Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17415
Program Title: SN 2019yvr: A Hydrogen-poor Supernova with Late-Time Circumstellar Interaction and a Progenitor Candidate

Principal Investigator: Kilpatrick, Charles

PI Institution: Northwestern University

There is now significant evidence that at least 10% of massive stars undergo substantial and impulsive mass loss within a few years of core-collapse. In particular, observations of interacting supernovae suggest that their progenitors undergo extreme episodes of mass-loss shortly before core collapse, creating a dense shell of circumstellar material (CSM). While most of our understanding of this link has come predominantly from hydrogen-rich supernovae, there is a growing population of SN initially classified as hydrogen free but with evidence of CSM interaction at later times. Here we propose to take advantage of HST sensitivity and angular resolution to observe the nearby (d=14.4 Mpc) Type Ib SN2019yvr and constrain the disappearance of its progenitor star and ongoing circumstellar interaction. SN2019yvr is only the second stripped envelope SN with a candidate progenitor detection in pre-explosion HST images, and 150 days post-explosion it began to shown signs of SN2014C-like interaction with a hydrogen-rich medium. We request new imaging in F438W and F555W to confirm the disappearance of its pre-explosion counterpart and determine whether it is interacting with CSM at large separations from the progenitor system, implying its progenitor system was losing mass thousands of years before core collapse.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17416
Program Title: Wind Structure of 31 Cygni from UV Eclipse Mapping

Principal Investigator: Bennett, Philip

PI Institution: Dalhousie University

Observing the stellar wind of a mass-losing red supergiant in an eclipsing binary system in absorption against the ultraviolet continuum of a hot companion provides an elegant way of mapping the structure of the supergiant's wind with high spatial resolution. Repeated observations near eclipse allow the wind to be mapped as the line of sight to the hot companion sweeps through the wind. The bright eclipsing binary 31 Cygni (K4 Ib + B3 V) is ideal for this work. It is bright enough for high-resolution UV spectroscopy with well-separated components and an orbital period of 10.34 years. In the ultraviolet, the hot early-type companion dominates the flux, thereby avoiding the complexities of analyzing a composite spectrum. We propose to map the wind structure of the 31 Cyg red supergiant by observing the FUV spectrum near and during the March 2024 eclipse at 10 visits with HST/STIS. These UV observations can only be done with HST.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17417
Program Title: Exploring the Dynamics of Quaoar's Rings

Principal Investigator: Proudfoot, Benjamin

PI Institution: Brigham Young University

Recent stellar occultations have revealed a pair of enigmatic rings around the dwarf planet Quaoar. These narrow rings, which lie well outside Quaoar's Roche limit are extremely interesting targets for study into ring formation, evolution, and ring particle interactions. Quaoar and its moon Weywot, are, unfortunately, not well enough characterized to study the dynamics of the newly discovered ring system. In this 5 orbit program, we propose to study the orbit of Weywot to constrain the dynamics of Quaoar's rings. By using state-of-the-art non-Keplerian orbit fitting techniques, the additional astrometric observations obtained in this program will strongly constrain Weywot's orbit and orbital precession, as well as Quaoar's mass and shape. This will enable further study of Quaoar's rings, allowing the system to act as a touchstone for future studies of rings around TNOs. Our proposal uses a novel observing strategy to ensure the most efficient use of HST time, while still allowing us to accomplish our goals.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17418
Program Title: Upon Reflection: Unveiling a Cloud Transition with a High-Precision Reflected Light Spectrum

Principal Investigator: Batalha, Natasha

PI Institution: NASA Ames Research Center

Measuring reflected light of exoplanets in the optical gives us a unique view of the stellar radiation backscattered by the atmosphere or surface. Unlike transmission and emission spectra, reflected light is uniquely sensitive to the properties of aerosols and ultimately reveals how much energy is absorbed by the planet contributing to its overall energy budget and climate. Yet, few measurements of reflected light have been made, with only two published results of spectroscopic albedo measurements probing the wavelength dependence of scattered light. Here we propose to utilize the spectroscopic capabilities of WFC3's UVIS G280 grism to measure the reflected light from 350-800nm of Saturn-mass exoplanet WASP-69b, which will make it the coolest object studied with reflected light spectroscopy. We will: 1) obtain a benchmark high-precision exoplanet reflected light spectrum, 2) extend the temperature phase space of exoplanets probed in reflected light to uncharted parameter space, and 3) uniquely complement existing JWST observations by providing information that could unveil key transitions in cloud physics regimes. WASP-69b has an equilibrium temperature of 990K, putting it in a regime where a dominant cloud transition process analogous to the L/T transition on Brown Dwarfs may be occurring. Results from this program will not only allow us to begin unveiling these key cloud processes, but will also kick-start investigations needed to enable successful direct imaging missions (Nancy Grace Roman Space Telescope, HWO) whose goals are to study reflected light spectroscopy of exoplanet atmospheres.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17419
Program Title: A 3-Epoch Time-Lapse Movie of the Kinematics Across the Carina Nebula

Principal Investigator: Smith, Nathan

PI Institution: University of Arizona

A cycle 13 ACS H-alpha imaging survey of the Carina Nebula covered 540 square arcminutes, concentrating on the two 2-3 Myr old central massive star clusters and several surrounding regions. This revealed dozens of protostellar outflows in a region thought to be devoid of active star formation. A 2nd epoch in cycle 21 allowed for the first proper motion (PM) estimates of such a large sample of irradiated jets, and roughly doubled the number of known jets identified via PM. Now we aim to add a 3rd epoch that will double the time baseline for PMs. In addition to improving the precision of PMs (1-2 km/s for point sources; 3 km/s for nebular features), these observations will achieve new goals not possible before: (1) For the first time, we will measure PM of edge-on ionization fronts at the cloud interface, including dust pillars, globules, and filaments. This will directly measure the impact of massive star feedback and will test otherwise ambiguous scenarios of triggered star formation. (2) We will measure PMs of previously discovered jets, but will push this to lower velocities or higher precision, will improve dynamical ages, and will identify many more outflows, thus completing the census of their mass-loss histories. (3) For faster jets, 3 epochs will reveal hydrodynamic evolution and deceleration of the shock fronts, critical for quantifying the mass-loss history. (4) While Gaia provides PMs for brighter stars, this H-alpha survey will measure PMs and H-alpha flux variability for low-mass pre-main-sequence stars (i.e. T Tauri stars) that are too faint for Gaia. This will yield the most complete census of stellar and gas dynamics in a massive OB association.

Proposal Category: SNAP
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17420
Program Title: A legacy survey for evolved planetary systems within 100pc

Principal Investigator: Gaensicke, Boris

PI Institution: The University of Warwick

In just 25 years, we went from not knowing if the solar system is a fluke of Nature to realising that it is totally normal for stars to have planets. More remarkably, it is now clear that planet formation is a robust process, as rich multi-planet systems are found around stars more massive and less massive than the Sun. More recently, planetary systems have been identified in increasingly complex architectures, including circumbinary planets, wide binaries with planets orbiting one or both stellar components, and planets in triple stellar systems. We have also learned that many planetary systems will survive the evolution of their host stars into the white dwarf phase. Small bodies are scattered by unseen planets into the gravitational field of the white dwarfs, tidally disrupt, form dust discs, and eventually accrete onto the white dwarf, where they can be spectroscopically detected. HST/COS has played a critical role in the study these evolved planetary systems, demonstrating that overall the bulk composition of the debris is rocky and resembles in composition the inner the solar system, including evidence for water-rich planetesimals. Past observations of planetary systems at white dwarfs were limited to biased and incomplete samples. Here we propose a legacy HST survey of all white dwarfs within 100pc identified with Gaia to answer the following questions: * How efficient is planet formation around 2-10Msun stars? * What are the metallicities of the progenitors of debris-accreting white dwarfs? * What is the fate of circumbinary planets? * Can star-planet interactions generate magnetic fields in the white dwarf host?

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17421
Program Title: Shocking detections: Characterising exocometary shock fronts by tracking star-grazing comets using the UV AlIII line

Principal Investigator: Strom, Paul

PI Institution: The University of Warwick

Exocomets are small icy bodies, which orbit stars other than the Sun and sublimate when close to their star, producing a tail of dust and gas (like solar system comets). During transit, the gas causes spectroscopic absorption signatures that are routinely detected in several systems. The most prolific case is beta Pic, which continuously displays narrow, variable, non-photospheric absorption features superimposed on the much broader stellar lines. The features vary on short timescales (hours) and are seen at optical (e.g. CaII) and UV (e.g. FeII, SiIV) wavelengths. Previous HST observations of beta Pic in the UV showed the presence of AlIII lines in the exocomet gas. The mere existence of AlIII is puzzling as beta Pic is unable to twice photoionise Al. Hydrodynamical models suggest that these highly-ionised species are formed in a shock where compression and thus collisions within the shock surface are sufficient to generate AlIII. This is theorised to occur when the exocomets get sufficiently close to the star (a few stellar radii). We propose to monitor beta Pic to characterise the doppler movement of the AlIII lines and from this directly measure the exocomets' acceleration. This we use to calculate the comet-star distances. The highly ionised species are thought only to be present in the shock fronts of exocomets close to the star. Measuring the distance between the star and the exocomets will allow us to directly test this hypothesis. The observations cover a wavelength range with other species thought to only emerge in shocks. Measuring the transit ingress/egress times of these species will give us the composition of the shock as a function of radial distance.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17422
Program Title: Bulk abundances of the planetary material in a nearby bright gaseous disk around a white dwarf

Principal Investigator: Gaensicke, Boris

PI Institution: The University of Warwick

The remnants of planetary systems that survived the metamorphosis of their host stars into white dwarfs are identified in the form of compact debris disks, formed from the tidal disruption of planetesimals. These disks are detectable as IR flux excess, and, in rare occasions, as metallic emission lines from a gaseous disk component in optical spectra. These gaseous disks are thought to host embedded solid fragments, maybe the core, of the disrupted planetesimal, and represent ideal targets for joint ultraviolet, optical and infrared observations that provide unrivalled insight into the formation of these disks, the nature of the disrupting planetesimal, the elemental abundances of the planetary debris, and its mineralogical make-up. Here, we propose COS far-ultraviolet spectroscopy of a new, bright, and nearby gaseous disk system to measure the elemental abundances of the planetary material. The far-ultraviolet wavelength range is critically important to access transitions of core (Cr, Fe, Ni), mantle (Si, Mg, O), and crust (Ca, Al), as well as volatiles (C, S, P) species that have no transitions at optical wavelengths, or are contaminated by the disk emission lines. This system is also a prime target for JWST MIRI spectroscopy of the circumstellar dust, and these COS observations will ensure that the composition of the debris is known well in time for the next JWST proposal round.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17423
Program Title: Towards an unbiased sample of sub-arcsec dual AGN with HST/STIS

Principal Investigator: Tozzi, Giulia

PI Institution: Universita di Firenze

Hierarchical cosmological models predict the existence of dual active galactic nuclei (AGN) to in-spiral at the centre of the same host galaxy. They are the parent population of interacting supermassive black holes, which will eventually merge by emitting low-frequency gravitational waves. To date, only a handful of dual AGN (15) have been confirmed residing within the same host galaxy (separations < 7 kpc), preventing us to test fundamental predictions of galaxy formation and to conduct any statistical study on dual AGN properties (e.g. separation, black hole mass, luminosity ratio of the two AGN components). Hence, we propose to use HST/STIS to confirm the nature of an unprecedented unbiased sample of 16 multiple AGN, selected via the novel "GMP" technique based on Gaia observations. This method has proven to successfully select dual and lensed AGN at sub-arcsec separations. The proposed spectroscopic observations with HST/STIS will allow us: 1) to classify the targets as dual AGN or lensed systems, excluding cases of AGN/star pairs; 2) to collect a first large enough sample of confirmed dual AGN to conduct a statistical study on their key properties (e.g. separation, mass, luminosity ratio); 3) to confirm new strongly lensed AGN at sub-arcsec separations, the most compact regime ever probed, which will allow us to investigate the innermost region of the lens galaxy with future deep HST imaging.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17424
Program Title: High-resolution imaging of the ionizing and non-ionizing radiation of extreme starbursts at z~2.4

Principal Investigator: Marques-Chaves, Rui

PI Institution: University of Geneva, Department of Astronomy

We used to think that cosmic reionization was likely dominated by faint, widely-distributed galaxies until recent results have shown that UV-bright galaxies i) are among the most powerful ionizing sources known, and ii) they appear to be much more numerous than previously thought at the Epoch of Reionization (EoR). These results are enigmatic, however, may completely change our understanding of the nature of very UV-bright galaxies and the potential role these sources play in cosmic reionization. This proposal aims to probe the nature of extremely UV-bright galaxies and the mode of escape of ionizing photons. Here we request high-resolution HST imaging of a representative sample of nine very UV-bright star-forming galaxies at z=2.3-2.5, possibly analogs of EoR bright sources recently uncovered with JWST and HST. These are extremely young (<10Myr), powerful, and very efficient starbursts, showing already hint at very high Lyman continuum (LyC) escape from available high-resolution and high S/N continuum spectra covering Ly-alpha to H-alpha. WFC3/UVIS imaging will probe the ionizing (~750A) and non-ionizing (~1600A) radiation at similar spatial scales (down to ~500pc) to test the LyC escape in these exceptional sources, including very efficient modes of production and escape of ionizing photons, and provide the first high-resolution studies of their morphologies. The requested observations will thus uncover some of the most important, but still open questions raised by these UV-bright sources, including those related to their origin and nature, and their potential role in cosmic reionization.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17425
Program Title: Mapping the Collision of the Nearest Interstellar Medium Clouds

Principal Investigator: Redfield, Seth

PI Institution: Wesleyan University

Evidence is emerging from different observations that the clouds in the local interstellar medium, which surround the Sun and the nearest stars, are young, low-density, and colliding with each other. Indeed, the Sun may be currently moving through the collision zone of the Local Interstellar Cloud and the G Cloud. Archival observations support the high column density that would result from this interaction, but the densest region of the interaction remains unobserved. We propose to obtain high resolution spectra of four nearby stars in this region to measure the kinematic and physical properties of the interaction zone. Coupling E230H and E140M spectra will enable a direct test of the mixing by modeling the absorption features in narrow and strong LISM features (i.e., MgII) while also leveraging the numerous ions that are likely to show LISM absorption (e.g., HI, DI, CII, NI, OI, SiII) to obtain gas abundances, depletion patterns, temperatures, and turbulent velocities. The kinematics and the fundamental physical properties in the collision zone can be compared to the average cloud properties already derived in the literature. The collision and mixing of LISM clouds have important implications for our understanding of the timing and magnitude that the heliosphere expands and contracts. This, in turn, impacts the severity of the modulation of energetic cosmic rays into the solar system and on to the tops of planetary atmospheres. The proposed observations will test a new model of LISM cloud collisions that could significantly change the view we have of our immediate Galactic neighborhood.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17426
Program Title: Benchmarking early-type Wolf-Rayet stars as sources of He II ionizing flux in stellar populations

Principal Investigator: Sander, Andreas

PI Institution: Astronomisches Rechen-Institut Heidelberg

Classical, hydrogen-depleted Wolf-Rayet (WR) stars mark an evolved stage of massive stars with major impacts to their environment. The high temperatures of WR stars, the progenitors of massive black holes, turn them into major sources of ionizing flux. In the last two decades, the discovery of strong high-ionization emission lines in both high-redshift galaxies and extremely low-metal local galaxies has raised more questions than answers about the origin of the He II ionizing radiation and its implications for the cosmic reionization and galaxy evolution. The current generation of stellar population synthesis models fails to reproduce the necessary hard ionizing fluxes. Yet, their treatment of hydrogen-depleted stars is still insufficient with regards to both theoretical insights as well as observational template material. Here, we propose a crucial observational solution by studying whether certain types of WR stars may be the missing ingredient required for stellar population synthesis models to reproduce the nebular emission line characteristics of high-redshift galaxies, enabling the inference of the properties of the first galaxies in the Universe. Most WR stars are consuming the necessary high-energy photons to drive their strong winds, but model calculations show that a subset of early-type WR stars with weaker winds can produce large amounts of He II ionizing photons. The proposed COS observations will allow us to probe the stellar and wind properties of this subset of the WR population, distinguish sources of strong He II ionizing flux, constrain pre-supernova feedback, and provide the necessary templates for a new generation of population synthesis models.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17427
Program Title: Monitoring the H-alpha Emission from the PDS 70 Planets

Principal Investigator: Zhou, Yifan

PI Institution: University of Texas at Austin

Protoplanets that are actively accreting within their circumstellar disks offer an exciting opportunity to investigate planet formation. Strong H-alpha emission lines produced by accretion shocks have been detected in direct-imaging observations of the ~5 Myr old giant protoplanets PDS 70 b and c. These observations measured snapshots of these planets' mass accretion rate. However, the time-varying aspects of planetary accretion have not been explored. Recent HST/WFC3/UVIS observations of PDS 70 b demonstrated this instrument's high-contrast imaging capability. We propose to apply similar observing strategies and leverage HST's excellent long-term photometric stability to monitor the PDS 70 planets' H-alpha emission. The observations are designed to cover three representative timescales, corresponding to the planetary rotational periods, circumplanetary disk Keplerian motion, and long-term irregular variability. These observations will allow us to determine whether the PDS 70 planets maintain a steady accretion rate. Comparing variability amplitudes between different timescales will help distinguish the physical origins of multiple potential shock fronts in this system. If rotational modulations are detected, we will measure the rotation rates, which will offer rare constraints on the angular momentum evolution of gas giants like Jupiter at young ages..

