter masses based on cooling models of EGPs and the likely age of 2M1207 (~ 8 Myr). Physical companionship of the EGP candidate with 2M1207 has been established at the 99.1% level of confidence via second-epoch NICMOS astrometric observations. Diagnostic spectra in the 0.8 to 1.9 micron region (unobtainable from the ground and overlapping the NICMOS imaging observations) will (a) critically inform on the physical nature of the EGP, (b) provide currently non-existing information to test/constrain theoretical models of EGP properties and evolution, and (c) unequivocally confirm the imaging of a bone fide EGP. Background light from 2M1207 would normally swamp the EGP spectrum with direct spectral imaging. To obviate this, we propose PSF-subtracted grism spectra of the EGP using 2M1207 as its own spectral template via two-orientation high-contrast image subtraction. The temporal stability of the HST+NICMOS PSF enables self-subtractions of targets at different field orientations resulting in contrast enhancements of 5 to 6 stellar magnitudes in the circumstellar background at ~ 0.8" at these wavelengths. With the grism field oriented to place the EGP "above" and "below" 2M1207 (at two observational epochs) two independent spectra of the EGP will emerge from a difference image. This prototypical spectrum will serve to test and improve upon current models of young EGPs which predict flux suppression by molecular absorption in their atmospheres.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10539
Title: Coronagraphic Imaging of Bright New Spitzer Debris Disks
PI: Karl Stapelfeldt
PI Institution: Jet Propulsion Laboratory

Fifteen percent of bright main sequence stars possess dusty circumstellar debris disks revealed by far-infrared photometry. These disks are signposts of planetary systems: collisions among larger, unseen parent bodies maintain the observed dust population against losses to radiation pressure and P-R drag. Images of debris disks at optical, infrared, and millimeter wavelengths have shown central holes, rings, radial gaps, warps, and azimuthal asymmetries which indicate the presence of planetary mass perturbers. Such images provide unique insights into the structure and dynamics of exoplanetary systems. Relatively few debris disks have been spatially resolved. Only nine have ever been resolved at any wavelength, and at wavelengths < 10 microns (where subarcsec resolution is available), only seven: beta Pictoris, HR 4796, HD 141569, AU Mic, HD 107146, HD 92945, and Fomalhaut. Imaging of many other

debris disk targets has been attempted with various HST cameras/coronagraphs and adaptive optics, but without success. The key property which renders a debris disk observable in scattered light is its dust optical depth. The seven disks imaged so far all have a dust excess luminosity >~ 0.01% that of the central star; no disks with smaller optical depths have been detected. Most main sequence stars known to meet this requirement have already been observed, so future progress in debris disk imaging depends on discovering additional stars with large infrared excess. The Spitzer Space Telescope offers the best opportunity in 20 years to identify new examples of high optical depth debris disk systems. We propose ACS coronagraphic imaging of nine bright, new debris disks uncovered during the first year of the Spitzer mission. Our goal is to obtain the first resolved images of these disks at ~3 AU resolution,define the disk sizes and orientations,and uncover disk substructures indicative of planetary perturbations. The results should double the number of debris disks observed at 0.06" resolution, and open a wider window into the structure of planetary systems.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10540
Title: Imaging Nearby Dusty Disks
PI: Alycia Weinberger
PI Institution: Carnegie Institution of Washington

Images of circumstellar debris disks around young stars display complex structures that suggest they harbor forming planets. Disks around stars of nearly the same age and mass show dramatically different morphologies including rings with brightness asymmetries and multiple warps. The reasons for this heterogeneity are not understood, nor given the small sample of imaged disks, can we be sure we have yet observed all possible outcomes of the planet formation process. Disk imaging programs have demonstrated that the Hubble Space Telescope is the only excellent platform for the high-contrast detection of scattered light disks in the presence of their bright parent stars. Therefore, we propose a NICMOS imaging survey of the nearest, youngest, stars to Earth with substantial disks known from infrared excess emission.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10541
Title: Probing the jet mattter content of quasar PKS 0637-752
PI: Markos Georganopoulos
PI Institution: University of Maryland Baltimore County

The matter content (electron-proton vs electron-positron composition) of extragalactic jets remains unknown, despite over three decades of work. Here, we propose NICMOS/NIC3 and ACS observations of the Chandra-detected, one sided jet of the superluminal quasar PKS 0637-752 to derive the jet matter content by measuring the component of the Cosmic Microwave Background (CMB) radiation that is bulk-Comptonized (BC) by the cold electrons in the relativistically flowing large scale jet. What makes this source particularly suited for this procedure, is the absence of significant non-thermal jet emission from the 'bridge', the region between the core and the first bright knot WK7.8, guaranteeing that most of the electrons in the bridge are cold, leaving the BC scattered CMB radiation as the only significant source of photons in this

region. The proposed NICMOS and ACS observations of the knot WK7.8 will provide spectral information in the IR-UV regime, which, together with existing multiwavelength data, will be used to derive the jet Doppler factor and minimum power necessary to power the knot emission as a function of the jet matter content. These will in turn be used to deduce, or strongly constrain, the actual jet matter content through comparison with the proposed NICMOS observations of the BC 'bridge' emission.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10542
Title: Charting the Sparkling Star Formation in NGC346
PI: Antonella Nota
PI Institution: Space Telescope Science Institute - ESA

New, stunning V, I images of the youngest and most massive star forming region NGC 346, in the Small Magellanic Cloud, have been recently obtained with the HST/ACS. They reveal a myriad of small compact clusters: some are still embedded in dust, possibly connected by gas and dust filaments. We also discover a rich population of pre-main sequence low mass stars (~3 - 0.6 Mo) mainly distributed in the body of NGC 346 and in these compact clusters, which formed with the central cluster (~5My ago), but have not reached the main sequence yet. The immediate question that emerges is: how did star formation occur in this region? Is there evidence for an age spread among these clusters, that could be indicative of sequential star formation? We are, therefore, requesting an immediate follow up investigation with the ACS/HRC to perform a comprehensive UV/U study of the ten largest clusters identified in the NGC 346 region, with the objective of determining, in combination with the already available deep V,I data, their mass function, their upper mass cut-off, whether mass segregation is present, whether there are age variations, and what is the impact of the stellar feedback, with the final aim to establish how star formation has occured and progressed in this low metallicity environment.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10543
Title: Microlensing in M87 and the Virgo Cluster
PI: Edward Baltz
PI Institution: Stanford University

Resolving the nature of dark matter is an urgent problem. The results of the MACHO survey of the Milky Way dark halo toward the LMC indicate that a significant fraction of the halo consists of stellar mass objects. The VATT/Columbia survey of M31 finds a similar lens fraction in the M31 dark halo. We propose a series of observations with ACS that will provide the most thorough search for microlensing toward M87, the central elliptical galaxy of the Virgo cluster. This program is optimized for lenses in the mass range from 0.01 to 1.0 solar masses. By comparing with archival data, we can detect lenses as massive as 100 solar masses, such as the remnants of the first stars. These observations will have at least 15 times more sensitivity to microlensing than any previous survey, e.g. using WFPC2. This is due to the factor of 2 larger area, factor of more than 4 more sensitivity in the I-band, superior pixel scale and longer baseline of observations. Based on the halo microlensing results in the Milky Way and M31, we might expect that galaxy

collisions and stripping would populate the overall cluster halo with a large number of stellar mass objects. This program would determine definitively if such objects compose the cluster dark matter at the level seen in the Milky Way. A negative result would indicate that such objects do not populate the intracluster medium, and may indicate that galaxy harassment is not as vigorous as expected. We can measure the level of events due to the M87 halo: this would be the best exploration to date of such a lens population in an elliptical galaxy. Star-star lensing should also be detectable. About 20 erupting classical novae will be seen, allowing to determine the definitive nova rate for this giant elliptical galaxy. We will determine if our recent HST detection of an M87 globular cluster nova was a fluke, or indicative of a 100x higher rate of incidence of cataclysmic variables and nova eruptions in globulars than previously believed. We will examine the populations of variable stars, and will be able to cleanly separate them from microlensing.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10544
Title: Resovled Images of LMC Microlensing Events Observed by a Telescope at 2 AU from Earth
PI: David Bennett
PI Institution: University of Notre Dame

The identity of the lens objects for most of the LMC microlensing events seen by the MACHO Project is unknown. The most popular explanations include a previously unknown population of old, cool white dwarfs in the Galactic halo or in a very thick disk, or a variation standard LMC models that would allow most events to be caused by faint LMC stars. This uncertainty exists because it is usually impossible to determine the lens distance from the observable features of a microlensing event. Distance estimates can be obtained by measuring the microlensing parallax effect with simultaneous observations of the events from Earth and from a small (~30cm) telescope located 1-2 AU from the Earth. Such a telescope has just been launched: the High Resolution Instrument on the flyby spacecraft of the Deep Impact (DI) Mission. This telescope has been placed in an ideal orbit for LMC microlensing parallax measurements, and the telescope will be at a distance of >1 AU from Earth when the DI prime mission ends this August. Our group plans to take advantage of this fortuitous circumstance and propose a "new science" extended mission for the DI flyby spacecraft to resolve the LMC microlensing puzzle with microlensing parallax observaions. This project is compatible with the DI Science Teams extended mission plans to visit a 2nd comet, and our extended mission proposal to NASA will be written in collaboration with the Deep Impact Science team. A crucial feature of these proposed microlensing parallax measurements is the determination of the absolute brightness of the source stars, which can only be resolved with HST images. The source star brightness must be measured over the entire sensitivity range of the Deep Impact High Resolution Instrument clear filter: 300-1000nm. We therefore request UBVriz HST images to resolve the blending of the microlensed LMC source stars observed by the Deep Impact 30cm telescope.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10545
Title: Icy planetoids of the outer solar system
PI: Michael Brown

PI Institution: California Institute of Technology

Early HST studies of satellites of Kuiper belt object focussed on the 50-200 km objects that were the largest known at the time. In the past 3 years we have discovered a population of much more rare and much larger (500-2000+ km) icy planetoids in the Kuiper belt. These objects are the largest and brightest known in the Kuiper belt and, in the era when we now know of more than 1000 Kuiper belt objects, these few planetoids are likely to be the focus of much of the research on physical properties of the outer solar system for years to come. We are currently engaged in an intensive program involving Spitzer, Keck, and other telescopes to study the physical and dynamical properties of this new population. HST is uniquely capable of addressing one parameter fundamental to completing the physical picture of these planetoids: the existence and size of any satellites. The detection and characterization of satellites to these large planetoids would allow us to address unique issues critical to the formation and evolution of the outer solar system, including the measurement of densities, internal properties, sizes and shapes of these objects, the study of binary formation as a function of primary size, and the context of the Pluto-Charon binary. For these bright objects, a satellite search takes less than a full orbit, allowing the opportunity for a new project on UV spectroscopy of the planetoids to piggyback at no added time cost. This poorly explored spectral range has the potential to show unique signatures of trapped gasses, cosmochemically important ices, and complex organic materials.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10546
Title: The filaments of NGC1275
PI: Andrew Fabian
PI Institution: University of Cambridge

The spectacular H-0alpha filaments stretching over 100 kpc around the central galaxy in the nearby Perseus cluster of galaxies, NGC1275, resemble those found around distant radio galaxies and some protogalaxies. The origin and ionization of the filaments are poorly understood and relate to heating and cooling processes in galaxy formation and evolution. We propose here to image the filaments in order to reveal their true small-scale structure and to search for clumps of young stars along them. The observations will produce the first deep high resolution images of the whole filament system and, with our 1 Ms Chandra image, constrain both particle and photon ionization models for its ionization and excitation.

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Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10547
Title: A SNAP Program to Obtain Complete Wavelength Coverage of Interstellar Extinction
PI: Edward Fitzpatrick
PI Institution: Villanova University

We propose a SNAP program to obtain ACS/HRC spectra in the near-UV (PR200L) and near-IR (G800L) for a set of main sequence B stars with available IUE UV spectrophotometry, optical photometry, and 2MASS IR photometry. Together with these existing data, the new observations will provide complete photometric

and spectrophotometric coverage from 1150 to 11000 A and enable us to produce complete extinction curves from the far-UV to the near-IR, with well-determined values of R(V). The proposed set of 50 program sight lines includes the full range of interstellar extinction curve types and a wide range of color excesses. The new data will allow us to examine variability in the near-UV through near-IR spectral regions, including the UV-optical "knee" and the "Very Broad Structure." We will examine the response of these features to different interstellar environments and their relationship to other curve features. These are largely unexplored aspects of extinction curves which will provide additional constraints on the properties of interstellar grains. The curves will be derived using stellar atmosphere models to represent the intrinsic spectral energy distributions of the program stars, eliminating the need to observe unreddened "standard stars." This approach virtually eliminates "mismatch error", allowing us to derive extinction curves with much higher precision than previously possible. In addition, the new spectra will provide higher S/N data for the peak of the 2175 A bump than previously available.

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Proposal Category: SNAP
Scientific Category: AGN/QUASARS
ID: 10548
Title: Near-UV Snapshot Survey of Low Luminosity AGNs
PI: Rosa Gonzalez Delgado
PI Institution: Instituto de Astrofisica de Andalucia (IAA)

Low-luminosity active galactic nuclei (LLAGNs) comprise ~30% of all bright galaxies (B<12.5) and are the most common type of AGN. These include low-luminosity Seyfert galaxies, LINERs, and transition-type objects (TOs, also called weak-[OI] LINERs). What powers them is still at the forefront of AGN research. To unveil the nature of the central source we propose a near-UV snapshot survey of 50 nearby LLAGNs using ACS/HRC and the filter (F330W), a configuration which is optimal to detect faint star forming regions around their nuclei. These images will complement optical and near-IR images available in the HST archive, providing a panchromatic atlas of the inner regions of these galaxies, which will be used to study their nuclear stellar population. Our main goals are to: 1) Investigate the presence of nuclear unresolved sources that can be attributed to an AGN; 2) Determine the frequency of nuclear and circumnuclear stellar clusters, and whether they are more common in Transition Objects (TOs) than in LINERs; 3) Characterize the sizes, colors, luminosities, masses and ages of these clusters; 4) Derive the luminosity function of star clusters and study their evaporation over time in the vicinity of AGNs. Finally, the results of this project will be combined with those of a previous similar one for Seyfert galaxies in order to compare the nature of the nuclear sources and investigate if there could be an evolution from Seyferts to TOs and LINERs. By adding UV images to the existing optical and near-IR ones, this project will also create an extremely valuable database for astronomers with a broad range of scientific interests.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10549
Title: SAINTS - Supernova 1987A INTensive Survey
PI: Robert Kirshner
PI Institution: Harvard University

SAINTS is a program to observe SN 1987A, the brightest supernova in 384 years, as it morphs into the youngest supernova remnant at age 18. HST is the unique and perfect tool for spatially-resolved observations of the many physical components of SN 1987A. A violent encounter is underway between the fastest-moving debris and the circumstellar ring, exciting hotspots seen with HST that are suddenly lighting up. The optical and X-ray flux from the ring are both rising rapidly: HST and Chandra observations taken together are needed to understand the physics of these shocked regions. In Cycle14, the hotspots may fuse as the shock fully enters the ring. Photons from these shocks may excite previously hidden gas outside the ring, revealing the true extent of the mass loss that preceded the explosion. The inner debris of the explosion itself, still excited by radioactive isotopes produced in the explosion, is now well resolved by ACS and seen to be aspherical, providing direct clues to the mechanism of the explosion. Our search for a compact remnant is beginning to eliminate some theoretical possibilities and we have the opportunity in Cycle 14 to place much more stringent limits with NICMOS. Many questions about SN 1987A remain unanswered. How did the enigmatic three rings form in the late stages of Sanduleak -69 202? Precisely what took place in the center during the core collapse and bounce? Is a black hole or a neutron star left behind in the debris? SAINTS has been a continuous program since HST was launched-- we propose to extend this rich and deep data set for present use and future reference to answer these central questions in the science of supernovae.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10550
Title: The Nature of LSB galaxies revealed by their Globular Clusters
PI: Markus Kissler-Patig
PI Institution: European Southern Observatory - Germany

Low Surface Brightness (LSB) galaxies encompass many of the extremes in galaxy properties. Their understanding is essential to complete our picture of galaxy formation and evolution. Due to their historical under-representation on galaxy surveys, their importance to many areas of astronomy has only recently began to be realized. Globular clusters are superb tracers of the formation histories of galaxies and have been extensively used as such in high surface brightness galaxies. We propose to investigate the nature of massive LSB galaxies by studying their globular cluster systems. No globular cluster study has been reported for LSB galaxies to date. Yet, both the presence or absence of globular clusters set very strong constraints on the conditions prevailing during LSB galaxy formation and evolution. Both in dwarf and giant high surface brightness (HSB) galaxies, globular clusters are known to form as a constant fraction of baryonic mass. Their presence/absence immediately indicates similarities or discrepancies in the formation and evolution conditions of LSB and HSB galaxies. In particular, the presence/absence of metal-poor halo globular clusters infers similarities/differences in the halo formation and assembly processes of LSB vs. HSB galaxies, while the presence/absence of metal-rich globular clusters can be used to derive the occurrence and frequency of violent events (such as mergers) in the LSB galaxy assembly history. Two band imaging with ACS will allow us to identify the globular clusters (just resolved at the selected distance) and to determine their metallicity (potentially their rough age). The composition of the systems will be compared to the extensive census built up on HSB galaxies. Our representative sample of six LSB galaxies (cz < 2700 km/s) are selected such, that a large system of globular clusters is expected. Globular clusters will

constrain phases of LSB galaxy formation and evolution that can currently not be probed by other means. HST/ACS imaging is the only facility capable of studying the globular cluster systems of LSB galaxies given their distance and relative scarcity.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10551
Title: Gamma-Ray Bursts from Start to Finish: A Legacy Approach
PI: Shrinivas Kulkarni
PI Institution: California Institute of Technology

The progenitors of long-duration GRBs are now known to be massive stars. This result lends credence to the collapsar model, where a rotating massive star ends its life leaving a black hole or a highly magnetized neutron star, and confirms its essential aspects. The focus of attention now is on the black hole or magnetar engines that power the bursts. Somehow these engines create the most highly relativistic and highly collimated outflows that we know of, through mechanisms that no current theory can explain. These astrophysical laboratories challenge our understanding of relativistic shocks, of mechanisms for extracting energy from a black hole, and of how physics works in extreme conditions. The launch of Swift is bringing us into a new era, where we can make broadband observations that will enable us to study these fascinating physical processes. We propose here an ambitious, comprehensive program to obtain the datasets that will become the standard that any successful model for the central engine must explain. This programs leverages the HST observations to the maximum extent by our commitment of Swift observations, a Large program at the VLA, and extensive ground-based optical resources. By studying the engines and searching for jets in a variety of events, this program will investigate the conditions necessary for the engine and jet formation itself.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10552
Title: The distance of the Orion Nebula Cluster
PI: Massimo Robberto
PI Institution: Space Telescope Science Institute - ESA

The HST Treasury program on the Orion Nebula, currently in execution, has surprisingly found that background sources are easily detected by HST at long wavelengths through selected fields within the nebula. We propose to use these background sources as a reference system to measure the trigonometric parallax of the Orion Nebula cluster. Using ACS in the F850LP filter and with a modest investment of HST time, we will reduce the error on the ~500pc distance of the Orion Nebula to ~15pc, or less, improving by a factor ~6 over current estimates. Our new value will have a major impact on star formation studies, allowing to determine with high accuracy the absolute luminosity of the cluster members and all derived stellar parameters (agee, masses, mass accretion rates...). Our current understanding of a great range of phenomena associated to the star formation activity in Orion will also benefit from an improved distance estimate.
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Proposal Category: GO

Scientific Category: AGN/QUASARS
ID: 10553
Title: Bipolar Scattering Structures in AGN
PI: Gary Schmidt
PI Institution: University of Arizona

The Unified Scheme for Seyfert galaxies successfully explains the basic distinctions between Type 1 and Type 2 AGN, including the existence of broad scattered lines in polarized flux spectra of the latter. However, it fails to account for the strongly polarized broad lines often observed in Type 1 AGN. We have discovered an intermediate type red QSO that exhibits polarization properties of both types; indeed it suggests a bipolar scattering geometry similar to that seen in Galactic protoplanetary nebulae. We request a small allocation with the high-resolution camera on ACS to image the object in two key spectral bands. The results will allow an unambiguous interpretation of ground-based data, and enable modeling of the inclination and opening angle that illuminates the scattering clouds. Like NGC 1068, a successful explanation of this object will not only allow further unification of AGN but also aid in unraveling the details of their inner structure.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10554
Title: Globular Cluster Systems of Elliptical Galaxies in Low Density Environments
PI: Ray Sharples
PI Institution: University of Durham

We propose to use the ACS/WFC to determine colour (metallicity) distributions and luminosity functions for the globular cluster populations in a well-defined sample of elliptical galaxies in low-density environments, and to compare the results with similar samples taken from a rich cluster environment. Low-luminosity ellipticals are now recognized to play a pivotal role in testing hierarchical models of galaxy formation, and their globular cluster populations provide a unique probe of their star formation and metal enrichment history. The data will be used to (i) determine whether the bimodal colour distributions indicative of multiple formation epochs in luminous ellipticals are also prevalent in low-luminosity field ellipticals; (ii) place joint constraints on age and metallicity in systems with more than one population and determine the spread of ages in any one system; (iii) test whether cluster destruction processes (e.g. tidal shocking) are more effective in low-luminosity ellipticals, as predicted from their higher mass densities. ACS observations are essential to eliminate foreground/background contamination and to probe deep into the luminosity function to obtain a good statistical sample of clusters. The TAC has previously awarded HST time to two large surveys of globular cluster systems in rich cluster environments, but there is currently no comparable survey in low-density environments with which to compare these results.
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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10555
Title: A Search for Satellites Around Kuiper Belt Objects Which Exhibit High Angular Momentum
PI: Scott Sheppard

PI Institution: Carnegie Institution of Washington

We propose to use the HST to search for satellites around Kuiper Belt Objects which have large amplitude, fast rotational light curves. Large main belt asteroids with similar light curve characteristics have been found to have near an 80 percent companion rate. This is over an order of magnitude more than the companion rate of main belt asteroids in general. The satellites were probably formed during the process which imparted the high angular momentum on the primary object. To date five Kuiper Belt objects exhibit high angular momentum through their rotational light curves. Two of them have been observed with STIS on the HST and one was found to be a binary. We request three orbits with HST/ACS in order to obtain deep high resolution images of the other three Kuiper Belt objects that have large amplitudes and fast rotations. In addition, we request one orbit to reobserve the other KBO which didn't have a satellite detection in order to obtain deeper and better resolution images than the first observations. Finding binaries is important not only to understand the processes which created the high angular momentum of the primary but also in determining the bulk densities and collisional histories of the objects.

