Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15627

Program Title: CLUES to galaxy evolution: young star clusters as engines of galactic feedback

Principal Investigator: Angela Adamo

PI Institution: Stockholm University

As a result of the unmatched HST capabilities, UV-optical imaging surveys are providing a complete view of the young stellar cluster (YSC) formation and evolution process in nearby galaxies. With the CLuster in the Uv as EngineS (CLUES) progam, we will take the next major step forward to probe how YSC feedback impacts the galactic interstellar medium (ISM). We propose to use young (<~10 Myr), UV bright star clusters as powerful FUV beacons to study the kinematics of the warm neutral ISM in a selected sample of galaxies, representative of the star formation in the local universe. YSCs are favored sites for massive star formation, hence carriers of radiative and mechanical feedback. Studies of the YSC populations in nearby galaxies are revealing changes in the clustering nature of star formation as a function of galactic environment. Simulations suggest that YSCs of similar mass and age may have different impacts in dwarf and spiral galaxies. CLUES will enable us to probe how variations in clustering, galactic environment, and cluster age correlate with the outflow strength and thus gather unique direct evidence of the role played by YSC feedback in galaxy evolution. The FUV spectroscopy will simultaneously produce fundamental information about the shape of the IMF, the number of very massive stars, and the ages of the stellar populations that ignite the engines. CLUES will become a fundamental reference sample for the upcoming JWST and ELT FUV rest-frame spectroscopy of star-forming galaxies at redshifts beyond the peak of the cosmic star formation history.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Galaxies and the IGM
ID:	15663
Program Title:	REsolving QUIEscent Magnified (REQUIEM) Galaxies: Uncovering Formation Pathways via Spatially Resolved Gradients at z=1.6-2.9

Principal Investigator: Mohammad Akhshik

PI Institution: University of Connecticut

An unexpected - and HST-driven - discovery of the last decade is the remarkable compactness of the quiescent progenitors of today's most massive elliptical galaxies. Although some consensus exists about how these early galaxies grow through merging to become present-day ellipticals, the details of the formation of such dense objects are hotly debated. Although formation models predict unique observational signatures that are imprinted on the stellar populations and structures, these galaxies are often barely resolved, even with HST and similarly in the future with JWST. Strong gravitational lensing can provide an unmatched improvement in spatial resolution, and, despite these objects' low space density, we have identified a unique sample of eight strongly lensed high-redshift (1.6<z<2.9), massive (10.5<logM*<11.7) quiescent galaxies at this pivotal epoch. We propose to use WFC3/G141 grism spectroscopy to measure age gradients in the inner cores (<1kpc) of the to-date most comprehensive sample of strongly lensed massive quiescent galaxies, building upon a successful pilot program and existing HST data. Our analysis will combine deep G141 grism spectroscopy with a wealth of existing rest-frame FUV-optical HST and Spitzer/IRAC imaging. Exploiting this unrivaled spatially resolved dataset, we will characterize the stellar populations and dust content of the premier sample of quiescent galaxies to provide strong constraints on the physical mechanisms driving massive galaxy evolution in this key phase of their formation.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Stellar Populations
ID:	15630
Program Title:	A Full Characterisation of the Multiple Population Properties of Young Globular Clusters

Principal Investigator:	Nate	Bastian
PI Institution:	Liverpool John Moores University	

Recent HST surveys of massive stellar clusters in the Galaxy and Magellanic Clouds have opened an entirely new window on the phenomenon of multiple populations (MPs, i.e. star-to-star abundance variations within clusters). First, the HST Galactic GC UV Legacy survey has found a strong trend between the present day mass of ancient globular clusters (GCs) and the properties of the multiple populations within them, namely an increase in the fraction of chemically anomalous (a.k.a. enriched or second generation) stars as a function of cluster mass. Secondly, the Magellanic Cloud survey has found a strong correlation between the cluster age and the properties of the MPs (at a fixed mass), with clusters younger than 2 Gyr not showing abundance variations and clusters above this age, showing them. Additionally, from 2 to ~10 Gyr the survey found an increase in the abundance spread ([N/Fe]) with increasing age.

These two surveys applied different strategies so that unfortunately the results are not directly comparable. Here we propose to put the two surveys on the same footing by observing a sub-sample of the Magellanic Cloud clusters with the F275W filter. By using the newly developed "chromosome maps" (exploiting the F275W, F336W, F438W, and F814W images) we will be able to directly compare the young, intermediate and ancient clusters in a homogeneous manner. It will also allow us to trace the evolution of MPs (in terms of their detailed abundances in N, O, and He), as a function of age. These observations will hopefully lead to new theories for the origin of MPs in an entirely unexpected direction from all previous work.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	AR
Scientific Category:	Galaxies and the IGM
ID:	15631
Program Title:	Physically Consistent Galaxy Stellar Masses and Star Formation Rates From z=0 to z=10
Principal Investigator:	Peter Behroozi
PI Institution:	University of Arizona

We propose a forward modeling approach that will self-consistently combine multi-epoch and multi-waveband data and reduce uncertainties in recovering galaxy stellar masses and star formation rates from current ~0.35 dex levels to the 0.15 dex level or less, benefiting both observers and theorists. Key outcomes include: a fully physical, self-consistent picture of galaxy stellar masses and star formation histories from z=0 to 10; significantly reduced uncertainties on the evolution of galaxies in dark matter halos; mock catalogs for arbitrary current and future surveys that simultaneously match currently observed galaxy number densities, colors, and clustering; and public code to enable easy incorporation of future datasets as they become available.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Planets and Planet Formation
ID:	15628
Program Title:	A search for sub-Jupiter mass companions to young planetary mass brown dwarfs

Principal Investigator:	Beth Biller
PI Institution:	University of Edinburgh, Institute for Astronomy

We propose for HST WFC3 follow-up imaging of a newly discovered population of brown dwarf / planetary mass members of Taurus and Serpens, with the goal of imaging the lowest mass object to date, potentially down to sub-Jupiter mass objects. The number of known L-type planetary mass objects in Taurus has increased by an order of magnitude in the last two years, from 1 known L to 16. L-type members of Taurus have estimated masses of 2-7 MJup at ages of 1-10 Myr, thus any companions to these objects will have even lower masses. Thus, this is the first chance to probe multiplicity properties for a purely planetary mass population. This project potentially offers the opportunity to study the atmospheres of sub-Jupiter mass objects similar to those that will be eventually imaged around young stars with future ELT instrumentation and missions such as LUVOIR. HST is critical for this project. HST WFC3 is the only instrument capable of high-resolution imaging in and out of the 1.45 um water absorption feature which uniquely identifies substellar and planetary mass objects. Using a reddening insensitive index built from photometry in the F850LP, F127M, and F139M filters, we will be able to immediately distinguish bonafide companions from the reddened background stars that are the dominant source of contaminants.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Solar System

ID: 15625

Program Title: Composition and physical processes of the inner coma of Comet 46P/Wirtanen