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17428
Program Title: The M dwarf FUV Continuum: A Missing Driver of Atmospheric Hazes in Exoplanet Atmospheres

Principal Investigator: France, Kevin

PI Institution: University of Colorado at Boulder

Photochemical hazes are common in exoplanetary systems, serving as important reservoirs for atmospheric molecules while influencing our ability to measure the local physical conditions in a planet's atmosphere. Characterization and modeling of aerosol and hazes have taken on added importance as JWST examines exoplanet atmospheres in exquisite detail. Understanding the formation and composition of atmospheric hazes on all types of exoplanets requires knowledge of both the atmospheric spectra and the driving stellar ultraviolet radiation. A key area of uncertainty in modeling haze formation on planets around M dwarfs is the spectral shape and absolute flux level of the stellar far-ultraviolet (FUV) continuum. The quiescent FUV continuum flux is below the instrumental background level for essentially all of HST's previous M dwarf characterization programs, and resultant uncertainty in input conditions changes the predicted haze abundances by an order-of-magnitude on temperate exoplanets. We propose a novel set of FUV spectroscopic observations with HST-COS to directly measure the quiescent FUV continuum flux in a small sample of benchmark M dwarfs for the first time. We will use a combination of COS G130M, G160M, and G185M settings to measure high-fidelity FUV continuum spectra in both quiescent and flare states, while avoiding the chromospheric emission lines that set the bright object avoidance levels for COS. We will release fully reduced FUV continuum spectra to support atmospheric models of haze formation, photochemistry, and simulated transmission spectra for a range of exoplanets observed with both HST and JWST.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17429
Program Title: Elevating the Scientific Output of JWST by using HST to Examine the Heart of Type Ia Supernova 2021aefx

Principal Investigator: Tucker, Michael

PI Institution: The Ohio State University

Despite Type Ia supernovae (SNe Ia) remaining a benchmark of precision cosmology, a consensus on how and why some white dwarfs explode as SNe Ia eludes the astronomical community. Photometric observations of SNe Ia at late times measure the conversion efficiency of radioactive decay energy into photons. We request 10 orbits of HST/WFC3 observations in Cycle 31 and 8 orbits in Cycle 32 to observe the normal SN Ia 2021aefx at 750d, 1000d, and 1150d after the explosion in conjunction with already awarded JWST near- and mid-infrared spectra. These complimentary HST and JWST observations provide complete wavelength coverage from 0.4-14 microns spanning years after the explosion. Such data are non-existent in the literature and we do not foresee similar opportunities in the overlapping lifetimes of HST and JWST. Measuring the complete spectral energy distribution at nebular phases allows a direct estimate of the total radioactive decay energy, which in turn depends on the nucleosynthetic yield of the explosion. Many correlations have been proposed for estimating the nucleosynthetic yield of a SN Ia but uncertainties regarding emission in the mid-IR prevented definitive conclusions. With the proposed HST/WFC3 time we can elevate the scientific output from this SN to a level that JWST cannot reach alone, and SN~2021aefx will become a once-in-a-decade event that paves the way for the next generation of SN Ia models.

Proposal Category: GO (GO-Archival)
Scientific Category: Galaxies
ID: 17430
Program Title: Pulling Back the Curtain Veiling Extreme UV Galaxies: Revealing the Mysterious Sources of He II Emission

Principal Investigator: Parker, Kaelee

PI Institution: University of Texas at Austin

Our first deep observations of high redshift galaxies revealed exceptionally strong high-ionization nebular emission lines. Characterizing and describing the detailed observations of the earliest galaxies with JWST and future extremely large telescopes will hinge on our understanding of these lines. However, current stellar population synthesis models catastrophically fail to reproduce the observed strengths of these extreme emission lines, often invoking theories of rare phenomena to understand this emission. Fortunately, progress is possible: high-spatial-resolution maps of very-high-ionization emission can help constrain the options for these potentially exotic sources. Here, we propose 25 orbits of high-spatial-resolution HST imaging to map the spatial morphology of HeII 4686 emission in five nearby low-metallicity, highly-ionized galaxies selected for their strong HeII emission. We will compare the spatial distribution of HeII emission with maps of the stellar population and the nebular gas traced by the Balmer lines, [OII], and [OIII], in order to distinguish between photoionization from massive and metal-poor stars, X-ray binaries, shocks, Wolf Rayet stars, and AGN. The compact nature for many of these sources requires a high spatial resolution (< 50 pc) that is only possible with HST. These observations will provide the necessary constraints to create the next generation of ionizing radiation models in highly-ionized galaxies, like those common during the Epoch of Reionization.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17431
Program Title: A Remarkable Wide Separation Lensed Quasar

Principal Investigator: Gladders, Michael

PI Institution: University of Chicago

We propose broadband HST imaging of a newly discovered wide-separation lensed quasar (WSLQ). There are only 7 WSLQs in the literature from 20 years of searching, and this new WSLQ is spectacular. The lensing cluster at z=0.42 is the most massive WSLQ lens found to date and is lensing a low luminosity quasar at z=1.524; initial ground-based imaging and spectroscopy shows four other obvious multiply-imaged sources, one of which is a second multiply-imaged AGN (obscured in this case, but readily apparent from emmission lines) at z=1.939. Both lensed AGN have multiply-imaged companion galaxies, and the foreground quasar shows numerous MgII absorbers - one of which matches one of the spectroscopically confirmed companions. Remarkably, the host galaxy of the quasar is also evident in ground-based NIR imaging, and so HST resolution will allow for a probe of quasar feedback in the host from color gradients. The scientific possibilities with this new discovery are manifold; we propose here an 8-orbit imaging program to acquire the data necessary to immediately build a robust strong lens model, which will rapidly unlock the potential of this new discovery.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17432
Program Title: Timescales of Stellar Feedback in Blue Galaxies: Critical Parameters for Galaxy Evolution

Principal Investigator: Hunter, Laura

PI Institution: Indiana University System

Stellar feedback is fundamental to modern models of galaxy evolution as it drives turbulence and outflows in galaxies, disrupts and triggers star formation events, and redistributes metals formed in stars. To empirically constrain the impact of stellar feedback, an understanding of the timescales involved is critical. We propose to measure the timescale over which stellar feedback drives turbulent motion in the multi-phase interstellar medium by comparing star formation histories - derived from resolved stars - to atomic and ionized gas motions on local scales across the disk of several nearby galaxies. For these spatially resolved studies, we selected 3 extremely blue, low-mass galaxies, each of which demonstrate key features for untangling the timescales involved. As part of our analysis, we will determine if stellar feedback impacts different phases of the ISM on different timescales and if there are galaxy parameters that alter the relationship. We will place constraints for simulations to model accurately this fundamentally important process and whether the implementation of dissipation and cooling can recreate the observed timescales.

Proposal Category: GO (GO-Archival)
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17433
Program Title: HST UV Spectroscopy of High-accretion-rate AGNs and the Origin of Offset in the Broad-Line Region Size-Luminosity Relation

Principal Investigator: Wu, Qiaoya

PI Institution: University of Illinois at Urbana - Champaign

Nearly two decades of reverberation mapping (RM) studies on local broad-line AGNs have revealed a tight correlation between the broad-line region (BLR) size and the AGN optical luminosity (the R-L relation), which provides the foundation for single-epoch virial black hole mass recipes that estimate AGN black hole masses using single-epoch spectra. However, recent RM studies for AGNs with a more diverse range of accretion parameters revealed an increased dispersion around the canonical R-L relation. In particular, high-accretion-rate (e.g., L/LEdd>0.5) AGNs show a significant lag offset by a factor of 3-4 at fixed optical luminosities. Understanding the origin of this dispersion/offset in the R-L relation is critically important for single-epoch mass recipes. One promising explanation for this dispersion/offset is that the underlying ionizing spectral energy distributions (SEDs) are different at different accretion rates. Here we propose HST UV spectroscopy for 16 high-accretion AGNs at 0.05<z<0.7 with RM measurements to test this hypothesis and to develop empirical corrections to tighten up the R-L relation. We will measure the rest-frame UV emission-line properties, and perform detailed photoionization calculations to constrain accretion disk models and SED predictions. The comparison of photoionization calculations and observed spectra for a unique high-accretion AGN sample would not only facilitate a better theoretical understanding of high-accretion disk models (e.g., the slim disk model), but also shed light on the physical driver of the R-L relation dispersion and enable better calibrations of single-epoch mass recipes.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17434
Program Title: Shedding Light on Dark Matter: Internal Proper Motions in Ursa Minor

Principal Investigator: Vitral, Eduardo

PI Institution: Space Telescope Science Institute

Determination of the mass density profiles of dwarf galaxies (and specifically whether there is a central core or cusp) provides a critical test of both the properties of dark matter (DM) and the physics of cosmological structure formation. The Milky Way nearby classical dwarf spheroidal galaxies (dSphs) provide some of the best dynamical constraints. While large line-of-sight velocity datasets exist (some thousand stars per galaxy), interpretation is hindered by the well-known mass vs. velocity-anisotropy degeneracy of stellar dynamics. This can be resolved with proper motion (PM) measurements that yield 3-D velocity information. This is well beyond the reach of Gaia, given the small velocity dispersions of dSphs and the absence of bright stars. HST is the only observatory that can advance this problem, given its combination of photometric depth, high spatial resolution, and long time baselines. We propose to obtain HST imaging of eight previously imaged fields (four prime plus four parallels) in the nearby Ursa Minor dSph, to obtain high-accuracy PMs for thousands of stars in this galaxy. This unique data set will provide a direct determination of the velocity anisotropy profile. Through detailed dynamical modeling, this will constrain the DM density cusp slope with an uncertainty of only 0.1, allowing us to discriminate at 10-sigma confidence between a core or NFW cusp. The results will give unique constraints on both the nature of DM, and the physical mechanisms that shape DM density profiles in galaxies. The proposed program therefore shows how HST can still be used, after 33 years in orbit, to tackle unanswered fundamental questions in astrophysics.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17435
Program Title: The Hubble Missing Globular Clusters Survey

Principal Investigator: Massari, Davide

PI Institution: INAF-Osservatorio di Astrofisica e Scienza dello Spazio

The detailed analysis, based on resolving individual stars, of the entire Globular Cluster (GC) system of a large galaxy is within reach only for the Milky Way and with the exquisite spatial resolution and photometric precision of the Hubble Space Telescope (HST). Such a complete view would enable a full investigation of several fundamental science cases, like, e.g., 1) reconstructing the timeline of the MW assembly history by means of the GC age-metallicity relation, 2) searching for the remnants of the primordial clumps that might have contributed to build-up the Bulge, and 3) testing the universality of the GCs stellar mass function. However, the census of Galactic GCs observed by HST is still significantly incomplete and the chances to reach this unique goal fades as HST gets older. For this reason we propose the Hubble Missing Globular Clusters Survey (MGCS), a Treasury Program targeting the 34 kinematically confirmed Milky Way GCs still missing HST observations, to get precise photometry of their stars down to at least 3 mag below the Main Sequence Turn Off. The proposed programme will provide the first complete catalog of homogeneous ages and distances for all the known GCs, and will investigate fundamental properties of still unexplored clusters located in the Galactic Bulge or in the distant Halo. MGCS will provide the astrophysical community with the essential observations, measures and tools to answer the three fundamental questions raised above, as well as many other open science cases related to GCs. Our survey will make the heritage of HST on GC science complete, a golden standard for the decades to come.

Proposal Category: SNAP
Scientific Category: Large Scale Structure of the Universe
ID: 17436
Program Title: An Independent High-Precision Distance Ladder for Cosmology

Principal Investigator: Jensen, Joseph

PI Institution: Utah Valley University

Surface brightness fluctuations (SBF) are a proven efficient and accurate distance indicator. SBF in E/S0 galaxies are sufficiently bright in the IR that they can be reliably measured to better than 5% in distance for galaxies within 85 Mpc in a single HST orbit. This outstanding and mature distance indicator will be used to determine distances for a random sampling of E/S0 galaxies from a list of 123 SNAP targets drawn from every massive cluster, and some non-cluster environments, within 85 Mpc. IR SBF using WFC3/IR will provide distances for the cosmological measurement of the Hubble-Lemaitre constant (H0) comparable in accuracy to supernovae, which is critical to resolving the disagreement between direct local measurements of H0 and those derived from cosmological models and the microwave background fluctuations in the early universe. SBF anchored by the tip of the red giant branch zero point measured using JWST (approved for cycle 2) will offer a competitive and completely independent alternative to the Cepheid+SN route to H0. The most massive clusters at 50-85 Mpc lie within either the Laniakea supercluster or in the Perseus-Pisces filament. This distance range is the sweet spot for HST IR SBF studies--distances too great to be reliably measured from the ground but comfortably accessible with HST in a single orbit. The dynamics in these two complexes are in the strongly non-linear regime. Numerical action methods will permit the recovery of physical orbits and the determination of 3D mass distribution of the local universe. The 3D information on positions and motions of massive galaxies affords a unique window into the construction of rich clusters.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17437
Program Title: When does the initial mass function become heavy? A unique view of two massive galaxies at z=1

Principal Investigator: Barone, Tania

PI Institution: Swinburne University of Technology

The stellar initial mass function (IMF) is a critical assumption underlying nearly every galaxy observable, yet it remains poorly constrained at high (z>0) redshift. The low-mass end in particular (M<0.4 Msun) significantly affects the mass-to-light ratio, and therefore measurements of key galaxy properties including the stellar mass and dark matter content are highly sensitive to its assumed shape. Thanks to upcoming cycle 2 JWST/NIRSpec IFU observations of 2 massive lensed quiescent galaxies at z~1, a precise measurement of the IMF at z~1 using spectral lines sensitive to low-mass stars will be possible for the first time. However, this forthcoming JWST IFU data has far more potential than solely measuring the IMF spectroscopically. This proposal will significantly expand the science available from this dataset by using only 2 orbits of HST/WFC3 to build a precise lens model of the one target without pre-existing WCF3 images and reconstruct the source galaxy's morphology. The high spatial resolution imaging from HST will open the door for spatially resolved studies of the target, allowing us to use the JWST data to its full capacity. With the combined HST imaging and JWST spectra we can then make an independent measurement of the IMF normalisation from dynamical modeling, a method which is in tension with results from stellar spectral features. Additionally, the dynamical models will provide a measure of the total mass density slope at an epoch where simulations and observations differ significantly in their predictions. This analysis will be the first of its kind and will provide a key test for galaxy formation and evolution theories.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17438
Program Title: Emission-line stars in the extremely metal-poor dwarf galaxy Sextans A