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Proposal Category: GO
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10556
Title: Neutral Gas at Redshift z=0.5
PI: David Turnshek
PI Institution: University of Pittsburgh

Damped Lyman-alpha systems (DLAs) are used to track the bulk of the neutral hydrogen gas in the Universe. Prior to HST UV spectroscopy, they could only be studied from the ground at redshifts z>1.65. However, HST has now permitted us to discover 41 DLAs at z<1.65 in our past surveys. Followup studies of these systems are providing a wealth of information about the evolution of the neutral gas phase component of the Universe. But one problem is that these 51 low-redshift systems are spread over a wide range of redshifts spanning nearly 70% of the age of the Universe. Consequently, past surveys for low-redshift DLAs have not been able to offer very good precision in any small redshift regime. Here we propose an ACS-HRC-PR200L spectroscopic survey in the redshift interval z=[0.37,0.7] which we estimate will permit us to discover another 41 DLAs. This will not only allow us to double the number of low-redshift DLA, but it will provide a relatively high-precision regime in the low-redshift Universe that can be used to anchor evolutionary studies. Fortunately DLAs have high absorption equivalent width, so ACS-HRC-PR200L has high-enough resoultion to perform this proposed MgII-selected DLA survey.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10557
Title: Probing Asteroid Families for Evidence of Ultraviolet Space Weathering Effects
PI: Faith Vilas
PI Institution: NASA Johnson Space Center

We propose six HST orbits to obtain UV reflectance spectra covering 200-460 nm of two Vesta asteroid family members, asteroid 832 Karin, and two Karin family members. These observations extend work done under a Cycle 13 AR grant, where

we analyzed all of the existing IUE and HST S-class asteroids in the MAST database to investigate the effects of space weathering at UV wavelengths. Our hypothesis is that the manifestation of space weathering at UV wavelengths is a spectral bluing, in contrast with a spectral reddening at visible-NIR wavelengths, and that UV wavelengths can be more sensitive to relatively small amounts of weathering than longer wavelengths. The proposed observations will address two objectives: (1) Measure the UV-visible spectra of 832 Karin and two members of the young Karin family (absolute age of 5.8 My), in order to determine whether intermediate space weathering is observable in objects likely pristine when they originated from the interior of Karin's parent body. (2) Measure the UV-visible spectra of two members of the Vesta family to compare with our analysis of IUE Vesta spectra. These observations will probe Vesta's interior, and test our hypothesis by contrasting the apparent amount of alteration on the surfaces of Vestoids with excavated material on Vesta.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10558
Title: Archaeology of Fossil Galaxy Groups
PI: Michael West
PI Institution: University of Hawaii

Fossil groups are concentrations of dark mater with masses and x-ray luminosities comparable to those of an entire group of galaxies, but whose light is dominated by a single, isolated, large elliptical galaxy. The origin of these systems remains a puzzle: they may be the end products of complete merging of galaxies within once normal groups, or they might originate from a very unusual galaxy luminosity function in those regions that inhibits the formation of moderate-sized galaxies. We propose the first study of the globular cluster populations of the dominant elliptical galaxies in fossil galaxy groups, which will provide important new insights into their origin.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10559
Title: Astrometric monitoring of binary L and T dwarfs
PI: Herve Bouy
PI Institution: Instituto de Astrofisica de Canarias

We propose to obtain high angular resolution ACS images of five binary L and T dwarfs in order to determine their orbital parameters and dynamical masses, and directly constrain the evolutionary models of ultracool and substellar objects. The binaries have estimated periods ranging between 5 and 14 years. All of them have already been resolved at least twice (sometimes more) using HST, providing first and second epochs measurements. We propose to obtain two more ACS imaging observations separated by 9 to 12 months during cycle 14. The expected period coverage should therefore range between 35% and 117%, allowing us to compute precise orbital parameters and masses. Our sample is large enough and covers a sufficiently wide range of spectral types (from L3 to T5.5) to allow us to obtain strong constraints the evolutionnary models.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER

ID: 10560
Title: Confirming Planetary Candidates in the Stellar Graveyard with NICMOS
PI: John Debes
PI Institution: The Pennsylvania State University

We propose to follow up planetary candidates imaged near the white dwarf WD 1620-391 with second epoch images from NICMOS. This white dwarf was imaged during Cycle 12 as part of a campaign to detect massive planetary companions to nearby white dwarfs with photospheric metal line absorption. While at a low galactic latitude, a puzzling excess of objects are present < 4", suggesting the possiblity of objects physically associated with the white dwarf. With second epoch information we can test these candidates for common proper motion, a test for physical association. If any of these candidates are confirmed, they will be consistent with 6-10 M$_{Jup}$ companions at projected orbital separations of between 25-50 AU.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10561
Title: A deep UV imaging survey of the Globular Cluster M 30
PI: Andrea Dieball
PI Institution: University of Southampton

We propose to carry out a deep FUV and NUV survey of M30 (NGC 7099) in order to find and study the hot and/or dynamically-formed stellar populations in the globular cluster. In particular, we will (i) search for the UV counterpart to a MSP binary, (ii) find and study the full population of cataclysmic variables in this cluster, (iii) study the UV properties of the cluster's extensive blue straggler population, (iv) detect the first set of white dwarfs in this cluster. Our survey will be sensitive to variability on time-scales from minutes to weeks, allowing us to search for variable stars in all of the FUV populations.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10562
Title: Validating a dark galaxy
PI: Mike Disney
PI Institution: University of Wales, College of Cardiff (UWCC)

VIRGOHI21 is an object detected in the Virgo Cluster HI survey of Davies et al (2004), with a velocity width typical of a disc galaxy (220 km/s) but which does not appear to have an optical counterpart down to a surface brightness level of 27.5 B mag/sq. arcsec. Altogether, it is the best ever candidate for a Dark Galaxy. We propose to image this object with the ACS through the F814W filter for 9 orbits to see if this object contains a population of individually very faint stars which would be missed by ground-based telescopes.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10563
Title: Accurate dark-matter mass profiles in 3 elliptical

galaxies as a test of CDM
PI: Simon Dye
PI Institution: University of Wales, College of Cardiff (UWCC)

A critical test of the successful Lambda-CDM picture for structure formation is the measurement of the power law exponent, gamma, of the centre of dark matter density profiles, predicted to lie in the range 1.0-1.5. Measurements of gamma derived from rotation curves of LSB galaxies appear to contradict CDM, but rely on assumptions that are difficult to verify (e.g. axisymmetry). We have recently demonstrated, using our new `semi-linear' inversion method, how strong gravitational lensing by galaxies can provide a clean and accurate measurement of gamma, free of such ambiguities. HST images of lensed non-AGN galaxies provide hundreds of resolution elements, each a constraint on the mass profile. Such lenses are exceedingly rare, but we have recently discovered new systems. We propose deep ACS-HRC observations of 3 systems to measure gamma in each, accurate to 0.15 (95% confidence) and to obtain an indication of its variation between galaxies. To establish the required number of orbits we have undertaken an end-to-end simulation of the problem, creating and analysing synthetic ACS images. Additionally the semi-linear method simultaneously reconstructs the pixelised source surface brightness distribution. Our simulations demonstrate that the fine sampling and small pixel scattering of the HRC, resolves the morphology of the sources with exquisite detail.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10564
Title: Resolving Ultracool White Dwarf Binaries
PI: Jay Farihi
PI Institution: Gemini Observatory, Northern Operations

We propose an ACS/HRC imaging survey of the coolest white dwarfs known in order to search for binarity. Current models fail to match observed spectral energy distributions of these sub-4000K stellar remnants, consistently predicting much lower luminosities than observed. A possible explanation is that they are binary in nature. Because these cool degenerates have no spectral features, the only way to investigate their apparent overluminosity is with very high resolution imaging, which can only be done with HST (these stars are far too faint to be observed with adaptive optics on the ground). Optical wavelengths are ideal because the spectral energy distributions of these old degenerates peak near 600 nm. With the F435W filter we will be able to partially resolve equally luminous binaries as close as 0.02", which corresponds to within 0.6 AU for over half of the 12 proposed target stars. The collected data will be critical in determining whether these stars represent the oldest white dwarfs in the solar neighborhood.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10565
Title: The outermost globular cluster of M31
PI: Silvia Galleti
PI Institution: Osservatorio Astronomico di Bologna

We have recently identified a previously unknown globular cluster in the M31 system that is located at 4 degrees from the center of the galaxy and in

proximity (14 arcmin apart) of the major axis. This is by far the most remote M31 cluster presently known, more than 1 degree farther than any other recognized cluster. Low resolution spectra have confirmed that the object is member of M31 and its line-of-sight velocity lie approximately on the extrapolation of the HI rotation curve of the galaxy. The projected position and kynematics of the cluster strongly suggest that it may be associated with the disc of M31. If this hypothesis will be confirmed it would imply that the stellar disc of M31 extends out to ~55 kpc (the projected galactocentric distance of the newly discovered object) with far reaching consequences on our ideas of the formation of galactic discs. We propose ACS/WFC observations aimed at obtaining the Color Magnitude Diagram of the cluster and its surroundig field to constrain the age and metallicity of both populations. This will provide direct indications on the actual extension and epoch of formation of the M31 disc as well as a deep insight in the stellar content of a remote region of this galaxy that has not been studied before.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10566
Title: Star Formation in the LMC - The complete IMF of a Stellar Association
PI: Dimitrios Gouliermis
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

We propose to use the large improvement in sensitivity and wide-field resolution provided by ACS to obtain, for the first time, the complete Initial Mass Function (IMF) down to sub-solar masses of a very young stellar association in the Large Magellanic Cloud (LMC). Such an IMF will serve as a reference IMF typical of low-metallicity regions. We want to obtain VI deep (V ~ 26.5 mag) WFC photometry of the association LH 95 and a nearby background field pointing. Special care will be taken to treat all the complications which arise in the reduction of data for the purpose of calculating the IMF of a young association of stars. Our object of study has been chosen because it is one of the associations, which provide the best combination of spatial resolution, crowding, low extinction, nebular contamination, and background confusion in comparison to others in the Local Group. The region also has the advantage of being very young with indications that it is still forming stars, thus allowing us to search for sub-solar pre-main-sequence stars, as well as for an embedded proto-cluster.

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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 10567
Title: Securing the Faint-End Galaxy Luminosity Function with Surface Brightness Fluctuation Distances
PI: Helmut Jerjen
PI Institution: Australian National University

The history of the formation of galaxies must leave an imprint in the properties of the mass function of collapsed objects and in it's observational manifestation the luminosity function. At present the faint end of the luminosity function of galaxies is poorly known. Accurate knowledge of the luminosity function over the full range of galaxy clustering scales would provide serious constraints on both initial cosmological conditions and modulating astrophysical processes. Wide field imaging surveys with large

groundbased telescopes now provide the capability to identify dwarf galaxy candidates to very faint levels. However distances to these candidates are needed to overcome the omnipresent problem of group membership uncertainties and to establish the intrinsic properties of the faint end of the luminosity function. Single orbit observations with HST ACS can provide adequate distances via the surface brightness fluctuation method for targets in this program, resulting in the best definition ever of the luminosity function to M_R=-11 in a specific environment.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10568
Title: Ultraviolet spectrum of the binary millisecond pulsar J0437-4715
PI: Oleg Kargaltsev
PI Institution: The Pennsylvania State University

PSR J0437-4715 is the nearest and the brightest millisecond (recycled) pulsar, and the only one detected at near-optical wavelengths. We detected it with the HST STIS/FUV-MAMA detector and found that its FUV spectrum is consistent with being emitted from the neutron star surface with a temperature of about 0.1 MK, surprisingly high for such an old object. We also found evidence of an emission line at 1372 A, tentatively interpreted as a Zeeman component of the hydrogen Ly-alpha line in a magnetic field of 700 MG. Unfortunately, the spectrum was imaged in a region of strong detector background, which strongly hampered the spectral analyses. We propose to re-observe the pulsar with the ACS/SBC in FUV and ACS/HRC in NUV to obtain the spectrum of the pulsar in a broad UV range. The spectral analysis will allow us to measure the temperature of the full neutron star surface and probe the heating mechanisms operating in old neutron stars. Confirmation of the spectral line would lead to a first direct measuremnt of the magnetic field and the radius of a spin-powered neutron star and uniquely constrain the equation of state of superdense matter. The NUV spectrum will also probe the magnetospheric emission and the thermal structure of the cool white dwarf companion.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10569
Title: A Last Look at the First Gravitational Lens
PI: Charles Keeton
PI Institution: Rutgers the State University of New Jersey

Strong gravitational lensing provides our best probe of the behavior of dark matter in galaxy halos and their substructure. We propose ACS imaging to gain new strong and weak lensing data for the first-discovered lens system Q0957+561. We will make a weak lensing image spanning 6' to map the potential of the cluster around the lens galaxy, and simultaneously obtain a deep image of more than 10 multiply-imaged features in the strong lensing region. This will complete HST's legacy dataset for Q0957+561: a deep multicolor image of a rich multiple-image system, an extremely high-quality weak lensing map, and an existing deep NICMOS image of the Einstein ring. We will combine these three kinds of data into a single lens model--a first--to produce a sophisticated dark matter map that will provide a uniquely detailed view of the relation between visible and dark matter on galaxy scales, and the best available constraints on dark substructure. In addition, the best available H_0

measurement from lensing will potentially allow us to leverage the WMAP data into a more precise measurement of dark energy properties as well. Astrophysics with strong lensing depends crucially on HST's unique capability for precise, well-resolved observations of low-surface-brightness structures next to bright objects, so it is a high priority to address outstanding questions before the demise of HST.

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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10570
Title: Hosts of Quasars with Opaque Partial Covering
PI: Makoto Kishimoto
PI Institution: University of Edinburgh, Institute for Astronomy

A few quasars are known to exhibit associated absorption lines with opaque partial covering. These are the lines which are clearly saturated but not completely dark, so that these absorbing clouds are opaquely and partially covering the quasar light. In some cases, ionization parameter and density arguments indicate that the absorbers are on kpc scale. This implies that at least in some cases, the residual, unabsorbed optical (rest-UV) continuum component originates from ~kpc scales, rather than microscopic scales (such as ~100 Schwarzschild radii). This could be a superluminous host galaxy or starbursting core, and could be resolved by HST. We address the nature of these opaquely and partially covered quasars with a simple and robust ACS imaging.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10571
Title: The Compact Disk of Blue Stars Orbiting the M31 Black Hole
PI: Tod Lauer
PI Institution: National Optical Astronomy Observatories, AURA

We propose ACS/HRC U and B band imaging of the compact cluster of blue stars at the precise center of M31, which hosts the 1.3X10^8 solar-mass nuclear black hole. Analysis of STIS spectra and WFPC2 images suggest that the cluster is actually a disk. Recovering an accurate light distribution of the disk is essential for obtaining a precise estimate of the black hole mass from the STIS spectra, an approach that is attractive as it bypasses modeling the complex structure and dynamics of the M31 double nucleus by using the Keplerian rotation of the blue disk as a direct mass indicator. Dithered ACS/HRC observations in the blue provide the best spatial resolution available from HST, which is ~2X finer than could be obtained by the WFPC2 observations that first elucidated the structure of the blue cluster. The cluster effective radius (barely resolved by WFPC2) is only ~ 0.06'', thus the ultimate resolution and improved S/N offered by re-observation with ACS/HRC are essential to fully understand the disk inclination and radial starlight distribution. Analysis of the "smoothness" of the blue light distribution may also reveal its composition. The low-luminosity of the disk, M(AB)=-5.5 can be produced by only a few hundred A-stars, a small enough number that fluctuation statistics should leave an obvious signature on the light distribution.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10572
Title: Resolving M32's Main Sequence: A Critical Test for Stellar Population Studies
PI: Tod Lauer
PI Institution: National Optical Astronomy Observatories, AURA

We propose to observe the M32 main-sequence turnoff (MSTO) with deep ACS/HRC B and V images. Only the superior resolution and blue sensitivity of ACS/HRC make this possible. M32 is the only elliptical galaxy close enough to allow direct observation of its MSTO - it is a vital laboratory for deciphering the stellar populations of all other elliptical galaxies, which can only be studied by the spectra of their integrated light, given their greater distances. Major questions about M32's star formation history remain unanswered. Spectral studies suggest that M32 underwent a recent burst of star formation 3 to 8 billion years ago; observation of the M32 MSTO will confirm this directly. In the process, ACS will easily resolve more luminous components: hot blue stars, luminous, intermediate-age red clump and AGB stars, and any extended blue horizontal branch. These detailed CMDs will provide a direct comparison with population synthesis models for M32, providing a bridge to studies of the integrated light of more distant elliptical galaxies, a crucial ingredient for understanding their star formation histories. As M32 is projected against the edge of the M31 disk, an essential part of our proposal includes deep observation of an M31 disk field to allow the M32 photometry to be background corrected. These observations will reveal the star formation history of M31's outer disk and are thus of interest in their own right.
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Proposal Category: SNAP
Scientific Category: STELLAR POPULATIONS
ID: 10573
Title: Globular Clusters in the Direction of the Inner Galaxy
PI: Mario Mateo
PI Institution: University of Michigan

The age, chemical and kinematic distributions of stellar populations provide powerful constraints on models of the formation and evolution of the Milky Way. The globular clusters constitute an especially useful case because the stars within individual clusters are coeval and spatially distinct. But a serious limitation in the study of many globular clusters -- especially those located near the Galactic Center -- has been the existence of large absolute and differential extinction by foreground dust. We propose to use the ACS to map the differential extinction and remove their effects in a large sample of globular clusters located in the direction of the inner Galaxy using a technique refined recently by von Braun and Mateo (2001). These observations and their analyses will let us produce high quality color-magnitude diagrams of these poorly studied clusters that will allow us to determine these clusters' relative ages, distances and chemistry and to address important questions about the formation and the evolution of the inner Galaxy. Our aim for these ACS observations is to obtain data for the most crowded clusters in the inner Galaxy where the excellent spatial resolution of the ACS is most necessary.
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Proposal Category: GO

Scientific Category: COSMOLOGY
ID: 10574
Title: Witnessing Galaxy Transformation in Galaxy Groups at z > 1
PI: Simona Mei
PI Institution: The Johns Hopkins University

The recent discover of five galaxy groups in the Lynx supercluster region offers us the exciting opportunity to observe for the first time groups in the process of collapsing into a merging pair of clusters at z > 1. Our current picture of structure formation suggests that substantial evolution of galaxy properties can occur in groups and filaments well before they enter the environs of massive clusters. However, neither current theoretical models nor observations give us a complete understanding of the relative importance of the different physical processes that control the structural and spectral transformations that occur prior to, during, and after infall into a dense environment. We propose direct observation of these newly discovered dynamically young structures in the Lynx region, in order to provide a critical benchmark in testing not only whether galaxy evolution occurs mostly prior to entry into the densest regions but will also constrain the relative importance of initial conditions in determining the fate of galaxy systems. Our analysis of these proposed ACS measurements will be complemented with an unique dataset we have already in the optical, infrared, mid-infrared, and X-ray.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10575
Title: Lyman alpha morphology of local starburst galaxies
PI: Goran Ostlin
PI Institution: Stockholm University

Our pilot imaging study of 6 local galaxies using ACS/SBC in the cosmologically important Lyman-alpha line has begun to reveal intriguing results. Here we propse ACS/HRC imaging of this sample, the approval of the which will allow for a significant increase in the impact of the original study and extend the limits of current understanding of Lyman-alpha escape. With this data we can accurately calibrate our Lyman-alpha line-only images and explore for the first time Lyman-alpha fluxes and equivalent widths in spatially resolved systems. These data would also allow us to test the current models of Lyman-alpha escape mechanisms and investigate possible correlations between Lyman-alpha emission and other local parameters such as age and internal reddening. The addition of high-resolution H-alpha data allows us to quantitatively study the decoupling of Lyman-alpha from non-resonant radiation and spatially explore the destruction and attenuation of Lyman-alpha. The study will go a long way towards resolving the outstanding issues complicating the interpretation of high redshift studies and the use of Lyman-alpha to quantitatively study the distant universe.
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Proposal Category: SNAP
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10576
Title: An ACS Imaging Survey of the Galaxies Hosting Strong Mg II Absorption
PI: Gabriel Prochter

PI Institution: University of California - Santa Cruz

Strong MgII absorbers (with rest-frame absorption equivalent width W_MgII > 0.3 A) at redshift z < 1 are known to arise in extended gaseous halos around luminous galaxies. Detailed absorption line studies based on high-solution spectra of background quasars yield tight constraints on the metallicity, ionization state, and kinematics of the gaseous clouds. But whether they originate in gas accreted from surrounding satellite galaxies or outflows associated with active starburst in the host galaxies remains unclear. We have recently completed a search of the Sloan Digital Sky Survey data archive for strong MgII absorbers and identified over 1000 new systems that are previously unknown. A subset of these MgII absorbers with W_MgII > 1.8 A exhibit extreme kinematics with velocity widths (exceeding 200 km/s) in our follow-up echelle spectra. Their dynamics are consistent with various scenarios that include gas accretion (with speeds exceeding the virial velocity) and starburst outflows (possibly driven by recent merger events). Independent of their exact nature, it is clear that strong MgII systems serve as signposts to galactic halos with extreme gas dynamics. Here we propose to conduct a snapshot survey of galaxies in the fields toward high-redshift quasars with known, strong MgII absorbers at 0.5 < z < 2. We plan to obtain high spatial-resolution ACS/WFC images of 60 fields to uncover galaxies fainter than L* at the redshifts of these absorbers and study their morphology. We will complement the HST observations with follow-up spectroscopic observations and IR images acquired at the Keck and Magellan Observatories to for redshift identifications and for measuring broad-band colors. We will investigate the correlation between absorption line kinematics and galaxy morphology. In particular, we will address whether on-going mergers is responsible for the extreme dynamics observed in MgII absorption based on their rest-frame ultraviolet morphology.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10577
Title: Resolving the non-radiative shock in SN1006
PI: John Raymond
PI Institution: Smithsonian Institution Astrophysical Observatory

An ACS image of the H alpha filament in the supernova remnant SN1006 will resolve the thickness of the H alpha emission zone. This will permit us to derive an accurate pre-shock density, which in turn can be used to model the time-dependent X-ray spectrum of the bright X-ray ridge with no free parameters, thus benchmarking these widely used models. We will also search for evidence of a shock precursor, and we will use the scale of ripples in the shock to estimate the level of density inhomogeneity in the pre-shock gas.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10578
Title: Eclipsing Binaries in the Local Group: Calibration of the Zero-point of the Cosmic Distance Scale and Fundamental Properties of Stars in M31
PI: Ignasi Ribas
PI Institution: Institut d'Estudis Espacials de Catalunya

The Andromeda Galaxy (M31) is potentially a crucial calibrator for the Cosmic

Distance Scale, and thus for determining the age and evolution of the Universe. Yet currently the M31 distance modulus (~750 kpc) is is still uncertain to within 0.2-0.3 mag. We have demonstrated in our work on the LMC distance that double-lined eclipsing binaries can 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 radii and temperatures, it is possible to determine reliable distances. We are extending our program of using eclipsing binaries as standard candles to determine an accurate distance to M31. As a first step, we are proposing to carry out HST spectroscopy of two carefully selected 19th mag early-B eclipsing binaries in M31. HST/ACS prism/grism low-resolution spectrophotometry (115-900 nm) is the only missing key element of this program and is used to determine reliable values for T_eff, [Fe/H], and ISM extinction. These quantities, when combined with the results from our existing light and radial velocity curves for the two targets, will yield the stellar masses, radii, luminosities, and, importantly, the distances. The resulting fundamental stellar properties will be the first directly determined for stars in M31. Based on our previous experience, we expect to reduce the uncertainty of the M31 distance to better than 5%, thereby leading to a firmer calibration of the Cosmic Distance Scale and the zeropoint of H_0.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10579
Title: ULX counterparts: the key to finding intermediate-mass black holes
PI: Timothy Roberts
PI Institution: University of Leicester

The origin and formation mechanism for supermassive black holes (SMBHs) found in the centres of most, if not all, galaxies remains one of the outstanding questions in astrophysics. Most scenarios involve the presence of massive black holes in the early universe, formed by the collapse of primordial Population III stars. It is predicted that a relic of this population could still be present in galactic halos in the current epoch, possessing masses from a few hundred times solar mass upwards. However, to date no CONCLUSIVE evidence for such a class of "intermediate-mass" black holes has been found. The most likely current candidates are the ultraluminous X-ray sources (ULXs), which show tantalising evidence for IMBHs (e.g. the extreme X-ray luminosities and low disk temperatures expected from accreting IMBHs). We propose to address this issue by identifying optical counterparts for six of the nearest ULXs. We will use this programme as a pathfinder for future radial velocity measurements, which will allow the orbital parameters and hence the first undisputed mass constraints for these systems to be determined.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10580
Title: A tip of the red giant branch distance to NGC 4038/39 ("The Antennae")
PI: Ivo Saviane

PI Institution: European Southern Observatory - Chile

We propose to use ACS to determine a tip of the red giant branch (TRGB) distance to the merger system archetype NGC4038/39 ("The Antennae"). This system is the closest major merger to us, but its distance remains a point of debate, with proposed values ranging from 14 to 33 Mpc. Our previous HST/WFPC2 V,I band observation targeted the star forming (SF) regions near the tip of the southern tail of NGC4038. These data revealed a background population of red stars far from SF regions which we identify as RGB stars. The TRGB was detected near our completeness limit at about 26.5 mag, suggesting a distance of 13.8+/-1.7 Mpc, 30% lower than the most accepted distance of 21 Mpc, and less than half the distance of 29 Mpc adopted to characterize the "ultraluminous X-ray binaries" (UXB) sources discovered in recent Chandra observations by Fabbiano et al. (2001). The lower distance has profound implications for the mass and luminosities of all sources associated with The Antennae, such as the Tidal Dwarf candidates, the globular cluster system, and the UXB population. With its greater sensitivity and higher resolution, ACS can resolve this issue in just a few orbits. We therefore request seven orbits to obtain V,I band images of the southern tail of NGC4038/39 to reach 1.6 mag lower than the TRGB, for our proposed distance modulus. Even if the larger distance is the correct one, our proposed imaging would still give a robust distance constraint from the TRGB.