Principal Investigator: Dennis Bodewits

PI Institution: Auburn University

Comet 46P/Wirtanen passes Earth with an historic closest approach distance of 0.077 au (12 million km) on 16 Dec. 2018. Its apparition is widely anticipated by planetary scientists and is the target of an organized world-wide observing campaign. We request HST STIS and COS observations of comet 46P/Wirtanen to create a comprehensive picture of the comet. We will measure its chemical composition (including H2O, CO2, CO, O2, and S2), investigate its hyperactivity by mapping the gas distribution, and to use the comet as a natural laboratory to study plasma processes that affect the gas in its coma. The unique close proximity of 46P allows us to study the inner part of the coma (within 100 km of the nucleus), a region rarely accessible to remote observations. These observations will allow us to detect the emission of short-lived species (such as S2, O2), of molecules not accessible from the ground (CO2), and to investigate the transitions between regions where either electrons or photons drive most of the chemistry in the coma. Finally, studies of comet Wirtanen around the time of its close approach to Earth will have spatial resolutions high enough to permit valuable comparisons to the Rosetta observations of 67P/Churyumov-Gerasimenko and the Deep Impact/EPOXI fly-by results of 103P/Hartley 2.

HST's sensitivity and spectroscopic abilities in the Far Ultraviolet makes it uniquely capable to simultaneously measure the highly diagnostics FUV gas emission features in the coma. HST cycle 26 offers the rare opportunity to measure the spatial profiles of these emission features at very small distances from the nucleus due to the close approach of 46P at perihelion.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR

Scientific Category: Stellar Populations

ID: 15632

Program Title: Expanding HST's Astrometry Legacy: A Comprehensive Astrometric Calibration of WFPC2

Principal Investigator: Dana Casetti

PI Institution: Southern Connecticut State University

High-precision astrometry is in the process of revolutionizing our understanding of the local universe. HST's contribution to this endeavor has been tremendous and complements that of the dedicated astrometry mission Gaia. The astrometric success of HST has been achieved due to a dedicated effort in calibrating instruments such as ACS/WFC and WFC3/UVIS. Here it is proposed that a comprehensive astrometric calibration of WFPC2 be undertaken, thus expanding the time baseline of HST proper-motion studies by 10-15 years and impacting areas of research that are currently very challenging, such as proper-motion measurements in globular cluster cores.

The proposed calibration process will make use of all appropriate images in filters F555W, F606W and F814W (of the order of thousands of exposures) over the life span of WFPC2. Gaia DR2 and HST standard astrometric catalogs (based on other cameras) will be used to map both low- and high-frequency distortion features, as well as CTE and possible manufacturing defects in WFPC2. Corrections for these will be developed that are functions of time, filter, and other observing parameters of the WFPC2 data. The outcome of the project will be a calibration methodology, code to apply the astrometric corrections, a WFPC2 position catalog, and proper-motion studies of two globular cluster cores, 47 Tuc and NGC 6341.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Populations

ID: 15649

Program Title: Clusters, Clumps, Dust and Gas in Extreme Star-Forming Galaxies

Principal Investigator: Rupali Chandar

PI Institution: University of Toledo

We propose to complete multi-wavelength broad- and narrow-band imaging, from the ultraviolet through the near-infrared, of a sample of 13 of the most extreme star-forming galaxies found in the nearby (D < 100 Mpc) universe. These include massive and dwarf, interacting and isolated, dusty and nearly dust-free galaxies. The intense star formation in these galaxies can result in the formation of extremely massive young star clusters, in excess of a million solar masses, similar to the most massive known ancient globular clusters and 1 -2 orders of magnitude more massive than any young cluster found in nearby quiescent/normal star-forming galaxies. The properties of clusters and larger scale star-forming clumps in intense star-forming environments are required to address a number of outstanding issues, including whether the fraction of stars in bound clusters or the upper cutoff in cluster mass functions increases with star formation intensity, and how long the clumps survive. Our results will differentiate between various assumptions and prescriptions for feedback used in the current generation of cosmological hydrodynamic simulations. The multi-wavelength observations will allow us to constrain dust geometry, and begin to peer through the dust to discover some of the clusters obscured at UV and optical wavelengths, work that will be completed by JWST. A similar suite of benchmark HST observations of normal, nearby galaxies already exists as part of the LEGUS project, and will be used as a reference to quantify the extreme star formation in our sample.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	AR
Scientific Category:	Stellar Populations
ID:	15633
Program Title:	The stellar dream team: Combining HST and Gaia to derive precise Proper Motions of resolved stellar populations.

Principal Investigator:	Andrés	del Pino Molina
PI Institution:	Space Telescope Science Institute	

The exquisite astrometric capabilities of HST have allowed us to measure proper motions (PMs) for many stellar systems in the Local Group. However, PMs require two epochs of observation which are not always available. PM precision depends on the time baseline of the observations, and on the feasibility of background galaxies to define an absolute reference frame, which are unfortunately not optimal in many cases. The second Gaia data release (DR2) offers unprecedented spatial coverage by providing PMs across the whole sky. However, Gaia's relatively short time baseline limits its highest PM performance to relatively bright stars. The positional error of DR2 is the same as a single HST exposure at G~18 mag and rapidly increases for fainter magnitudes.

Here, we propose to develop tools that will combine HST archival images with Gaia measurements to derive PMs for stars at G~18 mag and fainter. This will increase the scientific impact of both observatories beyond their individual capabilities by providing a second epoch observation for any HST archival image, and improving the PM accuracy for any faint source (G > 18) in the Gaia catalog observed by HST more than 5 years ago.

As specific applications, we will obtain precise PMs for stars in at least 4 dSphs, and thereby constrain their mass profiles and internal 3D dynamics. We will measure precise PMs for stars in a sample of GCs drawn from the distant and low-mass portions of the population, which we will use to study various aspects of their internal kinematics and put them in context with other GCs. Our source catalogs and tools will be made public so they may benefit the whole astronomical community.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Physics

ID: 15641

Program Title: Focus on Betelgeuse

Principal Investigator: Andrea Dupree

PI Institution: Smithsonian Institution Astrophysical Observatory

Multiple ultraviolet spectra of the nearby red supergiant, Betelgeuse, using STIS will enable spatially resolved measures of chromospheric structure and mass inflows and outflows. An HST campaign of 3 cycles will be complemented by multi-frequency photometry, spectroscopy, interferometry, and polarimetry at radio, infrared, and optical wavelengths in order to map surface structures and their variability, and the extended outer atmosphere over both the short (400-day) and long secondary (2000-day) periods of this supergiant. These observations, coupled with detailed modeling and simulations, will probe the structure, the dynamics, and the mass loss from Betelgeuse in unprecedented detail and provide crucial insights into the atmospheric physics and wind-driving mechanisms of red supergiants.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Cosmology