Principal Investigator: Gull, Maude

PI Institution: University of California - Berkeley

We propose HST/ACS Halpha (F658N) imaging to build the largest uniform sample of emission-line stars at sub-SMC metallicity by targeting the dwarf galaxy Sextans A. We will identify and characterize ~500 emission-line stars (Be, Oe, etc) at Z~0.1 Zsun, a >10x increase in the number of emission-line stars known at this metallicity. Such emission-line stars are expected to be a common phase of evolution for intermediate mass and massive stars, particularly at the low-metallicities, but there are few data points available to constrain theoretical predictions (fraction of emission-line stars, relationship to age, etc). Our large, homogenous study of these emission-line stars will greatly improve our knowledge of massive star evolution at low-metallicities as a function of age, metallicity, and location on the HR diagram. We will also supply the first constraints on the emission-line star contamination fraction of intermediate mass core blue helium burning stars (BHeBs; Mstar >~2 Msun) at such low metallicities. BHeBs provide critical tests for the physics of the post-main sequence stellar evolution (e.g., mass loss, rotation). This program will provide essential data to the broader community interested in other emission line stars such as symbiotic stars, PNe, luminous M(e) stars, massive young stellar objects, and binary-stripped stars. Observations of such low-metallicity emission line stars can only be made with HST, as they are all too faint and crowded for spectroscopic or ground-based imaging studies.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17439
Program Title: Skeletons in the Cluster: Unveiling the Stellar Mass Backbone of z=1.6 Galaxies

Principal Investigator: Noble, Allison

PI Institution: Arizona State University

The conversion of gas into stars on small spatial scales, and its connection to the underlying stellar backbone is key to understanding quenching in cluster galaxies. However, the dearth of high-resolution maps of the molecular gas, star formation, and stars has made it impossible to understand these processes. Recently, a new window into spatially-resolved molecular gas and far-IR emission has been opened through ALMA observations of high-redshift clusters. These gains have been mainly due to the high source density of star forming galaxies in young clusters, which allows for large multiplexing. The ALMA observations have delivered spatial and kinematic maps of the molecular gas at exquisite resolution for the first large sample of high-redshift galaxies, while the available rest-frame UV HST and ALMA FIR data have yielded star formation maps. We will combine these novel ALMA and HST data with new imaging in F105W, F140W, and F160W to derive stellar mass maps and to investigate the spatial distribution of the dominant baryonic components in main-sequence cluster galaxies at z~1.6. The target cluster contains galaxies in remarkable states of transformation and will be combined with analogous available data on 2 other z~1.6 clusters for a total sample of 29 galaxies at the same redshift with high-resolution spatial maps of their star formation, stellar mass, and gas. With these data we will, for the first time: 1) measure where star formation in cluster galaxies is halted (outskirts, centers, or everywhere); 2) connect deviations from scaling relationships to the stellar backbone of the galaxy; and 3) learn what role clumps play in driving mass buildup in cluster galaxies.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17440
Program Title: Assembling the Milky Way: Adding Globular Clusters from the Sagittarius Dwarf Galaxy

Principal Investigator: Garro, Elisa

PI Institution: Universidad Andres Bello

Globular clusters (GCs) are important tools to rebuild the accretion history of a galaxy. The newly discovered population of GCs in the main body of the Sagittarius (Sgr) dwarf galaxy can be used to probe this ongoing accretion event onto the Milky Way (MW). We propose to obtain deep WFC3 color-magnitude diagrams, reaching 2-3 magnitudes below the main sequence turn-off, for a dozen of these new Sgr GCs. Our main aim is to measure precise metallicities and ages for these objects, and also derive their structural parameters. The results will allow us to more fully characterize the complete GC system of the infalling Sgr dwarf galaxy, and its ongoing contributions to metallicity distribution, luminosity function, and age-metallicity relations of the Milky Way. This will help paint a detailed picture of galactic cannibalization in our own backyard, a process which continues to shape the Milky Way, and the evolution of galaxies everywhere.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17441
Program Title: UV spectroscopy of runaways from thermonuclear supernovae

Principal Investigator: El-Badry, Kareem

PI Institution: California Institute of Technology

We propose COS FUV spectroscopy of four newly-discovered hypervelocity white dwarfs that are runaways from double white dwarf binaries in which one component exploded in a type Ia supernova. Our targets have radial velocities ranging from 1100 to 2300 km/s -- the fastest stellar radial velocities ever measured. They are hot (20,000-140,000 K) and bright in the UV. The primary goal is measurement of their abundance patterns, particularly the abundances of Fe, Si, Mg, and Mn. The surfaces of these stars are predicted to be heavily polluted with supernova ejecta. Abundance measurements will constrain the yields of the supernovae from which these stars were born and the masses of the exploded white dwarfs, both clarifying their formation histories and informing models for their thermal evolution. Optical spectroscopy has shown that their atmospheres consist mostly of carbon and oxygen, but the abundances of most metals can only be measured in the UV at these temperatures.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17442
Program Title: Calibrating the Universe: Faint White Dwarf Standard Stars at the Ecliptic Poles for Cross-calibration of HST, Euclid and Roman

Principal Investigator: Deustua, Susana

PI Institution: National Institute of Standards and Technology

One of the most exciting results in modern cosmology has been the discovery of the accelerated expansion of the Universe. ESA's Euclid and NASA's Roman Space Telescopes are designed to illuminate the unknown nature of the observed cosmic acceleration, with launch dates in 2023 and 2026, respectively. They will complement each other in probing cosmic acceleration with high precision and accuracy, and need tight requirements on spectrophotometry to unprecedented accuracy. Accurate absolute spectrophotometry is vital to determine the fraction of baryonic matter turned into stars, for galaxy and supernovae surveys, and as importantly, enable legacy science. Extreme care must be taken to control systematic errors and biases. We propose to establish five DA White Dwarfs located near the ecliptic poles, within the Euclid and Roman continuous viewing zones, as spectrophotometric standards. This allows for year-round accessibility. The stars lie within two of the Euclid deep fields, and in a likely location to be observed by Roman for calibration purposes. Our program will double the number of CALSPEC white dwarf standards at V > 16 mag, and will be vital in tying Euclid/Roman deep field spectra of faint galaxies to well-calibrated HST standards.This proposed program is of critical importance to the successful calibration of both Euclid and Roman.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17443
Program Title: Establishing the Geometry of Lyman Continuum Escape

Principal Investigator: Carr, Cody

PI Institution: University of Minnesota - Twin Cities

The past decade has seen remarkable success in the direct detection of the fraction of ionizing radiation escaping from compact star-forming galaxies (r_50 < 500 pc) with high star formation rates (10 - 100 Msol yr^-1) in the rest frame Lyman continuum using the G140L, CENWAV800 mode of COS. We can now use confirmed LyC leakers to test how geometry and kinematics influence ionizing radiation escape in starbursting galaxies. We propose a pilot program to probe the nature of the outflows in a carefully chosen set of bright leakers and non-leakers, spanning a narrow range of metallicity to control on abundance uncertainties. We will use high resolution spectroscopy from COS G130M and archival G160M, to analyze absorption line profiles of HI and the host of low and high ionization species. We will employ the Semi-Analytical Line Transfer (SALT) code to determine the geometry, terminal velocities, and mass outflow rates as a function of ionization for each atomic species. We will address the long standing problem of whether ionizing radiation, at these select metallicities, escapes through holes in a patchy ISM/CGM or through a relatively smooth and tenuous density bounded optically thin medium. These analyses will inform the potential yield of a future program to examine objects at lower metallictities where the range in observed escape fraction is more extreme but the objects are fainter.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17444
Program Title: Mapping the geometry of the new lensed quasar eRASS1 J050129.5-073309 using high resolution imaging of the lens and quasar host

Principal Investigator: Tubin, Dusan

PI Institution: Leibniz-Institut fur Astrophysik Potsdam (AIP), Germany

The newly discovered lensed quasar eRASS1 J050129.5-073309 at z = 2.47 represents a perfect laboratory to estimate the Hubble constant via time-delay cosmography, study ongoing microlensing effects, and also characterize the host galaxy properties of the quasar. The two lensed images show a time delay of 107.8 +- 8.5 days. This time-delay timescale, the brightness of the quasar, and the separation of the images make it a unique source for time-delay cosmography studies. Imaging and image modeling reveal both the lensing galaxy and tentatively the lensed image of the quasar host galaxy. We propose HST observations, with a resolution of ~0.1'', to investigate the mass profile of the lensing galaxy in order to obtain an accurate model of the lens, aiming to calculate the Hubble constant via time-delay cosmography. The high-resolution observation will also confirm the presence of lensed arcs which correspond to the host galaxy of the quasar, allowing us to constrain even more the mass distribution of the lensing galaxy.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17445
Program Title: Masses of Be+sdO binaries with visual orbits

Principal Investigator: Gies, Douglas

PI Institution: Georgia State University Research Foundation

Massive stars are often created in close binary systems that are destined to exchange mass and angular momentum. The more massive component will begin transferring photospheric gas to its companion when it attains a physical size becomes comparable to its Roche surface. The mass donor will eventually be stripped of its outer envelope to become a hot He star, and the mass gainer will be spun up to near critical rotation. The rapidly rotating Be stars may have formed through such close binary interaction, and a large fraction of them may exist as Be+He binaries, which have been called Be+sdO systems in published research papers. Searches for the hot He stars are only feasible with ultraviolet spectroscopy. Here we propose to obtain FUV spectroscopic observations for five Be+sdO binaries systems that were recently angularly resolved through near-IR long baseline interferometry with the CHARA Array. The visual orbits combined with distances yield the total system masses, but to obtain individual masses requires spectroscopic orbits from radial velocities. Our goals here are to confirm the detection of the stripped helium stars in these Be binaries, determine their orbital elements through measurements of the Doppler shifts, find the individual masses, and refine the physical properties of both components from the reconstruction of individual component spectra using Doppler tomography. We aim to compare the fundamental physical parameters of these systems with evolutionary models to estimate their ages and to trace their formation processes through the mass transfer.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17446
Program Title: Extending Precision Cosmology to Early Hosts of Type Ia Supernovae via Surface Brightness Fluctuation (SBF) Distances

Principal Investigator: Milne, Peter

PI Institution: University of Arizona

We propose to measure Surface Brightness Fluctuation (SBF) distances to the early-type host galaxies of 30 nearby Type Ia supernovae (SNe Ia) using WFC3/IR imaging. Combined with the existing HST-SBF distances, these new measurements provide a complete sample of 62 SBF-calibrated, SALT2-fitted SNe Ia reaching out to 100 Mpc. This compares with 42 SNe calibrated with Cepheid variables and 18 calibrated through the TRGB method. However, the cost per calibrator using SBF is significantly less than for the other methods. The SBF technique is currently tied to Cepheids, but a recently-approved JWST program will allow anchoring to the TRGB distances of early hosts, providing a precise estimate of the Hubble constant that is independent of Cepheids. Comparisons between the two zero-point anchors will isolate variations in SN luminosities and determine if there are systematic differences between the SN Ia distances to early- and late-type galaxies. Since SN Ia properties have been shown to depend upon the host galaxy type, it is essential that SNe Ia from all galaxy types be included in the calibration as a check on systematic population shifts impacting the Hubble constant, the Hubble tension and conclusions about the accelerating universe. The TRGB+SBF method is a good complement to the Cepheid+SN technique: it has comparable statistical uncertainties, requires many fewer orbits to achieve the distance measurements, and reaches well into the Hubble flow. This Cycle 31 proposal will roughly double the number of SNe Ia with SBF distances and will particularly improve the sampling of narrow-peaked SNe Ia.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17447
Program Title: Joint HST+XMM time-resolved UV+X-ray observations of a quasi-periodically erupting X-ray source

Principal Investigator: Wevers, Thomas

PI Institution: Space Telescope Science Institute

Quasi-periodic eruptions (QPEs) are recurrent, high-amplitude bursts of X-ray emission in the nuclei of galaxies hosting low mass (10^5-6 M_sun) black holes. Their nature is still hotly debated, with the main two model classes including various flavours of accretion disk instabilities, and two (or multi-)body interactions between the central SMBH and a stellar-mass perturber. The latter can involve a main sequence star, white dwarf, or stellar mass black hole, and the eruptions are variously related to tidal stripping of orbiting companions, Roche lobe overflow, or interactions of the perturber with an accretion disk. The main QPE properties are short recurrence times (2-20 hrs), short durations (27 min - few hrs) and high amplitudes (factor 10-100). Discovered and well studied in X-rays, the UV, IR and radio properties remain poorly constrained. We propose to obtain the first deep observations in the UV (currently constrained only with the XMM-Newton Optical monitor), with high cadence (3 min) HST FUV imaging of a QPE with eruptions lasting only 27 min and recurring every 114 min. These timescales are perfectly suited to perform the first time-resolved UV variability search during the X-ray eruptions. The HST spatial resolution will resolve out the host galaxy emission; with HST sensitivity in the FUV this will lead to a >2 orders of magnitude improvement compared to current constraints. A detection of UV variability and how it correlates with the X-rays will have field-defining implications that will redraw the theoretical landscape. Non-detections will provide very strong additional constraints on the geometry, extent and properties of the putative accretion disks.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17448
Program Title: MASQUERADE: Mapping A Super-Luminous Quasars Extended Radiative Emission

Principal Investigator: Eilers, Anna-Christina

PI Institution: Massachusetts Institute of Technology

The ultraviolet radiation of luminous high-redshift quasars lying deep within the Epoch of Reionization carves out large bubbles of highly ionized intergalactic gas in the quasar's environment. The resulting decrease in the optical depth of the Lya forest at redshifts near to the systemic redshift of the quasar is known as the proximity effect. Recently, JWST has revealed 43 spectroscopically confirmed galaxies in the background of the most luminous, high-redshift quasar known, at a redshift of z=6.327. By a fortuitous coincidence, the narrow-band filter F892N on ACS/WFC is perfectly centered around the quasar's redshift to capture the transmitted flux in the Lya forest of background galaxies at close projected separations to the quasar. This will allow us to tomographically map the quasar's ionized region for the first time by means of the transverse proximity effect. Our observations aim to reveal the geometry of the quasar's ionization cone, and constrain its opening angle and obscuration. Additionally, the extent of the ionized region, also known as the quasar's light echo, provides a model-independent constraint on the quasar's UV luminous lifetime based on the light crossing time, which has profound implications for the early growth phases of supermassive black holes. The recent detection of an overdensity of bright galaxies in the background of this super-luminous quasar, whose systemic redshift perfectly matches an existing narrow-band filter on ACS, provides the most promising opportunity to probe the transverse proximity effect for the first time in the high-redshift universe and makes HST uniquely suited for our proposed experiment.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17449
Program Title: Early spectroscopy of tidal disruption events: outflow signatures or chemical composition ?