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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10581
Title: Imaging a Proto-cluster at z=2.3: The Morphology-Density Relation at High Redshift
PI: Alice Shapley
PI Institution: University of California - Berkeley

We propose deep ACS/WFC imaging in the HS1700+643 field, which contains a significant galaxy over-density at z=2.30+/-0.015. This structure is the largest and most robustly established cluster-sized over-density at z>1.5. We have spectroscopically confirmed 100 z~2 star-forming galaxies in this field and find significant differences in their stellar populations as a function of large-scale environment. Here we propose to measure the detailed morphological properties of this sample, to determine if the universal morphology-density relationship observed in the low-redshift universe is already in place in and around a forming proto-cluster region at high redshift. As well as providing a unique window into galaxy formation through studies of the z=2.3 proto-cluster, the HS1700+643 field has an extensive wealth of complementary data to recommend it. We will combine the new ACS observations with existing multi-wavelength imaging ranging from 0.3--8.0 microns, optical and near-IR spectroscopy, and narrow band imaging of z=2.3 H-alpha emitters, to understand the evolving properties of a complete and unbiased sample of high-redshift galaxies.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10582
Title: Probing The Galaxy-wide Globular Cluster - Low Mass X-ray Binary Connection in Early-type Galaxies
PI: Gregory Sivakoff
PI Institution: The University of Virginia

The combination of high-resolution imaging from Hubble (HST) and Chandra (CXO) has completely revolutionized our understanding of extragalactic low-mass X-ray binaries (LMXBs) and globular clusters (GCs); however, studies have been limited by short X-ray exposures and relatively small fields. NGC 4697 amd NGC 4365 are relatively simple elliptical galaxies in the X-ray that will have deep CXO observations. We propose ACS observations in six flanking fields per galaxy to provide a study of the GC-LMXB connection in normal early-type galaxies with unprecedented depth, spatial resolution and areal coverage. Combined with existing central field observations, we will detect ~900 and ~2700 GCs GCs in most of NGC 4697 and all of NGC 4365. These two galaxies will have the greatest number of detected GC-LMXBs to date (~70 & 120). We will measure the fraction of LMXBs found in GCs, and the fraction of GCs which contain LMXBs, as a function of X-ray luminosity, galactocentric distance, color, GC half-light radius, and local GC specific frequency. We will test existing models of GC formation/evolution and LMXB formation/evolution. Using the radial profile of optical light, GCs, and LMXBS, we will determine the percentage of field LMXBs which may have originated in GCs.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10583
Title: Resolving the LMC Microlensing Puzzle: Where Are the Lensing Objects ?
PI: Chris Stubbs
PI Institution: Harvard University

We are requesting 32 HST orbits to help ascertain the nature of the population that gives rise to the observed set of microlensing events towards the LMC. The SuperMACHO project is an ongoing ground-based survey on the CTIO 4m that has demonstrated the ability to detect LMC microlensing events in real-time via frame subtraction. The improvement in angular resolution and photometric accuracy available from HST will allow us to 1) confirm that the detected flux excursions arise from LMC source stars rather than extended objects (such as for background supernovae or AGN), and 2) obtain reliable baseline flux measurements for the objects in their unlensed state. The latter measurement is important to resolve degeneracies between the event timescale and baseline flux, which will yield a tighter constraint on the microlensing optical depth.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10584
Title: The link between X-ray source and stellar populations in M81
PI: Andreas Zezas
PI Institution: Smithsonian Institution Astrophysical Observatory

We propose to perform a deep v~26-27.0 HST-ACS survey of the nearby (3.6 Mpc) spiral galaxy M~81 in order to study the nature of its X-ray source populations detected with Chandra. For the first time in a galaxy other than the Milky-Way or the Magelanic Clouds, we will classify X-ray sources as High-Mass and Low-Mass X-ray binaries (HMXBs, LMXBs) and investigate how these populations depend on their galactic environment. The classification will be performed (a) by finding and classifying unique optical counterparts for the X-ray sources and (b) studying the stellar populations in their vicinity. Both

tasks require the <0.1'' resolution of HST-ACS which matches well the positional accuracy of Chandra. Finally we will use these results together with X-ray binary evolution synthesis models in order to constrain X-ray binary (XRB) evolution channels. These data will also be a great resource for studies of the star-formation and star-cluster populations in one of the prototypical spiral galaxies.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10585
Title: NGC 4449: a Testbed for Starbursts in the Low- and High-Redshift Universe
PI: Alessandra Aloisi
PI Institution: Space Telescope Science Institute - ESA

We propose deep ACS/WFC broad-band imaging in F435W, F555W, and F814W of the Magellanic irregular galaxy NGC 4449 in order to infer the properties of the resolved (young and old) stellar population, compare the current strong star-formation activity to that at earlier epochs, trace the major episodes of star formation over cosmic time, and relate them to the past history of interaction/merging of this galaxy. NGC 4449 is one of the closest (< 5 Mpc) global starbursts with a widespread star-formation activity that could have been triggered by interaction or accretion. It is, therefore, the perfect laboratory where to address issues related to star formation in extreme environments and investigate processes connected to the formation and evolution of galaxies in the early universe. At a distance of 4.2 Mpc, the stellar content in NGC 4449 can easily be resolved with HST. Yet, up to date no comprehensive dataset has been collected that is suited to infer a global star-formation history of the galaxy and to better understand its evolution. ACS/WFC provides the angular resolution and sensitivity to easily reach magnitude limits necessary for the detection of individual stars at the tip of the red giant branch (i.e., with ages from 1 Gyr up to 12 Gyr) with the required accuracy. A mosaic of 2 pointings along the major axis will give a good coverage of the galaxy and will allow us to infer a star-formation history unbiased by local properties of peculiar regions. Narrow-band imaging in F658N (Halpha) will provide a map of the ionized gas. Finally, WFPC2 parallel observations in F555W and F814W will allow to search deep in the HI halo of NGC 4449 for evidence of stars belonging to tidal streams. Our investigation of NGC 4449 will benefit from the wealth of observations already available over almost the whole electromagnetic spectrum and will be crucial in better understanding how starbursts can be influenced by merging phenonema in both the low- and high-redshift universe.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10586
Title: The Rosetta Stone without a Distance: Hunting for Cepheids in the "Primordial" Galaxy I Zw 18
PI: Alessandra Aloisi
PI Institution: Space Telescope Science Institute - ESA

The Blue Compact Dwarf galaxy I Zw 18 is one of the most intriguing objects in the Local Universe. It has the lowest nebular metallicity of all known galaxies (Z=1/32 solar). It has long been regarded as a possible example of a galaxy undergoing its first burst of star formation. However, its real

evolutionary state continues to be controversial. The WFPC2 and NICMOS detection of AGB stars by our group and others suggested the presence of an underlying older population. However, deeper ACS observations by Izotov & Thuan (2004) recently failed to detect the signature of RGB stars. This was interpreted as confirmation that I Zw 18 is in fact a galaxy "in formation", a local analog of primordial galaxies in the distant Universe. This result was widely reported in the international news media. However, an alternative possibility is that I Zw 18 is somewhat further away than previously believed, so that Red Giant Branch stars were too faint to detect. Quoted distances in the literature have ranged from 10 to 20 Mpc. We propose to resolve this controversy by direct determination of the distance to 1 Mpc accuracy using Cepheids. For this we request 12 visits of two orbits each, to execute at carefully planned intervals. We will obtain V and I band ACS/WFC photometry in each visit. The new data will be combined with archival data, but we show that the archival data by themselves are insufficient to achieve our science goals. The distance will allow us to place I Zw 18 into its proper place in the evolutionary sequence of galaxy formation. If this study is not undertaken before HST ceases operation, then the true nature of this most metal-poor galaxy known in the local Universe will continue to remain uncertain for at least another decade.

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Proposal Category: SNAP
Scientific Category: GALAXIES
ID: 10587
Title: Measuring the Mass Dependence of Early-Type Galaxy Structure
PI: Adam Bolton
PI Institution: Massachusetts Institute of Technology

We propose two-color ACS-WFC Snapshot observations of a sample of 118 candidate early-type gravitational lens galaxies. Our lens-candidate sample is selected to yield (in combination with earlier results) an approximately uniform final distribution of 40 early-type strong lenses across a wide range of masses, with velocity dispersions (a dynamical proxy for mass) ranging from 125 to 300 km/s. The proposed program will deliver the first significant sample of low-mass gravitational lenses. All of our candidates have known lens and source redshifts from Sloan Digital Sky Survey data, and all are bright enough to permit detailed photometric and stellar-dynamical observation. We will constrain the luminous and dark-matter mass profiles of confirmed lenses using lensed-image geometry and lens-galaxy structural/photometric measurements from HST imaging in combination with dynamical measurements from spatially resolved ground-based follow-up spectroscopy. Hence we will determine, in unprecedented detail, the dependence of early-type galaxy mass structure and mass-to-light ratio upon galaxy mass. These results will allow us to directly test theoretical predictions for halo concentration and star-formation efficiency as a function of mass and for the existence of a cuspy inner dark-matter component, and will illuminate the structural explanation behind the fundamental plane of early-type galaxies. The lens-candidate selection and confirmation strategy that we propose has been proven successful for high-mass galaxies by our Cycle 13 Snapshot program (10174). The program that we propose here will produce a complementary and unprecedented lens sample spanning a wide range of lens-galaxy masses.

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Proposal Category: SNAP

Scientific Category: AGN/QUASARS
ID: 10588
Title: The Host Galaxies of Post-Starburst Quasars
PI: Michael Brotherton
PI Institution: University of Wyoming

We propose to use ACS to conduct a snapshot imaging survey of post-starburst quasars now being discovered in signficant numbers by the Sloan Digital Sky Survey. Post-starburst quasars are broad-lined AGN that also possess Balmer jumps and high-n Balmer absorption lines indicative of luminous stellar populations on order of 100 Myr old. These objects, representing a few percent of the z < 0.5 quasar population, may be an evolutionary stage in the transition of ultraluminous infrared galaxies into normal quasars, or a type of galaxy interaction that triggers both star formation and nuclear activity. These sources may also illustrate how black hole mass/bulge mass correlations arise. Ground-based imaging of individual poststarburst quasars has revealed merger remnants, binary systems, and single point sources. Our ACS snapshots will enable us to determine morphologies and binary structure on sub-arcsecond scales (surely present in the sample and impossible to do without HST), as well as basic host galaxy properties. We will be looking for relationships among morphology, particularly separation of double nuclei, the starburst age, the quasar black hole mass and accretion rate, that will lead to an understanding of the triggering activity and mutual evolution. This project will bring quantitative data and statistics to the previously fuzzy and anecdotal topic of the "AGN-starburst connection" and help test the idea that post-starburst quasars are an early evolutionary stage of normal quasars.
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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 10589
Title: The highest redshift Einstein ring: probing a dark matter halo at z=1 and galaxy morphology at z=3.8
PI: Remi Cabanac
PI Institution: Canada-France-Hawaii Telescope Corporation

The occurence of nearly complete Einstein rings is very low, but their importance cannot be overstated : in comparison with configurations which have a few images, Einstein rings provide a full characterisation of the dark matter halo when combined with measures of the velocity dispersion gradient in the lens. The projected gravitational potential is vastly constrained by the polar information given by the shape of the ring at different position angles. Our discovery of the highest redshift Einstein ring so far, a configuration where the lens is an elliptical galaxy at z=0.986 and the source a post-starburst Lyman break galaxy at z=3.77, yields several intriguing results. The modelling of the ring, which streches some 260 degrees around the lens, points to a very slow evolution in the mass-to-light ratio, as indicated by its position with respect to the fundamental plane of nearby ellipticals. This is at odds with the results obtained by the few lenses existing at this redshift. The M/L ratio within the effective radius is consistent with the one produced by stellar populations, indicating that the dark matter is not dominant at this radius. To fully characterise the dark matter halo of this unique elliptical at a look-back time of 50% of the current age of the universe, we require both a measure of the gradient in velocity dispersion and a high-resolution image of the ring. The former will be measured by our forthcoming VLT medium-resolution spectroscopy, while the later can only be provided by the ACS onboard HST. The presence of a counter-image which is radially

elongated, combined with the shape of the main ring will lead to the first reconstructed projected potential of an isolated dark halo at z=1, with unprecedented accuracy. In addition, the exquisite image quality provided by the ACS will allow us to reconstruct the imaged source, providing the first ever high-resolution morphology of a Lyman-break galaxy at z=3.77.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10590
Title: Star-Formation History of an Unmerged Fragment: the Leo A Dwarf Galaxy
PI: Andrew Cole
PI Institution: Kapteyn Astronomical Institute

The Leo A dwarf irregular is the only known Local Group galaxy that on the weight of current evidence has been suggested to have experienced its first star formation within the past 2-3 billion years. As a galaxy that could have been almost purely gaseous during the epoch of giant galaxy assembly, Leo A is the best nearby candidate to be a redshift zero analogue to the major building blocks of the Milky Way. We propose to obtain deep optical images of Leo A with the ACS/WFC to achieve three main goals: 1) To establish the fractions of star-formation, by mass, that occurred prior and subsequent to the main epoch of hierarchical merging (redshift z ~ 2-4, Age ~ 10-12.5 Gigayears); 2) to measure the time variation in Leo A's star-formation rate over the past 10 Gyr, based on statistical analyses of its (V-I, I) color-magnitude diagram; and 3) to measure the radial distributions of young and old stellar populations and quantify the degree to which the optically prominent, young population is embedded in an extended, low-surface brightness sheet or halo of ancient stars. Because of the distance modulus (24.5 mag) and high degree of stellar crowding at the level of the oldest main-sequence turnoffs, the observations necessary to achieve these goals are unobtainable except with HST. The ONLY way to reliably derive the star-formation history of Leo A over its entire lifetime is with photometry to magnitudes of (B,I) = (28.6, 27.9), the level of the oldest main-sequence turnoff in Leo A. These data would confirm and extend the limited inferences obtained from WFPC2 photometry over 2 magnitudes less deep, and provide the first opportunity to measure the complete star-formation history of a potential "living fossil" analogue to the building blocks of the Milky Way. We propose to use WFPC2 in parallel to measure radial variations in the stellar populations between the galaxy's core and outskirts. Because the expected 2-gyro jitter ellipse is comparable to the pixel scale of ACS/WFC, we rely on point-spread function fitting photometry, and we require no special scheduling constraints, our proposed program would be virtually unaffected by entry into 2-gyro mode.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10591
Title: ACS Observations of the Galaxies in A Giant Ly-alpha Nebula at z~2.7
PI: Arjun Dey
PI Institution: National Optical Astronomy Observatories, AURA

Giant Ly-alpha nebulae appear to be sites of ongoing massive galaxy formation, as evidenced by their association with very luminous, young, star-forming galaxies and large galaxy overdensities. However the origin of the extended

gas and the source of ionization remain mysterious. We have discovered a ~200 kpc size nebula which appears to contain a number of embedded sources, including a very obscured, luminous mid-infrared source and a Lyman break galaxy. We propose to obtain deep ACS and NICMOS images of this nebula in order to: (i) determine the spatial morphology of the Ly-alpha emission on sub-kpc scales; (ii) precisely locate the known continuum sources within the nebula; (ii) determine their morphologies; (iii) detect the source of ionizing photons at the very center of the nebula; (iv) constrain the ionizing luminosity contributed by a possible distributed population of faint, compact continuum sources in the nebula; and (v) by SED fitting of population synthesis models, constrain the ages of the ionizing sources with the aim of determining the timescale of the galaxy formation process in the nebula.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10592
Title: An ACS Survey of a Complete Sample of Luminous Infrared Galaxies in the Local Universe
PI: Aaron Evans
PI Institution: State University of New York at Stony Brook

At luminosities above 10^11.4 L_sun, the space density of far-infrared selected galaxies exceeds that of optically selected galaxies. These `luminous infrared galaxies' (LIRGs) are primarily interacting or merging disk galaxies undergoing enhanced star formation and Active Galactic Nuclei (AGN) activity, possibly triggered as the objects transform into massive S0 and elliptical merger remnants. We propose ACS/WFC imaging of a complete sample of 88 L_IR > 10^11.4 L_sun luminous infrared galaxies in the IRAS Revised Bright Galaxy Sample (RBGS: i.e., 60 micron flux density > 5.24 Jy). This sample is ideal not only in its completeness and sample size, but also in the proximity and brightness of the galaxies. The superb sensitivity, resolution, and field of view of ACS/WFC on HST enables a unique opportunity to study the detailed structure of galaxies that sample all stages of the merger process. Imaging will be done with the F439W and F814W filters (B and I-band) to examine as a function of both luminosity and merger state (i) the evidence at optical wavelengths of star formation and AGN activity and the manner in which instabilities (bars and bridges) in the galaxies may funnel material to these active regions, (ii) the relationship between star formation and AGN activity, and (iii) the structural properties (AGN, bulge, and disk components) and fundamental parameters (effective radius and surface brightness) of LIRGs and their similarity with putative evolutionary byproducts (elliptical, S0 and classical AGN host galaxies). This HST survey will also bridge the wavelength gap between a Spitzer imaging survey (covering seven bands in the 3.6-160 micron range) and a GALEX UV imaging survey of these galaxies, but will resolve complexes of star clusters and multiple nuclei at resolutions well beyond the capabilities of either Spitzer or GALEX. The combined datasets will result in the most comprehensive multiwavelength study of interacting and merging galaxies to date.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10593
Title: The Dynamical Mass of the Bright Cepheid Polaris
PI: Nancy Evans
PI Institution: Smithsonian Institution Astrophysical Observatory

Cepheid variables are of central importance in Galactic and extragalactic astronomy. They are the primary standard candles for measuring extragalactic distances, and they provide critical tests of stellar-evolution theory. Surprisingly, however, there is not a single Cepheid with a purely dynamical measurement of its mass. Polaris (alpha UMi) is the nearest and brightest of all Cepheids. It offers the unique opportunity to measure the dynamical mass of a Cepheid, because it is in a binary system for which a single-lined spectroscopic orbit is already available. We show that the binary should be easily resolved in the UV using ACS/HRC, thus providing the first direct detection of the companion. In the present proposal we request one HST orbit in order to make this detection and measure the separation. We show that this initial detection, combined with the HST/FGS parallax (see below), will provide a mass accurate to 0.9 Msun. Only HST's combination of high spatial resolution and UV sensitivity can achieve this result. We plan to continue the program in future cycles, leading to rapid refinement of the dynamical mass measurement of the Cepheid. The parallax is a key ingredient in the mass determination. In an ongoing multi-year program (GO-9888, GO-10113), we are using the FGS to improve significantly upon the Hipparcos parallax of Polaris. The ACS imaging proposed here will thus provide extremely valuable astrophysical information from a very modest additional investment of observing time.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10594
Title: The Formation of Spiral Spheroids and Their Globular Cluster Systems
PI: Paul Goudfrooij
PI Institution: Space Telescope Science Institute

The assembly history of spiral galaxies remains one of the most pressing questions in astrophysics today. In particular, we do not have a clear picture of the formation mechanism for bulges of spiral galaxies. Are bulges of spirals simply "small ellipticals", formed via rapid dissipative collapse during the early universe? Or is bulge building through secular evolution of inner disk stars a more common mechanism? Is there any dependence on bulge mass? A powerful yet relatively simple way to probe these fundamental questions is by studying the properties of globular cluster (GC) systems of spirals. Specifically, bulge formation via secular evolution is expected not to form GCs, whereas bulge formation via dissipative collapse is. We therefore propose to obtain ACS/WFC imaging as well as ground-based, wide-field imaging of five edge-on Sa spirals which cover a factor ~15 in luminosity/mass, and for which spectroscopic follow-up is feasible. This constitutes the first luminosity-selected sample of early-type spirals, which will allow us to directly probe the dependence of GC properties on the bulge luminosity. We will detect a minimum of ~100-200 GCs per galaxy in the ACS images, sufficient to reveal GC subpopulations, their relative numbers, sizes, and radial distributions. This study will more than double the number of well-studied early-type spiral systems, and will allow --for the first time-- a meaningful comparison of their GC systems with those of E and S0 galaxies which have been extensively studied with HST.