ID: 15642

Program Title: An Independent Determination of the Hubble Constant

Principal Investigator: Wendy Freedman

PI Institution: University of Chicago

Constraints on Ho, based on cosmological modeling of the Planck data and local values based on the Cepheid distance scale tied to Type Ia supernovae (SNe Ia), differ by several sigma. It is not yet understood whether this tension is a result of systematic errors, or perhaps an indication of fundamental physics beyond the standard cosmological model. Our aim in this proposal is straightforward: increase the number of galaxies with well-measured distances using the Tip of the Red Giant Branch (TRGB) for the calibration of SNe Ia. TRGB distances can be precisely and accurately measured out to distances of 30 Mpc using HST. Out to these distances, their precision and accuracy rivals that of the Cepheid Leavitt Law. Moreover TRGB measurements in the halos of galaxies offer many advantages over Cepheids, including decreased sensitivity to dust; and they are less affected by crowding than measurements in the disks of galaxies. Most importantly for our purposes, the TRGB measurements, in combination with future Gaia parallaxes, will provide an independent determination of Ho to an uncertainty of 1.5%, and a means of assessing the significance of the current tension in local versus high-redshift determinations of Ho.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Physics

ID: 15659

Program Title: The Missing Link in Massive Binary Star Evolution

Principal Investigator: Douglas Gies

PI Institution: Georgia State University Research Foundation

The path to the formation of neutron stars and black holes in massive X-ray binaries involves a post-mass transfer stage that has been observed in a only few objects, but an ultraviolet survey has now detected a dozen such systems at this key stage. Close pairs of massive stars are destined to interact and exchange mass and angular momentum in ways that transform both stars. The mass gainer star is spun up to near critical rotation, while the mass donor is stripped of its envelope to reveal the hot, He-burning core. These hot remnants are small and faint, lost in the glare of their massive companions. The best strategy to detect the hot cores is to obtain spectroscopy in the far ultraviolet where the remnants are relatively brighter and their spectra are rich in lines of highly-ionized atomic species. Five such systems are known from large sets of observations made with the International Ultraviolet Explorer Satellite, and the spectra reveal the sharp lines of the hot subdwarf together with the broad lines of a Be star, the rapidly rotating mass gainer star. A recent survey of over 3200 IUE spectra of Be stars led to the identification of 12 new Be + subdwarf binaries. We propose to obtain new HST/STIS spectroscopy of these systems and HD55606 to determine their orbital Doppler shifts, effective temperatures, and flux and mass ratios, so that subdwarf properties can be compared to evolutionary models in the H-R diagram. The comparison will test the idea that the detected systems reside in a bright, short-lived He-shell burning stage. If correct, then

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Solar System
ID:	15638
Program Title:	Auroral and magnetospheric context for Juno in situ instruments during Cycle 26

Principal Investigator:	Denis	Grodent
PI Institution:	Universite de Liege	

We are very fortunate that HST cycle 26 falls in the middle of an era of discoveries made possible by the extension of the NASA Juno mission, in polar orbit around Jupiter. The Juno spacecraft is currently exploring Jupiter's intricate magnetosphere and revealing unexpected connections between the charged particles filling it, mainly originating from the vigorous volcanic activity of its moons, especially Io, and Jupiter's powerful auroral emissions. In the upcoming phase of the Juno mission, the spin axis approaches a direction perpendicular to the orbital plane critically limiting the coverage of the remote-sensing instruments. Hence, the role of HST to provide the necessary global context for the in-situ instruments is even more crucial than in the previous stages of the mission. The present HST program incorporates lessons learned from previous ones and strategically focuses on the times during which HST remains the only observatory capable of making the needed high spatial and temporal resolution FUV observations, while Juno is traveling through the auroral source region. This medium campaign will yield high-impact results and significantly augment the science return of the NASA Juno mission.

The Juno era is a unique opportunity to sample Jupiter's magnetosphere in situ along with remote observations of its auroral emissions. This opportunity will not be replicated in decades.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15643

Program Title: The Cosmic Evolution of Circumgalactic Gas and Lyman alpha Halos

Principal Investigator: Matthew Hayes

PI Institution: Stockholm University

The Lyman alpha emission line (Lya) has recently fulfilled its decades-old promise to map the distribution of atomic gas around high-z galaxies: large, extended Lya halos are routinely discovered, and statistical samples are emerging. Unfortunately, at z>2-3 where this is systematically possible, galaxies are too faint, and poorly resolved to be studied in much detail, and the origin of these halos remains elusive. In the low-z universe, where galaxies' properties can be determined with high precision, the UV capabilities of HST have also made a huge impact. Lya halos are also common here and shown to result from resonance scattering, but the reported sizes are very different: halos become 3-10 times smaller, which hints at the cosmic evolution of circumgalactic gas. Absorption studies, however, show that the low-z CGM is still thick with HI, so why do the Lya halos disappear?

Another possibility is that almost every low-z galaxy imaged in Lya to date is too nearby to properly measure the CGM. Taking advantage of the UV initiative, we therefore propose to obtain deep Lya images and spectra of a new low-z sample that is nearby enough for high resolution, high SNR studies, but distant enough to capture CGM scales and halo sizes comparable to high-z. We will quantify the Lya scattering scales, search for low-z gas inflows, and detailed radiation transfer modeling will constrain density and clumping of the circumgalactic gas. This optimized sample will provide the anchor point for cosmic evolution studies that is ~10 Gyr later than high-z surveys, and will shed light on the formation process of cold gas in galaxy halos that is theoretically still not well understood.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Massive Black Holes And Their Host Galaxies

ID: 15650

Program Title: Ultraviolet Echoes of Quasar Accretion Disks

Principal Investigator: Yasaman Homayouni

PI Institution: University of Connecticut

We propose a pioneering ultraviolet monitoring campaign with WFC3/UVIS to measure quasar accretion disk structure as a function of black hole accretion rate. Measuring accretion-disk structure is the next frontier in understanding the growth of supermassive black holes, the bulk of which happens in rapidly accreting quasars. There is indirect evidence that accretion rate changes lead to dramatic changes in disk geometry and the strength and type (wind/jet) of the AGN outflow. But this has yet to be tested by direct observations, as only 5 previous AGNs, all with a narrow range of Eddington rates, have measured UV/optical disk sizes. We propose UV monitoring of 3 new quasars that span two orders of magnitude in accretion rate. The 3 new targets are drawn from SDSS-RM, a pioneering multi-object spectroscopic RM campaign, and have been monitored with optical photometry and spectroscopy since 2014. The higher luminosity and reliable RM masses of the sample are also accompanied by measured optical disk sizes. UV monitoring is the only missing ingredient to measure the full span of disk structure, probing the inner disk where accretion-rate effects are expected to be most dramatic. We use simulations to demonstrate that our 2-day cadence over 40 epochs will accurately measure continuum lags and accretion-disk structure. Ultraviolet monitoring of these 3 quasars will enable critical new measurements of accretion-disk structure during the rapid accretion mode that dominates black hole growth.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Galaxies and the IGM
ID:	15639
Program Title:	Lyman continuum leakage in z~0.3 - 0.4 dwarf compact star-forming galaxies with stellar masses < 1.e8 Msun

Principal Investigator:	Yuri Izotov
PI Institution:	Ukrainian National Academy of Sciences, ITP