Principal Investigator: Leloudas, Giorgos

PI Institution: Technical University of Denmark-DTU Space

Tidal Disruption Events (TDEs) happen when stars get tidally disrupted by the gravitational field of a supermassive black hole. TDEs are bright panchromatic events and evolve on human-friendly time scales, which makes them prime tools to study accretion physics and black holes in all types of galaxies. Despite considerable progress achieved in the last few years, and the increasing number of TDEs discovered in the optical/UV wavelengths, we still do not know what powers the optical/UV emission of these events, with reprocessed accretion and debris stream collisions being the leading candidates. Important clues to their nature can be derived from spectroscopy, including the presence of Bowen fluorescent emission and the study of kinematical offsets. A growing number of optical TDEs show transient blueshifted line profiles, which are particularly prominent at the He + Bowen blend and at early phases. These have been interpreted as signatures of outflows, which are an inherent prediction of super-Eddington accretion models. However, the blended nature of optical lines makes it hard to disentangle outflows (measured by blueshifts) from chemical composition (the relative contributions of He II and N III). Early UV spectroscopy is required to break this degeneracy by observing the profiles of isolated He II and high-ionisation lines before maximum light, something which has never been possible to achieve before. We therefore propose a ToO program to obtain the first pre-max spectrum of a TDE in the UV and solve this outstanding question. In addition, our proposed COS-STIS observations will contribute to slowly increasing a small legacy sample of TDEs with UV spectroscopy.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17450
Program Title: A holistic view of compact binary mergers: from kilonova to afterglow

Principal Investigator: Troja, Eleonora

PI Institution: Universita di Roma Tor Vergata

The fate of two compact objects is to spiral into each other and eventually collide (or merge) due to angular momentum and energy losses to gravitational radiation. By combining extreme gravity, copious emission of gravitational waves, and luminous electromagnetic radiation, these mergers serve as excellent astrophysical laboratories to explore a wide range of fundamental problems: from the formation of ultrafast outflows to the cosmic production of heavy metals, from the equation of state of cold ultra-dense matter to the expansion rate of the universe. Our understanding of these systems was revolutionized in 2017 by the discovery of GW170817, the first mergers of two neutron stars (NSs) studied through gravitational waves and light. Thanks to its proximity and an unprecedented observing campaign, this one event revealed the rich complexity of the merger phenomenon and opened up new horizons for the study of these systems. Here we propose a comprehensive investigation of compact binary mergers aimed at maximizing the scientific return of future GW events. By using of the unique HST capabilities, we will map the explosion properties and environment of NS mergers with unprecedented detail, thus realizing in full the potential of multi-messenger astrophysics.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17451
Program Title: UV Spectroscopy of the D-type Symbiotic, R Aquarii: Revealing the Energetics of the Inner Nebula

Principal Investigator: Sankrit, Ravi

PI Institution: Space Telescope Science Institute

The much anticipated eclipse of R Aquarii (R Aqr) in its 44 year binary orbit is underway. The hot White Dwarf (WD) and accretion disk have moved in front of the cool, dusty mass losing AGB companion giving us a direct view of the accretion flow. The system has just passed periastron, and is in a high state of binary activity, with material being injected near the base of the bipolar jet into a fast collimated flow. Fast shocks with speeds of up to, perhaps, 250 km/s are being driven into the surrounding photoionized nebula and into the pre-existing jet material. These shocks will raise the ionization levels of the gas and produce bright high-ionization emission lines in the ultraviolet (UV). We propose to use COS to obtain UV spectra (spanning 1135-3200 Ang.) of the region immediately surrounding the binary, and use the emission lines to identify and measure the various processes energizing the inner nebula during this extremely active phase. We will study the evolution of the UV emission and their causes by comparing our data with IUE spectra obtained over half an orbital period ago. During this critical phase in its binary orbit, R Aqr is being intensively monitored from the ground, and has been observed at all wavelengths from the radio to the X-ray except that no UV spectra have been obtained. This eclipse will end in a few years time, and there is an urgent imperative that COS spectra be obtained to unravel key physical processes underlying the accretion and jet formation in this nearby object. The insights gained will have wide applicability, in many astronomical systems where accretion and jets are present.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17452
Program Title: Lyman-alpha emission in low-mass compact galaxies with most extreme [OIII]5007/[OII]3727 ratios of above 30

Principal Investigator: Izotov, Yuri

PI Institution: Ukrainian National Academy of Sciences, BITP

Compact and low-mass star-forming galaxies (SFGs) at low redshifts are considered to be the likely nearby counterparts of the high-z star-forming dwarf galaxies thought to be responsible for the reionization of the Universe. We propose to observe with the HST/COS a sample of the five compact SFGs with the highest O32 = [OIII] 5007/[OII] 3727 ratio of 30 - 69 known in the local universe, to obtain medium-resolution spectra of the Ly-alpha emission line. These SFGs were selected from the Data Release 16 of the Sloan Digital Sky Survey to be very compact and to have very young starbursts (EW(Hbeta)>250A). Two SFGs are characterized by the extremely high [OIII]5007/[OII]3727 emission-line ratios of 57 and 69, indicating extreme ionization conditions in their HII regions. The Ly-alpha profiles in those medium resolution spectra will be used to indirectly estimate the escape fraction of the Lyman continuum and will provide important insight on the ISM and radiation field of the star-forming regions. Obtaining the rest-UV spectra of these five SFGs which will serve as templates for the analysis of spectra of high-z dwarf galaxies with active star formation, is thus both urgent and crucial for studies with the JWST and the largest ground-based facilities.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17453
Program Title: Activity at the Edge

Principal Investigator: Ayres, Thomas

PI Institution: University of Colorado at Boulder

A central goal of cool-star astronomy is to link the high-energy FUV+X-ray ("XUV") luminosity -- which among other things can affect the local stellar environs, especially orbiting exoplanets -- to properties of the "dynamo" that controls the generation of magnetic flux deep inside spinning, convective stars. In the 1980s it was discovered that the ratio of the stellar rotation period to a convective turnover time could unify the behavior of Ca II HK chromospheric fluxes broadly over the FGK spectral types. This "Rossby number" plays a fundamental role in terrestrial and stellar dynamo theories, so the unification was promising. A more recent attempt to achieve a similar synthesis at high energies, more closely connected to concentrated surface magnetic activity, met with some success for the early- to mid-G types, but theoretical convective turnover times showed a sharper drop in the early-F types than empirical estimates. That "edge" occurs where stellar convection zones are rapidly thinning toward the warmer spectral types, a challenge to theory. Unfortunately, the existing sample of empirical turnover times has a conspicuous gap in the F types, so the intermediate behavior is unknown. This gap can be filled by new HST/COS FUV (and Chandra X-ray) observations of 17 carefully selected F5-G1 dwarfs in the nearby Pleiades cluster; which have accurate photometric rotation periods, common age and similar composition. Validation of the Rossby framework with this unique stellar cohort not only could strengthen the theory; but also ultimately allow "one-stop shopping" to estimate XUV luminosities of cool stars beyond the range of current high-energy space observatories.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17454
Program Title: A candidate nearly-dark galaxy with 4 globular clusters

Principal Investigator: van Dokkum, Pieter

PI Institution: Yale University

CDG-1 is a recently-discovered system that may have the most extreme properties yet seen for a low surface brightness dwarf galaxy. An HST imaging survey of the Perseus cluster revealed a tight clump of 4 apparent globular clusters, indicating the presence of a galaxy, but no associated diffuse light. The probability that this grouping occurred by chance is less than 1 in 10^6. CDG-1 may represent the most extreme known case of a galaxy that experienced strong early feedback, driven by the young clusters themselves, that prevented subsequent star formation. In most formation scenarios at least some diffuse star light is expected, and here we propose a sensitive search between the globular clusters using the efficient F200LP filter of UVIS. A detection of diffuse light would demonstrate that CDG-1 is indeed a galaxy, with at least ~95% of its luminosity in the form of globular clusters. The separations between the clusters are only 1-2 arcsec, which makes it impossible to do this program from the ground.

Proposal Category: SNAP
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17455
Program Title: A Snapshot Survey of Sub-arcsec Dual Quasars and Lenses at z>2

Principal Investigator: Shen, Yue

PI Institution: University of Illinois at Urbana - Champaign

The search for and characterization of the binary supermassive black hole (SMBH) population over cosmic history is a critical pathway to understanding galaxy/SMBH assembly and predicting low-frequency gravitational waves from the mergers of these SMBHs. The high-redshift (z>2) regime (i.e., the "quasar epoch") is of particiular importance, where SMBH accretion and global star formation reached their peak activity, and galaxy mergers occur much more frequently than at lower redshifts. This is also the regime where observations of close SMBH pairs significantly lag behind theories: due to observational limitations, there are few unambiguously confirmed SMBH pairs below ~10 kpc at z>2. Here we propose a WFC3 UVIS+IR snapshot imaging program of luminous z>2 quasars to systematically discover kpc-scale dual (unobscured) quasars and sub-arcsec lenses, using recently developed astrometric techniques with Gaia data that have been proven efficient in this redshift-separation regime. The three-band imaging (UVIS-F475W/F625W and IR-F160W) will resolve the pair at ~0.1" resolution, provide color information and detect a potential lens galaxy and/or merger features to assess the nature of the resolved pair. This program will produce an unprecedented large sample of kpc-scale quasar pairs at cosmic noon, which will not only provide the first quantitative constraints on this progenitor population of SMBH mergers, but also critical insights on the galaxy formation story.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17456
Program Title: Travelling Through Time in the Beta Pictoris Disk: Exploring the Frequency of Protoplanet Collisions

Principal Investigator: Wagner, Kevin

PI Institution: University of Arizona

Debris disks represent the end-stages of planet formation. Similar to the moon-forming impact and the collosion that stripped the mantle of Mercury during our own solar system's late stages of formation, major collisions between planetesimals and protoplanets shape the end products of mature planetary systems. Giant planets perturb the orbits of planetesimals, increasing the rate of collisions and the generation of micron-sized dust. These are blown out by radiation pressure to replenish the dust of the outer disk on timescales of centuries, and therefore measuring the surface density distribution of the outer disk can reveal the historical rate of collisions. There is evidence for at least one giant impact in the most nearby debris disk around Beta Pictoris having occurred in the past decades (due to the presence of CO gas which photo-dissociates within ~100 years). This suggests that such events may be even more common than previously thought. STIS images from 1997-2012 confirm the evidence of a recent impact, but only cover a quarter of the possible outer working angle. We propose to revisit the system with STIS to characterize the surface density distribution of the outer disk and thus the system's collision history over the past four centuries. By repeating the earlier observations with the optimal large outer working angle (43") orientation and occulting mask combination, we will recover surface density modulations of <20% at 200-400 au for the first time, representing collisions occurring from ~1860-1960. These observations will provide an entirely new set of constraints on the collision dynamics of the end stages of planet formation in the Beta Pictoris system.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17457
Program Title: Zooming in on HII regions: a comprehensive view of dust attenuation and embedded star formation in local galaxies

Principal Investigator: Belfiore, Francesco

PI Institution: INAF - Osservatorio Astrofisico di Arcetri

HII regions and the emission lines originating from ionised gas are key tracers of star-formation rate in galaxies across Cosmic Time, but we currently lack a comprehensive understandig of how dust attenution on small (5-10 pc) scales affects our inferences. We propose to build a legacy dataset for ~50000 HII regions in a representative sample of local main sequence galaxies to provide a detailed view of embedded star formation, dust attenuation, HII region morphology, and stellar feedback processes. We will achieve this by using using the narrow-band filter on HST to obtain maps of the Hydrogen alpha (Ha) line emission and combining it with upcoming JWST imaging of the same area with the Paschen alpha filter on NIRCam. This dataset will be complemented by a rich multi-wavelength archive, including a new JWST imaging, existing braodband imaging from HST, extensive mapping with ground-based integral field spectroscopy (MUSE/VLT), and coverage with ALMA. We will leverage this combined dataset to 1) anchor MIR star-formation rate tracers on 'gold standard' hydrogen recombination lines, 2) jointly analyse HII regions and their ionising star clusters to determine the dominant sources of stellar feedback as a function of environment, and 3) test the universality of the dust attenuation curve and infer the relative geometry of gas, stars and dust on ~10 pc scales.

Proposal Category: GO (GO-Archival)
Scientific Category: Galaxies
ID: 17458
Program Title: Spatially Resolving the Baryon Cycle at z~2-3

Principal Investigator: Erb, Dawn

PI Institution: University of Wisconsin - Milwaukee

Galactic outflows powered by star formation are a key driver of the baryon cycle, regulating star formation in galaxies and the gaseous content of the circumgalactic medium across cosmic time. We propose to combine high resolution, spatially resolved stellar population measurements from broadband HST imaging with spatially resolved measurements of gas flows from the Keck Cosmic Web Imager (KCWI; all data is already in hand), in order to assess the relationships between star-formation-driven outflows, galactic structure and stellar populations at the peak epoch of star formation. Our sample consists of ten gravitationally lensed galaxies at z~2-3, including some of the brightest lensed galaxies known. We have already obtained and analyzed the necessary HST imaging for three objects in the sample, and this combined archival + GO proposal completes the wavelength coverage with five orbits of new WFC3 imaging and extensive leverage of the archive for the remaining galaxies. The exquisite spatial resolution of HST combined with both the magnification of gravitational lensing and the power of Keck to probe the rest-frame UV will provide important new constraints on the baryon cycle, enabling us to discriminate between local outflows that depend on the properties of individual star-forming regions and global outflows that cover the entire source. The proposed new observations will also increase the legacy value of the existing data for these template galaxies.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17459
Program Title: High-resolution imaging of Fomalhaut's newly discovered intermediate dust belt to precisely measure the planetary system geometry

Principal Investigator: Kalas, Paul

PI Institution: University of California - Berkeley

The dusty debris belts surrounding the nearby star Fomalhaut show indirect evidence for hidden planets gravitationally sculpting the system. Fomalhaut has been studied by every major observatory and interpreted through many theory papers, demonstrating wide interest by the astronomical community. The most recent breakthrough comes from JWST/MIRI images that reveal the existence of an intermediate dust belt at ~100 au not previously seen in any other data set. Here we show that the intermediate belt can be detected in dust-scattered light in archival STIS data. However, these observations used a subarray that limited the detection to roughly 90 degrees along the belt's minor axis. Here we propose new observations that increase both the field of view and integration time to map the entire intermediate belt in dust-scattered light. These data will exceed JWST/MIRI's angular resolution by a factor of seven and enable a precise measurement of the belt's geometric properties. The results will show to what extent the intermediate belt is misaligned with the inner asteroid belt analog and the outer belt. Its stellocentric offset will be measured to the same precision as the outer belt, and the radial gap between belts will give theorists more precise information on modeling the properties of hypothesized planets inferred to exist between the belts.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17460
Program Title: Heavy metals escaping from a hot Neptune

Principal Investigator: Oklopcic, Antonija

PI Institution: Universiteit van Amsterdam

A large fraction of known exoplanets orbit their host stars at very short periods. Due to such close proximity to the parent star, their atmospheres are exposed to high levels of stellar radiation and stellar wind, as well as strong tidal interactions, which can lead to atmospheric escape operating in a regime much more efficient than in the Solar System planets. Efficient atmospheric mass loss has the power to radically transform planets by changing their atmospheric structure or by removing the atmosphere altogether. Even though the first evidence of ongoing atmospheric escape in exoplanets was acquired for close-in gas giants, exoplanet demographics suggest that this process likely plays a much greater evolutionary role in planets the size of Neptune and smaller. It is believed to be responsible for shaping the so-called 'hot Neptune desert', the observed paucity of intermediate-sized planets at close orbital separations. LTT 9779b is a rare example of a planet residing well within this desert, in the part of the parameter space where atmospheric escape driven by stellar high-energy radiation can be further assisted by Roche lobe overflow, resulting in extremely high mass-loss rates. The goal of our proposal is to observe the ongoing atmospheric escape for this ultra-hot Neptune through transmission spectroscopy at NUV wavelengths with STIS. The NUV wavelength range gives us the best opportunity to observe the upper atmosphere in multiple lines of different species, which is necessary in order to break modeling degeneracies and constrain the atmospheric mass-loss rate.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17461
Program Title: Unlocking the rich potential of JWST slitless spectroscopy with the help of HST: an optical follow-up campaign