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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS

ID: 10595
Title: A Reference Database for Accurate Ages and Metallicities of Globular Clusters in the Magellanic Clouds
PI: Paul Goudfrooij
PI Institution: Space Telescope Science Institute

We propose to finalize the compilation of a comprehensive database of high-quality ages and metallicities of Simple Stellar Populations (SSPs) in the Milky Way and the Magellanic Clouds. We will acquire new ACS imagery for 8 young and intermediate-age globular clusters in the Magellanic Clouds to create high-quality color-magnitude diagrams (CMDs) to enable accurate measurements of their ages and metallicities. In concert with a similar analysis of CMD data already available in the HST archive for 8 more such GCs, the resulting database will provide a well-sampled coverage of the full range of ages and metallicities known among globular clusters (0.5 <= Age (Gyr) <= 13.5 and -2.3 <= [Fe/H] <= +0.1, respectively). This database will form the crucial basis for our ongoing, comprehensive multi-wavelength program to: (1) establish empirical relations among SSP colors (from the UV [GALEX] through the mid-IR [Spitzer]), line strengths, ages and metallicities, and (2) provide a stringent test of the systemic accuracy of age and metallicity determinations using state-of-the-art population synthesis models.
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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10596
Title: AGNs with Intermediate-mass Black Holes: A Test of the Black Hole-Bulge Paradigm
PI: Luis Ho
PI Institution: Carnegie Institution of Washington

The recent progress in the study of central black holes in galactic nuclei has led to a general consensus that supermassive (10^6-10^9 solar mass) black holes are closely connected with the formation and evolutionary history of large galaxies, especially their bulge component. Two outstanding issues, however, remain unresolved. Can central black holes form in the absence of a bulge? And does the mass function of central black holes extend below 10^6 solar masses? Intermediate-mass black holes (10^4-10^6 solar masses), if they exist, may offer important clues to the nature of the seeds of supermassive black holes. In a first systematic search using the Sloan Digital Sky Survey, we have recently discovered 19 Type 1 AGNs with candidate intermediate-mass black holes that reside in low-luminosity, presumably late-type host galaxies. Follow-up observations with Keck indicate that these objects obey the low-mass extension of the well-known correlation between black hole mass and bulge stellar velocity dispersion. However, very little is known about the host galaxies themselves, including the crucial question of whether they have bulges or not. We propose to obtain ACS/WFC images of this unique sample of AGNs in order to investigate the detailed structural properties of the host galaxies. We are particularly keen to determine whether the hosts contain bulges, and if so, where they lie on the fundamental plane of spheroids compared to the bulges of supermassive black holes. We will also be able to measure an accurate optical luminosity for the AGN, which is an essential ingredient to improve the current mass estimates.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS

ID: 10597
Title: Resolving the Connection Between Globular Clusters and Low-Mass X-ray Binaries
PI: Andres Jordan
PI Institution: European Southern Observatory - Germany

Because of their high central densities, globular clusters (GCs) are efficient producers of low-mass X-ray binaries (LMXBs). To shed light on the detailed formation mechanism of LXMBs in GCs, we propose to measure accurate structural parameters for hundreds of GCs in NGC 5128: the only giant elliptical galaxy within 5 Mpc of the Milky Way. We will carry out the first complete survey of GCs in the inner region of NGC 5128, measure GC structural parameters of unprecedented acccuracy, and derive GC luminosity profiles in the cluster cores. These measurement will allow us to determine precisely which GC structural properties control the presence of an X-ray source and thus probe the details of the LXMB formation process in GCs. We will additionally use the measured structural parameters to perform the most comprehensive study of the fundamental plane of GCs in early-type galaxies, a fundamental set of correlations which holds key information on GC formation and evolution.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10598
Title: ACS Imaging of Fomalhaut: A Rosetta Stone for Debris Disks Sculpted by Planets
PI: Paul Kalas
PI Institution: University of California - Berkeley

The Sun and roughly 15% of stars are surrounded by dust disks collisionally replenished by asteroids and comets. Disk structure can be directly tied to the dynamical influence of more massive bodies such as planets. For example, planetary perturbations offset the center of our zodiacal dust disk ~0.01 AU away from the Sun and also maintain a ~40 AU radius inner edge to our Kuiper Belt. Here we propose follow-up observation to the first optical detection of reflected light from dust grains surrounding the nearby star Fomalhaut using HST/ACS. We find a belt of material between 133 and 158 AU radius that has a center position offset ~15 AU from the stellar position, and with a sharp inner edge. A tenuous dust component interior to the belt is also detected in the southeast. Given Fomalhaut's proximity to the Sun (7.7 pc), these images represent the closest and highest angular resolution view of an extrasolar analog to our Kuiper Belt. The center of symmetry offset and the sharp inner edge of Fomalhaut's belt are evidence for planet-mass objects orbiting the star as predicted by dynamical theory and simulations. We propose comprehensive follow-up ACS imaging to fully exploit this discovery and map the disk around its entire circumference with higher signal-to-noise and at multiple wavelengths. HST/ACS is certainly the only facility capable of performing this relatively wide field optical study at high contrast ratios and diffraction-limited resolution. The Cycle 14 data will provide key measurements of belt width as a function of azimuth, the scattered light color of the belt versus the inner dust component, and the azimuthal structure of the belt. These data will be used to constrain dynamical models of resonances and shepherding that ultimately elucidate the dynamical properties of planet-mass objects in the system.
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Proposal Category: GO

Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10599
Title: Multi-color imaging of two 1 Gyr old debris disks within 20 pc of the Sun: Astrophysical mirrors of our Kuiper Belt
PI: Paul Kalas
PI Institution: University of California - Berkeley

We report the first scattered light detections of two debris disk around an F star and a K star using optical coronagraphy and the Hubble Space Telescope. With ages ~1 Gyr, these are the oldest debris disks thus far seen in the optical. We propose deep, multi-roll angle coronagraphic imaging with HST ACS and NICMOS to confirm and characterize the disks in terms of structure and composition. The disks appear to have belt-like morphology that is consistent with the existence of planetary companions or other perturbing bodies. Since these disks are close to our Kuiper Belt in an evolutionary context, detailed understanding of their mass, structure and composition will provide a fresh perspective for inferring the history and properties of our own trans-Neptunian region.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10600
Title: Studying the spectum of PSR B0656+14
PI: Oleg Kargaltsev
PI Institution: The Pennsylvania State University

PSR B0656+14 is the brightest intermediate-age pulsar which has been extensively studied in X-rays and optical with different instruments. The wide-band photometry of PSR B0656+14 strongly suggests the presence of spectral features between 4000 and 11,000 A. The sensitivity and resolution of ACS/WFC opens an opportunity to study the pulsar spectrum with a higher resolution and a better S/N than it was previously possible. This will allow us to accurately measure the pulsar spectrum, confirm the spectral features and investigate their shape and strength.

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Proposal Category: SNAP
Scientific Category: HOT STARS
ID: 10601
Title: The high proper motion of PSR B0540-69.3
PI: Peter Lundqvist
PI Institution: Stockholm University

We wish to pin down the proper motion of the Crab-like pulsar PSR B0540-69.3. HST/WFPC2 archival data have an epoch separation by 4 years which we have already used to obtain a very high transverse velocity, 1190 +/- 560 km/s. The indicated direction of the proper motion is consistent with it being along the southern jet of the pulsar wind nebula. The high velocity could be linked to the high asymmetry of the supernova ejecta, which suggests a highly asymmetric supernova explosion. We need a third epoch of HST imaging to test our present 2-sigma limit. With the suggested SNAPSHOT observation we will obtain a 1-sigma limit on the transverse motion better than 200 km/s. PSR B0540-69.3 could be the third young pulsar connected to a supernova remnant for which a proper motion is established. The other two are the Crab and Vela pulsars. Both these pulsars have their proper motions aligned with the jet axis of

their pulsar wind nebulae. PSR B0540-69.3 could thus be the third object (of three) to reveal that it shares this property. This would provide vital information to supernova explosion and pulsar kick models. PSR B0540-69.3 would undoubtedly also be the most distant pulsar ever for which a proper motion is established. The proposed SNAPSHOT program is flexible as it can be done either with WFPC2 or ACS/WFC. It also requires a maximum of only 26 minutes, which makes it suitable for the SNAPSHOT mode.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10602
Title: A Complete Multiplicity Survey of Galactic O2/O3/O3.5 Stars with ACS
PI: Jesus Maiz-Apellaniz
PI Institution: Space Telescope Science Institute - ESA

Massive stars are preferentially formed in compact multiple systems and clusters and many of them remain spatially unresolved to date, even in our Galaxy. This has hindered the determination of the stellar upper mass limit. The lack of an accurate knowledge of the multiplicity of massive stars can also introduce biases in the calculation of the IMF at its high-mass end. We have recently used ACS/HRC to resolve HD 93129 A, the earliest O-type star known in the Galaxy, into a 55 mas binary. We propose here to extend that work into a complete multi-filter ACS imaging survey of all (20) known O2/O3/O3.5 Galactic stars to characterize the multiplicity of the most massive stars. The data will be combined with existing FGS observations to explore as large a parameter range as possible and to check for consistency. We will also derive the IMF of each system using a crowded-field photometry package and processing the data with CHORIZOS, a code that can derive stellar temperatures, extinctions, and extinction laws from multicolor photometry.
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Proposal Category: GO
Scientific Category: STAR FORMATION
ID: 10603
Title: Multiwavelength Imaging of Edge-on Protoplanetary Disks: Quantifying the Growth of Circumstellar Dust
PI: Deborah Padgett
PI Institution: Jet Propulsion Laboratory

Young, edge-on circumstellar disks are uniquely valuable laboratories for the study of planet formation. In these objects, the central star is occulted from direct view, significant PSF artifacts are absent, and the disk is clearly seen as a central dust lane flanked by faint disk reflected light. The detailed morphology of these nebulae and its variation with wavelength provide crucial information on the disk internal structure and the properties of its constituent dust grains. A key observable is the slope defining the wavelength dependence of the dust scattering opacity, which becomes shallower when grain growth has taken place; multiwavelength resolved disk images are the key dataset enabling such measurements. Recent analyses of three different edge-on disks have revealed a diversity in their dust properties that is indicative of different degrees of dust grain evolution having taken place in each system. This characterization of disk grain growth, when applied comparatively to a larger sample of these objects, would enable the construction of an evolutionary sequence of young disks at successive stages on the road to planet formation. In pursuit of this goal, we have identified

a sample of 15 edge-on disks previously discovered by HST or groundbased telescopes, but for which high fidelity, high spatial resolution images do not yet exist in both the optical and near-infrared. We propose broad-band multicolor imaging with NICMOS of all these targets, and ACS imaging of nine of these targets In combination with existing data, the proposed images will form a complete database of high resolution optical/near-IR images for these 15 disk systems. Scattered light modeling will be used to derive the disk structure and dust properties, yielding results that will be of fundamental importance for our understanding of grain properties during protoplanetary disk evolution.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10604
Title: The Formation History of the M81 Spheroid
PI: Ata Sarajedini
PI Institution: University of Florida

Spheroidal stellar populations (elliptical galaxies, bulges, and halos) contain a significant fraction of all stars and metals in the local universe. The mechanisms responsible for their formation are ultimately the ones which governed galaxy formation during early epochs. To begin understanding the M81 spheroid, we are currently studying the globular cluster population using HST/WFPC2 multiband imaging and ground based optical spectroscopy. To complete this effort, we propose to use ACS/WFC to obtain deep (I, V-I) color magnitude diagrams (to the horizontal branch) of two fields in M81 - one dominated by thick disk stars and the other halo stars. These observations will provide tight constraints on the formation timescales and chemical enrichment history of the field star population. Combined with results on the globular clusters, we will reconstruct the early formation history of M81, and compare with those found for other nearby, massive galaxies. Because M81 is the earliest type spiral galaxy (Sab) available for such a detailed study, it provides a unique opportunity to probe the connection between elliptical halos and lower mass spiral spheroids.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10605
Title: Quantifying Star Formation and Feedback: The M81 Group Dwarf Galaxies
PI: Evan Skillman
PI Institution: University of Minnesota - Twin Cities

Studies of the impact of star formation via stellar winds and supernovae ('feedback') on the properties of a galaxy are of fundamental importance to understanding galaxy evolution. One crucial aspect in these studies is a precise census of the recent star formation in a galaxy. The aim of this proposal is to obtain spatially resolved star formation histories with a time resolution of roughly 30 Myr over the last 500 Myr in a carefully designed sample using the absolutely unique capabilities of the ACS. Our sample comprises 10 galaxies in the M81 group which is host to a wide diversity of dwarf star forming galaxies. They span ranges of 6 magnitudes in luminosity, 1000 in current star formation rate, and 0.5 dex in metallicity. The ACS observations will allow us to directly observe the strength and spatial relationships of all of the star formation in these galaxies in the last 500

Myr. We can then quantify the star formation and measure (1) the fraction of star formation that is triggered by feedback, (2) the fraction of star formation that occurs in clusters and associations, and (3) to what degree future star formation is governed by the feedback from previous star formation. The ACS observations will be complemented with high-quality ancillary data collected by our team for all galaxies (e.g., Spitzer, UV/optical/NIR, VLA HI). We will calculate the energy created by star formation events and compare it to the estimated energy deposited into the local ISM. This will enable us to construct prescriptions of how star formation and feedback depend on metallicity, size, gas content, and current star formation rates in galaxies. Our resolved star formation maps will be compared with star formation rates inferred from H-alpha, UV, and IR observations - allowing an independent calibration of these techniques. Recent ACS imaging by us of one galaxy in the same group clearly demonstrates the feasibility of the proposed program. Most of the sample galaxies are located in the CVZ, making this an extremely efficient program.
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Proposal Category: SNAP
Scientific Category: AGN/QUASARS
ID: 10606
Title: Ultraviolet Snapshots of 3CR Radio Galaxies
PI: William Sparks
PI Institution: Space Telescope Science Institute

Radio galaxies are an important class of extragalactic objects: they are one of the most energetic astrophysical phenomena and they provide an exceptional probe of the evolving Universe, lying typically in high density regions but well-represented across a wide redshift range. In earlier Cycles we carried out extensive HST observations of the 3CR sources in order to acquire a complete and quantitative inventory of the structure, contents and evolution of these important objects. Amongst the results, we discovered new optical jets, dust lanes, face-on disks with optical jets, and revealed point-like nuclei whose properties support FR-I/BL Lac unified schemes. Here, we propose to obtain ACS NUV images of 3CR sources with $z<0.3$ as a major enhancement to an already superb dataset. We aim to reveal dust in galaxies, regions of star and star cluster formation frequently associated with dust and establish the physical characteristics of the dust itself. We will measure frequency and spectral energy distributions of point-like nuclei, seek spectral turnovers in known synchrotron jets and find new jets. We will strongly test unified AGN schemes and merge these data with existing X-ray to radio observations for significant numbers of both FR-I and FR-II sources. The resulting database will be an incredibly valuable resource to the astronomical community for years to come.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10607
Title: Probing Circumstellar and Interstellar Dust with Scattered-Light Echoes
PI: Ben Sugerman
PI Institution: Space Telescope Science Institute

Scattered-light echoes are one of the most powerful and efficient probes of the structure and composition of dust in circumstellar and interstellar (ISM) environments. Observations of light echoes provide exact three-dimensional

positions of dust while constraining its density, grain-size and chemical make-up. Furthermore, echoes can be used as distance indicators via polarization measurements. We propose to take deep, high-resolution ACS/HRC images of five supernovae (SNe). Two of these, SNe 1991T and 1998bu, have known circumstellar echoes that have only recently become fully resolvable with HST, and therefore require new observations. Only four echo-producing SNe are currently known, and in an attempt to increase this sample, we will also observe SNe 1999bw, 2002hh, and 2004dj. All three SNe are strong candidates for producing echoes from circumstellar and ISM dust, but only at angular sizes that HST can resolve. With these observations, we will use light echoes to their full advantage, to study (1) the mass-loss histories of Type II and Ia SN progenitors, (2) the contributions of these SNe and their progenitors to the dust content of their galaxies, (3) the structure of gas and stars in the ISM of external galaxies, and (4) we will independently measure the distance to the host galaxies, including a member of the Virgo cluster, and M96, a Type Ia cosmological distance-scale calibrator.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10608
Title: Probing the star formation law in the extreme outer limits of M83, a prototypical XUV-disk galaxy
PI: David Thilker
PI Institution: The Johns Hopkins University

The Galaxy Evolution Explorer (GALEX) has discovered a new sub-class of spiral galaxy, which we refer to as extended UV-disk (XUV-disk) galaxies. They are distinguished by conspicuous UV-bright star clusters located at galactocentric radii extending to many times the optical (R25) extent, and appear to represent a population of spiral galaxies still actively building, or augmenting, their stellar disk. However, XUV-disks pose a mystery in the form of a relative lack of HII regions (traced by H-alpha emission) associated with outer disk, UV-bright stellar clusters. M83 is an XUV-disk prototype and the focus of this proposal. It has an H-alpha surface brightness profile characterized by a steep decline at the radius beyond which the gaseous disk is thought to become dynamically stable (against collapse and ensuing star formation), but GALEX UV profiles show no "edge" at this location. Our HST study of M83 aims to resolve this puzzling discrepancy, confirmed in several XUV-disks, by searching for Lyman-continuum producing O stars that are either absent or present without nebulosity. HST provides the only means of resolving individual massive stars in the FUV band at M83's distance. Without HST, we lose the critical ability to photometrically classify O and B stars. Our multiwavelength observations will also constrain the history of star formation in the outer disk over Gyr timescales by characterizing the evolved stellar population, both using resolved giants and color analysis of the diffuse background.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10609
Title: Sizes, Shapes, and SEDs: Searching for Mass Segregation in the Super Star Clusters of Nearby Starburst Galaxies
PI: William Vacca
PI Institution: Universities Space Research Association

We propose to investigate mass segregation and star cluster evolution and dissolution processes in Super Star Cluster (SSC) populations in a small sample of nearby starburst galaxies. ACS/HRC and NICMOS images of these nearby (d < 10 Mpc) starbursts can reveal evidence for mass segregation in the form of variations in size, shape, and color of the SSCs as a function of wavelength. The compactness of the cluster light profiles, and hence the stellar mass distributions, is a critical indicator of the likely fate of an SSC: long life and eventual evolution into a globular-like cluster, or dissolution. These observations will allow us to generate spectral energy distributions (SEDs) for a large sample of the SSCs at all ages and extinctions in each system. We will combine the SEDs with population synthesis models and existing ground-based spectra and Spitzer images to estimate ages, reddenings, and masses thus derive a more complete picture of the star-formation histories of the galaxies. For the brightest and most likely virialized among the SSCs we will also constrain their initial mass functions (IMFs) using high-resolution spectroscopy. Conclusions about IMFs from this technique require detailed information about the SSC concentration, light profiles, and virial status, which are only possible via ACS data. The proposed observations will provide an extensive and comprehensive data set for a large number of SSCs. By addressing the issues of mass segregation, evaporation, and destruction of SSC populations, the proposed observations will provide strong constraints on theories regarding the processes involved in the formation and evolution of SSCs and globular clusters. Given the dire predictions for the lifetime of HST, and its tremendous impact on the study of SSCs, we feel that the proposed observations not only are necessary and timely (even urgent) but will also be a fitting (and possibly final) addition to HST's legacy in the study of starburst SSCs.

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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10610
Title: Astrometric Masses of Extrasolar Planets and Brown Dwarfs
PI: George Benedict
PI Institution: University of Texas at Austin

We propose observations with HST/FGS to estimate the astrometric elements (perturbation orbit semi-major axis and inclination) of extra-solar planets orbiting six stars. These companions were originally detected by radial velocity techniques. We have demonstrated that FGS astrometry of even a short segment of reflex motion, when combined with extensive radial velocity information, can yield useful inclination information (McArthur et al. 2004), allowing us to determine companion masses. Extrasolar planet masses assist in two ongoing research frontiers. First, they provide useful boundary conditions for models of planetary formation and evolution of planetary systems. Second, knowing that a star in fact has a plantary mass companion, increases the value of that system to future extrasolar planet observation missions such as SIM PlanetQuest, TPF, and GAIA.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10611
Title: Precise Distances to Nearby Planetary Nebulae - Finishing Up in Cycle 14
PI: George Benedict
PI Institution: University of Texas at Austin

This project was granted 20 orbits in Cycle 13. The STScI insists that we again present to the Cycle 14 TAC, to obtain the remaining 15 orbits required to finish this project that originally totaled 35 orbits. Exploration with the Two-Gyro Mode scheduling tools indicate that we can successfully finish this program, even under two-gyro pointing control. We propose to carry out astrometry with the FGS to obtain accurate and precise distances to four nearby planetary nebulae. In 1992, Cahn et al. noted that ``The distances to Galactic planetary nebulae remain a serious, if not THE most serious, problem in the field, despite decades of study.'' Twelve years later, the same statement still applies. Because the distances to planetary nebulae are so uncertain, our understanding of their masses, luminosities, scale height, birth rate, and evolutionary state is severely limited. To help remedy this problem, HST astrometry can guarantee parallaxes with twice the precision of any other available approach. These data, when combined with parallax measurements from the USNO, will improve distance measurements by more than a factor of two, producing more accurate distances with uncertainties that are of the order of ~6%. Lastly, most planetary nebula distance scales in the literature are statistical. They require several anchor points of known distance in order to calibrate their zero point. Our program will provide "gold standard" anchor points by the end of 2006, a decade before any anticipated results from future space astrometry missions.
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Proposal Category: SNAP
Scientific Category: HOT STARS
ID: 10612
Title: Binary Stars in Cyg OB2: Relics of Massive Star Formation in a Super-Star Cluster
PI: Douglas Gies
PI Institution: Georgia State University Research Foundation

We propose to make a high angular resolution SNAP survey of the massive stars in the nearby, super-star cluster Cyg OB2. We will use FGS1r TRANS mode observations to search for astrometric companions in the separation range of 0.01 to 1.00 arcsec and in the magnitude difference range smaller than 4 magnitudes. The observations will test the idea that the formation of very massive stars involves mergers and the presence of nearby companions. Discovery of companions to massive stars in this relatively nearby complex will provide guidance in the interpretation of apparently supermassive stars in distant locations. The search for companions will also be important for verification of fundamental parameters derived from spectroscopy, adjustments to main sequence fitting and distance estimations, determining third light contributions of eclipsing binaries, identifying wide colliding wind binaries, studying the relationship between orbital and spin angular momentum, and discovering binaries amenable to future mass determinations. The massive star environment in Cyg OB2 may be similar to the kinds found in the earliest epoch of star formation, so that a study of the role of binaries in Cyg OB2 will help us understand the formation processes of the first stars in the Universe.
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Proposal Category: GO
Scientific Category: COOL STARS
ID: 10613
Title: Calibrating the Mass-Luminosity Relation at the End of the Main Sequence
PI: Todd Henry

PI Institution: Georgia State University Research Foundation

We propose to use HST-FGS1R to calibrate the mass-luminosity relation for stars less massive than 0.2 Msun, with special emphasis on objects near the stellar/brown dwarf border. Our goals are to determine Mv values to 0.05 magnitude and masses to 5%, and thereby build the fundamental database of stellar masses that we will use to test theoretical models as never before. This program uses the combination of HST-FGS3/FGS1R at optical wavelengths, historical infrared speckle data, ground-based parallax work, and radial velocity monitoring to examine nearby, subarcsecond binary systems. The high precision separation and position angle measurements with HST-FGS3/FGS1R (to 1 mas in the separations) for these faint targets (V = 10-15) simply cannot be equaled by any other ground-based technique. As a result of these measurements, we are deriving high quality luminosities and masses for the components in the observed systems, and characterizing their spectral energy distributions from 0.5 to 2.2 microns. One of the objects, GJ 1245 C with mass 0.066 +/- 0.002 Msun, is the only object known with an accurate dynamical mass less than 0.10 Msun. The payoff of this proposal is high because all 9 of the systems selected have already been resolved during Cycles 5-12 with HST-FGS3/FGS1R and contain most of the reddest objects for which dynamical masses can be determined.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10614
Title: Internal Structure and Figures of Binary Asteroids
PI: Daniel Hestroffer
PI Institution: Observatoire de Paris

The goal of this proposal is to obtain very important information on the internal structure of a number of asteroids, and insight on the gravitational reaccumulation-process after a catastrophic disruptive collision. High resolutions observations with the HST/FGS interferometer are proposed to obtain high precision data for the topographic shape and size of a number of selected asteroids. Here we focus on objects with satellites, hence with known masses, so that the bulk density and porosity will be derived in the most accurate manner. This will yield plausible estimates on the internal properties of the objects, test wether they are close or not to figures of equilibrium (in terms of shape and adimensional rotational frequency), and provide estimates of their relative density. The HST/FGS in interferometric mode is an ideal facility to carry out this program.