One of the key questions in observational cosmology is the identification of the sources responsible for cosmic reionization. The general consensus is that a population of faint low-mass galaxies must be responsible for the bulk of the ionizing photons. However, until recently, attempts at identifying individual galaxies showing Lyman continuum (LyC) leakage have only found very few such galaxies, both at high and low redshifts. A breakthrough was recently achieved by Izotov et al. (2016ab, 2018ab), who detected LyC emission in eleven out of eleven low-redshift (z~0.3) compact star-forming galaxies (SFG) with LyC escape fractions of 2-72%, using HST/COS observations. However, all these galaxies have relatively high stellar masses > 1e8 solar masses while it is generally thought that the lower mass galaxies were the main sources of the reionization of the Universe. It is proposed here to extend previous studies to nine compact SFGs at z~0.3-0.4 with lower stellar masses in the range ~2e7 - 1e8 Msun, a range which has not been explored by HST/COS. This will allow to determine if they are also LyC leakers and if the LyC escape fraction continues to rise with decreasing stellar masses. Finally the requested COS observations will allow for the determination of the Lyman alpha line profile of these objects, providing thus an empirical probe of this indirect LyC leakage indicator. Since the low-mass compact SFGs share many properties with typical SFGs at high redshift this study will provide important insight on the sources of cosmic reionization.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15626

Program Title: The Low-Redshift Lyman Continuum Survey

Principal Investigator: Anne Jaskot

PI Institution: University of Massachusetts - Amherst

One of the primary science goals of JWST is to identify the sources responsible for reionizing most of the hydrogen in the universe in the first billion years after the Big Bang. However, at high redshift, the intergalactic medium absorbs the ionizing Lyman continuum (LyC) photons, making it impossible for JWST to directly identify these ionizing sources. Instead, JWST observations must rely on indirect indicators of LyC escape. Understanding and testing these indicators with LyC-emitting galaxies at lower redshift is critical.

Building on recent successful detections of LyC from z~0.3 galaxies, we propose to obtain the first large statistical sample of LyC measurements at low redshift. Our COS observations will reach LyC escape fractions of 5% for 67 z~0.3 star-forming galaxies. We will systematically test five proposed indicators of LyC escape, which are accessible to JWST at z>6: (1) high [O III]/[O II], (2) strong, narrow Ly-alpha emission, (3) weak low-ionization UV absorption lines (4) high star-formation surface densities, and (5) reduced H-beta equivalent widths. By spanning a range of parameter space, our sample will discriminate between the different proposed diagnostics, quantify LyC scaling relations and their scatter, and provide fundamental statistics on the LyC emission within different selected populations. Our theoretical modeling efforts will improve our understanding of indirect LyC diagnostics by simulating the expected spectra from LyC emitters with realistic galaxy geometries. This program will reveal how LyC emission correlates with galaxy physical properties, thereby providing crucial information for JWST studies of reionization.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Physics

ID: 15660

Program Title: Testing M Dwarf Mass Loss Across the Fully Convective Boundary

Principal Investigator: Christopher Johns-Krull

PI Institution: Rice University

Studies of the rotational distribution of open clusters show that the efficiency of stellar spin down dramatically decreases once stars become fully convective. It is generally understood that this stellar spin down is the result of magnetized stellar winds torquing down the stars as they age. The magnetic field properties of fully convetive stars suggest they should still efficiently spin down, yet they do not. One potential explanation is that the mass loss rates from dwarfs dramatically decreases once stars become fully convective. We will test this hypothesis using HST+STIS to measure astrospheric absorption in a sample of nearby M dwarfs to see if the winds of fully convective stars are significantly weaker as group relative to the partially radiative M dwarfs.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Massive Black Holes And Their Host Galaxies
ID:	15655
Program Title:	The first high resolution view of the full extent, morphology, and multi-phase nature of radio-loud and quiet AGN feedback with ACS+SBC

Principal Investigator:	Sean	Johnson
PI Institution:	Princeton University	

Energy and momentum released by AGN is thought to couple to the interstellar medium of the host and regulate star-formation in massive galaxies. AGN feedback mechanisms are often divided into two distinct physical modes: radio-loud and radio-quiet. Direct evidence of AGN feedback from radio-loud AGN has long been established. Recent observations of spatially and kinematically extended [OIII] emission around radio-quiet AGN demonstrate that the radio-quiet systems that dominate the quasar population can provide feedback as well. However, the morphology, multiphase nature, and mass of AGN outflows remain largely unconstrained. An exciting new technique to produce synthetic narrow-band images of HI Ly-alpha and OVI emission with the ACS+SBC for sources at z~0.26 has been successfully demonstrated for a starbursting galaxy (Hayes et al., 2016). We propose to obtain deep, high resolution narrow-band Ly-apha and OVI images of two luminous, obscured AGN at z~0.26 with recently discovered extended [OIII] outflows, one of which is radio-loud and one which is radio-quiet. The unique combination of redshift, known outflows, and dust obscuration acting as a natural coronagraph for these AGN provide a new opportunity to study AGN feedback in diffuse and coronal gas. The proposed UV images together with multi-wavelength data will measure the ionization state/mechanisms and masses of outflows from the two AGN feedback modes in a completely new way.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Planets and Planet Formation
ID:	15653
Program Title:	Optical coronagraphic imaging of debris disks newly resolved around young stars

Principal Investigator:	Paul	Kalas
PI Institution:	University of California - Berkeley	

Dusty debris disks trace the physical location of solid material in exoplanetary systems. High resolution images provided by HST, ALMA, and ground-based adaptive optics map the dynamical architecture with exquisite precision. Each observatory has unique but complementary strengths in terms of wavelength coverage and sensitivity at different angular scales. In the past, HST high-contrast imaging produced the first optical/NIR images of dust scattered light from debris disks. These observations have a remarkable legacy in terms of scientific impact, motivating multiple follow-up campaigns from the ground and significant theoretical work. However, H-band surveys for debris disks using GPI and SPHERE have recently created a list of newly resolved debris disks that have never been targeted by past HST programs. Here we propose to exploit the last remaining coronagraph aboard Hubble - STIS - to produce unique and comprehensive optical images of debris belts around these young stars. Our science goals are to deliver empirical knowledge of how planetary systems dynamically evolve at age 10 - 20 Myr, to quantify the physical properties of circumstellar dust grains, and to test if the fast outflowing dust features seen in AU Mic are a more general phenomenon of debris disks around M stars.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15654

Program Title: PHANGS-HST: Linking Stars and Gas throughout the Scales of Star Formation

Principal Investigator: Janice Lee

PI Institution: California Institute of Technology

We seek to build the first astronomical dataset charting the connections between young stars and cold gas, on the fundamental scales of star clusters and molecular clouds, throughout a diversity of galactic environments found in the local Universe. To enable this work, we propose to conduct HST UV-optical imaging for 38 galaxies from PHANGS, the principal ALMA Large Program for nearby galaxies, which has obtained CO (2-1) maps for all massive star forming systems where ALMA can detect molecular clouds and efficiently capture the star-forming disk. HST's high resolution and UV capabilities are required to identify young stellar associations and clusters, and accurately measure their ages and masses.