Principal Investigator: Mehta, Vihang

PI Institution: California Institute of Technology

The first round of JWST data are already revolutionizing the field of galaxy evolution. The large amount of slitless spectroscopic data collected in Cy1 are well poised to extend our knowledge about galaxies at the cosmic high-noon (z=1 to 3) down to unprecedented stellar masses of ~10^8 Msol. The pure-parallel PASSAGE program is currently the largest-area survey with contiguous, deep 1-2.2 micron JWST grism data. Unfortunately, the corresponding photometric coverage is severely limited making it extremely challenging to accurately recover fundamental physical properties of galaxies such as their stellar masses and dust attenuation, which are vital for answering the majority of galaxy evolution science questions. Here, we propose to follow-up 7 premier PASSAGE fields with 3-band grism coverage (1-2.2 micron) from JWST to obtain the crucial rest-frame UV imaging needed to accurately measure their physical properties. We request a combination of WFC3/UVIS F475W, F625W and ACS/WFC F814W imaging (1 orbit each) for a total of 21 orbits (3 per field). These data in combination with PASSAGE will enable: (i) accurate stellar mass estimates for hundreds of galaxies over 0.5<z<3.5 and constrain the low-mass end of the star-forming main sequence and mass-metallicity relation; (ii) spatially resolved comparison between UV and Halpha to reveal a resolved picture of star-formation burstiness in galaxies and their mass assembly; and (iii) accurate measurement of the stellar dust attenuation and the relative strengths of stellar vs. nebular dust components in star-forming galaxies at z~2.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17462
Program Title: Evolution of an isolated shock-cloud interaction along the southeastern boundary of the Cygnus Loop supernova remnant

Principal Investigator: Sankrit, Ravi

PI Institution: Space Telescope Science Institute

We propose to use WFC3 narrowband imaging to obtain HST 2nd epoch H-alpha, [S II] and [O III] images of an isolated shock-cloud interaction in the Cygnus Loop that was previously observed in 1994 using WFPC2. The two sets of images separated by over 30 years will allow us to characterize the evolution of the shocked gas in great detail. Proper motions will be measured to an accuracy of better than 1.5 mas/yr. Thus, for well defined filaments and knots, the shock velocities will be determined based on the accurate GAIA-derived distance to the Cygnus Loop (725 +/- 15 pc) to within about 5 km/s. The differences in shock velocities along a filament and at different locations will allow us to estimate the variation in the pre-shock densities that exist within the cloud. Instabilities and shearing in the flow, or the development of turbulence will be seen as changes in the emission morphologies. The brightening of [O III] and [S II] emission relative to H-alpha will indicate that the recombination zone behind the shock front is getting stronger, and conversely the morphologies and brightnesses will remain more or less the same if the shock-front is moving in steady state. The long temporal baseline between observations combined with the high angular resolution of the HST instruments provides a powerful tool for analyzing the various physical processes that drive supernova remnant shock-cloud interactions.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17463
Program Title: Evolution of the Obscuring Outflow in the Active Galaxy Mrk 817

Principal Investigator: Kriss, Gerard

PI Institution: Space Telescope Science Institute

The intensive multi-wavelength campaign to monitor the active galaxy Mrk 817 with HST, Swift, and NICER is now the longest, most intensive probe of an AGN's broad emission line region, the continuum emitted by its accretion disk, and its evolving, powerful X-ray and UV-absorbing outflow. Understanding the structure and kinematics of the gas surrounding supermassive black holes is crucial for understanding accretion, black-hole growth and associated feedback governing host-galaxy evolution. The BLR of Mrk 817 is dominated by virial motions, and its obscuring outflow plays a significant role in regulating the ionizing flux reaching the BLR gas. Continued monitoring of Mrk 817 in X-ray, UV, and optical with Swift (2 years, every other day), NICER (2 years, every other day), and ground-based observatories is still ongoing (private communication). To take advantage of these multi-wavelength programs, we propose to continue observing Mrk 817 with COS, with a cadence of one orbit per month in Cycle 31 through April 2024, the end of the current Swift monitoring program. Our primary science goal is to monitor the continuing evolution of the obscuring outflow, which has been dissipating over the past several months as shown by Swift, NICER, and HST spectra. Observing the moment that the obscurer has dissipated completely and how the BLR reacts to this clearing would be a unique moment in the life of an AGN never seen before. We also propose a triggered observation to obtain a comprehensive broad-band spectrum of Mrk 817's accretion disk and broad emission-lines from the Lyman limit to 1 micrometer once Swift, NICER, and HST have confirmed that the obscuration has dissipated.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17464
Program Title: From High-Energy Particle Beam Heating in Stars to Ozone Destruction in Planets: NUV Spectra as the Fulcrum for a Comprehensive Understanding of Flaring M Dwarf Systems

Principal Investigator: Kowalski, Adam

PI Institution: University of Colorado at Boulder

Stellar flares are the most dramatic examples of energy release that non-degenerate stars undergo while on the main sequence. In our search for habitable zone planets around M dwarf stars, characterizing the flare activity of M dwarfs is a key ingredient to understanding the impact the star can have on its near stellar environment. Recent results have also demonstrated that particle acceleration in the stellar atmosphere plays a crucial role in the shape and amount of UV and optical radiation released during M dwarf flares. The NUV range is unequivocally a "fulcrum" between the optical and shorter wavelength FUV continua but has been woefully undersampled in observations. We propose a HST Treasury program to characterize the NUV continuum and emission lines in M dwarf stellar flares. Only HST can empirically constrain the spectral peak and slope in the NUV and thus physically explain the origin of the flare in the low stellar atmosphere through the heating by accelerated particles. Our strategy spans a 4.5x greater spectral range in the NUV than previous studies and will provide flux-calibrated, time-resolved flare spectra just below the atmospheric cutoff (lam < 3200 A). The flare and quiescent data will have broad legacy value for characterizing the high-energy radiation environment of exoplanets, comparing to IRIS data of solar flares, and interpreting archival broadband NUV photometry of magnetically active stars. The science products -- time-resolved NUV spectra along with best-fit models to the NUV spectra calculated on a wider wavelength range from FUV through red-optical wavelengths -- will also benefit multiple communities.

Proposal Category: GO (GO-Archival)
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17465
Program Title: NGC 4214: Spatially-Resolved Calibration of Indirect Methods to detect LyC Leaking Photons at all Redshifts

Principal Investigator: Aloisi, Alessandra

PI Institution: Space Telescope Science Institute

The escape fraction f_esc of LyC photons from star-forming galaxies (SFGs) is a topic of great interest. Leaking dwarf SFGs have been indicated as candidates for the re-ionization of the Universe at z ~ 7-10. Only a fraction of candidate LyC leakers at z > 0.5 -5 have shown enough leakage for such re-ionization (> 10-20%). Direct detections are difficult due to absorption of the LyC emission at < 912 A from the Milky Way (z ~ 0) or the IGM (z > 0). To move this field forward, indirect methods need to be spatially resolved down to the scales of individual SF regions to establish if the low detection rate is due to spatial variations and geometry within galaxies or global versus local properties. The first of a kind spatially-resolved f_esc map from HST broadband photometry indicates variations between 0-40% within NGC 4214 (~ 3 Mpc). Here we propose to use 1 archival and 6 new COS G130M pointings in NGC 4214 to probe the paths for LyC escape through analysis of the residual intensity in the core of saturated UV absorption lines (e.g., C II). We will complement these data with guaranteed simultaneous STIS G430L and G750L long-slit spectra, gaining access to another indirect indicator, O32, and emission lines critical to constrain the local physical conditions of the clumpy ISM and the ionizing photon production. Archival optical IFU data will provide the gas kinematics in the very center of NGC 4214. This wealth of data will be key to characterize the local physical processes regulating the creation and leakage of LyC photons in galaxies, and deliver to the community spatially calibrated indirect methods to measure f_esc at all redshifts in the era of JWST and ELT.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17466
Program Title: Tracing the wobble: astrometric monitoring of the first Y+Y brown dwarf binary

Principal Investigator: Fontanive, Clemence

PI Institution: Universite de Montreal

We propose a comprehensive astrometric follow-up of the first Y+Y brown dwarf binary, WISE 0336-0143 AB, a <1-AU separation and low mass ratio system detected with JWST. We aim to follow the ~50-mas astrometric wobble of the photocentre resulting from the binary orbital motion, by exploiting HST's high astrometric precision with WFC3/IR. Our program will accurately measure the system's proper motion, trigonometric parallax, and orbital configuration, at an unprecedented accuracy of <0.5 mas through asbolute astrometric calibrations using Gaia. Capitalising on the three archival HST epochs already available and the recent JWST results, we have a unique opportunity to simultaneously refine the system's distance and to measure the individual components' dynamical masses, by acquiring only four new HST epochs over the next two years. These additional carefully timed datasets are required to demarcate the absolute astrometric displacement of the barycentre and remaining on-sky offsets due to the orbital motion of the binary components around the centre of mass. This work will be crucial to anchor current and future observed characteristics of the unique WISE 0336-0143 benchmark, significantly contributing to our understanding of its fundamental and binary properties, and an important step forward in the characterisation and atmospheric modelling of Y-temperature giant exoplanets and brown dwarfs. In addition, this program will also pave the way for future investigations of sub-AU binary systems around faint Y dwarfs, and will provide us with an extensive dataset to develop a framework for joint astrometric analyses linking HST, JWST and Gaia data.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17467
Program Title: An HST + JWST Investigation of Two Protostellar Outflows in Orion: Tracing Jets From 100 au to 100,000 au

Principal Investigator: Megeath, Tom

PI Institution: University of Toledo

Leveraging existing JWST IFU and HST WFC3/IR data, we propose to observe the jets of two young protostars in Orion: the low mass protostar HOPS153 and the intermediate mass protostar HOPS 370. Collimated jets from low to intermediate mass protostars shape the IMF and lower the star formation efficiency by carving cavities in the infalling envelopes of gas feeding the protostars. The jets then propagate into the surrounding cloud, stirring up gas, and likely regulating or lowering the rate of star formation in molecular clouds. JWST NIRSpec and MIRI MRS > 3 micron IFU observations of HOPS 153 and 370 shows jets traced by [FeII] in the inner 1200 au of the protostars, with spatial resolutions down to 80 au. At distances of 30,000 to 100,000 au from the protostar, where the extinction no longer hides the jets from 1-2 micron observations, the proposed HST WFC3/IR observations will trace shocks in jets launched by these protostars using narrow band filters covering the [FeII] 1.66 and 1.26 micron lines, and the Paschen Beta HI line. By comparing the [FeII] 1.64 um maps to F160W observations from 2010 and 2019, we will measure the proper motion of the shocks. By comparing the [FeII] 1.66 um to Paschen Beta line ratio to models, we will measure the velocity of the pre-shock (jet) gas relative to the shocks. We will also determine the propagation timescale between shocks in the jet, and thereby the interval being accretion events thought to drive the shocks. This program will trace the flow of mass, momentum and energy in jets of representative young protostars from 100 to 100,000 au, providing new constraints on the role of jets in shaping the IMF and regulating SF.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17468
Program Title: Space weather on GJ 436 b

Principal Investigator: Schneider, Christian

PI Institution: Universitat Hamburg, Hamburger Sternwarte

GJ 436 b produces a spectacular Lya transit with a depth in excess of 50%, an ingress well before, and an egress well beyond the optical transit. This transit, however, proves to be challenging to simulate despite numerous attempts and no consensus on the planetary wind properties has been reached. Yet, GJ 436 b is one of the few hot Neptunes where we can directly observe mass-loss through a planetary wind and study processes that may cause the hot-Neptune desert and the radius gap. The Lya transit, however, has been pieced together using data from eight(!) different epochs spread over six years. This would be acceptable if the system were stable in time, but we now know that the host star has a 7.4 year long activity cycle. This entails changes of more than a factor of two in the EUV regime compared to changes of only 1% in the optical, and the stellar wind is expected to change, too. EUV illumination and stellar wind control the Lya transit properties, and simulations already suggest that the discrepancies between predictions and data are largely caused by assuming a constant star. Therefore, GJ 436 b likely experiences severe space weather effects measurable in Lya. We propose to check this hypothesis by obtaining a complete Lya transit light curve of GJ 436 b within only 10% of its activity cycle. Seven visits strategically spread over GJ 436 b's Lya transit will allow us to measure, for the first time, how changes in the host star's activity affect the Lya transit, check if simulations include the dominant physical processes, and probe GJ 436 b's wind as a direct tracer of its photoevaporative mass-loss, crucial to understand the exoplanet population at large.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17469
Program Title: Bridging the Gap Between Exo-Kuiper Belts and the Solar System's Zodiacal Light in Support of Future NASA Exoplanet Missions

Principal Investigator: Debes, John

PI Institution: Space Telescope Science Institute - ESA - JWST

The NASA Strategic Plan, NASA Astrophysics Roadmap, and the 2010 Decadal Survey note direct imaging and characterization of nearby terrestrial exoplanets as a key goal over the next several decades in the search for life within the Galaxy. Given the extreme contrast ratios between an Earth twin and its host star in visible reflected light, astrophysical sources of background noise or confusion can make or break humanity's search for habitable worlds outside the Solar System. Circumstellar dust in orbit around a host star is one unknown source of noise. Current observations of more extended cold debris disks are not yet sufficient to predict how bright exozodi dust will be at visible wavelengths--predictions currently assume that the Solar System Zodiacal Cloud represents all nearby exozodis, which represents real risk to mission planning. We propose to use 48 orbits with the STIS coronagraph to observe eight benchmark Herschel-resolved debris disk systems that have optical depths in between previously observed cold debris disks and the Solar System zodiacal cloud. These disks are unobservable by other observatories either due to their large extent, or predicted surface brightness. Our proposed survey has three science goals: 1) reveal the morphology of the lowest luminosity disks accessible with STIS and model their properties 2) join our sample to brighter debris disks to study the scaling between infrared dust luminosity and dust scattered light emission, and 3) pre-image the innermost regions of these high value stars in preparation for future direct imaging missions.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17470
Program Title: HST-Juno Io Campaign: Connecting Volcanos to the Plasma Environment

Principal Investigator: Retherford, Kurt

PI Institution: Southwest Research Institute

Io is the most volcanically active body in the solar system and its escaping atmosphere is the dominant source of material for the Jovian magnetosphere. Despite decades of research and major advances in understanding individual processes and features, the connections between Io's volcanos, surface volatiles, atmosphere, magnetospheric plasma-interaction, and beyond to Io's neutral cloud, the Io Plasma Torus, and Jupiter's ionosphere, all remain difficult to quantify and understand. Juno, a polar orbiter originally designed to study Jupiter's deep interior, magnetosphere, and aurora, is now in an extended mission focused on studying the Galilean satellites. Juno's upcoming Io flybys in Cycle 31 offer an excellent opportunity for combining Juno's intensive in situ measurements with Earth-based remote sensing to advance our understanding of Io's role in driving coupled phenomena within the Jupiter system. Two flybys come within ~1500 km of Io, with a third more distant encounter at ~120,000 km. Our HST-Juno Io campaign performs numerous coordinated Io observations to take full advantage of this opportunity for combining in situ and remote sensing datasets within a comprehensive modeling framework (not otherwise possible until the late 2030's). We plan multi-spectral, multi-instrument HST observations of the following types: Io neutral cloud profiling and ansae stares, Io FUV aurora imaging, Io transit imaging, Io eclipse imaging (with hot spot and time series studies), and Io surface mapping. Coordinated JWST MIRI/MRS IFU measurements of Io's 7.3 um SO2 band and newly detected 5 um features are requested for Juno's Sep. 2024 encounter (following plans for JWST program 4078).