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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10615
Title: Timing Studies of the X-ray Binary Populations in Globular Clusters
PI: Scott Anderson
PI Institution: University of Washington

Close binaries are fundamental to the dynamical stability and evolution of globular clusters, but large populations have been extremely difficult to identify. Chandra X-ray images provide a revolutionary resource, revealing a few to dozens of low-luminosity X-ray sources in every cluster deeply examined; our own Chandra programs uniformly study these ubiquitous X-ray

sources (close binaries and their progeny) in a dozen clusters. We have obtained multicolor, single-epoch, ACS images, from which to obtain initial optical counterparts, especially CVs (the dominant population in most clusters), BY Dra's, and qLMXBs. As HST capability for follow-on, confirming, spectra of our multicolor-selected counterparts is now severely curtailed, we propose an ACS time-series imaging program that will yield equivalent follow-on information for 5 of our clusters. The proposed ACS time-series data with 6 min resolution and 8 hr time-span, will: provide variability information to secure our suggested multicolor identifications; allow secure classifications of the various X-ray subpopulations (e.g., CVs vs. BY Dra's); yield quality lightcurves, whose shape will help test the notion that magnetic CVs are more common in globular clusters than the field; and, provide interesting contraints on the period distributions of cluster X-ray binaries.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10616
Title: Gotcha
PI: Using Swift GRBs to Pinpoint the Highest Redshift Galaxies Edo
PI Institution: Berger

Carnegie Institution of Washington

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Proposal Category: GO
Scientific Category: AGN/QUASARS
ID: 10617
Title: HST / Chandra Monitoring of a Dramatic Flare in the M87 Jet
PI: John Biretta
PI Institution: Space Telescope Science Institute

As the nearest galaxy with an optical jet, M87 affords an unparalleled opportunity to study extragalactic jet phenomena at the highest resolution. During 2002, HST and Chandra monitoring of the M87 jet detected a dramatic flare in knot HST-1 located ~1" from the nucleus. As of late 2004 its brightness has increased fifty-fold in the optical band, and continues to increase sharply; the X-rays show a similarly dramatic outburst. In both bands HST-1 now greatly exceeds the nucleus in brightness. To our knowledge this is the first incidence of an optical or X-ray outburst from a jet region which is spatially distinct from the core source -- this presents an unprecedented opportunity to study the processes responsible for non-thermal variability and the X-ray emission. We propose seven epochs of HST/STIS monitoring during Cycle 14, as well as seven epochs of Chandra/ACIS observation (5ksec each). We also include a brief HRC/ACS observations that will be used to gather spectral information and map the magnetic field structure. The results of this investigation are of key importance not only for understanding the nature of the X-ray emission of the M87 jet, but also for understanding flares in blazar jets, which are highly variable, but where we have never before been able to resolve the flaring region in the optical or X-rays. These observations will allow us to test synchrotron emission models for the X-ray outburst, constrain particle acceleration and loss timescales, and study the jet dynamics associated with this flaring component.

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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10618
Title: The Light Echoes around V838 Monocerotis: MHD in 3 Dimensions, Circumstellar Mapping, and Dust Physics
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 ever seen. The light echoes, which were imaged by us with HST during 2002, provide the means to accomplish four 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; and (4) Determine the distance to V838 Mon through two independent direct geometric techniques (polarimetry and angular expansion rates). 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 a campaign during Cycle 14 of imaging the echoes every 8 days for a total of 6 epochs, in order to fully map a thin slab through the dust shell and achieve the other goals listed above.
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Proposal Category: GO
Scientific Category: HOT STARS
ID: 10619
Title: Dynamical Masses and Third Bodies in the Sirius System
PI: Howard Bond
PI Institution: Space Telescope Science Institute

Sirius B is the nearest and brightest of all white dwarfs (WDs), but it is fiendishly difficult to observe from the ground because of the overwhelming brightness of Sirius A. We propose a continuation of our program of imaging observations of the Sirius system with WFPC2, which has been underway since 2001. The resulting astrometric data will not only greatly improve the precision of the binary orbit and the dynamical mass measurements for both the main-sequence and WD components, but will also test definitively for the claimed presence of a third body in this famous system, down to planetary masses. At present, there is a tantalizing suggestion in our data that there indeed may exist a substellar or planetary third body in the system. Our team has also obtained superb spectra of Sirius B using STIS, and we have achieved an excellent fit to the spectrum using model stellar atmospheres. However, the implied mass of the WD disagrees significantly with the dynamical mass implied by the existing visual-binary orbit (which still has to be based on a combination of low-accuracy ground-based astrometry plus the small number of existing HST astrometric observations). This is another critical motivation for improving the astrometry.
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Proposal Category: GO
Scientific Category: STAR FORMATION

ID: 10620
Title: Massive Star Formation and the Proper Motions of the OMC-1 Molecular Hydrogen Fingers
PI: Sean Colgan
PI Institution: NASA Ames Research Center

The Orion Molecular Cloud OMC-1 is by far the nearest region of massive star formation, and as such provides a laboratory for studying massive star formation with unprecedented detail. Using NICMOS, eight years ago our group discovered unique molecular hydrogen 'fingers' emanating from the IRc2 area. We propose new NICMOS imaging of the same region to compare with our earlier results. This will determine spatial motions to ~3 AU/year. Using the two data sets, we will: 1) bound the age range of the features and thus address whether all the molecular hydrogen features were produced in a single event - such as an explosion or a stellar merger - or in multiple events/steady outflow; 2) limit the location of the outflow source(s), which remain to be identified despite sub-arcsecond imaging at thermal infrared wavelengths; and 3) characterize inhomogeneities on the 100 AU scale. Together these findings will significantly constrain how massive star formation proceeds in OMC-1. NICMOS achieves the highest quality, near-infrared images for diffuse objects in crowded regions. Because of the complexity of the OMC-1 region, and the difficulty in using Adaptive Optics to measure small position shifts for diffuse, low contrast objects, these high precision proper motion measurements require the stable PSF, high Strehl ratio, and low response in the PSF wings which HST/NICMOS uniquely provides.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10621
Title: ACS Zero Point Verification
PI: Andrew Dolphin
PI Institution: University of Arizona

The uncertainties in the photometric zero points create a fundamental limit to the accuracy of photometry. The current state of the ACS calibration is surprisingly poor, with zero point uncertainties of 0.03 magnitudes. The reason for this is that the ACS calibrations are based primarily on semi-emprical synthetic zero points and observations of fields too crowded for accurate ground-based photometry. I propose to remedy this problem by obtaining ACS images of the omega Cen standard field with all nine broadband ACS/WFC filters. This will permit the direct determination of the ACS zero points by comparison with excellent ground-based photometry, and should reduce their uncertainties to less than 0.01 magnitudes. A second benefit is that it will facilitate the comparison of the WFPC2 and ACS photometric systems, which will be important as WFPC2 is phased out and ACS becomes HST's primary imager. Finally, three of the filters will be repeated from my Cycle 12 observations, allowing for a measurement of any change in sensitivity.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10622
Title: ACS Photometric Calibration from Faint Standards
PI: Andrew Dolphin
PI Institution: University of Arizona

When calibrating photometry, the typical approach is to use short exposures of bright standard stars to calibrate long exposures of faint scientific targets. This is fine for most ground-based telescopes, whose detectors are linear, but presents difficulties when calibrating HST. The resulting HST calibrations are thus extremely sensitive to the accuracy of linearity corrections such as that for CTE loss. We propose a more robust calibration of ACS/WFC using our photometric sequences in Pal 4 and Pal 14 (Saha et al. 2005). These sequences include stars with 10% photometry down to V=24.2 and I=23.4, a brightness comparable to that of many HST science targets. We believe these data will allow us to determine a complete set of transformations accurate to 1% and relatively insensitive to errors in the CTE correction.

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Proposal Category: SNAP
Scientific Category: GALAXIES
ID: 10623
Title: HST Optical Snapshot Survey of Intermediate Redshift Ultraluminous Infrared Galaxies
PI: Aaron Evans
PI Institution: State University of New York at Stony Brook

Ultraluminous infrared galaxies (ULIGs) are commonly believed to be a transitory phase in the evolution of disk galaxy mergers into QSOs. However, a recently reported discrepancy between the morphological and structural properties of z < 0.13 ULIGs and z = 0.12-0.25 QSOs with M(V) < -23.5 has cast doubt on their evolutionary connection. We propose an ACS snapshot survey of a sample of 39 ULIGs with z = 0.35-1.0. These galaxies are the best suited for comparison with luminous z=0.12-0.25 QSOs because (1) they are at larger lookback times than local ULIGs, and thus are likely representative of the systems that evolve into lower redshift luminous QSOs, (2) they have luminosities comparable to luminous QSOs and, (3) they are selected in a manner that biases the sample towards harboring imbedded AGN, and thus are the most likely precursors to optical QSOs. High resolution HST ACS images will allow a determination of galaxy morphology and reveal the presence of bright AGN. The 2-D profile of each galaxy will be modeled using GALFIT, with the AGN comprising one component of the fit where applicable to better characterize the underlying galaxy. Fundamental parameters (effective radius and surface brightness, and F814W-band magnitude) of the underlying galaxy will thus be measured and compared with the host galaxies of the luminous QSO sample. This imaging campaign will consume a modest amount of HST time, but will provide for the first time a statistically significant view of ULIGs at look-back times of 30-65% the age of the universe, and sufficient resolution and sensitivity to conduct a meaningful comparison with z=0.12-0.25 QSOs, as well as with local (z < 0.3) IRAS-detected and distant (z > 2) SCUBA-detected ULIGs.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10624
Title: Solving the Mystery of the Short-Hard Gamma-Ray Bursts
PI: Derek Fox
PI Institution: California Institute of Technology

Eight years after the afterglow detections that revolutionized studies of the long-soft gamma-ray bursts, not even one afterglow of a short-hard GRB has been seen, and the nature of these events has become one of the most important

problems in GRB research. The Swift satellite, expected to be in full operation throughout Cycle 14, will report few-arcsecond localizations for short-hard bursts in minutes, enabling prompt, deep optical afterglow searches for the first time. Discovery and observation of the first short-hard optical afterglows will answer most of the critical questions about these events: What are their distances and energies? Do they occur in distant galaxies, and if so, in which regions of those galaxies? Are they the result of collimated or quasi-spherical explosions? In combination with an extensive rapid-response ground-based campaign, we propose to make the critical high-sensitivity HST TOO observations that will allow us to answer these questions. If theorists are correct in attributing the short-hard bursts to binary neutron star coalescence events, then they will serve as signposts to the primary targeted source population for ground-based gravitational-wave detectors, and short-hard burst studies will have a vital role to play in guiding those observations.

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Proposal Category: GO
Scientific Category: SOLAR SYSTEM
ID: 10625
Title: A Multiwavelength Investigation of Comet 73P/SW3-C
PI: Philippe Lamy
PI Institution: Laboratoire d'Astronomie Spatiale

The nucleus of comet 73P/Schwassmann--Wachmann~3 experienced a non-tidal breakup in late 1995. The largest fragment (73P/SW3-C) survived its subsequent perihelion passage in 2001 and will return in 2006, when it will pass very close to (0.08 AU) Earth. This represents an outstanding opportunity to characterize a fresh cometary nucleus, and we propose an intensive investigation using both the Hubble and Spitzer telescopes. Employing the technique that our group has developed over the past decade to characterize 31 cometary nuclei, we will use HST/ACS to photometrically resolve the nucleus of 73P/SW3-C at optical wavelengths and SST/MIPS to do the same thing at thermal infrared wavelengths, thereby allowing us to determine both the size and albedo of this fragment. We also plan to measure the lightcurve of 73P/SW3-C to obtain detailed shape information, and use HST/NICMOS to probe the composition, in particular to search for evidence of icy material on the fresh surface. Previous observations indicate that most of the remaining mass of 73P/SW3 is in the form of numerous small fragments. A few of those may have been captured by the C fragment, and the determination of their orbits would allow the first, direct measurement of the mass of a cometary nucleus. Thus, we will also perform a deep search for any possible companions to the C-fragment.

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Proposal Category: SNAP
Scientific Category: COSMOLOGY
ID: 10626
Title: A Snapshot Survey of Brightest Cluster Galaxies and Strong Lensing to z = 0.9
PI: Yeong-Shang Loh
PI Institution: University of Colorado at Boulder

We propose an ACS/WFC snapshot survey of the cores of 150 rich galaxy clusters at $0.3 < z < 0.9$ from the Red Sequence Cluster Survey (RCS). An examination of the galaxian light in the brightest cluster galaxies, coupled with a statistical analysis of the strong-lensing properties of the sample, will

allow us to contrain the evolution of both the baryonic and dark mass in cluster cores, over an unprecedented redshift range and sample size. In detail, we will use the high-resolution ACS images to measure the metric (10 kpc/h) luminosity and morphological disturbances around the brightest clusters galaxies, in order to calibrate their accretion history in comparison to recent detailed simulations of structure formation in cluster cores. These images will also yield a well-defined sample of arcs formed by strong lensing by these clusters; the frequency and detailed distribution (size, multiplicity, redshifts) of these strong lens systems sets strong constraints on the total mass content (and its structure) in the centers of the clusters. These data will also be invaluable in the study of the morphological evolution and properties of cluster galaxies over a significant redshift range. These analyses will be supported by extensive ongoing optical and near-infrared imaging, and optical spectroscopy at Magellan, VLT and Gemini telescopes, as well as host of smaller facilities.
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Proposal Category: SNAP
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10627
Title: A Snapshot Survey of Post-AGB Objects and Proto-Planetary Nebulae
PI: Margaret Meixner
PI Institution: Space Telescope Science Institute

We propose an ACS/HRC snapshot survey of 50 post-AGB sources, objects which have evolved from the AGB but may or may not become planetary nebulae (PNe). This survey will complement existing HST images of proto-planetary nebulae (PPNe) and PNe in addressing circumstellar envelope morphology as a function of: 1) the progenitor star mass; 2) the chemical composition; and 3) evolutionary stage. We will connect the observed diversity of nebualar shapes with the main physical and chemical conditions characterizing post-AGB objects, to identify the mechanism that breaks the symmetry of AGB mass loss. To our knowledge, no previous HST projects have been specifically designed to address this issue. From our database of 360 post-AGB candidates, we have selected approximately 50 targets, none of which have been or are being observed with HST, to sample different central star masses, chemical compositions, and evolutionary stages, uniformly across the sky. These new data will also provide important constraints to a quantitative analysis of Spitzer Space Telescope (SST) observations planned for a similar sample of objects. We will model the HST images and SST spectra using our axisymmetric dust code 2-Dust, to derive dust density distributions, pole to equator density ratios, dust shell masses, inclination angles as well as dust composition.
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Proposal Category: GO
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10628
Title: Determining the Lifetime of Planetary Nebula Knots from Observations of the Core of the Helix Nebula.
PI: C. O'Dell
PI Institution: Vanderbilt University

Knots within the Planetary Nebulae (PN) are ubiquitous components and form at the interface of the expanding ionized zone and the surrounding dusty and molecule-rich neutral layers. About half of the total mass ejected by the

precursor star becomes trappped in the Knots, which will join the Interstellar Medium (ISM) within a few tens of thousands of years. If they survive, they may be the source of the micro-structures that appear to be common in the ISM, a result that would be important in understanding the exchange of matter between stars and the ISM. We propose observations that will characterize the Knots over a wider ionization range and ages than has been done before, which should yield the best model for the Knots and therefore the best prediction of their fates. Knots are not seen within a well defined distance from the central star. We don't know if this is because they are being destroyed by photoevaporation (since the inner Knots would be the youngest), an important factor in our modeling. However, the inner core of the Helix Nebula has not been imaged in the HeII emission that dominates the region. We propose eight orbits of observations that will search the inner core of the Helix for undetected knots using the WFPC2 HeII F469N filter and the ACS-WFC F502N filter that isolates [OIII] emission. Our WFPC2 pointing will also allow imaging the best studied knot in HeII, giving us the best possible data for that Knot. These combined results will be modeled with the new Hydro-Cloudy code, allowing us to determine if they will survive the PN stage and become components of the ISM. At no additional cost of observing time we will be able to derive a calibration of the WFPC2 F469N filter, to make unprecedented quality parallel images in molecular hydrogen, and to extended the coverage of high resolution emission-line images of the Helix Nebula.

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Proposal Category: SNAP
Scientific Category: STAR FORMATION
ID: 10629
Title: Are Field OB Stars Alone?
PI: Sally Oey
PI Institution: University of Michigan

This SNAP program offers an inexpensive, simple program to search for low-mass companions of field OB stars. Do field OB stars exist in true isolation, as suggested by a recent Galactic study, or are they the tip of the iceberg on a small cluster of low-mass stars as predicted by the cluster mass function and stellar IMF? Short ACS/WFC V and I observations proposed here may easily resolve this issue for field OB stars in the Small Magellanic Cloud. Truly isolated OB stars represent a theoretical challenge and variation from clusters, in mode of star formation, and have important consequences for our understanding of the field stellar population in galaxies. Small clusters around the field OB stars, on the other hand, may confirm the universality of the stellar clustering law and IMF.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10630
Title: The Fine Structure of Elliptical Galaxies in Voids
PI: Anna Pasquali
PI Institution: Eidgenossiche Technische Hochschule (ETH)

Elliptical galaxies constitute a remarkably homogeneous class of objects with a tight color-magnitude relation and a well-defined Fundamental Plane. In spite of their bland and symmetrical morphology, they are characterized by a wealth of structural features (such as nuclear disks, dust lanes, shells, blue cores, etc.) which contain important clues to their formation history. Little is known about how and if these sub-structures vary as a function of

environment; in fact, due to the morphology density relation, our knowledge of ellipticals is strongly biased towards overdense regions such as clusters. But what of the fine structure of ellipticals in voids? According to theoretical predictions, void galaxies should have different merger histories than those in clusters, which may imply that their fine structure also differs. We address these issues using the exquisite angular resolution of HST/ACS to resolve sub-structures in the most accurately classified sample, to date, of truly isolated ellipticals, identified using the 2dFGRS.
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Proposal Category: GO
Scientific Category: STELLAR POPULATIONS
ID: 10631
Title: Intermediate-Age Globular Clusters in M31
PI: Thomas Puzia
PI Institution: Space Telescope Science Institute

We propose deep ACS/WFC imaging of four halo M31 globular clusters in order to derive their horizontal branch morphologies. Our spectroscopic investigation of their integrated light identifies them as members of an intermediate-age population of globular clusters in M31. Since our spectroscopic results are based on the analysis of Balmer absorption lines, we need to secure our results against an artificial juvenation due to extreme horizontal branch morphologies. The proposed observations will allow a clear-cut answer to the question of whether spectroscopically derived intermediate-age estimates are due to genuinely younger ages or are the result of anomalously hot horizontal branch morphologies. Either way, our results will have important implications for spectroscopically derived ages and metallicities of distant stellar populations. Because of the high spatial resolution of the proposed ACS/WFC observations we will also derive accurate surface brightness profiles of our target globular clusters and investigate the influence of stellar density on horizontal branch morphology. Moreover, together with deep parallel WFPC2 fields we will study the metallicity dispersion of the background stellar population in M31 as a function of galactocentric radius.
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Proposal Category: GO
Scientific Category: COSMOLOGY
ID: 10632
Title: Searching for galaxies at z>6.5 in the Hubble Ultra Deep Field
PI: Massimo Stiavelli
PI Institution: Space Telescope Science Institute

We propose to obtain deep ACS (F606W, F775W, F850LP) imaging in the area of the original Hubble Ultra Deep Field NICMOS parallel fields and - through simultaneous parallel observations - deep NICMOS (F110W, F160W) imaging of the ACS UDF area. Matching the extreme imaging depth in the optical and near-IR bands will result in seven fields with sufficiently sensitive multiband data to detect the expected typical galaxies at z=7 and 8. Presently no such a field exist. Our combined optical and near-IR ultradeep fields will be in three areas separated by about 20 comoving Mpc at z=7. This will allow us to give a first assessment of the degree of cosmic variance. If reionization is a process extending over a large redshift interval and the luminosity function doesn't evolve strongly beyond z=6, these data will allow us to identify of the order of a dozen galaxies at 6.5<z6.5.
Conversely, finding fewer objects would be an indication that the bulk of

reionization is done by galaxies at z=6. By spending 204 orbits of prime HST time we will capitalize on the investment of 544 prime orbits already made on the Hubble Ultra Deep Field (UDF). We have verified that the program as proposed is schedulable and that it will remain so even if forced to execute in the 2-gyro mode. The data will be non-proprietary and the reduced images will be made public within 2 months from the completion of the observations.

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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10633
Title: GRB afterglows and host galaxies at very high redshifts
PI: Nial Tanvir
PI Institution: University of Hertfordshire

Cosmology is beginning to constrain the nature of the earliest stars and galaxies to form in the universe, but direct observation of galaxies at z>6 remains highly challenging due to their scarcity, intrinsically small size, and high luminosity distance. GRB afterglows, thanks to their extreme luminosities, offer the possibility of circumventing these normal constraints by providing redshifts and spectral information which couldn't be obtained by direct observation of the hosts themselves. In addition, the association of GRBs with massive stars means that they are a tracer of star formation, and that their hosts are likely responsible for a large proportion of the ionizing radiation during that era. Our collaboration is mounting a campaign to rapidly identify and study candidate very high redshift bursts, bringing to bear a network of 2, 4 and 8m telescopes with nIR instrumentation. The capabilities of Swift to detect faint, distant GRBs, and to report accurate positions for many bursts in near real-time makes our program now feasible. HST is crucial to this endeavour, allowing us (a) to monitor the late time afterglows and hence compare them to lower-z bursts and test the use of GRBs as standard candles; and (b) characterise the basic properties, luminosities, and in some cases morphologies, of the hosts, which is essential to understanding these primordial galaxies and their relationship to other populations.