PHANGS-HST will yield an unprecedented catalog of ~100,000 star clusters, associations, and clouds to provide new constraints on star formation timescales, efficiencies, the evolution of multi-scale structure, and finally enable systematic study of their dependence on key galaxy-scale properties such as ISM phase balance, gas mass, star formation rate, surface densities, and galaxy morphology. These investigations are critical for informing a unified theory of star formation, gaining insight into galaxy scaling relationships such as the Kennicutt-Schmidt star formation law, and bridging the detailed study of star formation in Milky Way and select nearby galaxies, to the field of galaxy evolution. PHANGS-HST will produce a treasury of science and HST-ALMA joint data products which will be essential for maximizing the scientific return in a major area of study for JWST - dust embedded star formation - and will seed a wealth of community science in star formation and beyond.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR

Scientific Category: Galaxies and the IGM

ID: 15634

Program Title: A Comprehensive Study of Multiphase Gas in Absorption-Selected Galaxy Halos

Principal Investigator: Nicolas Lehner

PI Institution: University of Notre Dame

Observations of the circumgalactic medium (CGM) about galaxies are providing independent constraints on cosmological simulations tuned to match galaxies' stellar properties. We propose to produce a large statistical sample of CGM measurements at z<1 using the entire HST/COS G130M/G160M and G185M/G225M archive of QSO observations. We will select galaxy halos using ~300 strong HI absorbers, which have been demonstrated to probe dense gas in the CGM, including tidal material, feedback-expelled material, and intergalactic accretion. We will derive new metallicity estimates for all absorbers, marginalizing over EUV background uncertainties; we will use the ensemble of measurements to quantitatively describe the best ionizing background for deriving future ionization corrections. We will characterize the multiphase ionized gas associated with strong HI-selected galaxy halos using the full set of UV+EUV lines to trace all gas-phases of the CGM at T<500,000 K. We will quantify the dichotomy in the multiphase gas properties between metal-poor (~2% solar) and metal-rich (~40% solar) absorbers to understand the relationship of high ionization gas to accretion and feedback structures. Our survey, of unprecedented size for CGM studies, will provide empirical constraints needed to understand the mismatch between simulations and CGM observations. We will release over 650 fully continuum fitted, science ready COS spectra as part of this program, which will undoubtedly leads to several major ancillary discoveries.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Physics

ID: 15664

Program Title: New insights from gravitational waves combined with electromagnetic light

Principal Investigator: Andrew Levan

PI Institution: The University of Warwick

Multimessenger astronomy -- the use of light combined with non-photonic messengers such as gravitational waves or neutrinos -- has come of age in the past year, thanks to the discovery of emission across the electromagnetic spectrum from a gravitational wave detected merging neutron star binary, and the identification of at least one source of very high energy neutrinos. Here we propose to exploit the unique UV to near-IR abilities of HST, in combination with a large ground-based campaign, to pair gravitational wave and EM information for a range of merger events with varying inclinations and mass ratios. We will map out the diversity of transient behaviour, addressing many central questions in contemporary astrophysics, including; i) what is the contribution of binary neutron stars to heavy element enrichment across the Universe? ii) what is the local Hubble constant measured from gravitational waves, and how can HST determined distances enhance its accuracy? iii) what are the properties of jets launched during the merger, do all mergers create short GRBs for some observers? iv) what are the environments of the mergers, and what does this tell us about the channels to create the binaries? v) how do EM properties depend on binary parameters, particularly if one component is a black hole? The multimessenger era offers the ability to answer these questions for the first time. The capabilites of Hubble to observe outside atmospheric windows, with the spatial resolution to resolve point soures from complex backgrounds, and to track them beyond the limits of ground-based instrumentation will enable us to make pivotal contributions to this new, emergent field.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Stellar Physics
ID:	15651
Program Title:	The Origin and Impact of Flares in the Closest Planetary System- Proxima Centauri
Principal Investigator:	Meredith MacGregor
PI Institution:	Carnegie Institution of Washington

At a distance of only 1.3 pc, Proxima Cen is the closest extrasolar planetary system, and has long been known as a flare star, making it a benchmark case for exploring the potential effects of variability on the planet's properties. After the detection of a large millimeter flare was reported by MacGregor et al. (2018), the team was awarded 36 more hours of observations (project 2018.1.00470.S) to monitor the Proxima Cen system in 2019 with ALMA. In order to determine how stellar flaring emission correlates across the electromagnetic spectrum, simultaneous observations with other facilities across a broad range of wavelengths should be obtained along with the ALMA project. With the UV being the most critical wavelength to understand planet photochemistry and habitability, we propose to obtain simultaneous UV spectroscopy with HST in order to better constrain the properties of detected flares and their potential impact on planetary habitability. By undertaking this comprehensive, multi-wavelength monitoring campaign of Proxima Cen, we will execute the first truly panchromatic analysis of M dwarf flaring activity.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Stellar Populations
ID:	15629
Program Title:	MAssivE STaR Outflows (MAESTRO)

Principal Investigator:	Laurent	Mahy
PI Institution:	KU Leuven	

Massive stars are key components of galaxies. Characterized by high luminosities and strong outflows, their evolution is strongly impacted by the amount of mass and angular momentum lost through stellar winds. While previously deemed smooth and spherically symmetric, the outflows of massive stars are now found to be inhomogeneous, i.e. clumpy. This severely hampers earlier estimates of the mass-loss rate of hot massive stars and the validity of mass-loss recipes widely adopted in stellar evolution and population synthesis computations.
In the context, the MAESTRO (MAssivE StaR Outflows) project aims to achieve a comprehensive analysis of the wind structure by combining ultraviolet and optical observational diagnostics and a new generation of stellar wind models capable of a detailed treatment of clumping structure (including porosity and vorosity).

To derive meaningful results and improve on existing mass-loss recipes, we need to study
of a representative set of massive stars covering the upper Hertzsprung-Russell diagram (HRD) and in multiple metallicity environments (as required to investigate the cosmologically important metallicity dependence of the mass-loss rates).