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17471
Program Title: Elucidating Jupiter's auroral processes with HST and JWST

Principal Investigator: Nichols, Jonathan

PI Institution: University of Leicester

The unique partnership between HST and JWST available at this juncture presents an exciting new prospect to understand planetary auroral processes as never before, representing the most powerful remote sensing tool ever available to understand this phenomenon. We propose joint HST-JWST observations of Jupiter's prompt electron-excited far-ultraviolet (FUV) auroral emissions and near-infrared (NIR) H3+ thermal auroral emissions that will reveal the true nature and physics behind Jupiter's enigmatic and spectacular auroras. While the two observatories have observed Jupiter's auroras separately, they never observed them simultaneously. The next step in understanding the auroral processes is to compare simultaneous images of FUV and NIR emissions to address the following questions: *How does the instantaneous FUV emission relate to the slower H3+ emission? *How does the instantaneous energy input and temperature seen in FUV emission relate to H3+ thermal emissions? *How do the H3+ thermal emissions relate to well-known FUV features, i.e. the main oval emission, polar emissions, satellite footprints, and dawn storms? *What is the lifetime of H3+ ions in Jupiter's auroral ionosphere? *What processes govern the energy balance in Jupiter's upper atmosphere? Only HST can obtain the FUV high time- and spatial resolution auroral images and high-resolution spectra of Jupiter's FUV emissions, and only JWST can obtain the high time- and spatial resolution images and spectral images of Jupiter's polar H3+ emission required to address these science questions. These observations will yield high-profile discoveries and vital context for ongoing Juno observations of Jupiter's auroras.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17472
Program Title: Gamma-ray burst supernovae across cosmic time

Principal Investigator: Levan, Andrew

PI Institution: Radboud Universiteit Nijmegen

Long-duration gamma-ray bursts (GRBs) are the most luminous stellar explosions in nature and are associated with the collapse of massive stars. GRBs are bright enough to see at great distances, with a median redshift of z>2 and some GRBs seen out to z>8, perhaps even z>9. Therefore, they pinpoint the locations of supernovae at distances where we have never directly observed them. Here we propose to measure the evolution of three GRB supernovae at 1.5 < z < 3 for the first time. These observations give us the ability to test if supernovae (in particular GRB-SNe) change with redshift. Differences in metallicity and stellar winds are quite likely to alter the evolution of massive stars with redshift. This is especially true if rare pathways only accessible at low metallicities, such as chemically homogeneous evolution, begin to dominate the lives of GRB progenitors. Since supernovae are a vital feedback mechanism to the interstellar and intergalactic medium via elements ejection and winds, a change in the properties of supernovae could have significant implications not only for the progenitors of GRBs but also for galaxy evolution more generally. Our photometric observations will determine the peak magnitude and decay, while a single JWST spectrum at peak will measure composition and velocities. This will provide a measurement of radioactive nickel production and luminosity. From this, we can begin to ascertain how the properties of GRB progenitors, and by extension massive stars, vary over cosmic time.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17473
Program Title: Moving beyond the Milky Way: Enabling Cross-Observatory Proper Motion Determinations with HST and JWST

Principal Investigator: Warfield, Jack

PI Institution: The University of Virginia

HST has made unique contributions to our understanding of the dynamical evolution of the Milky Way and its constituent satellites, globular clusters, halo stars and tidal streams. Proper motions enabled by multi-epoch HST observations have been used to probe the nature of dark matter, the epoch of reionization, and correlated satellite infall. While Gaia now too provides unparalleled astrometric precision for the Milky Way, at outer halo distances this is only for intrinsically bright stars. Moving beyond the Milky Way halo will only be possible by utilizing long baselines with HST or by extending these baselines using another facility, such as JWST and Roman, in tandem with a first epoch from HST. Thus, it is imperative that we calibrate cross-observatory techniques to measure absolute proper motions. Here, we request 8 orbits with ACS/WFC and 3.27 hours with JWST's NIRCam for Draco II, an ultra-faint dwarf galaxy, and WLM, a star-forming galaxy. Both objects already have an epoch of ACS/WFC data, as well as publicly available NIRCam data from the Resolved Stellar Populations Early Release Science program. We will use the newly requested data to measure an HST-HST proper motion for each dwarf. This proper motion will be used as a "ground truth" to investigate and calibrate (i) detector-based systematics and (ii) reference frame-based systematics, in combining HST and JWST data. We stress the urgency of getting these observations now while HST is operating well. Such cross-observatory calibrations will be extremely difficult if the astrometric capabilities of HST degrade.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17474
Program Title: Pioneering Precision: Advancing Cosmology with the First Statistical Sample of Gravitationally Lensed Supernovae

Principal Investigator: Pierel, Justin

PI Institution: Space Telescope Science Institute

There is a 5-sigma tension between local measurements of the Hubble constant (H0) from Type Ia supernovae (SNe Ia), and the value inferred using late universe constraints from the cosmic microwave background (CMB). Independent measurements of H0 can help resolve the tension by agreeing with one method or the other, but a ~2.7% uncertainty is needed to distinguish between the values. The first H0 measurement from observing the multiple images of a gravitationally lensed SN (glSN) was recently made using SN Refsdal (6% precision), paving the way for glSNe to realize their promise as precise and single-step cosmological probes. This program will pursue complete follow-up campaigns for up to three glSNe using target of opportunity (ToO) observations over Cycles 31 & 32, which combined with the current sample (two glSNe) will enable a ~2.7% measurement of H0. GlSNe also have unique leverage on dark energy properties, such that this program alone will increase our best dark energy constraints by 40%. The total request for this proposal is 45 HST imaging orbits (15 per glSN) and 8.1 JWST NIRSpec hours (2.7 per glSN, with all overheads), which includes all observations necessary to deliver our cosmological measurements.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17475
Program Title: Probing the limits of nitrogenic ultraviolet emission in the most extreme nearby star-forming galaxies

Principal Investigator: Senchyna, Peter

PI Institution: Carnegie Institution of Washington

The unexpected discovery of prominent lines of doubly- and triply-ionized nitrogen in one of the most luminous galaxies at z~10 has dramatically demonstrated both the power and the challenge represented by JWST spectroscopy. The spectrum of GN-z11 dramatically yields both a super-solar estimate of N/O and a measurement of the electron density orders of magnitude larger than anticipated for normal star-forming systems. Yet beyond these facts, the nature of this object remains hotly debated - in particular, whether such features necessitate a supermassive black hole or whether they can be produced by extremely concentrated metal-poor star formation remains unclear. As for many of the other surprising high-ionization emission lines found at high-z, galaxies in the local Universe may represent our best hope of casting empirical light on such distant detections - yet few constraints on these lines are available in the local UV archive. Here we propose unique COS spectroscopic follow-up of both the crucial NIV] and NIII] transitions in the UV at moderately-high resolution, in a sample of compact star-forming galaxies with strong evidence of substantial N/O enhancement nearby. These spectra will probe the limits of these emission lines produced by intense star formation today. We will leverage the constraints on both multiplets to investigate nitrogen production in very young star-forming environments near the metallicity of GN-z11, and probe gas conditions across densities orders of magnitude higher than accessible in the optical. This is a prime opportunity for direct dialogue between JWST and HST observations, which can only be realized while HST/COS remains operational.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17476
Program Title: The most puzzling UV-optical-NIR spectrum of an isolated neutron star: A disk or a magnetosphere?

Principal Investigator: Pavlov, George

PI Institution: The Pennsylvania State University

Unlike the commonly known rotation-powered pulsars, X-ray thermal isolated neutron stars (XTINSs) do not show radio/gamma-ray emission or other signs of magnetospheric activity but emit purely thermal soft X-ray radiation. A few HST observations of these sources have shown very puzzling results, with possible contribution from neutron star magnetospheres or fallback disks, challenging the simplistic model of a purely thermal emitter. However, because most XTINSs only have HST coverage in two spectral bands, the actual spectral shape and the origin of the XTINS UV-optical-IR emission remain unknown. RX J1243.0+0654, the most intriguing XTINS, provides the best opportunity to clarify the origin of the XTINS emission. We propose photometric measurements with high S/N in five spectral bands in the wavelength range of 0.14-1.7 microns. Fits of the five flux density points with different spectral models will help to understand the nature of this and other XTINSs. Using the same observations, we will also check for long-term variability of the target in two bands and measure its (currently unknown) proper motion with an uncertainty not exceeding 2 mas/yr, much lower than expected proper motion values. This will allow us to locate the birth place of this neutron star and estimate its kinematic age. These properties are required to constrain the neutron star cooling models and learn about evolutionary links between the diverse neutron star populations.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17477
Program Title: HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

Principal Investigator: Perley, Daniel

PI Institution: Liverpool John Moores University

High-cadence time-domain surveys have unveiled a population of fast-evolving, luminous extragalactic transients with SEDs that remain dominated by ultraviolet emission for long after peak and also exhibit luminous X-ray and radio counterparts. While they show some observational similarities with strongly-interacting supernovae, optical follow-up has failed to identify any recognizable supernova features and the extreme properties of these events strain theoretical models for what is possible in a supernova explosion. Ultraviolet spectroscopy has the power to reveal similarities or differences betwen this event and other supernova classes not apparent from optical observations alone, and offers a means of identifying the progenitor star via transmission spectroscopy of the dense stellar wind before the explosion sweeps it up. We propose to obtain target-of-opportunity UV spectroscopy of a new event of this type in Cycle 31 or 32 to secure the physical origins of this class while HST's unique UV spectroscopic resource is still available.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17478
Program Title: A comprehensive survey of diffuse gas in the Fornax Cluster

Principal Investigator: Burchett, Joseph

PI Institution: New Mexico State University

We propose an HST/COS study of the cool and warm gas contents of the Fornax cluster. Fornax is among the closest massive galaxy clusters, at a distance of only 20 Mpc, enabling a deep characterization of the galaxy populations and intracluster medium. Indeed, much ancillary data exists on Fornax with deep optical imaging, substantial spectroscopic coverage, and X-ray imaging/spectroscopy, and is currently the focus of a deep, high-resolution 21cm HI mapping campaign with the MeerKAT array. The Hubble legacy includes similar COS surveys of QSOs probing two other massive clusters, Coma and Virgo, but Fornax is even more ideal for a study of this kind. These other systems have provided the first glimpses of just how unique cluster environments are relative to the gaseous halos of galaxies, as surveyed by such programs as COS-Halos. For example, clusters do not show the characteristic anti-correlation between HI absorber strength and impact parameters as do galaxy halos. Also, the studies of Virgo and Coma as well as other higher redshift clusters indicate that the virialized medium is devoid of HI relative to the expected HI reservoir contents observed around less massive systems. This indicates that cluster galaxies lack the abundant reservoirs to fuel star formation, a key quenching mechanism. However, Fornax contains several galaxies that appear to be undergoing interactions with the environment and many galaxies that are still forming stars. Combined with the extensive ancillary data available, our survey of Fornax will provide the most comprehensive look at a massive halo in transition in the nearby Universe.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17479
Program Title: Capturing the signatures of planets shaping two large-radius debris belts unveiled with ALMA

Principal Investigator: Kalas, Paul

PI Institution: University of California - Berkeley

Compared to ALMA, JWST, and ground-based AO systems, HST stands out with its unparalleled ability to provide optical images of nearby debris disks at the highest resolution across wide angular scales. While scattered-light imaging has unveiled several dozen disks, most are either too distant or too small to reveal fine-scale features associated with planet-disk interactions. However, the largest disks surrounding the nearest stars present unique opportunities for detailed investigations, such as with Beta Pic, Fomalhaut, and AU Mic. Recent lower-resolution ALMA maps have identified two additional nearby disks as compelling candidates for HST imaging. Their belt-like morphologies at >5" radius suggest possible dynamical perturbations caused by sub-stellar objects orbiting within. In this proposal, we aim to conduct STIS coronagraphic observations of these targets to detect dust-scattered light from each debris belt at a resolution 4-20 times higher than that provided by ALMA. Our primary scientific objective is to identify predicted disk structures resulting from dynamic interactions with hypothesized planets. By precisely measuring the inner and outer belt radii, edge sharpness, stellocentric offsets, and azimuthal clumps, we can infer the masses and orbital elements of sub-stellar objects. The outcomes of this survey will pinpoint the most promising targets for future JWST observations, capable of directly detecting sub-Jupiter mass planets and resolving the thermal structure of each disk. When combined with HST data, the comprehensive multi-wavelength dataset will allow us to quantify the physical properties of constituent grains and examine their spatial variations.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17480
Program Title: The Turn-Down in the Baryonic Tully-Fisher Relation (BTFR)

Principal Investigator: McQuinn, Kristen

PI Institution: Rutgers the State University of New Jersey

The baryonic Tully-Fisher relationship (BTFR) is a correlation between the total baryonic mass in a galaxy and the maximum velocity of a galaxy's rotation curve (Vmax), which is a tracer of the halo mass. Simulations predict that this power-law relationship will show an inflection at low baryonic masses in the sense that low mass galaxies will have higher values of Vmax than predicted from an extrapolation from higher masses. This inflection is due to the lowest mass galaxies' inability to accrete and retain baryons. A recent analysis of low mass galaxies has shown evidence in support of this inflection, but with only four galaxies in the critical regime below the inflection point where the prediction can truly be tested. We have identified twelve additional Local Volume galaxies with suitably low baryonic masses and high quality HI velocity fields. Including these galaxies in the analysis will quadruple the number of systems in the key daignostic part of the BTFR, and will fully characterize this putative inflection. However, because these galaxies are nearby and star-forming, their distances cannot be accurately determined from their radial velocities nor from surface brightness fluctuations, and accurate distances are critical to the analysis. Fortunately, the galaxies are close enough that the HST can provide distances from their red giant branch tips through observations of their resolved stars. This type of work can only be done with nearby galaxies and their distances can only be accurately measured with space-based observations.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17481
Program Title: Discovery of Six Isolated Ultra-Faint Dwarf Galaxy Candidates in the Local Group

Principal Investigator: McQuinn, Kristen

PI Institution: Rutgers the State University of New Jersey

Ultra-faint dwarf galaxies are the least luminous, most dark matter dominated, and least chemically evolved galaxies known. Detailed studies have shown that their star formation quenched at early times, which is generally thought to be caused by reionization and stellar feedback. Intriguingly, the recently discovered, relatively isolated ultra-faint dwarf, Pegasus W, has had an extended star formation history, suggesting it was not quenched by reionization and contradicting the generally accepted framework that reionization ubiquitously quenches ultra-faint dwarfs. This suggests that, in addition to reionization, environment may play a role in quenching ultra-faint dwarfs. Pegasus W is thought to be the tip-of-the-iceberg of a population of low mass halos in the Local Group at farther distances that have yet to be detected. Indeed, we have found six ultra-faint dwarf galaxy candidates that appear to be in the Local Group, but, similar to Pegasus W, outside the halos of the MW, M31, and the LMC. Here, we propose 1-orbit of HST imaging per target to confirm these systems are bona fide ultra-faint dwarf galaxies and characterize their properties. The data will be of sufficient depth to (i) robustly measure their distances via horizontal branch stars, (ii) determine the systems' structural parameters and total luminosities, and (iii) derive the star formation histories, placing constraints on the quenching timescales. We will explore the role of enviroment in determining their properties via comparison with Pegasus W as well as ultra-faint dwarf galaxies that are satellite galaxies, all as a fuction of distance to a massive host.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17482
Program Title: Probing active atmospheric erosion across an adolescent planet system

Principal Investigator: Zhou, George

PI Institution: University of Southern Queensland

Atmospheric erosion is the universal process that shapes all small planets. We will use STIS to search for the extended neutral hydrogen exosphere around two Neptunes orbiting the 200 million year old star TOI-2076. These observations will reveal active ongoing mass loss from these planets. Detections of Lyman alpha excess around young planets is one of few direct tracers of photoevaporation in real time. We are experimentally testing the factors that influence early atmospheric erosion in young planets by observing a multiplanet system, allowing us to vary the levels of incident XUV irradiation, while holding the stellar XUV evolution history constant. The photoevaporation paradigm is thought to sculpt the entire small planet population we know today, STIS UV observations of young multiplanet systems as TOI-2076 will provide real time tests that anchor this model.