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Proposal Category: SNAP
Scientific Category: HOT STARS
ID: 10634
Title: White Dwarf Cooling Physics: Calibrating the Clock
PI: Theodore von Hippel
PI Institution: University of Texas at Austin

We know approximate ages for the Galactic disk from white dwarf cooling theory applied to local white dwarfs and for the Galactic halo from main sequence stellar evolutionary theory applied to star clusters. However, the two chronometers are not cross-calibrated to the same absolute scale; our observations will perform this cross-calibration and improve the precision of both chronometers. We propose to use HST/ACS photometry of white dwarfs in five moderately old open cluster (0.6-2.2 Gyr), along with all available up-to-date white dwarf interior and atmosphere models and a powerful new statistical approach, to compare main sequence evolutionary theory and white dwarf cooling theory. This comparison will be done in such a manner as to test white dwarf crystallization and carbon/oxygen phase separation, as well as main sequence models in the range where they are sensitive to the degree of core overshooting and where PP burning transitions to CNO burning. This

confrontation is essential before we can accurately and precisely apply white dwarf cosmochronometry to the disk and halo field populations and to globular clusters. Past support by HST for white dwarf ages in globular clusters (123 orbits for M4 and a similarly large scheduled campaign for NGC 6397) will only be fully levereged by ensuring that both stellar chronometers are calibrated to the same age scale. Only then can white dwarf chronometers live up to their potential as fundamental, independent, and new age estimators for the Galaxy.
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Proposal Category: GO
Scientific Category: GALAXIES
ID: 10635
Title: Galaxy Transformation as probed by Morphology and Velocity Fields of Distant Cluster Galaxies
PI: Bodo Ziegler
PI Institution: Universitats-Sternwarte Gottingen

We seek to obtain ACS imaging of four distant (0.3<z**PI**: Nicholas Abel
PI Institution: University of Kentucky

Star Formation is a complex interplay among magnetic, thermal, turbulent and gravitational energies. Magnetic energies are crucial to the evolution of molecular clouds, when comparable to other energies. Magnetic field strength measurements are, however, sparse. Detailed field strength maps exist in only one region of the ISM, the veil of neutral material in front of the Orion Nebula. From the Zeeman Effect seen in 21cm H I absorption, we have maps of the field strength in two velocity components. The veil is therefore a unique laboratory to study magnetic effects in star forming regions. Abel et al. (2004) combined archival IUE absorption data with modeling to estimate the veil's density, temperature, and level of ionization. We found that magnetic energies far exceeded other energies in at least one of the components. This is unique, as data from other regions suggest energy equipartition. Unfortunately, IUE data lacked the resolution to separate both H I components, meaning our models are average conditions over both components. We propose an archival, high-resolution UV study to determine conditions in both velocity components. Previous studies obtained spectra in the 2124-2496 & 1170-1372 Angstrom range, for study of C and O abundances in translucent clouds. We will analyze this data for other lines, which we predict in our calculations and are observed in previous IUE studies. Multiple ionization stages for S, Si, C, and Fe should be observed, along with excited state O I absorption, a good density diagnostic. Archival data combined with modeling will determine the density, temperature, and level of ionization in each velocity component. We will compare magnetic and thermal energies in each component, along with determining the distance of each component from the Trapezium. This will lead to a better understanding of the role of magnetic fields in star forming regions. This is analogous to approved proposal 10124, which was granted time on STIS to obtain high resolution UV data for the same line of sight (which, due to the failure of STIS, could not be executed).
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Proposal Category: AR
Scientific Category: COOL STARS
ID: 10637
Title: Finding Terrestrial Planets with HST
PI: Eric Agol
PI Institution: University of Washington

We propose to study the problem of finding terrestrial mass planets with HST by measurement of the transit timing deviations of gas giant planets due to a perturbing terrestrial planet. We will develop the analytic theory of n:1 resonances and inclined planets, we will carry out simulations to determine the sensitivity of HST observations to terrestrial planets, we will explore the best observing strategy, and we will make available to the community routines for finding the best-fit parameters of a perturbing planet. We will apply our codes to the existing HST observations of 25 transits of HD 209458.

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Proposal Category: AR
Scientific Category: COOL STARS
ID: 10638
Title: StarCAT
PI: Thomas Ayres
PI Institution: University of Colorado at Boulder

StarCAT is a two-year Legacy Archival project to assemble all of the STIS ultraviolet echelle exposures of normal stars into a broad-ranging UV spectral library. The STIS echelle collection will be unique for the decade, or more, that it will take to reproduce the lost UV high-resolution capability in space. Consequently, StarCAT will be an important resource for a wide variety of investigations, for years to come. It follows-on an earlier Cycle 11 effort--CoolCAT--focussing on late-type stars, which stands as a successful demonstration project. But, StarCAT will capture as many as 300 targets and 2000 individual spectra (6X CoolCAT), so it will have much further reach and impact. Equally important, we can improve upon the CoolCAT post-processing procedures and employ the definitive version of the STIS pipeline when it becomes available. StarCAT will serve a broad cross-section of the community beyond the familiar stellar enterprises, supporting work on the interstellar medium, asterospheres, circumstellar environments, exoplanets, and more. Now, at the end of STIS operations, is the time to undertake such a UV preservation effort for the benefit of future researchers, before the current expertise with the instrument inevitably fades away.

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Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 10639
Title: Studies of Europa's Plasma Interactions and Atmosphere with HST/STIS FUV Images
PI: Gilda Ballester
PI Institution: University of Arizona

Europa's tenuous atmosphere was discovered by HST/GHRS in OI 1304 A and OI] 1356 A emissions that were inferred to be produced by Jovian plasma electrons dissociatively exciting molecular oxygen (the dominant end product of a water-derived atmosphere). The properties and spatial distribution of Europa's FUV emissions are diagnostic for the specific characteristics of Europa's magnetospheric interactions and atmosphere. Although Europa's plasma interaction was expected to resemble Io's, later HST/STIS FUV imaging studies have yielded unexpected, puzzling results. Therefore, many fundamental questions regarding the nature of Europa's thin, water-derived atmosphere, and of its plasma interactions, induced magnetic field, and emission excitation processes still remain. The proposed Archival program will address these questions by analyzing the existing set of STIS FUV images of Europa

concentrating on the temporal variations that have not been reported in the literature. The derived distribution of the emissions and variations with magnetic System III longitude and plasma conditions will be compared with expectations based on the various published models of the Europa's magnetospheric interaction.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10640
Title: HST Observations of MilliJansky Radio Sources from the VLA FIRST Survey
PI: Robert Becker
PI Institution: University of California - Davis

The VLA FIRST survey has imaged 9,000 square degrees of the North and South Galactic Caps at 1.4 GHz to a peak flux density limit of 1 mJy with an angular resolution of 5 arcsec and source positions better than 1 arcsec down to the catalog detection limit. The source catalog from this area contains about 900,000 objects. The median optical brightness of mJy radio galaxies is approximately 23.5. The number of magnitude 23.5 galaxies per square degree is large (2.5 x 10^4\ deg^-2), so that positions of <1 arcsec accuracy are required to identify the optical counterparts with confidence. The FIRST survey is the only wide area radio survey with positions accurate enough to identify and study the faint optical counterparts for the majority of the sources. Of course, these galaxies are not only faint; they are also of small angular size and usually have point-like, active nuclei. Only HST has the angular resolution required to study the morphology and evolution of these objects. We propose to study the optical characteristics of a large sample of faint radio galaxies by analyzing all the publicly available ACS images in the HST Data Archive that contain cataloged FIRST sources.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10641
Title: Looks Matter: Tracing Galaxy Evolution Through the Morphologies of GRB Host Galaxies
PI: Edo Berger
PI Institution: Carnegie Institution of Washington

The assembly and evolution of structure from high redshift to the present is a major focus of modern cosmology. While theory and simulations provide a picture of the hierarchical assembly of dark matter, the relation to the assembly of baryonic matter is not fully understood. The complex evolutionary process (e.g., mergers) are manifest partly in the morphologies of galaxies, but current studies are limited to only the bright end of the luminosity function beyond z~1. Moreover, the inter-relation between the different flux-limited galaxy samples and their relevance to present-day galaxies is difficult to assess. In this context, the host galaxies of gamma-ray bursts (GRBs) provide a unique opportunity to observe the evolution of star-forming galaxies across a wide redshift and luminosity range. GRB selection allows a spectroscopic redshift determination of even the faintest galaxies and peaks at z~1-2 where the bulk of star formation takes place and where the Hubble sequence begins to take shape. Here we request support for an extensive archival investigation of the morphologies of GRB host galaxies using HST data for fifty GRB hosts, and integrating these data with Keck, SCUBA, and VLA

observations. The bulk of this support is for summer students who will perform some of the reduction and analysis, will present the results at a AAS meeting, and will provide a nexus between Carnegie Observatories and Pomona College in the training of young astronomers.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10642
Title: Measurements of Surface Brightness Fluctuations Gradients in Normal and Peculiar Early-type Galaxies
PI: Michele Cantiello
PI Institution: INAF, Osservatorio Astronomico di Teramo

Surface Brightness Fluctuations (SBF) provide a highly promising tool for tracing the properties of unresolved stellar populations in external galaxies. We propose to measure radial SBF gradients in archival ACS/F814W images of early-type galaxies and correlate these gradients with their broadband colors. As we have demonstrated in preliminary investigations, the exceptional imaging capabilities of ACS now makes it possible to measure highly accurate SBF gradients in a large sample of galaxies. Comparison of our preliminary results with new stellar population models shows that SBF, and SBF gradients with radius, complement the information provided by classical photometry, helping to break the usual age/metallicity degeneracy. The proposed archival research would more than double the number of galaxies with measured SBF gradients, including the addition of shell galaxies, which likely have had interesting and complex star formation histories. In addition, we will measure near-IR SBF properties in a subsample of these galaxies that also have NICMOS imaging, providing substantially more leverage for breaking the age/metallicity degeneracy.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10643
Title: Digging for Interstellar Rare Elements in Archival UV Spectra
PI: Stefan Cartledge
PI Institution: Louisiana State University and A & M College

The complex history and evolution of element production is reflected in the abundance ratios of the elements. The distinctive abundance patterns produced by nucleosynthesis in supernovae and stars can be used to explore the history of star formation and evolution in galaxies. Recent observations of damped Lyman-alpha systems have suggested that observations of r- and s-process elements at high redshifts may soon provide a new window to explore chemical evolution. Paradoxically, we may soon have more detections of some elements in the interstellar medium of these high redshift galaxies than in the Galactic ISM. However, without an understanding of the depletion behavior of these elements based upon observations of nearby sight lines we may be unable to correctly disentangle the effects of dust depletion and nucleosynthesis. We therefore propose to mine the STScI Archive for spectra of sufficient resolution and signal-to-noise ratio to detect these rare elements and explore the implications of the results for the proportions of each element depleted into dust, the efficiency with which each is produced, and any variations in abundances, or their ratios to hydrogen or other elements, as functions of basic sight line properties.

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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10644
Title: Morphologies and MgII/CIV Absorption in 85 Intermediate Redshifts Galaxies
PI: Christopher Churchill
PI Institution: New Mexico State University

We propose to analyze archival WFPC-2 images of 85 MgII absorption selected intermediate redshift galaxies, FOS spectra for 81 of these systems, and STIS quasar spectra for 23 of these systems. Our goal is to chart the connections between the kinematics, spatial distribution, and ionization conditions of the extended gaseous components of earlier epoch galaxies and the morphologies, sightline orientations, kinematics, and stellar populations of the host galaxies. The galaxy kinematics and stellar populations are being obtained with ground based spectra of the galaxies. The gas properties are studied from their absorption signatures in both ground based and HST quasar spectra. The galaxy moprhologies are studied using the high-spatial resolution HST images. The archival HST data will also be used to study the quantified morphological properties of all detected galaxies within 100-200 kpc of the quasar. We should be able to perform this analysis on galaxies with m_r<24. Thus, we will exploit the HST data beyond their originally proposed science goals by undertaking an ambituous study of very weak and "non-absorbing" galaxies in these fields. Overall, our goal is to perform an unprecedented study of the galaxy-gas connection in intermediate redshift galaxies. We will increase the sample size by a factor of ten over previous studies and we will, for the first time, include quantified morphological information on the galaxies. Due to the large field of view and high spatial resolution of the HST images and to the very high sensitivity of the HIRES spectra (by a factor of ten over previous studies), we will be able to perform a thorough analysis of "non-absorbing" galaxies. We aim to measure the absorbing gas physical extent and covering factor as a function of MgII column density and compare this with the high ionization absorption and galaxy morphological properties.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10645
Title: Si III Absorption as a Sensitive Probe of the High-Velocity Cloud Population
PI: Joseph Collins
PI Institution: University of Colorado at Boulder

We propose an archival HST program, surveying Si III absorption from high-velocity clouds (HVCs) in STIS E140M and G140M data for 70 AGN/QSO sight lines. The interstellar Si III line at 1206.50 Angstroms is the strongest metal line in the HST-STIS bandpass for HVC studies and is not often contaminated by IGM interlopers. At present, large surveys have been carried out for only the highest-column-density HVCs through studies of H I 21cm emission. This program will map the distribution, covering factor, and kinematics of HVCs down to a sensitivity of logN(H I)=15-16, an improvement of approximately 3 orders of magnitude over previous HVC surveys in H I emission. In addition, we will explore the ionization characteristics of the Si III-detected HVCs in order to assess models of HVCs and their role in structure

formation scenarios. Despite the problems with current UV instruments and uncertainty surrounding future missions, this program presents new science through the use of existing HST data.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10646
Title: Marked Correlation Functions and Understanding the Evolution of Galaxies
PI: Andrew Connolly
PI Institution: University of Pittsburgh

The last decade has seen the development of a basic observational framework for the evolution of galaxies with lookback time. From the timescales we observe it has become clear that galaxy morphology and star formation are interlinked; with the decrease in star formation at redshifts z<1 corresponding to the formation of the morphological sequence we know today. Given this simplified picture of galaxy evolution questions that arise are: what drives the evolution and how is it related to the environment? Is it a local phenomenon (depending simply on the mass of the dark matter halo) or are galaxy properties influenced by larger scale structures? Classical approaches to this problem involve subdividing samples of galaxies based on their observed properties (e.g. luminosity, color or morphology). While this provides some insight it does not fully exploit the information present within these data. We propose here to exploit a new set of clustering statistics, marked correlation functions, that can be used to express galaxy evolution in terms of the dark matter halo mass, the underlying large-scale environment and that can be compared directly to semi-analytic models for galaxy formation. Our goals with this proposal are: (a) to utilize archival multicolor HST data to derive a statistically robust sample of galaxies from which to study the properties of galaxies at intermediate and high redshift (0.5<z**Proposal Category: AR**
Scientific Category: GALAXIES
ID: 10647
Title: High-Redshift Galaxies in GOODS: Simulations vs. Observations
PI: Romeel Dave
PI Institution: University of Arizona

We propose to carry out detailed comparisons of cosmological hydrodynamic simulations of galaxy formation versus HST/ACS and Spitzer/IRAC observations of z~4 "B-dropout" galaxies in the Great Observatories Origins Deep Survey. The goals are to (1) Test whether current simulations of galaxy formation produce results compatible with high-redshift galaxy observations; (2) Constrain model parameters, particularly those associated with dust extinction and galactic feedback; and (3) Provide detailed interpretations of observed broad-band colors in terms of galaxy physical properties such as stellar mass and extinction within a self-consistent cosmological scenario. We will carry out the comparisons by "observing" simulated galaxies through the appropriate broad band filters, computing each galaxy's magnitudes from its star formation history using population synthesis models. From this, we will gain insights into the physical processes that govern galaxy formation at these epochs, and provide a baseline concordant model that can be used to compare simulations to a wider range of observations such as galaxy clustering, redshift evolution, extragalactic background light, and galaxy properties observed at non-optical/NIR wavelengths.

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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10648
Title: A Search for the Missing Baryons in Nearby Cosmic Filaments II - Sources of Bias
PI: Renato Dupke
PI Institution: University of Michigan

The local "missing baryons" are predicted to be in a warm-hot low density phase, largely in the giant cosmic filaments that connect the denser virialized clusters and groups of galaxies. We have recently detected a high fraction of absorption systems towards the direction that connects galaxy clusters within superclusters, indicating the presence of the predicted cosmic filaments. The association between the absoption systems and individual clusters of galaxies is, however, a source of uncertainty in determining the nature of the detections. Here, we aim at improving the reliability of previous determination of absoption systems in the line of sight towards cosmic filaments by establishing a relation between absorption systems and galaxy cluster "halos". We will look for Ly\alpha absorption lines in the spectra of a large sample of background AGNs distributed at various projected distances from clusters of galaxies. This will be used to quantify the likelihood of competing scenarios to explain the recently detected series of absorption systems in cosmic filaments.

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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10649
Title: Probing the Circumstellar Environment and Shock Interaction in SN 1987A and Cas A
PI: Vikram Dwarkadas
PI Institution: University of Chicago

Hubble Space Telescope (HST) observations of Supernovae (SNe) and Supernova Remnants have revolutionized our knowledge of these objects. The spectacular HST images of SN 1987A have allowed us a real-time look into the impact of the SN shock wave with the surrounding bipolar nebula, and the development of 'hotspots' along the equatorial ring. HST and other multi-wavelength data have fostered the development of models for the structure of the medium surrounding SN 1987A. HST images of the SN remnant Cas A have revealed an intricate array of knots and filaments, and confirmed that the ejecta in SNe can be very clumpy in nature. These observations can only be understood via detailed, and equally high-resolution, numerical modeling that takes the evolution of the pre-SN star into account. I propose a two-year study to investigate the interaction of SN shock waves with the ambient medium formed by the pre-SN star. This study will differ from others in computing the structure of the circumstellar medium around the star throughout its evolutionary history. The mass-loss properties at each timestep in the evolution will be computed from the stellar properties, which are obtained from the latest stellar evolution models. My multi-dimensional simulations will provide an important step towards understanding the complex interaction of the shock-wave with the equatorial ring seen in SN 1987A. I will study the formation of various instabilities, and their effect on the growth and evolution of small-scale structures as seen in Cas A. Although my work is motivated primarily by these two objects, the results will be broadly applicable to a wide variety of

phenomena in which shock wave interaction with the ambient medium is predominant.

Proposal Category: AR
Scientific Category: GALAXIES
ID: 10650
Title: On the Road to Coma: A "Longitudinal Study" of Galaxy Cluster Evolution
PI: Erica Ellingson
PI Institution: University of Colorado at Boulder

The evolution of massive galaxy clusters provides a unique opportunity to probe the formation of large scale structures and environmental effects on the stars and galaxies within them. We propose a uniform analysis of archival HST ACS and Chandra ACIS observations of 15-20 galaxy clusters at redshifts 0.15-1.3 with the specific goal of tracing the evolution of clusters that will have Coma-like masses in the present day. Our approach combines hydrodynamical simulations, X-ray images and temperatures, and optical observations. We will choose our sample by matching broad cluster properties such as X-ray temperature and luminosity measured via the Chandra observations to hydrodynamical simulations of clusters which evolve to Coma's properties at z=0. Thus we use the properties of the dominant baryon reservoir to select clusters forming a consistent evolutionary sequence. By confining our sample to clusters along this sequence, our program is in distinct contrast with previous studies which generally highlight very massive systems at high redshift- objects which will not evolve to any known present-day cluster. This previous selection bias may mask any actual evolution in the cluster galaxies that occurs as the clusters form. ACS observations of our carefully selected sample will allow us to quantitatively inventory the cluster galaxy population and trace galaxy evolution along with the intracluster gas in these clusters as they evolve from relatively low-mass, shallow potential-well structures to the typical rich clusters of today.

Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10651
Title: The Stellar Mass Function of Disks and Bulges at z = 1
PI: Sandra Faber
PI Institution: University of California - Santa Cruz

The disks of galaxies are thought to form quiescently, while bulges form in mergers. Measuring the amount of mass in bulges and disks separately therefore determines the relative importance of these two formation channels versus time. This proposal would exploit a unique multiwavelength database to measure the total stellar mass functions of red and blue galaxies down to 1 billion solar masses at z = 1, and obtain the first measurement of the mass functions of bulges and disks SEPARATELY at that redshift. The cornerstone of the project is a set of parallel NIC3 images in the Extended Groth Strip, which is unique among Hubble near-IR imaging surveys and is much more sensitive to old stellar components than ACS V or I. NIC3 photometry will be used to improve and deepen IRAC photometry and to measure accurate photo-z's for faint galaxies far below the spectroscopy limit. ACS and NIC3 images together will be used to construct SEDs separately for bulge and disk components to determine bulge-to-disk mass ratios of individual galaxies and, from them, mass functions. The data will go deep enough to reveal any faint

population of red galaxies at z = 1, and will provide the first measurement of disk-radius evolution based on underlying old stars. High Level Data Products will be created to distribute all catalogs to the public.

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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10652
Title: Numerical simulations of time-variable AGN emission and absorption line regions
PI: Gary Ferland
PI Institution: University of Kentucky

A great effort has gone into obtaining extensive time-series spectra of AGN emission and absorption lines with HST. This has shown that the gas is photoionized and distributed over a wide range of density and ionization. The BAL outflows are a case where a wind lies along our line of sight, producing absorption lines, while emission lines are at least partly an outflow above an accretion disk. Analysis of the lines reveals the chemical composition, energetics, and acceleration of the ejected material, and offers clues to the physics of the central powerhouse. HST has allowed these phenomena to be studied in great detail. HST spectra are often analyzed by reference to large-scale plasma simulations that take into account the detailed microphysics of the gas. However, the fact that the continuum source is variable changes some of the assumptions that are the basis of current plasma codes ? in particular the assumption that the gas is in a local steady state. Actually, changes in the continuum, and the presence of the flow itself, introduces additional terms into all the rate equations. These can affect the thermal and ionization balance of the gas, and high velocities affects the line and continuum transfer. This proposal requests support for the continued enhancement of the spectral simulation code Cloudy to allow it to do time-dependent calculations. Time-dependent terms will introduce a density-dependent lag in the response of the gas to changes in the continuum, allowing new insights be be gained into the gas conditions. Cloudy is openly available on the web and other investigators use it to produce more than 100 papers per year. This insures that this work will have broad application. I will also create grids of predictions that span the range of parameters seen in AGN, but which include the effects of the outflow on both the physical state of the gas and its resulting spectrum.

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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10653
Title: Dynamical flows in PNe: interpreting HST images on a physical basis
PI: Gary Ferland
PI Institution: University of Kentucky

This theory proposal requests support to develop a combination of chemistry and hydrodynamics, and apply it to the analysis and interpretation of HST observations of knots in the Helix. They offer a laboratory to understand flows from molecular condensations into a low-density ionized medium, and so have implications for other environments, such as H II regions and Starbursts. The project involves developing the chemistry and dynamics in the spectral simulation code Cloudy. Cloudy is widely used across the astronomical community, so the proposed developments will have broad application. Recent

NICMOS observations detail aspects of the flow from the molecular core, where the gas is surprisingly warm, into the ionized region, where STIS and WFPC2 measure the surface brightness and relative intensities of emission lines. We will make the following improvements: The heavy element chemical network (including CO) and a complete model of molecular hydrogen will be integrated into our treatment of dynamics. Our previous work had only included atomic and ionized regions. We will consider strongly divergent flows, as seen in the Helix; our previous work used only a plane-parallel geometry. We will use the improved code to create evolutionary grids that follow changes as the system ages. Our goals are to determine the mass, mass-loss rate, and lifetime of the knots, and identify the mechanisms responsible for their current physical state.

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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10654
Title: Absolute Spectrophotometric Calibration to 1% from the FUV through the near-IR
PI: David Finley
PI Institution: Eureka Scientific Inc.

We propose a significant improvement to the existing HST calibration. The current calibration is based on three primary DA white dwarf standards, GD 71, GD 153,and G 191-B2B. The standard fluxes are calculated using NLTE models, with effective temperatures and gravities that were derived from Balmer line fits using LTE models. We propose to improve the accuracy and internal consistency of the calibration by deriving corrected effective temperatures and gravities based on fitting the observed line profiles with updated NLTE models, and including the fit results from multiple STIS spectra, rather than the (usually) 1 or 2 ground-based spectra used previously. We will also determine the fluxes for 5 new, fainter primary or secondary standards, extending the standard V magnitude lower limit from 13.4 to 16.5, and extending the wavelength coverage from 0.1 to 2.5 micron. The goal is to achieve an overall flux accuracy of 1%, which will be needed, for example, for the upcoming supernova survey missions to measure the equation of state of the dark energy that is accelerating the expansion of the universe.