Unfortunately, existing FUV archival data do not offer sufficient coverage of the HRD at sub-solar metallicity. We therefore propose to use COS/G140L to obtain FUV spectroscopy of 42 massive stars that have been selected to fill existing gaps in the parameter space. This will provide us with a continuous view of the mass-loss and clumping properties as a function of stellar mass and of metallicity, allowing us to derive modern

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15661

Program Title: Testing the Limits of AGN Feedback in Starburst and QSO Central Cluster Galaxies

Principal Investigator: Michael McDonald

PI Institution: Massachusetts Institute of Technology

In the cores of galaxy clusters, the hot intracluster medium should cool rapidly, leading to "cooling flows" of order ~100-1000 Msun/yr. Our current picture is that AGN feedback is responsible for preventing these runaway cooling events, leading to more typical star formation rates of ~1-10 Msun/yr in the centers of relaxed, cool core clusters. However, recent work suggests that feedback may saturate in the most massive clusters, leading to a cooling imbalance in the most extreme systems. In this proposal, we target five of the six most star-forming central cluster galaxies (the sixth has sufficient quality existing data), all of which are forming stars at nearly the original cooling flow prediction. We will obtain narrow-band [O II] imaging using the ACS ramp filter on each of these clusters, allowing us to probe the development of thermal instabilities as gas condenses out of the hot phase and ultimately forms stars. This total sample of six massive clusters provides an opportunity to test the limits of AGN feedback, where cooling does not appear to be significantly suppressed. Three of the six clusters also harbor central QSOs, allowing us to probe the different effects of mechanical (radio-mode) and radiative (quasar-mode) feedback in the inner regions of clusters. As the six most star-forming central cluster galaxies, these will make stunning and inspiring images and have tremendous legacy value, as recent Chandra+ALMA and future JWST targets.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Stellar Physics
ID:	15636
Program Title:	What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-ray binary M33 X-7.

Principal Investigator:	Lida Oskinova
PI Institution:	Universitat Potsdam

We request 12 HST orbits to obtain the first UV spectra of the most massive known high-mass X-ray binary M33 X-7. This eclipsing system consists of a very massive O-type star and a 16 solar mass black hole immersed in the O star wind and feeding on it. The archival optical spectroscopy does not provide information on wind parameters of the donor star. Our immediate objective is to secure COS spectroscopy of M33 X-7 at different orbital phases. Obtaining these data is imperative to characterize the mass flow in this key system - a likely binary black hole progenitor. M33 X-7 is a strong source of X-rays which influence the donor star wind and affect its dynamics. Therefore, we request 25 ks of XMM-Newton time to obtain X-ray spectroscopy simultaneously with the UV observations.

We propose observations at three key orbital phases, tracing the BH eclipse, egress, and inferior conjunction. From the eclipse spectrum we will accurately measure the wind velocity and mass-loss rate of the donor star which has a metallicty ten times lower than solar. Realistic wind parameters are crucially needed to develop the models of massive binary evolution towards binary black holes. Coordinated UV and X-ray measurements in eclipse and egress will describe the gas flows towards the BH and empirically establish its accretion efficiency, thus probing the theories of accretion onto a BH. This innovative study is possible only jointly with the HST and XMM and will have a long lasting science legacy.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Solar System

ID: 15648

Program Title: The Solar System Origins Legacy Survey

Principal Investigator: Alex Parker

PI Institution: Southwest Research Institute

The cold classical Kuiper Belt is likely a completely unique surviving remnant of the solar system's primordial planetesimal disk, and it has an extraordinarily high near-equal mass binary fraction. The binary rate, binary separation distribution, and binary color distribution within planetesimal populations are powerful tracers of planetesimal formation and evolution processes. At the present time, the Kuiper Belt's binary rate, binary separation distribution, and binary color distribution can only be measured effectively by HST. We propose to perform the first major HST contribution to the characterization of a large, well-defined "Treasury Sample" of 221 cold classical Kuiper Belt Objects by making an extremely well-characterized measurement of the sample's binary and color properties. The proposed 206-orbit program builds upon the legacy of OSSOS and CFEPS, the two largest well-characterized Kuiper Belt surveys ever conducted. This will be the first high-precision measurement of the Kuiper Belt's binary properties drawn from a well-characterized sample. The proposed program addressed several key observational questions about this population, which together provide a coherent framework to robustly test current leading theories of planetesimal formation and the origin and evolution of the outer system's architecture.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Galaxies and the IGM

ID: 15656

Program Title: QuaStar: The first unobscured view of the Milky Way's Circumgalactic Medium

Principal Investigator: Joshua Peek

PI Institution: Space Telescope Science Institute

The circumgalactic medium (CGM) of the Milky Way is thought to contain the majority of Galactic baryons and metals. It has also been proposed as the source of fuel for Galactic star formation. For all the CGM's importance to Galactic evolution, we have yet to get an unobscured view of its contents and structure. Models predict that the circumgalactic medium should, on average, be at rest with respect to the Galactic disk. Thus, the standard quasar absorption line method for probing the CGM of other galaxies produces results corrupted by absorption originating in the Galactic disk ISM. Recent work on pairs of quasar absoption lines has shown that C IV absorption at Galactic rest does not vary detectably over ~2 degree scales. This result provides opportunity for exporing the Galactic CGM without obscuration for the first time. We propose to observe the 1550 Angstrom C IV doublet in 30 halo stars (D ~ 7 kpc) that have archival quasars C IV observations within ~2 degrees. The difference in the C IV absorption between the halo stars and the archival quasars originates in the CGM. With this data set we will be able to probe far more than the carbon column, metal mass, and baryonic mass of the Milky Way's CGM. We will also be able to measure Milky Way CGM rotation, radial structure, and perhaps even extended streams and clouds, aspects unavailable to extragalactic studies of the CGM. We believe this project will revolutionize the study of the Milky Way CGM, as well as the study of the CGM as a whole.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Cosmology

ID: 15644

Program Title: An Independent View of the z=5 Galaxy Population

Principal Investigator: Daniel Perley

PI Institution: Liverpool John Moores University

Even as successive generations of HST (and soon, JWST) surveys push further to the high-redshift frontiers, they remain blind to the contribution of the smallest galaxies except via extrapolation. Gamma-ray bursts offer a powerful and dust-independent means to directly measure the contribution to cosmic star-formation from these galaxies and to verify our understanding of high-redshift galaxy populations generally. We propose for moderately deep WFC3-IR observations of a population of 23 GRB host galaxies between $4.0<z<5.5$ in order to independently assess the nature of the star-forming galaxy population at this epoch, resolve disagreements between earlier (shallower and smaller) campaigns, and bridge previous work on the lower-redshift and higher-redshift GRB host populations. Our observations will also shed light on the nature of metal-poor galaxies and unusual dust-extinction sightlines uniquely revealed by distant GRBs.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Galaxies and the IGM
ID:	15637
Program Title:	Exploring the gaseous surroundings of low-mass galaxies with an HST+MUSE Deep Field

Principal Investigator:	Marc Rafelski
PI Institution:	Space Telescope Science Institute

We propose a 90 orbit WFC3/G141 grism survey in the field P2139-443 to advance our view of galaxy evolution in different environments and the connection between gas and low-mass galaxies across 5 billion years. P2139-443 is made remarkable by two quasars separated by less than 500 kpc at z=2-3, which not only pinpoint a z = 3.22 proto-cluster, but also act as double beacons to probe the intervening intergalactic (IGM) and circumgalactic medium (CGM). The synergy between the proposed WFC3/G141 observations and a public 150-hour MUSE Ultra Deep Field in the same field will yield significant advancements in three key areas. i) We will connect the physical properties of over 100 IGM and CGM absorption lines with hundreds of galaxies discovered in emission, investigating in detail how low-mass galaxies shape the CGM and IGM enrichment. ii) By combining multiple emission lines with deep F140W imaging, we will unveil the physical properties of tens of galaxies in a wide range of cosmic structures, including a rich group at z=0.88, a proto-cluster at z=3.22, and a z=3.04 IGM filament. iii) Combining the deepest optical and near-infrared wide-field spectroscopic surveys to date, we will complete a detailed study of the spatially-resolved and integrated physical properties (including metallicity, density, dust, and kinematics) of individual galaxies up to z=2.5, unveiling the emergence of the Hubble sequence across the peak of the cosmic star formation history. The proposed observations will further provide a proof of concept of the unrivalled potential of synergistic JWST and 30m telescope observations to study the faint-end of the galaxy population with redshift.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Cosmology