Proposal Category: SNAP
Scientific Category: Galaxies
ID: 17483
Program Title: Characterizing Lyman-Alpha emitters with Snapshot Survey (CLASS)

Principal Investigator: Dutta, Rajeshwari

PI Institution: Universita degli Studi di Milano-Bicocca

Lyman-alpha emitters (LAEs) are incredibly useful tracers of the low-mass galaxy population at high redshifts due to their very bright emission line fluxes. Utilizing integral field spectroscopy, astronomers have identified thousands of LAEs in the early Universe, enabling the analysis of clustering, star formation rates and the connection between gas and galaxies. However, given that their identification is typically reliant on a single line, often without the detection of the faint continuum, studies have been restricted by the inability to measure some of the fundamental galaxy properties. In particular, stellar mass, a key parameter in models of galaxy evolution, is poorly constrained. This proposal resolves this issue by obtaining WFC3 imaging in F160W for 100 archival MUSE fields that are well-distributed across the sky and that contain ~3000 z~3.5 LAEs. Combining HST and MUSE data, we will measure the stellar masses of low-mass, high-redshift galaxies to unprecedented accuracy. This enables the study of the stellar mass function in a regime where stellar feedback suppresses galaxy formation, allowing our measurements to act as stringent constraints on galaxy formation models. Moreover, the resolution of HST imaging is paramount to study the morphology of these highly star-forming galaxies. Given the size of the sample achievable with HST, this snapshot programme offers significant legacy value, and facilitates ancillary science including the potential identification of extreme objects such as Pop III candidates and high precision measurements for a wealth of low redshifts sources.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17484
Program Title: Beyond PAndAS: Two Extremely Faint Candidate Satellites of M33 Identified in Diffuse Light

Principal Investigator: Patel, Ekta

PI Institution: University of Utah

M33 is predicted to host more than ten satellites galaxies, but only two potential companions (And XXII, Pisces VII) have been discovered to date. Is this a failure of galaxy formation models, or simply a by-product of how difficult it is to find low surface brightness galaxies in the nearby Universe? In this proposal, we request deep HST observations of two candidate dwarf satellite galaxies identified around M33 using the Dragonfly Telephoto Array. We have undertaken ground-based follow-up which strongly suggests these candidates are dwarf galaxies in the Local Group, but definitive confirmation requires high-resolution space-based imaging. With high-quality HST data, we will (1) confirm the nature of these candidates as galaxies by detecting an adequate number of red giants associated with these galaxies; (2) measure the precise distance to these dwarf candidates to confirm whether they are indeed M33 satellites; (3) measure their physical properties -- geometry and structural parameters, total luminosities, stellar masses, and preliminary star formation histories. If these candidates are indeed dwarfs around M33, this small HST program would quickly double the known population of M33 satellite galaxies and provide a new avenue for carrying out a rigorous search for all potential M33 satellites. This data set will also enable follow-up studies of the dynamics of the M33-M31 system, including new constraints on the orbit of M33, and a direct test for the hierarchical nature of the LCDM paradigm in the regime of low mass galaxies.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17485
Program Title: Dissecting Red geyser winds: low luminosity AGNs with large scale outflows in the ionized phase

Principal Investigator: Roy, Namrata

PI Institution: The Johns Hopkins University

Spatially resolved optical spectroscopy from ground-based SDSS-MaNGA survey has recently discovered a new class of early-type galaxies - known as red geysers, that show signatures of large-scale active galactic nuclei (AGN) driven winds in the ionized gas phase. These are exciting candidates for black hole feedback driven by radiatively inefficient AGNs in quiescent galaxies. However, MaNGA's spatial resolution is relatively low (1-2 kpc), and is thus insufficient to probe the ionized winds close to the vicinity of the AGN. We propose a small program of 5 orbits to observe the ionized gas in a prototypical red geyser that is interacting with a companion galaxy using a combination of narrowband filters of the HST WFC3/UVIS instrument. This HST observation will be complemented by a large set of existing datasets from SDSS-MaNGA, Gemini GMOS, LOFAR (radio), and Keck ESI. Using HST, we will obtain an order-of-magnitude increase in the spatial resolution of ionized gas, traced by H-alpha, [OIII], [NII], and H-beta emission lines, using four narrowband filters. Our study will open a new window for studying low luminosity AGN-driven winds in early-type galaxies. We will be able to exploit the extremely high angular resolution of HST to probe length scales down to a few tens of pc zooming in close to the black hole, which is impossible to resolve using ground-based observations. The simultaneously large field of view will help us capture the complete picture of this fascinating interacting galaxy with winds. This study will serve as a pilot study on the red geyser sample, which will be supplemented in the future with additional objects with diverse characteristics.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17486
Program Title: UV-MAGPI: Sharpening our View of Dust Attenuation

Principal Investigator: Battisti, Andrew

PI Institution: Australian National University

A description of dust attenuation curves and how they evolve with time is a critical ingredient of future precision studies of distant galaxies. The aim of the UV-MAGPI survey is to develop a revolutionary understanding of how light from galaxies is affected by dust attenuation at varying spatial scales, gas-phase metallicity, and galactic environment. This will help to inform more versatile prescriptions of dust attenuation as a function of cosmic time. We will combine UV data from HST with VLT/MUSE and VISTA, providing rest-frame UV to near-IR coverage, to perform a spatially-resolved (~3kpc-scales) study of dust attenuation at z~0.3 in 41 star-forming galaxies (SFGs) and in an integrated manner for an additional 57 SFGs (98 total). This is expected to provide fundamental insight into (1) how dust properties, most notably the 2175Ang absorption feature, and dust attenuation curves vary within galaxies and between galaxies and (2) which intrinsic galaxy properties are responsible for attenuation variation. The extensive data for these fields will also provide numerous opportunities for legacy science to study spatially-resolved and integrated properties of SFGs and early-type galaxies at low and intermediate redshifts.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17487
Program Title: A Fundamental Test of Black Hole Masses: Ultraviolet Echo Mapping the Multi-Scale Broad Line Gas around Quasars

Principal Investigator: Homayouni, Yasaman

PI Institution: The Pennsylvania State University

We propose a novel spectroscopic ultraviolet monitoring campaign that uses the STIS/MAMA G230L grating to map the broad-line gas and assess its role as a mass estimator across a wide range of ionization conditions in two luminous quasars. Recent studies of a more diverse sample of AGN have unveiled shortcomings in the fundamental framework for black-hole mass measurements. This experiment presents a new test of the reliability of black-hole mass measurements over cosmic time in two sources that are selected to be representative of a previously unexplored region of the broader AGN population, with higher luminosity, accretion rate, and significantly shorter optical Hb lag compared to the existing AGN samples. Previous RM measurements of stratified UV/optical broad-line regions exist for only six well-studied, local, low-luminosity AGN. We propose to use HST/STIS to monitor the strong UV broad emission lines (Lya and CIV), supported by contemporaneous spectroscopic monitoring from SDSS-V for the lower ionization and more distant optical broad emission lines. We analyze comprehensive light curve simulations using the proposed 3-day cadence, 75-day duration, and 1-orbit depth per epoch to demonstrate that our observations will successfully measure broad-line region sizes, map emission-line gas, and test the reliability of black-hole mass estimators for two luminous quasars that are representative of the bulk of black hole mass assembly over cosmic time.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17488
Program Title: Unraveling the mystery of the rare 2175 A extinction bump in the SMC

Principal Investigator: Yanchulova Merica-Jones, Petia

PI Institution: Space Telescope Science Institute

Understanding the properties of dust extinction is fundamental to answer questions ranging from how dust grains form to what drives galaxy evolution. The dust extinction curve at ultraviolet (UV) wavelengths is known to vary widely in the Local Group and beyond, but the reason is still not fully understood. It is an open question how, and physical conditions of the interstellar medium (ISM) may affect extinction curve features such as the far-UV rise and the properties of the 2175A bump. The Small Magellanic Cloud (SMC) is key to studying such variations since it is our best nearby analog to low-metallicity and high-redshift observations, there are plenty of observations of its ISM, and spatially-resolved individual stars and dust/gas complexes enable analyzing correlations between environment and dust extinction properties. The limited number of high-quality SMC UV extinction curve measurements needs to be supplemented with new targeted measurements of sightlines in a variety of ISM physical conditions. We propose to measure UV extinction curves and the HI column densities of a carefully selected sample of 6 reddened, hot stars to evaluate the dependence on environment of the 2175A bump and the FUV rise. These stars have a high probability of a strong bump in their extinction curves based on modeling their spectral energy distributions from an existing large photometric survey in the SMC Southwest Bar. Our proposed sample will triple the UV extinction curve database of SMC sightlines with a strong bump from 3 to 9 improving the statistical significance of correlations of bump properties with environment.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17489
Program Title: Hunting for Hazes in the Atmosphere of a Warm Super-Puff

Principal Investigator: Vissapragada, Shreyas

PI Institution: Harvard and Smithsonian Center for Astrophysics

We aim to constrain the presence of aerosols in the atmosphere of TOI-1420b, a warm (Teq = 960 K) super-puff planet with an exceptionally low density (0.08 g/cc). A leading hypothesis for the apparently inflated radii of super-puffs is high-altitude dust/haze lofted by atmospheric outflows. The atmospheres of this planet is indeed outflowing as evidenced by ground-based He 10830 A measurements, making it an ideal laboratory to study the interplay between aerosols and atmospheric outflows. In particular, lofted haze should produce a strong Rayleigh or super-Rayleigh scattering slope for the transmission spectrum in the optical/near-ultraviolet (NUV). In an efficient 10 orbit program with WFC3/UVIS G280, we will obtain an optical transmission spectrum for TOI-1420b between 200--800~nm to either confirm or rule out the presence of hazes. If hazes are ruled out by our observations, our measurement would instead implicate alternate mechanisms like tidal inflation.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17490
Program Title: A Local Lyman Continuum Leaker: Direct and Indirect Detections with KISSB 85

Principal Investigator: Hirschauer, Alec

PI Institution: Space Telescope Science Institute

The specific mechanisms responsible for the reionization of the Universe remain poorly understood. While it is generally accepted that this period of transformation was primarily a consequence of highly-ionizing Lyman continuum (LyC) radiation leaking from high-redshift star-forming galaxies (SFGs), their direct detection is observationally precluded due to the high opacities of the ubiquitous intergalactic medium. Local analogs to these systems, with attributes which mirror the environments of the early Universe such as high ionization and low metal abundances, represent our best accessible means to obtain detailed measurements of LyC photons. We propose for COS far-ultraviolet (FUV) observations of the candidate LyC leaker KISSB 85, a nearby (z = 0.046; D = 206 Mpc), metal-poor (12+log(O/H) = 7.42; ~5% Z_solar), high-ionization (O32 = 17.3) SFG. This dwarf system possesses similar charateristics to early-Universe LyC leakers, but is nearby enough to allow for meticulous examination of its radiation profile. In addition, we will utilize these direct detections to examine an indirect means for estimating LyC with the saturated C II 1334.5 A absorption feature, which will allow for a broader understanding of the mechanisms which enable LyC leakage. With measurement of the Lyman-alpha line profile, we will study the neutral gas properties of this high-z analog system, and through efforts fitting the spectral profile with two different theoretical models, we will characterize the metallicity, age, and dust attenuation of the observed young, massive stellar population which produces the ionizing radiation, supporting current efforts being undertaken with JWST.

Proposal Category: GO (GO-Archival)
Scientific Category: Stellar Physics and Stellar Types
ID: 17491
Program Title: A Legacy Far-Ultraviolet Spectral Atlas of Extremely Metal-Poor O Stars

Principal Investigator: Telford, Grace

PI Institution: Rutgers the State University of New Jersey

JWST is revealing the low-metallicity galaxies that likely powered cosmic reionization at high redshift. These observations are revolutionizing our view of the early universe, but the community is under-prepared to interpret them because models of massive stars remain entirely theoretical and uncertain at the relevant metallicities (<20% Z_sun). FUV spectra from HST suggest that the winds and ionizing fluxes of O stars change substantially at low metallicity, but our understanding of this complex astrophysics is fundamentally limited by glaring gaps in the observational coverage of O-star parameter space. We propose to assemble a comprehensive FUV spectral library of O stars in nearby galaxies at 5-10% Z_sun to complement the ULLYSES dataset at 20-50% Z_sun. New COS G130M and/or G140L spectra of 12 stars will complete the wavelength coverage and moderate resolution required to determine their stellar and wind properties. The new spectra efficiently build on those already in MAST to sample the full range of O-star temperatures and luminosities. We will analyze the combined new and archival COS spectra of 29 O stars to (1) empirically calibrate mass-loss models below 20% Z_sun for the first time; and (2) produce data-driven ionizing spectral templates suitable to determine the contribution of metal-poor galaxies to cosmic reionization. We will release a science-ready, legacy dataset of FUV spectra and reduced ancillary observations as HLSPs for the community to enable new investigations of stellar and ISM physics at low metallicity. This program can only be completed with COS and will form the definitive FUV spectral atlas at very low metallicity for decades to come.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17492
Program Title: Zooming in on the locations of short gamma-ray bursts

Principal Investigator: O'Connor, Brendan

PI Institution: George Washington University

The study of short duration gamma-ray bursts (sGRBs) and their host galaxies provide a unique view of the environments of gravitational wave sources. The locations of sGRBs within their hosts is the strongest constraint on fundamental properties of the progenitor systems (e.g. kick velocity, time delay), with important implications for binary stellar evolution, galactic chemical enrichment, and the expected Advanced LIGO and Virgo detection rate. HST observations of sGRBs host galaxies are the benchmark dataset against which models of neutron star (NS) mergers are tested. This dataset, affected by small number statistics in the past, is now expanding, allowing us to consider more sophisticated scenarios, such as multiple channels of binary formation and different progenitor systems. However, targeted observations of sGRBs are introducing complex selection biases. In order to mitigate these effects, we propose a public survey of well-localized sGRBs to build a high-quality homogeneous sample of sGRB locations and environments. The proposed observations, together with existing archival HST data and an extensive ground-based campaign, would form a legacy dataset for the study of compact binary mergers and their diverse evolutionary pathways. In addition, sGRBs with no coincident host galaxy in these HST images constitute excellent targets for future JWST observations.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17493
Program Title: Mapping the inner disk wind of RU Lup with molecular hydrogen

Principal Investigator: Keppler, Miriam

PI Institution: University of Arizona

The evolution of gas in protoplanetary disks sets direct constraints on the formation and evolution of planets. However, the exact mechanisms of how gas in disks evolves are not yet clear. It is now thought that disk winds play an essential role in removing angular momentum from the disk and are thus driving accretion onto the star, with significant implications on the viscous state of the disk. Measuring the ratio of wind mass loss rate to stellar accretion rate allows to estimate the disk viscosity - one fundamental parameter needed in all planet formation models. To now, winds are observationally mainly characterized through the analysis of secondary tracers, such as forbidden atomic lines, CO or dust. However, the main mass component of disks and winds is molecular hydrogen (H2), and it is not entirely clear if wind properties derived from secondary tracers directly relate to those derived from H2. In this program, we propose to spatially and spectrally map the inner disk wind of RU Lup, which hosts one of the best characterized inner disk winds from secondary tracers. Our measurements will target multiple lines of fluorescent H2 emission in the UV, and therefore directly trace the main mass component in the wind. The comparison of H2 wind mass loss rate, as well as the wind's spatial and kinematic structure to wind properties derived from other tracers will fundamentally probe the viscous state of the disk, and reveal how the main mass component behaves with respect to other components.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17494
Program Title: Resolving the C/O Abundance Discrepancy with HST/COS

Principal Investigator: Berg, Danielle

PI Institution: University of Texas at Austin

While oxygen and nitrogen have been widely observed in spiral and dwarf galaxies, the study of the next most abundant element, carbon, resides in a state of relative infancy. This is due, in large part, to the lack of strong C emission lines in the optical regime, which has made carbon abundance measurements in HII regions, despite their clear astrophysical importance, relatively rare. To complicate matters futher, there exists an unresolved discrepancy (the abundance discrepancy factor; ADF) between the two methods of deriving accurate abundances: the collisionally-excited emission lines (CELs) method and the recombination emission lines (RLs) method. Because the optical RLs are intrinsically very faint, there is only a small collection of extragalactic HII regions for which O/H abundances from RLs and, subsequently, the O ADF can be determined, while little to no ADF studies of other elements exist. Fortunately, HST provides the opportunity to observe the UV CIII] 1907,1909 and OIII] 1666 CELs. We request 20 orbits of COS G160M+G185M spectra of 10 HII regions in M33 and M101 with optical C RL detections. We will measure the UV C and O CELs, determine robust C/O abundances and gradients, measure the ionizing massive star population properties, and, combined with the existing RLs, provide a novel pathway to accessing the ADF with C. Owing to their different nucelosynthetic pathways and emission sensitivies, we will be able to compare the O and C ADFs for these 10 regions relative to their gaseous and stellar properties and constrain the source of the ADF; this will be the first coherent UV+optical C+O ADF analysis of its kind.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17495
Program Title: Oscillations of Jupiter's Great Red Spot