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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10655
Title: Flares from Tidal Disruption of Stars by Galactic Supermassive Black Holes
PI: Robert Geller
PI Institution: University of California - Santa Barbara

We are searching for flares expected to occur when a supermassive black hole (SMBH) tidally disrupts a star from its host galaxy and accretes the captured gas. The expected event rate for complete stellar disruptions of main sequence stars is 2.2 x 10^-4 (L/10^10Lo)^-0.30 per galaxy per year, according to calculations recently published by one of us. The flares should be easy to detect, even for partial disruptions, if anywhere near the Eddington luminosity as expected theoretically. The HST archives are currently the best resource for finding flares. HST's resolution allows fitting of a host and nuclear component on galaxies that could barely be resolved from the ground. In the first of two methods, we will compare the same galaxies at two

different HST imaging epochs: Approximately 30 flares are expected in about 16,000 galaxies in WFPC2 archival images taken at two or more epochs. In a second method, we compare about 200,000 galaxies in WFPC2 and ACS archival single-epoch images with subsequent Sloan images. This is expected to lead to the discovery of ~ 60 flares. ACS provides fewer two-epoch observations but a comparable database for the one-epoch method. Taken together, we estimate 90 detectable flares.

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Proposal Category: AR
Scientific Category: STELLAR POPULATIONS
ID: 10656
Title: An HST/NICMOS Study of our Galaxy's Central Supermassive Black Hole and its Environment
PI: Andrea Ghez
PI Institution: University of California - Los Angeles

The pace of discovery in Galactic center research has been extraordinary over the past few years, largely as a result of high angular resolution infrared observations. We propose to extract unique measurements from the HST archive that will augment high-resolution, ground-based studies of the Galactic center, with three primary objectives: 1) using the short-period (as low as 15 yr) orbits of the closest measurable stars near the black hole to determine the distance to the Galactic center, 2) addressing the problem of how massive, young stars can be present in the central parsec, where the strong tidal forces from the black hole are expected to counteract the gravitational collapse that leads to star formation, by measuring stellar accelerations and intensity variations and 3) characterizing the innermost portions of the accretion flow onto the black hole using the recently-detected, variable near-infrared emission that presumably arises from relativistic electrons in the inner accretion flow.

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10657
Title: Combined HST-FUSE Far Ultraviolet Spectral Study of Cataclysmic Variables
PI: Patrick Godon
PI Institution: Villanova University

The white dwarfs (WDs) in cataclysmic variables (CVs) are probes of cataclysmic evolution and accretion physics because they bear the thermal, chemical and rotational imprint of their long term accretion and thermonuclear history. An understanding of the consequences of accretion in CVs is the first step in a global understanding of accretion-related phenomena throughout the universe including Young Stellar Objects, galactic binaries (accretion onto neutron stars and black holes) and AGNs, which can't be easily observed. We propose an archival study of 25 CV systems, for which the HST/STIS (and/or HRS, FOS) spectra can be combined with matching FUSE spectra, covering a total spectral wavelength range 905-1725A. Such a systematic study of a large sample of combined HST-FUSE spectra of CVs systems is unique. We propose to use these 25 CVs as probes of CV evolution and accretion physics by deriving, for each system, the WD masses, surface temperatures, rotation rates, abundances and the mass accretion rate. This will be achieved by analysing the combined spectra with state-of-the-art stellar & accretion disk synthetic spectrum programs TLUSTY and BINSYN. The combined HST-FUSE spectra are expected to

improve the accuracy of the measurements from the individual HST and FUSE spectra alone.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10658
Title: Measuring Gravitational Flexion in ACS Clusters
PI: David Goldberg
PI Institution: Drexel University

We propose measurement of the gravitational "Flexion" signal in ACS cluster images. The flexion, or "arciness" of a lensed background galaxy arises from variations in the lensing field. As a result, it is extremely sensitive to small scale perturbations in the field, and thus, to substructure in clusters. Moreover, because flexion represents gravitationally induced asymmetries in the lensed image, it is completely separable from traditional measurements of shear, which focus on the induced ellipticity of the image, and thus, the two signals may be extracted simultaneously. Since typical galaxies are roughly symmetric upon 180 degree rotation, even a small induced flexion can potentially produce a noticeable effect (Goldberg & Bacon, 2005). We propose the measurement of substructure within approximately 4 clusters with high-quality ACS data, and will further apply a test of a new tomographic technique whereby comparisons of lensed arcs at different redshifts may be used to estimate the background cosmology, and thus place constraints on the equation of state of dark energy.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10659
Title: Constraining Both the Star-Formation History and Metal-Enrichment History of Galaxies
PI: Sara Heap
PI Institution: NASA Goddard Space Flight Center

Using 380 stellar spectra from Hubble's Next Generation Spectral Library (NGSL; PI=Michael Gregg; GO 9088, 9786) incorporated in our stellar population synthesis code (Bruzual & Charlot 2003), we propose to constrain simultaneously the star-formation history and mean age, stellar metallicity and mass of galaxies over a wide redshift interval (z= 0 -2). The main advantages of the NGSL are the high-quality spectrophotometry (S/N >50) and broad wavelength coverage (2000-10,000 Ang) of the STIS spectra. The NGSL enables mid-UV as well as optical spectral indices to be used, thereby increasing the redshift interval of their application. It also guarantees consistency in treating low- and high-redshift galaxies, since the same stars are used as spectral templates. To realize the full potential of the NGSL, however, will require significant custom data-processing, calibration, and evaluation of the STIS data.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10660
Title: The Spectral Energy Distributions of Low-luminosity AGNs
PI: Luis Ho
PI Institution: Carnegie Institution of Washington

The spectral energy distributions (SEDs) of AGNs encode valuable information on the physics of accretion onto black holes. Until very recently, however, data on SEDs for low-luminosity AGNs (LINERs and nearby Seyferts) have been sorely lacking. Initial studies based on small samples indicate that the SEDs of low-luminosity AGNs exhibit profound differences compared to those of their more luminous counterparts such as classical Seyferts and quasars. The most noticeable trait is the weakness of the "big blue bump," a feature normally attributed to thermal emission from a thin accretion disk. This unexpected but potentially very important result has led to suggestions that low-luminosity AGNs accrete via a fundamentally different mode, perhaps in a hot, radiatively inefficient flow. This proposition, if it can be confirmed, has important implications for our understanding of black hole accretion and for elucidating the physical properties of low-level nuclear activity, which is extremely common in nearby galaxies. We propose to significantly enlarge the current sample of SEDs for low-luminosity AGNs by combining existing high-resolution nuclear fluxes measured in the radio (VLA) and X-rays (Chandra) with new optical and near-infrared data points to be extracted from archival WFPC2, ACS, and NICMOS images. This project will increase the current sample of SEDs by more than an order of magnitude.

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Proposal Category: AR
Scientific Category: SOLAR SYSTEM
ID: 10661
Title: Search for companions to known asteroids using archived images from ACS and WFPC2
PI: Matthew Holman
PI Institution: Smithsonian Institution Astrophysical Observatory

Recent discoveries of companions to main belt asteroids, near-Earth asteroids, Jupiter Trojans, and Kuiper belt objects, and the resulting estimates of the orbital elements and total masses of some of these systems, have challenged our expectations of the physical properties of these bodies. This new data has compelled a flurry of work on the formation and destruction processes of solar system binaries and on the overall evolution of small bodies in the solar system. Although the HST has been used successfully for some of these searches, this success has been restricted by limited HST time allocations. We propose to conduct an extensive archival search of WFPC2 and ACS images for companions to known asteroids. As of 2002, HST archival searches for asteroid trails have yielded more than 300 detections, roughly 30 of which are previously known asteroids. The ever-growing number of asteroids with well-determined orbits in the Minor Planet Center databases and an enlarged number of WFPC2 and ACS images in the Archive taken within 30 degrees of the ecliptic suggest that roughly 100 known asteroids have now been serendipitously observed by HST. The Hill spheres of these asteroids are large enough to harbor companions that could be resolved with HST. This archival search will allow us to measure the binary fraction of asteroids in a size range that is out of reach of ground-based AO observations and which has been largely unexplored in targeted HST searches. Although serendipitous observations of asteroids are often significantly trailed, the signal from the asteroid and any possible companion can be concentrated by summing the pixels along the asteroid trail, a modification of the technique used by Bernstein et al. (2004) to detect faint Kuiper belt objects. The accurate ephemerides of these asteroids will permit any asteroid binaries that are detected to be re-observed with targeted observations, in order to determine their binary orbital parameters.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10662
Title: An dust extinction map of M51 from counts of distant galaxies
PI: Benne Holwerda
PI Institution: Kapteyn Astronomical Institute

The number of distant galaxies seen in Heritage Project's ACS images of M51 can be used to probe the extinction in this spiral disk. The ``Synthetic Field Method'' (Gonzalez et al. (1998), Holwerda et al. (2005a)) can be used to calibrate this number for crowding and confusion effects. The Heritage Project observing strategy is very suitable for this kind of work. The total extinction of the disk can be compared to the disk emission, such as SCUBA sub-mm observations and Spitzer maps and the atomic hydrogen column density (HI). Such comparisons will reveal the role of dust in spiral disk of M51.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10663
Title: Tracing the dust extinciton in M101 from counts of distant galaxies
PI: Benne Holwerda
PI Institution: Kapteyn Astronomical Institute

The number of distant galaxies seen in ACS imaging of M101 can be used to probe the extinction in this spiral galaxy. The ``Synthetic Field Method'' (Gonzalez et al. (1998), Holwerda et al. (2005a)) can be used to calibrate this number for crowding and confusion effects. The ACS fields in the archive are a uniquely suitable dataset for such a project. The total extinction of the disk in relation to the infrared emission, HI column density and disk light should reveal more on how the dust component relates to all the other constituents of the spiral disk of M101.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10664
Title: Linking Galaxies and their Dark Matter Haloes with Gravitational Lensing
PI: Michael Hudson
PI Institution: University of Waterloo

We propose to use existing ACS images to derive, for the first time, solid measurements of the ratio of dynamical and halo masses for a sample of distant, and thus younger, galaxies using the technique of galaxy-galaxy lensing. The 2 filter HST images are critical in providing both the weak lensing signals to derive the halo masses, and the set of information (inclination, size, position angle, and emission line distribution) needed to convert spatially resolved Keck spectra into dynamical masses. Besides dynamical masses, the multiband ACS images are essential for extracting morphological, photometric, and structural information for the distant galaxies. We plan to use 3 ACS surveys with 2 or more filters (GOODS-N, GOODS-S, and the Extended Groth Strip) for this analysis. The wide areal coverage of

these fields (900 sqarcmin) will allow us to improve on previous lensing results in the Hubble Deep Field by a factor of 20 in signal-to-noise ratio. With over 4500 kinematic measurements and 1000 rotation curves to be studied via galaxy-galaxy lensing, the sample enables powerful new tests of the relationship of halo masses of younger galaxies to not only dynamical masses, but also to subsets divided by redshift, luminosity, morphology, B/T, color, etc. The direct measurements of the connections between dark matter halos and their baryonic galaxies provide fundamental knowledge and checks of the reigning LCDM models for galaxy formation.

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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10665
Title: Legacy HST Spectroscopy of the Low Redshift Intergalactic Medium
PI: Chris Impey
PI Institution: University of Arizona

We propose a homogeneous analysis of all HST spectra of quasars and AGN that probe the low redshift intergalactic medium (z < 0.4). Data taken at moderate resolution with each of the three spectroscopic instruments -- FOS, GHRS, and STIS -- will be included. The analysis will involve 316 targets, span a total redshift path of ~110 and yield an estimated 1500 Lyman-alpha absorbers. In this redshift range, it will incease the number of absorbers by a factor of 15 over the HST Absorption Line Key Project. Data products include co-added and calibrated spectra, continuum fits, absorption line lists, and line identifications, all on a web site that includes hyperlinked information from NED and ADS. About 90% of the sightlines are in regions covered by the SDSS, 2dF and 6dF surveys. This Archive Legacy database will facilitate a range of scientific investigations, including (a) studies of the relationship between luminous baryons in galaxies and diffuse baryons in the IGM, (b) comparisons between the observations and simulations that incorporate gas dynamics, (c) measures of cosmic variance in structure on the largest scales, (d) new tests of the gravitational instability paradigm, (e) accurate determination of the proximity effect at low redshift, and (f) measurements of the chemical enrichment of the IGM. With no prospect of sensitive UV spectroscopy in the forseeable future, this dataset will form part of HST's unique and enduring legacy.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10666
Title: The ACS Mosaic of M51 and the Intersection of Research and Education
PI: Chris Impey
PI Institution: University of Arizona

This archive proposal is based on the opportunity afforded by the new six-pointing mosaic of M 51, taken as part of the Hubble Heritage project. The goal is to produce a set of educational activities for non-science majors taking introductory astronomy courses. In the first phase, the subject of this archive proposal, surface photometry and aperture photometry will be carried out for selected regions that are typical of (a) the nucleus, (b) the bulge, (c) an inner spiral arm, (d) an inter-arm region, (e) an outer spiral arm, (f) the nucleus of the companion, (g) an off-nuclear region in the companion, (h)

the edge of the disk, (i) the tidal tail connecting the two galaxies, and (j) a region displaced from both galaxies. A fully registered true-color image will also be created. In the second phase, the subject of a companion E/PO proposal to be submitted later this year, instructional modules will be created based on the ten sample regions, where each can be viewed and measured by students using Java web tools. The goals of the activities will be to use research-level astronomical data to teach about (a) the range of stellar colors, (b) stellar luminosity, (c) different stellar populations, (d) effects of dust, (e) active nuclei, (f) the significance of angular resolution, and (g) the concept of surface brightness. The potential audience for these new materials is the 250,000 students who take introductory astronomy courses each year at colleges across the country.

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10667
Title: The Proper Motion and The Parallax of the Crab Pulsar
PI: David Kaplan
PI Institution: Massachusetts Institute of Technology

The Crab pulsar is the prototypical young neutron star and is one of the most studied extrasolar objects. It provides the foundation for our understanding of pulsar spin-down, magnetospheric physics, and energy loss through relativistic winds. With an indisputable supernova association and a known age, it is also an ideal laboratory to study core-collapse supernovae and neutron star birth kicks, but useful constraints on all of these questions require accurate distance and velocity measurements. However, despite the preeminence of the Crab these quantities are poorly known: the distance to the supernova remnant has been estimated with 30% uncertainties and there are no direct measurements of the pulsar's distance, while its proper motion has been estimated from a crude analysis of saturated HST data spanning only two years. Here we propose to analyze the full set of existing HST/WFPC2 data on the Crab pulsar, spanning seven years and using multiple filters. We will fully characterize the measurement uncertainties, including the effects of saturation, and determine a precise proper motion. We will also attempt to measure an astrometric parallax to the source, or determine the minimum additional data necessary to enable such a measurement.

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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10668
Title: The Theory of Multiscale Gravitational Lensing
PI: Charles Keeton
PI Institution: Rutgers the State University of New Jersey

Strong gravitational lensing probes the mass distributions of distant galaxies on scales from tens of kiloparsecs (dark matter halos and "macrolensing") through parsecs (dark matter substructure and "millilensing") all the way down to individual stars ("microlensing"). Wonderful data are now available, thanks in large part to HST. However, the theoretical understanding of lensing on different scales is much less mature, which has complicated efforts to interpret the data. We have begun a comprehensive theoretical study of multiscale lensing, to develop a formalism that will enable us both to interpret existing data and to inspire and guide new observations. In this proposal, we specifically seek to develop the first code that simultaneously

includes macro-, milli-, and microlensing. We will then use it to: (1) Find clear observational signatures that reveal the scale(s) being probed in data, and then resolve the debate about whether millilensing truly reveals Cold Dark Matter substructure. (2) Show how observations at different scales can constrain the mass function of stars in lens galaxies, and apply the method to existing HST data for seven distant galaxies. (3) Examine non-linearities that link micro-, milli-, and macrolensing, and use the combined analysis to open a new window on dark matter studies with strong lensing. We will also make the code available to the community as part of PI Keeton's public lensing software.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10669
Title: A Comparative X-ray and Optical Study of M51
PI: Roy Kilgard
PI Institution: Smithsonian Institution Astrophysical Observatory

Observations of nearby galaxies with the Chandra X-ray observatory reveal a multitude of X-ray point sources, largely X-ray binaries and SNR. The X-ray data can provide crude classifications for these sources, but the only way to unambiguously classify the source is by observing an optical counterpart. The Hubble Heritage observations of M51, to be taken before the beginning of Cycle 14, provide the perfect optical dataset for comparison with existing X-ray data, combining large field of view, high angular resolution, and long exposure times. The resulting information on optical counterparts and environments will allow us to test two important X-ray diagnostics: first, that X-ray color can be used as a crude method of source classification, and second that the environment of X-ray sources within a host galaxy can help determine the formation history of the X-ray population.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10670
Title: The Geometry of Broad Emission Line Regions in AGN
PI: Hermine Landt
PI Institution: Smithsonian Institution Astrophysical Observatory

We propose to determine the gross structure and flow of the broad emission line region (BELR) of radio-loud active galactic nuclei (AGN). Our approach is to look at the change of emission line properties (such as, e.g., FWHM and equivalent width) with inclination angle, the latter determined by a new VLBI/X-ray technique. This will extend the work of Rokaki, Lawrence, et al. by including both low- and high-ionization broad emission lines. We will use 197 HST archival spectra for 25 AGN covering multiple broad emission lines of varying ionization (and so radius). We shall be able to distinguish rotation about the radio axis, outflow and turbulent motions within the BELR. The result will be more accurate black hole masses at low and high redshifts and a deeper understanding of AGN dynamics.
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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10671
Title: Accurate Accelerations in AGN Outflows

PI: Karen Leighly
PI Institution: University of Oklahoma Norman Campus

We propose to construct models of radiation-driven outflows in Active Galactic Nuclei (AGN). Our models will use the generalized radiative transfer code PHOENIX to self-consistently compute the line emission and absorption, and the accelerations. We will use a parameterized dynamical model employing magnetic and radiation pressure confinement plus continuity and momentum conservation. We will do a parameter survey, varying the wind footpoint, and the spectral energy distribution, and constrain the results using HST spectra of broad-absorption line quasars and narrow-line Seyfert 1 galaxies. The goal of this phase of our model building is to compute the first accurate accelerations in the context of AGN outflows. Our long term goal is to compute the range of kinetic luminosities possible from AGN outflows, and so determine the potential for radiation-driven quasar outflows to act as a feedback mechanism in models for the coevolution of galaxies and black holes.

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10672
Title: Calibrating Post-Main-Sequence Evolution in the Upper HRD
PI: Claus Leitherer
PI Institution: Space Telescope Science Institute

Over its 10 years of Costar-enabled lifetime, HST has accumulated a rich legacy of resolved stellar photometry in nearby galaxies. The resulting color-magnitude diagrams of the massive stellar populations rival those obtained from the ground for the Magellanic Clouds. We propose to analyze multiband imagery of 19 nearby galaxies to derive densely populated upper color-magnitude and Hertzsprung Russell diagrams (HRD). This study generalizes previous attempts done for the Magellanic Clouds to lower metallicities. Our primary scientific goal is a comparison with stellar evolution and evolutionary synthesis models, identification of mismatches, and an empirical recalibration. All major models are known to fail to reproduce both the colors and the population densities of metal-poor red supergiants in the HRD. We intend to use average HRDs at low metallicity for a recalibration of the stellar temperatures and lifetimes in stellar evolution models of red supergiants. Lacking such a recalibration, current synthesis models are inadequate for modeling metal-poor star-forming and starburst regions containing cool, evolved stars.

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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10673
Title: A Reevaluation of the Cepheid Distance Scale from a Homogeneous Analysis of 22 Galaxies Observed with WFPC2
PI: Douglas Leonard
PI Institution: California Institute of Technology

One of the most valuable datasets in the HST archive is the collection of repeated images of nearby galaxies obtained in an effort to determine H_0 through the analysis of Cepheid variable stars. With total exposure times of ~18 orbits for each galaxy, the combined frames in V- and I-band are also among the deepest HST images ever obtained of individual galaxies, and represent a largely unexploited wellspring of photometric data for additional

investigations. We propose to carry out a homogeneous analysis of all images obtained with the WFPC2 for Cepheid studies, and make available to the community the complete catalog of photometric measurements of all point- and extended-sources detected in the final, processed frames. With 100,000 objects typically detected per target galaxy, the final catalog will contain two-color photometry of over 2 million objects. The scope and accessibility of the catalog will facilitate an array of scientific investigations, including comparative studies of the star formation history and stellar content of spiral galaxies, planetary nebula, OB associations, stellar populations and abundances, supergiant stars, and young stellar clusters. Our own goal with the dataset is to produce a uniform, objective recalibration of the Cepheid distance scale using rigorous, quantitative methods of analysis developed by our group to permit the automated selection of Cepheid candidates from the thousands of objects detected and photometered.

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10674
Title: Winds of Cataclysmic Variables
PI: Knox Long
PI Institution: Space Telescope Science Institute

Non-magnetic cataclysmic variables are important, nearby examples of the accretion disk phenomenon. In the high or outburst state, their FUV spectra are due primarily to a disk continuum modified by scattering in a rotating bi-conical outflow. Here, we propose to advance our understanding of kinematic and ionization structure of CV winds by performing a detailed analysis of archival FUV spectra of 11 disk-dominated CVs observed in the high state with HST. We will use a state-of-the-art Monte Carlo radiative transfer program to produce detailed simulations of all of the features of the wind. This is needed to determine basic parameters of the flow, such as mass-loss rate and collimation, and to explore physical questions, such as the underlying wind-driving mechanism and the effect of the wind on the disk. By studying multiple systems viewed at different inclination angles, we will attempt to generalize the results to produce a "standard model" for the winds of CVs.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10675
Title: A Multi-Wavelength Study of Galaxy Mergers out to z ~2
PI: Jennifer Lotz
PI Institution: University of California - Santa Cruz

Galaxy mergers are expected to play a critical role in the formation of massive red spheroids, feeding active galactic nuclei, and triggering dust-enshrouded starbursts. Current cosmologically-motivated models of galaxy evolution fail to produce enough red bulge-dominated galaxies at early and late times as well as the dust-enshrouded populations of luminous infrared galaxies at z ~ 2. It is likely that these failures are due to our poor understanding of the physics associated with mergers. We propose a multi-wavelength archival study to identify mergers, classify merger type and stage, and determine their AGN and starburst activity out to z ~ 2 in the Extended Groth Strip, GOODS, and UDF. Morphology is the most accessible signature of a galaxy merger, but the classification of z > 1 galaxy morphologies from optical ACS data is challenging because of the increasingly irregular

appearance of normal galaxies at rest-frame ultraviolet wavelengths. The core of our program is the analysis and comparison of NIC2/3 derived morphologies and merger-fractions for > 200 merger candidates to those derived with ACS in order to constrain the effect of wavelength on morphologically-derived merger rates and to calibrate the large ACS Legacy data-sets for which high-resolution NIR data is not available. With the rich multi-wavelength data in our selected fields (Spitzer, Chandra, VLA), we will also be able classify our merger candidates as major or minor, gas-rich or gas-poor, and early or late-stage using the HST quantitative morphologies, IR luminosities and other star-formation indicators. Finally, we will correlate our merger candidates with the presence of X-ray selected AGN to better understand the role of mergers in feeding AGN and the bulge-massive black hole correlation.