ID: 15640

Program Title: The Search for New Physics Amid the Hubble Constant Tension

Principal Investigator: Adam Riess

PI Institution: The Johns Hopkins University

Improved measurements of the Hubble constant demonstrate that the Universe is expanding at present about 9% faster than expected from the LambdaCDM model calibrated to the early Universe, with a significance approaching 4 sigma. The higher, local value has been confirmed by 5 independent, geometric calibrations of Cepheids, now including Gaia DR2 parallaxes. Cepheid relative distances have been confirmed by those from TRGB and Miras. At the other end, the low expected value of H_0 predicted from the early Universe is corroborated by independent measurements of the CMB or Omega_B with BAO data. This "H_0 Tension", as it is widely known, offers the exciting and best opportunity in decades of discovering new fundamental physics such as exotic dark energy, a new relativistic particle, dark matter-radiation interactions or a small curvature, each producing a different-sized shift. Pinpointing the cause of the tension requires continued focus on precision and accuracy in the local measurements. After Gaia, the small number of SNe Ia calibrated with Cepheids will dominate the final error. A modest tweak in the observing strategy can provide a 50%-70% boost in the volume and sample reachable by Cepheids. We propose a two-in-one program to achieve a dual purpose: to extend the range of Cepheid measurements to increase the sample of Cepheid/SN Ia hosts and the precision of H_0, opening a path to reach 1%, while simultaneously confirming the tension with a simpler route that is independent of SNe Ia, the only part of the distance ladder without independent corroboration. On the cusp of a possible breakthrough, an investment is needed to pinpoint the cause of the tension.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Stellar Physics
ID:	15657
Program Title:	HD 222925: A unique opportunity to study the full range of nuclei produced by a single r-process event

Principal Investigator:	Ian	Roederer
PI Institution:	University of Michigan	

The r-process is one of the fundamental ways nature produces heavy elements, but the specific physical characteristics of the r-process are not yet fully understood. HD 222925, the brightest and most highly r-process-enhanced star known, provides the first opportunity to test unexplored regimes of r-process models. New STIS/E230H observations are proposed to obtain a high-S/N, high-resolution UV spectrum of HD 222925, which will provide the most detailed census of elements produced by a single r-process event, such as a neutron star merger. Twenty-eight r-process elements have been detected in the optical spectrum of HD 222925; the proposed UV spectra would enable the detection of 13 additional elements produced by the r-process (Ge, Se, Cd, Sn, Sb, Te, Ta, W, Re, Pt, Au, Pb, and Bi) that cannot be detected in ground-based spectra of HD 222925 and are rarely, if ever, detected in optical/UV spectra of other r-process-enhanced stars. The proposed observations would yield the most complete and precise r-process abundance template beyond the Solar System, and it would be the only r-process pattern formed by a single r-process event where all three r-process peaks (Se, Te, and Os-Ir-Pt) are detected. Comparing the r-process abundance pattern derived from HD 222925 with model predictions links directly to the physics at the site of the r-process, including the level of neutron richness, the role played by mixing between the r-process peak production sites, and the importance of fission recycling. This approach to understanding the r-process complements and extends the approach informed by observations of the kilonovae associated with neutron star mergers.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Physics

ID: 15645

Program Title: The Identification of Failed Supernovae

Principal Investigator: David Sand

PI Institution: University of Arizona

We request 41 orbits of HST/ACS F814W imaging of a specially chosen sample of nearby galaxies to identify failed supernovae---the literal disappearance of a massive star after collapse into a black hole. Based on recent theoretical work on how massive stars end their lives, and the apparent lack of stars >18 M_sun exploding as core collapse supernovae, we expect to detect ~5-20 failed SNe, a sample large enough to provide a conclusive test of this idea. These observations will address the long standing mystery of missing core collapse supernova progenitors and test models of black hole formation, with broad-reaching consequences for our understanding of stellar remnants, chemical enrichment, and predictions for gravitational wave event rates.

Any failed supernova candidates will be prime targets for the JWST era, both to search for associated cold transients, and to rule out alternative explanations for the massive star's disappearance.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Stellar Populations

ID: 15658

Program Title: Resolved Proper Motions of M31 and the M31-M32 Interaction

Principal Investigator: Sangmo Sohn

PI Institution: Space Telescope Science Institute

We propose to measure the proper motion (PM) of M31 stars to unprecedented precision, using multi-epoch HST data of seven ACS/WFC fields. Our first goal is to measure M31's mean tangential motion with a precision nearly triple that of the previous HST and Gaia measurements. The better-determined center-of-mass (COM) motion of M31 will be essential for refining models of the local Universe, the orbits of objects in M31's halo, the total dark matter halo masses of the Milky Way (MW) and M31, and the evolution and fate of the MW. Second, we will clearly resolve the internal kinematics of M31 with PMs. We will obtain useful precision for multiple structural components and even the brighter individual stars. We will measure the bulk flows between cold components such as M31's disk and giant stream, and resolve the tangential velocity dispersion in M31's hot halo. Third, we will obtain the PM of M32 for the first time. This will provide crucial information about M32's orbit, evolution, and interactions with M31. In particular, we will test scenarios where it is the stripped remnant of a major merger, responsible for shaping many of M31's properties. Gaia (which can only measure young M31 disk stars) cannot undertake the differential PM investigations proposed here, and would require many more years of data to compete with our expected M31 COM motion. Based on previous works, the PM accuracies required for our scientific goals are well within reach of HST's demonstrated capabilities. HST's 2012 M31 bulk PM measurements were highly publicized, but due to HST's longevity it is now possible to address many new questions that were previously out of reach.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Galaxies and the IGM
ID:	15646
Program Title:	Massive Stellar Populations at Reionization-Era Metallicities with Ultra-Deep HST/COS Spectroscopy