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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10676
Title: The HST Archive Galaxy-scale Gravitational Lens Search
PI: Philip Marshall
PI Institution: Stanford University

We propose the largest homogeneous space-based optical gravitational lens search possible prior to the launch of SNAP/JDEM. The HST archive contains a total of 2.2 square degrees of sky imaged with either ACS (78%) or WFPC2 in at least two filters to an appromximate I-band depth of 25 magnitudes. We estimate (with some uncertainty) this area to contain approximately 20-30 elliptical-galaxy strong gravitational lenses, enlarging the currently known sample by some 25%. Complementing those discovered by other means, this lens sample will enable such applications as: the detailed study of galaxy dark matter distributions, their relation to luminous matter, their evolution and their environments; cosmology, through the measurement of time delays (and so the Hubble constant), and via the observed lensing rate and image separations which probe volumes and distance ratios sensitive to the dark energy parameters. The legacy of this survey will also be that of a suite of automated lens detection algorithms; continuing to refine and apply these to future ACS images as they are archived will allow the discovered lens numbers given above to be doubled. Finally, these algorithms will provide the foundations for the analysis of data from future wide-field space-based optical imagers, which will repeat this lens survey on three orders of magnitude larger a scale.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10677
Title: The Influence of Bars on the Centers of Galaxies
PI: Paul Martini
PI Institution: Smithsonian Institution Astrophysical Observatory

HST observations have recently discovered pronounced differences between the circumnuclear morphology of barred and unbarred galaxies. This discovery provides some of the first evidence that bars directly impact the structure of the circumnuclear ISM and has many implications for bar-induced matter transport, bulge growth, and black hole fueling. I propose to use a new, physically motivated measure of bar strength and the structure map technique of Pogge & Martini to quantify how circumnuclear structure is impacted by bar strength, as well as other galaxy properties such as morphological type and

luminosity. This analysis will provide important new insight into how bars drive evolution at the centers of galaxies, particularly what fraction and type of bars have any significant impact at all on their circumnuclear region.
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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10678
Title: Simulated HST Images of Merging Galaxies Including Star Formation and Dust
PI: Joel Primack
PI Institution: University of California - Santa Cruz

We propose a theoretical program to study merging and interacting galaxies through numerical simulations and radiative-transfer calculations. This program will create a library of simulated images of interacting galaxies which can be compared directly to Hubble Space Telescope observations of high-redshift galaxies. We will seek a quantitative understanding of the increased fraction of morphologically disturbed galaxies at higher redshifts by comparing observations and predictions from theoretical cosmological models on the same footing. This will be accomplished by the use of morphological statistics applied to both observed and simulated images. Our simulations will also improve the modeling of merging galaxies in semi-analytic models of galaxy formation which indicate that merger-driven starbursts are the dominant mode of star formation at redshifts around 1, a conclusion supported by recent observations. Once information about star formation efficiency, dust attenuation, and other properties of merging galaxies from our simulations is incorporated into these models, they will predict cosmological star-formation rates in merging galaxies as a function of redshift and mass, as well as the distribution of galaxy morphologies.
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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10679
Title: The Low Redshift IGM Enrichment History
PI: Jason Prochaska
PI Institution: University of California - Santa Cruz

We will analyze the IGM enrichment history at z<1.5 by surveying CIV, SiIV, and OVI absorption in HST/STIS E140M and E230M archival spectra. Current results on low-z IGM enrichment are based primarily on OVI and CIV surveys from the HST Key Project FOS data. The archival STIS spectra have >20x higher resolution and correspondingly >10x higher sensitivity to metal-line absorption. With this program, we will investigate the mass density of CIV, OVI and SiIV gas and infer the metallicity of the IGM. In so doing, we will examine the enrichment history over the past 10 Gyr (which includes the peak in the cosmological star formation history), as well as provide a zero-point for comparisons against measurements at z>2. We will also study the intensity and nature of the low-z extragalactic UV background, and measure the galaxy/absorber cross-correlation function for a subset (~15) of the sightlines. Altogether, this program will provide key constratins on metal production and transport processes including galactic winds, pregalactic enrichment, and AGN outflows.
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Proposal Category: AR

Scientific Category: AGN/QUASARS
ID: 10680
Title: AGN outflows and their three-dimensional nature
PI: Daniel Proga
PI Institution: Princeton University

We propose to study the three-dimensional nature of AGN outflows.To some degree one can interpret and model the outflows assuming axial symmmetry. However, HST observations show directly and indirectly that AGN outflows are very asymmetric. Axisymmetric radiation driven disk wind models, such as developed by us, have sufficient predictive power to make direct contact between theory and observations. Our model can successfully explain launching and acceleration of AGN winds as well as predicts synthetic line profiles which are consistent with highly blueshifted absorption lines. However, the model seriously underestimates the line emission and does not predict multicomponent absorption. Thus, the model does not fully capture the complex wind geometry. Because the model has many successes, the above difficulties suggest that the model is incomplete rather than wrong. Therefore, we plan to take the natural step of generalizing the model to three-dimensions and address the above issues within a relatively simple disk wind scenario. We will continue to use the multi-dimensional, time-dependent, magnetohydrodynamical code ZEUS to compute the wind structure. We will also compute synthetic line profiles and continuum spectra based on the theoretical model. We plan to broaden our focus and consider the problem of line emission as well as line absorption. The key element of our project is a comparison of our synthetic profiles with HST and other observations.

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Proposal Category: AR
Scientific Category: COOL STARS
ID: 10681
Title: Corkscrew Structures and Precessing Jets
PI: Raghvendra Sahai
PI Institution: Jet Propulsion Laboratory

Collimated jets are one of the most intriguing, yet poorly understood phenomena in astrophysics. Jets have been found in a wide variety of object classes which include AGNs, YSOs, massive X-ray binaries (e.g. SS433), black hole X-ray transients, symbiotic stars, supersoft X-ray sources, and finally, planetary and preplanetary nebulae (PNs & PPNs). In the case of PNs and PPNs, we have propsoed that wobbling collimated jets are the universal mechanism which can shape the wide variety of bipolar and multipolar morphologies seen in these objects. Most of our knowledge of post-AGB jets is indirectly inferred from their effects on the circumstellar envelopes of the progenitor AGB stars and, for that reason, these jets remain very poorly understood. Thus the mechanism that powers and collimates these jet-like post-AGB outflows remains as one of the most important, unsolved issues in post-AGB evolution. We propose an archival study of two bipolar PPNs, motivated by two recent discoveries which indicate that precessing jets are likely to be operational in them, and that the properties of the jets and the bipolar lobes produced by them, may be directly measured. One of these is IRAS16342-3814 (IRAS1634), previously imaged with WPFC2, in which new Adaptive Optics (AO) observations at near-IR wavelengths show a remarkable corkscrew-shaped structure, the tell-tale signature of a precessing jet. Inspection of WFPC2 images of another PPN, OH231.8+4.2 in which we have recently discovered a A-type companion to the central mass-losing star, shows a sinuous nebulosity in a broad-band continuum image, resembling a corkscrew structure. We will use the latter to constrain

the phsyical properties of the jet (precession period, opening angle, jet beam diameter, temporal history) in OH231.8. Using the multi-wavelength data on both sources, we will build models of the density distribution of the lobes and their interiors. In the case of IRAS1634, these models will be used to investigate the hypothesis that the HST images do not show the corkscrew structure because of opacity effects. Under the assumption that the jets are driven by an accretion disk around the companion, we will use theoretical relationships between disk precession and binary rotation period to estimate the properties of the binary (period, separation). The results of this study will provide quantitative constraints for jet-driven shaping of PNs and inspire new models for the launching of jets from accretion disks in dying stars with binary companions.

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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM
ID: 10682
Title: Tracing Baryons in the Warm-Hot Intergalactic Medium with Broad Ly-alpha Absorption
PI: Blair Savage
PI Institution: University of Wisconsin - Madison

Cosmological hydrodynamical simulations predict that at the present day 30% to 50% of the baryons reside in the warm-hot intergalactic medium (WHIM). Directly detecting this gas is difficult but extremely important for tracing the evolution of baryons in the evolving universe. The best evidence so far for the WHIM comes from OVI absorbers seen toward background quasars. However, estimating the total baryon content depends on assuming a metallicity. We have recently discovered that the WHIM may also be detectable in the form of thermally broadened Ly-alpha absorption, for which the estimate of baryonic content is not dependent on an assumed metallicity. We have found many broad Ly-alpha lines toward three quasars with dN/dz(BLya)~50 for EW>30mA. In a few cases we also see accompanying OVI absorption with b(HI)/b(OVI)~4, the ratio expected if the broadening is thermal. We propose to analyze all broad Ly-alpha absorbers toward the other eleven quasars for which high S/N STIS-E140M and FUSE data exist. We will determine whether the broad to narrow absorbers are thermally broadened or composed of narrower multiple components. Finding associated metal lines will aid the analysis and will provide estimates of the metallicity of the WHIM. We will study the relation between the HI column density and line width. We will compare the properties of the low and high-redshift Ly-alpha absorption in order to search for the expected increase in the relative number of broad to narrow absorbers with decreasing redshift. We will use our results to estimate the baryonic content of the gas in the WHIM between 10^5 and 10^6 K and to obtain a revised estimate of the baryonic content of the cooler photoionized IGM at low redshift.

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Proposal Category: AR
Scientific Category: GALAXIES
ID: 10683
Title: S0 Evolution from Archival HST Images
PI: James Schombert
PI Institution: University of Oregon

This is an archival project to study the structural properties of S0 galaxies as a function of redshift. S0 galaxies divide into those with bulge+disk structure (classic S0's) and those composed of a pure exponential disk

structure (lenticulars). While studying the structural properties of the blue Butcher-Oemler population in distant clusters, we discovered that intermediate redshifts clusters are rich in B+D type S0's, but in nearby clusters the S0 population is dominated by lenticulars. The hypothesis to be tested is that B+D S0's are stripped of their disks at intermediate redshifts to become ellipticals, while the blue population fades into lenticulars. Secondary goals are to trace the structural parameters of the red population with redshift, compare structure parameters with morphological classifications and select candidates for kinematic studies. This study is the structural equivalent of morphological studies where the galaxy's surface brightness profile is used to classify systems rather than the Hubble scheme.
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Proposal Category: AR
Scientific Category: STAR FORMATION
ID: 10684
Title: Multiwavelength Analysis of the Star Formation Process in M51
PI: Paul Scowen
PI Institution: Arizona State University

We propose to use the data from the ACS/WFC 10452 imaging survey of M51 to study in detail the structure, dynamics, stellar populations and ongoing star formation in this unique galaxy. We intend to (1) Investigate the morphology, ionization structure, and internal reddening of an unbiased sample of HII regions in a range of galactic environments; (2) Study the relationship between HII region structure and ground-based integrated line ratios and fluxes; (3) Compare HII region structure within M51 with regions in diverse environments; (4) Investigate systematic changes in HII region structure as a function of position within the galaxy (specifically inner disk vs. outer disk and arm vs. interarm); and (5) Examine the relationship between HII region structure and the characteristics (determined from ground based data) of the ubiquitous warm ionized phase of the ISM. Using the broadband filters we will 1. Observe colors and magnitudes of individual sources within HII regions covering a range in luminosity and galactocentric radius within M51, 2. Using UV photometry of HII regions (from GALEX) as a means to improve constraints on bolometric luminosities and thus the scales of the star-forming events, 3. Comparison of the census of the stellar contents of HII regions with Halpha luminosities will be used to probe the evolutionary phase of the HII regions, 4. The stellar data will be used to study of the relationship of the stellar content of both normal and supergiant HII regions with HII region morphology, ionization structure, and integral properties, 5. Measuring recent star-forming histories in the areas surrounding HII regions, 6. The photometric data will give us information on luminosity functions within and surrounding HII regions. We intend to map in detail the star forming environments (HII regions) in the inner and outer disk to assess the impact of the galactic interaction on the global star formation process as well as how material is being channeled in and out of star forming regions. We will directly compare the structural and evolutionary properties of the star forming complexes with the apparent extinction from both FUV and FIR (Spitzer) datasets to resolve the inconsistency in the measurement of the current star formation rates from the 2 bands, and use the high resolution images to establish the real physical distribution of dust in the galactic disk. We intend to use the underlying stellar populations as well as the observed structure and distribution of current and ongoing star formation to characterize the relationship between FIR (24micron) and optical tracers of star formation. In addition we will use the HII region sample to gauge the local SF history as a function of position

and determine the role of environment and triggers on the rate and efficiency of the process.
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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10685
Title: The co-evolution of spiral structure and mass distribution in disk galaxies
PI: Marc Seigar
PI Institution: University of California - Irvine

We propose to use a new diagnostic tool to study the mass buildup in disk galaxies as a function of look-back time out to z~1. The tight correlation between spiral arm pitch angle and rotation curve shear rate (Seigar et al. 2005) demonstrates that the tightness of spiral structure in disk galaxies depends on the central mass concentration (including dark matter), as this determines the shear rate. Galaxies with high central mass concentration have a higher shear rate and more tightly wound spiral structure than those with low mass concentration. As a result, the evolution of spiral structure over time can be used to search for evolution in the mass distribution in spiral galaxies. The main goal of this project is to determine evolution in the mass distribution of disk galaxies, using spiral arm pitch angles as a quanitative indicator. In order to do this we will use nearly face-on disk galaxies with measurable spiral structure, observed in the GOODS fields.
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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10686
Title: Evolution of Molecular Gas and the Origin of Cometary Knots in Planetary Nebulae
PI: Angela Speck
PI Institution: University of Missouri - Columbia

Planetary Nebulae (PNe), as the final phase of evolution for intermediate mass stars, are major contributors to the enrichment of the interstellar medium (ISM). In PNe, a hot central star illuminates a gas and dust shell which was ejected during earlier evolutionary phases. UV radiation from the star creates an ionized region bounded by neutral gas and molecules. A better understanding of the nature of the molecular and ionized gas envelopes of PNe is important to our understanding of the evolution of PNe and their contribution to the enrichment of the ISM. Knots and filaments in the ionized gas images of PNe are common, if not ubiquitous. Additionally, it has been shown that molecular gas exists inside dense condensations within the ionized regions, but the origins of these clumps are not known. We propose to study the morphologies of both molecular and ionized gas for five PNe that have been imaged by both WFPC2 and NICMOS (at the 2.12um H2 line). The structure and appearance of the knots in ionized and molecular gas for each PNe can be compared to assess the evolutionary status of the molecular clumps and how it is affected by the evolutionary status of the whole PN. This will aid our understanding of the origin of the molecular knots, and the enrichment of the ISM by dying intermediate mass stars.
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Proposal Category: AR
Scientific Category: QUASAR ABSORPTION LINES AND IGM

ID: 10687
Title: Are Our Ideas About Quasar Absorption Lines Consistent with Galaxy Images?
PI: David Turnshek
PI Institution: University of Pittsburgh

We propose to develop a new, more physical method to describe QSO absorption-line statistics and their relationship to galaxies visible in the sky. We propose to apply this method to the Hubble Ultra Deep Field (UDF). Using results on QSO absorption-line statistics and direct observations of galaxies that give rise to QSO absorption lines, we will develop a prescription for the gaseous cross-sections surrounding galaxies. We will apply this prescription to the UDF galaxies, simulate sightlines through the UDF galaxies, and infer QSO absorption-line statistics which are expected given the observed UDF galaxy properties. The prescription will be iterated until consistency with observed QSO absorption-line statistics is obtained. We believe that such a study can help bridge the gap between traditional QSO absorption-line and galaxy imaging surveys.

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Proposal Category: AR
Scientific Category: COSMOLOGY
ID: 10688
Title: High resolution simulations of the low redshift intergalactic medium
PI: David Tytler
PI Institution: University of California - San Diego

We propose to use the hydrodynamic code Enzo to run the first adaptive mesh refinement (AMR) simulations of the Lyman alpha forest to z=0 that have the size, resolution and parameter values to permit precise quantitative comparison with redshifted H I absorption lines in hundreds of HST QSO spectra from FOS, GHRS, and STIS. We will explicitly explore the effects of the intensity of the ionizing radiation (UVB) and the amplitude of the matter power spectrum. We will derive scaling relations between the simulation input and the statistics of the output Lyman alpha forest, which we will use to estimate the parameters that best match the Lyman-alpha forest in HST spectra. We expect two immediate results. First, we will discover whether popular values for cosmological parameters and UVB provide a precise description of the Lyman-alpha forest at z < 1.6. Second, we will make more accurate measurements of the evolution of the intensity of the UVB. The simulations will be useful for a wide variety of studies of the redshifted absorption in QSO spectra, such as the distribution of metals including O~VI absorption that traces the warm-hot intergalactic medium. We will make the simulated absorption spectra and the raw simulation box data available to the community through our site http://www.cosmos.ucsd.edu/~gso/index.html.

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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10689
Title: Host Galaxy Morphologies and SEDs of High Luminosity AGN
PI: Claudia Urry
PI Institution: Yale University

We propose to study the morphologies and environments of 482 X-ray selected AGN host galaxies and a comparison sample of thousands of normal galaxies in

the GEMS field, also known as the Extended Chandra Deep Field South (ECDFS), a 30' x 30' field centered on the much smaller GOODS field. The AGN are selected from a recent deep Chandra survey of the ECDFS. The combination of HST, Chandra, Spitzer, and multi-band ground-based data in this field is unique apart from GOODS, and because the ECDFS is larger and shallower, it samples luminous quasars rather than the lower luminosity AGN found in GOODS. The HST data are critical for determining the AGN host morphologies, host galaxy evolution, and obscuration, up to z~1. We will compare the results for luminous quasars in the GEMS area to those obtained for low-luminosity AGN in the GOODS area, using identical measurement techniques. This study, combined with our ongoing work in the GOODS area, will determine whether AGN hosts are identical to normal galaxies or are significantly influenced by the nuclear activity.

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Proposal Category: AR
Scientific Category: STELLAR POPULATIONS
ID: 10690
Title: The Local Environments of Supernovae
PI: Schuyler Van Dyk
PI Institution: Jet Propulsion Laboratory

The locations of supernovae (SNe) in the local stellar and gaseous environment in galaxies, as measured in high spatial resolution WFPC2 and ACS images, contain important clues to their progenitor stars. They provide accurate determinations of any association of SNe with H II regions or star clusters. In cases where multi-filter observations are available, we can determine the local stellar population, setting constraints on the mass of the progenitor, we can also search for possible attenuation of the SN by dust in the host galaxy by studying the colors of the stars in its environment. By checking the fields for background sources, we can correct the existing SN light curves and luminosities if necessary. When a SN has been observed incidentally, information can be gained on its optical and UV emission. Deep HST images can be used to find light echoes of SNe, as well as recover SNe interacting with circumstellar material at very late times. A direct search for the progenitor stars of SNe can be made in pre-existing HST images of their locations; as the number of archival HST images steadily increases, along with the number of newly discovered SNe, positive identifications become progressively more likely. In Cycle 14, we plan to extend our successful work from previous cycles. This proposal is complementary to our Cycle 14 snapshot proposal for an ACS imaging survey of the sites of nearby, relatively recent supernovae, whose primary purpose is to obtain late-time photometry of SNe and to pinpoint their locations (to help in the hunt for their progenitor stars).

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Proposal Category: AR
Scientific Category: AGN/QUASARS
ID: 10691
Title: Accuracy of Quasar Black Hole Mass Estimates
PI: Marianne Vestergaard
PI Institution: University of Arizona

We propose to quantify the accuracy to which black hole masses in high-redshift quasars can be estimated by using single-epoch spectra and scaling relationships that relate broad-line region size to luminosity. This study will be based on the large existing databases of UV and optical HST spectra and ground-based optical spectra from previous monitoring programs on the 36

active galactic nuclei with reverberation-based black hole mass measurements. Scaling relationships based on reverberation results can be and are already being used to estimate black hole masses at high redshift, as they are easy to use and it is the only method of mass estimation that is at present straightforwardly extendable to large samples of distant, luminous quasars. Knowledge of the efficacy, accuracy, and limitations of the methods used to estimate black hole masses at high-z is crucial to our quest to advance our understanding of structure growth and evolution in the early Universe. This study will also address the systematic errors that can be encountered when applying this methodology to narrow-line Seyfert 1 galaxies. We will consider in detail the slope of the radius-luminosity relationship for the C IV emission line in light of recent HST evidence that the slope of this relationship differs from that of the radius-luminosity relationship for the Balmer lines.

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Proposal Category: AR
Scientific Category: ISM AND CIRCUMSTELLAR MATTER
ID: 10692
Title: An Archival Survey of Interstellar Abundances in the Magellanic Clouds
PI: Daniel Welty
PI Institution: University of Chicago

Studies of the interstellar medium in the Magellanic Clouds explore somewhat different environmental conditions from those typically probed in our own Galactic ISM. Apart from a few studies of individual sightlines, however, little is known about the abundances and depletions in the ISM of the LMC and SMC. HST spectra of three SMC stars indicate that Si and Mg (generally thought to be major dust constituents) are essentially undepleted in the SMC gas --- even for components with severe depletions of Fe and Ni. Similar "anomalous" Si depletions have now been seen in cycle 12 STIS spectra of one LMC star, though "normal" Si depletions are seen toward a second. Intriguingly, the "anomalous" Si depletions are all found for sightlines which probe regions where the 2175 A extinction bump is either absent (most of SMC) or very weak (LMC2). We therefore propose an archival survey of interstellar absorption lines toward ~40 stars distributed throughout the LMC and SMC, using STIS E140M and E230M spectra originally obtained for stellar studies. The spectra include lines from species such as Mg II, Si II, S II, Cr II, Fe II, Ni II, Zn II, and several trace neutral species --- allowing the abundance/depletion patterns to be determined at many locations in the two galaxies. The analysis of these spectra will have significant implications for (1) making models of interstellar dust grains (which currently rely heavily on silicates); (2) understanding the relationships between depletions, dust, and H_2 (which may be somewhat different in the Milky Way, LMC, and SMC); and (3) interpreting the gas-phase abundances observed for more distant low-metallicity systems, such as the QSO absorption-line systems (which exhibit some similar properties).

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10693
Title: Treating the UV and X-ray Spectral Regions Self-Consistently: Developing an Enhanced Stellar Atmosphere Code
PI: Janos Zsargo

PI Institution: University of Pittsburgh

We propose to implement plasma emission calculations into our widely used stellar atmophere code (CMFGEN) to treat all relevant spectral regions, X-rays, UV, optical, and IR self-consistently. This new version of CMFGEN will allow the stellar community to maximize the information return from modelling efforts and utilize all available observations simultaneously. The enhanced version will also help to clarify the effects that X-rays have on the ionization state of the cool wind and allow for the correct interpretation of STIS and GHRS spectra of wind-sensitive lines. X-rays, via Auger ionization, are important in high density winds because they produce observable quantities of super-ions, like N V and O VI. On the other hand, preliminary results show that X-rays dominate the wind ionization balance in OB stars with low mass-loss rates. X-ray ionization MUST be considered in such stars if mass-loss rates and abundances are to be correctly inferred from UV wind lines. Accurate mass-loss rates are crucial for stellar evolution calculations, while abundances provide invaluable insights into stellar evolution.

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Proposal Category: AR
Scientific Category: HOT STARS
ID: 10694
Title: NGC 6681: The Deepest Ultraviolet Observations of a Globular Cluster
PI: David Zurek
PI Institution: American Museum of Natural History

The globular cluster NGC 6681 (M70) has been imaged in the ultraviolet 605 times on 53 occasions resulting in the largest dataset in the far ultraviolet and near ultraviolet that has ever been taken for a globular cluster. The investment in time (about 54 orbits) is not insignificant and has fantastic science possibilities. We propose to retrieve all of these images and discover the various stellar populations, the variables and exotic stars. This study will result in the deepest ever far ultraviolet and near ultraviolet survey of a globular cluster.

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