Principal Investigator:	Daniel	Stark
PI Institution:	University of Arizona	

The first glimpse of the spectral properties of z~7-10 galaxies has recently emerged. Deep UV spectra have revealed intense emission from nebular CIII] and CIV, implying a hard radiation field that is rarely seen at lower redshifts. Unfortunately, we are currently unprepared to interpret these features, owing to shortcomings in our understanding of the radiation field powered by low metallicity stellar populations. Recent work with HST/COS in the local universe has provided a way forward, unveiling four nearby metal poor galaxies with UV nebular line spectra approaching those seen at z>7. The discovery of these galaxies opens the door for the first comprehensive investigation of the low metallicity stellar populations that likely dominate at z>7. Here we propose to obtain ultra-deep (10 orbit) COS/G160M spectra capable of measuring stellar photospheric and wind absorption features in these four galaxies. The data will provide the first quantitative constraints on the metallicity of massive stars required to power the hard radiation fields implied by the nebular lines and will allow us to investigate whether the stellar metallicity (sensitive to iron) departs from the metallicity of the nebular gas (sensitive to oxygen) in the extreme UV line emitters. Using new spectral tools, we will simultaneously fit the stellar absorption features and nebular lines, providing a powerful stress test of population synthesis models at low metallicity. If this UV spectral database is not obtained while COS is still functioning, the interpretation of reionization era galaxy spectra will be severely jeopardized throughout the JWST era.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	GO
Scientific Category:	Galaxies and the IGM
ID:	15647
Program Title:	Ultraviolet Imaging of the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey Fields (UVCANDELS)

Principal Investigator:	Harry	Teplitz
PI Institution:	California Institute of Technology	

We propose UVCANDELS -- the definitive extragalactic UV imaging of the four premier HST deep-wide survey fields best suited to JWST observations. We will investigate the key processes of galaxy evolution during the epoch of vigorous star formation at 0.5<z<3 by: (1) Using the high spatial resolution UV and Blue data (700 pc at z~1) to study the structural evolution of galaxies and create 2D maps of their star-formation history. (2) Combining UVCANDELS with irreplaceable Herschel legacy data to trace the evolution of the dust content of moderate redshift (z<1) galaxies. (3) Probing the role of environment in the evolution of low-mass star-forming galaxies. (4) Investigating the decay of star-formation in massive early type galaxies and the role of minor mergers. (5) Stacking images to constrain the escape fraction of ionizing radiation from galaxies at z~2.5 to better understand how star-forming galaxies reionized the Universe at z>6.

We propose WFC3/F275W imaging of four CANDELS fields (~430 sq. arcmin; 4x increased UV coverage when combined with archival data), reaching AB=27 for compact galaxies (SFR~0.2 Msun/yr at z=1), together with parallel ACS/F435W (AB>=28.0) imaging. These fields have extensive treasury data and are the natural place to complete HST's UV imaging legacy. The proposed wide-area program will complement existing deep UV observations (HDUV, UVUDF, ERS, and the Frontier Fields). We will increase the data's legacy value by providing public science quality images, catalogs, and improved photometric redshifts to enable a wide range of research. UVCANDELS is a natural component of the UV Initiative and will support JWST observations of these fields.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Cosmology

ID: 15652

Program Title: H0, the stellar initial mass function, and other dark matters from a large sample of quadruply imaged quasars

Principal Investigator: Tommaso Treu

PI Institution: University of California - Los Angeles

We propose to collect a large enough sample of lensed quasars to provide definitive answers to two fundamental questions in astrophysics: 1) What's the Hubble Constant (H0) and is the tension between the local distance ladder measurement and that extrapolated from the CMB indicative of new physics beyond LCDM? 2) Is the stellar initial mass function universal or does it vary with galaxy properties? A sample of 40 quadruply imaged quasars is sufficient to measure H0 to 1% precision (thus settling the 8% difference between current measurements) and distinguish between a Chabrier and Salpeter IMF at the 99%CL. Thanks to a large collective effort to discover these extremely rare systems, we now know enough systems to reach this goal for the first time, by combining this proposal with previous efforts already in the HST archive. In addition to the two key science drivers, uniform multicolor HST imaging of this large sample of quads will enable a wealth of investigations covering topics ranging from the size of accretion disks, to the relationship between quasars and their host galaxies, to the properties of dark matter halos in massive elliptical galaxies.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO

Scientific Category: Massive Black Holes And Their Host Galaxies

ID: 15662

Program Title: Galactic Winds across the Gas-Rich Merger Sequence

Principal Investigator: Sylvain Veilleux

PI Institution: University of Maryland

Galactic winds in gas-rich mergers are an essential element of galaxy and SMBH evolution. The most powerful of these outflows are driven by quasars and likely feed the circumgalactic medium. The outflow energetics are often dominated by the outer (> kpc) and cooler dusty molecular and neutral atomic gas phase, but the driving mechanism is best probed by the inner (sub-kpc) highly ionized gas phase. While current X-ray observatories are not sensitive enough to carry out a systematic survey of these inner winds, recent results from two independent FUV studies have shown that COS is very well suited for this task. Prominent, highly blueshifted (1000 km/s) Ly-alpha emission has been detected in most ULIRGs, often accompanied by blueshifted absorption features. The internal kinematics of ULIRGs seem to be the single most important factor determining the profile and escape fraction of the Ly-alpha emission. However, the trends so far are entirely driven by the few AGN-ULIRGs in the current sample and are therefore highly uncertain. So here we propose to more than triple the sample size of AGN-ULIRGs (from 6 to 21 objects) and combine the results from our analysis of the new data and archival COS spectra to study, for the first time, the gaseous environments of gas-rich mergers as a function of host properties and age across the merger sequence ULIRG --> QSO. These data will allow us to distinguish between quasar-driven outflows, starburst-driven winds, and tidal debris around the mergers. They will also provide new constraints on the critically important warm-hot gas phase associated with the cooling shocked ISM predicted in some quasar feedback models.

Cycle 26 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:	AR
Scientific Category:	Planets and Planet Formation
ID:	15635
Program Title:	Recovering Stellar Lyman alpha and O I Emission Line Profiles from Airglow-Dominated COS Spectra of Cool Dwarf Stars

Principal Investigator:	Allison	Youngblood
PI Institution:	NASA Goddard Space Flight Center	

H I Lyman alpha (1215.67 Ang; LyA) and O I (1302.2, 1304.9, 1306.0 Ang) are stellar emission lines in the COS FUV bandpass with great utility for stellar and exoplanet observations (e.g., chromosphere diagnosis and probing exoplanetary mass loss). However, emission from Earth's exosphere (airglow) entering through COS's large (2.5") aperture typically swamps the stellar LyA and O I signal in COS observations. Airglow subtraction is easily performed for STIS observations of these lines, because STIS employs a narrow slit and has spatial resolution in the cross-dispersion direction that simultaneously captures a spectrum of the airglow. Here we propose to apply proven airglow subtraction techniques homogeneously to the COS archive of F, G, K, and M dwarf spectra to extract true stellar LyA and O I spectra, increasing the number of stars with such spectra by a factor of 5. We will measure LyA and O I emission line fluxes and statistically compare fluxes and line kinematics to various stellar properties to uncover variations with mass and age. We will benchmark the airglow subtraction technique by comparing with STIS airglow-subtracted spectra for a subset of stars that have both COS G130M/G140L or STIS G140M/E140M/E140H spectra. We focus on stellar types that host exoplanets, because UV emission is an important for photochemistry in exoplanet atmospheres, but this program will produce legacy, user-friendly tools that will enable airglow subtraction on any COS spectrum.