Principal Investigator: Simon, Amy

PI Institution: NASA Goddard Space Flight Center

Jupiter's Great Red Spot (GRS) is the longest-lived, most mysterious, storm in the solar system. Similar large vortices on Neptune last only a few years, as they drift in latitude or simply fade away. Conversely, Jupiter's strong alternating wind field anchors the GRS in latitude, perhaps contributing to its longevity. On Earth, vortices are also disrupted by changes in latitude (Coriolis forces) or by forces that lead to instability (e.g., landfall, upper-level wind shear), and only rarely last longer than a year. Terrestrial eddies have been extensively studied, showing they dissipate as the mid-level core of storm erodes over time, but intensifying internal winds can increase their longevity. Comprehensive datasets do not yet exist for giant planet vortices, but some peculiar behaviors have been observed over shorter periods. First, the GRS drifts westward relative to Jupiter's wind field but with a ~90-day oscillation in the absolute drift rate. Similarly, a small Neptune dark was seen to oscillate in both latitude and longitude, while the larger Great Dark Spot oscillated in shape. The nature of such oscillations and why they manifest differently in each storm is a mystery. The GRS's smaller size at present allows increased interaction with Jupiter's winds; transient changes of this type were seen in 2019. Our proposed intense Hubble observational study would use the GRS as a fluid dynamics laboratory for studying vortex/wind interaction without terrestrial topography or latitudinal motion by measuring how its internal motions, size, and shape vary to stabilize it against the wind field over an oscillation cycle.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17496
Program Title: Expanding shocks and the emergence of the compact object in Supernova 1987A

Principal Investigator: Larsson, Josefin

PI Institution: Royal Institute of Technology

By a fortunate turn of events, SN 1987A, the brightest supernova (SN) since 1604, exploded just a few years before the launch of HST. This has allowed HST to monitor the evolution from the very beginning as the SN evolves into a remnant, proving astronomers with a unique laboratory for SN physics. The most recent observations show major changes in the interaction with the iconic triple-ring nebula of circumstellar material. The dense, inner ejecta are just starting to crash into the equatorial ring, while the shocks further out in the system are gradually revealing the mass-loss history of the progenitor star. Furthermore, JWST has recently detected the first clear electromagnetic signal from the compact object created in the explosion, though its properties are yet to be determined. We request imaging in narrow and broad filters over the next three cycles, as well as a COS spectrum in Cycle 31, to study the shock interaction and compact object. The observations will be used to determine the conditions in the shock region, the properties of the circumstellar medium, and constrain the main competing scenarios for the compact object. Annual observations are needed to track the rapid evolution of the shocks and the emerging emission from the compact object. Taken together, this will allow the properties of the progenitor and compact object to be connected for the first time. The HST observations are also indispensable for interpreting other multiwavelength observations of SN 1987A.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17497
Program Title: UV CSM Interaction in the extremely nearby SN 2023ixf in M101

Principal Investigator: Valenti, Stefano

PI Institution: University of California - Davis

The 2023 May 19 explosion of SN2023ixf in the nearby (~6.4 Mpc) spiral galaxy M101 has presented us with a once in an HST-lifetime chance to get a comprehensive NUV to NIR dataset of an interacting core collapse supernova. This non-disruptive ToO will be complementary to two already approved Cycle 30 proposals which have been triggered on this object. We will observe SN~2023ixf between 100 and 200 days after explosion to constrain any CSM interaction with CSM interaction. Late UV observations are the best way to constrain interaction for typical RSG mass loss rates. With only a handful of core-collapse supernovae observed in the ultraviolet with HST, and almost all within 3 weeks of explosion, this proposal fills a crucial gap in our knowledge of the evolution of core-collapse supernovae in the ultraviolet. This can only be done with HST, and only with a SN that is this close can we probe the UV far into time periods when the flux has normally faded significantly.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17498
Program Title: The Ultra-faint Dwarf Galaxy System of NGC300 -- A New Frontier and Analog to the Large Magellanic Cloud

Principal Investigator: Sand, David

PI Institution: University of Arizona

We request three orbits of HST/ACS imaging (F606W+F814W) of three new ultra-faint dwarf galaxy candidates around NGC300 (D=2 Mpc), a nearby analog to the Large Magellanic Cloud (LMC). The faint end of the galaxy luminosity function is a strong probe of dark matter physics and galaxy formation models, but can only be studied in the most constraining "ultra-faint" regime in the nearby universe. Of particular interest are the dwarf satellite properties of lower mass LMC-like galaxies because these systems will experience weaker tidal fields and ram pressure environments in comparison to those of the Local Group, possibly leading to dwarfs with different physical properties. A search for dwarf satellites around the isolated LMC-analog NGC300 has uncovered three strong ultra-faint dwarf galaxy candidates, ranging in luminosity between M_V=-5.8 to -7 mag (log(M_star)~4.5--5). Two out of three of these discoveries are observed near the viral radius of NGC300, potentially probing its ram pressure environment. These candidate dwarf galaxy satellites represent the faintest population ever found outside the Local Group. HST imaging will allow us to measure the distance, luminosity, structure and approximate star formation history/metallicity of these dwarf candidates, and place them in context with similar ultra-faint dwarf galaxies near the Milky Way and LMC that have been discovered in the last ~20 years.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17499
Program Title: Dust Destruction in Supernova Remnant Shock Waves

Principal Investigator: Raymond, John

PI Institution: Smithsonian Institution Astrophysical Observatory

Supernova remnant shock waves dominate the destruction of interstellar dust, but the observational constraints on the destruction efficiency are poor. This is partly due to incomplete knowledge of the shock parameters and partly to inadequate observations, especially in the UV. We propose to obtain accurate fractions of the dust destroyed in 6 radiative shocks in the Cygnus Loop for which the shock wave parameters - shock speed, preshock density and magnetic field - are accurately known. We will use the COS UV spectra to measure the gas phase abundances of C, O and Si. Oxygen is nearly undepleted in the preshock gas, while C and Si are locked up in grains until the grains are destroyed.

Proposal Category: GO (GO-Archival)
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17500
Program Title: Expansion and Evolution of the Crab Nebula: A 23+ Year HST Perspective

Principal Investigator: Blair, William

PI Institution: The Johns Hopkins University

The Crab Nebula is an iconic and well-studied galactic core-collapse supernova remnant with an active pulsar energizing an expanding debris field created in the 1054 CE explosion. Because of its proximity and known age, it has become a key object for study across the EM spectrum. It is thus surprising that no emission line imagery has been obtained with HST since the WPFC2 mosaic dating to circa 2000. With an expansion velocity of roughly 1250 km/s and a distance of ~2 kpc, significant and spatially variable proper motions of the filamentary structures are expected, as well as possible changes in the detailed ionization structures and evolution of the synchrotron nebula over time. Many more recent data sets, including JWST Cycle 1 NIR and MIR images of the filaments, dust, and synchrotron emission, require a current epoch of HST optical imaging to make accurate comparisons. Thus, we propose new emission line mosaics of the Crab with WFC3 and filters comparable to those use in the earlier WFPC2 mosaic. A continuum band (F547M) will sample the synchrotron emission and allow subtraction from the emission line data. We also propose a second continuum band (F763M) which will be used to study spatial spectral index variations and compare to JWST IR synchrotron maps when they are available. Finally, a two F487N (Hbeta) fields will provide a clean hydrogen linemap for the central bright filaments, permitting improved abundance studies. Finally, since comparison to the earlier WFPC2 data are so important, we will reprocess these data to the same standards and reference frame as the new WFC3 data and archive all as a High Level Science Product.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17501
Program Title: Lone Lion or Part of a Pride: Proper Motion and Orbit of Leo P

Principal Investigator: Bennet, Paul

PI Institution: Space Telescope Science Institute

We propose to measure the first proper motion (PM) of a galaxy outside the LG by observing Leo P, a low mass, very low metallicity dwarf beyond the edge of the Local Group (LG, D=1.6 Mpc). By combining the new HST PM with the existing line-of-sight velocity, position and distance, we will precisely determine Leo P's trajectory, and compare the orbital characteristics and timescale with the existing star formation history (SFH). This will enable us to address several key questions such as: Is Leo P a member of the Antlia-Sextans group (ASG) or is it truly isolated? If it is part of the ASG, how did that dwarf galaxy group form? What is the transverse motion of galaxies outside the zero-velocity sphere of the LG? How does the SFH of Leo P relate to its environment, and are the sequence of bursts and quenches seen in its SFH driven by internal or external processes? And what are the implications for galaxy evolution at low masses? Leo P is far too distant and faint to be studied by Gaia. Only HST has the depth, astrometric precision and long time baselines via its archives to start measuring PMs of galaxies outside the LG. Thus, with Hubble's exceptional longevity and stability, we are able to continue to push back the frontiers of extra-galactic science.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17502
Program Title: Resolving gas, star formation and feedback in nearby galaxies with an HST+JWST+ALMA Treasury

Principal Investigator: Thilker, David

PI Institution: The Johns Hopkins University

The flow of matter and energy through the gas-star formation-feedback cycle drives the growth and evolution of galaxies at all cosmic epochs. We are on the verge of a transformation in our understanding of the matter cycle in galaxies, as a Cycle 2 JWST Treasury program will unveil the dust rich ISM and embedded star clusters in a sample of 55 nearby galaxies. We request 169 orbits to obtain WFC3/UVIS imaging in 5 broad-band filters (F275W, F336W, F438W, F555W, and F814W) and Halpha (F657N) to identify and physically characterize clusters, multi-scale stellar associations, and HII regions in these galaxies. HST UV/optical observations, including nebular emission from Halpha, are critical to make a complete, accurate census of the stellar population, particularly the clusters with ages less than a few Myr that emit strongly at UV/optical wavelengths. This is essential to accurately age-date stellar components to infer missing evolutionary timescales, and quantify the coupling and efficiency of stellar feedback into the ISM. With robustly age dated stellar populations, we will trace the entire timeline of the matter cycle starting at the moment of star (cluster) birth, proceeding through young-to-intermediate periods after star formation locally ceases and the natal ISM clears, next addressing topics related to future feedback, and ending with a study of globular clusters as the detritus of ancient star-forming epochs. The science return on previous cross-observatory, multi-wavelength approaches has been remarkable, and we believe this HST project will ensure the full Legacy value of the significant Cycle 2 JWST investment in observations of nearby galaxies.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17503
Program Title: Hot Rock Stars: Capturing high-energy spectra of 5 M dwarfs hosting terrestrial exoplanets that JWST will test for atmospheres

Principal Investigator: Diamond-Lowe, Hannah

PI Institution: Technical University of Denmark-DTU Space

With the launch of JWST we are finally in a position to determine if terrestrial exoplanets orbiting M dwarfs can develop and retain atmospheres in the presence of their hosts' harsh high-energy environments. Necessary to the interpretation of any planetary atmospheric data is the measured high-energy spectra, from the UV to the X-ray, of the M dwarf hosts. A JWST Cycle 2 Large program will survey nine rocky worlds orbiting nearby M dwarfs for the presence of atmospheres. If the rocky worlds in the JWST sample show evidence of having atmospheres, high-energy spectra of their host stars are needed to determine photochemical production rates of key molecular species, such as water, methane, carbon dioxide, and ozone. These constraints will alert us to disequilibrium chemistry, which can be a sign of surface processes such as volcanism and mantle outgassing. On the other hand, if the rocky worlds in the JWST sample are airless, high-energy spectra of their host stars are needed to calculate atmospheric mass-loss rates, which can explain how an atmosphere was lost, or could never form. Of the nine M dwarf planet hosts in the large JWST program, five are amenable to high-energy spectral observations, yet lack them. Only HST can capture the critical UV information, which we will supplement with X-ray observations, to provide a complete picture of the high-energy output of these M dwarf hosts. We request 47 HST orbits to capture the UV spectra of these five M dwarfs. Making these UV observations while HST is still operational is critical to the scientific output of JWST, and will further our understanding of the complexities of M dwarfs as long-lived exoplanet hosts.

Proposal Category: SNAP
Scientific Category: Large Scale Structure of the Universe
ID: 17504
Program Title: SNAP Survey for Strongly Lensed Supernovae and Magnified Stars

Principal Investigator: Kelly, Patrick

PI Institution: University of Minnesota - Twin Cities

Nearby Type supernovae (SNe Ia) yield a local value of the Hubble constant H0 (73.0 +/- 1.0 km/s/Mpc; Riess et al. 2022) that is in strong tension (5 sigma) with that inferred from the Cosmic Microwave Background (CMB; 67.4 +/- 0.6 km/s/Mpc; Planck Collaboration 2020). If the tension represents a true difference, reconciling the inferred values of H0 may require new physical phenomena. SNe strongly lensed by galaxy clusters -- whose models' systematics differ from those of galaxy-scale lenses -- offer a new means of constraining the value of H0, and the multiply imaged Supernova Refsdal has recently yielded a +/-6% measurement (Kelly et al. 2023) Individual stars at cosmological distances can become highly magnified by foreground galaxy-cluster lenses. These stars can experience extreme microlensing events due to objects in the intracluster medium. High signal-to-noise ratio follow-up spectra of bright events offer the opportunity to characterize, for the first time, individual stars at redshift z > 1 in detail. Moreover, the rates of the microlensing events of stars will provide constraints on a prospective population of primordial black holes accounting for a small fraction of dark matter. Here we propose a SNAP program to image cluster fields to identify strongly lensed SNe, as well as highly magnified stars. A previous program of equal size employing the same strategy detected two high-redshift supernovae in strongly lensed galaxies. Here we target a set of thirty new, well-studied galaxy-cluster fields that have existing imaging. The program will be able to provide magnified, high-redshift supernovae and magnified for JWST follow-up imaging and spectroscopy.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17505
Program Title: Constraining dark matter near the Galactic plane with precisely timed eclipsing binary stars

Principal Investigator: Chakrabarti, Sukanya

PI Institution: University of Alabama in Huntsville

Measuring the accelerations of stars that live within the gravitational potential of the Galaxy using precise, time-series observations gives the most precise probe of the mass distribution, including the dark matter. For more than a century, astronomers have estimated the accelerations of stars in the Galaxy, assuming equilibrium. Evidence that our Galaxy is out of equilibrium has snowballed in recent years. Acceleration measurements have recently become possible from analysis of pulsar timing observations. These very small accelerations (~ few cm/s/decade) hold the key to mapping the spatial density of dark matter on sub-galactic scales, thereby constraining the nature of dark matter, including the possibility of a dark matter disk. Our observations will effectively double the sample of acceleration measurements and extend them to a new kind of clock - eclipsing binaries (EBs). Acceleration mechanisms induce a period drift for EBs, manifesting as a deviation in the eclipse mid-point time from a linear ephemeris. Mid-eclipse times of EBs observed by the Kepler mission have been measured so precisely that we can now measure the shift in the eclipse mid-point time induced by the Galactic potential in the last decade. We request HST observations to measure the eclipses of four EBs from the Kepler field, which will provide the first eclipse timing measurement of the mid-plane density (also known as the Oort limit) to 3-sigma. Together with the pulsar observations, we should obtain a 4-5 sigma measurement of the Oort limit, and a meaningful constraint on the local dark matter density.

Proposal Category: SNAP
Scientific Category: Stellar Physics and Stellar Types
ID: 17506
Program Title: Constraining the CSM Interaction Engine in Type II Supernovae

Principal Investigator: Jacobson-Galan, Wynn

PI Institution: University of California - Berkeley

Late-stage evolution of red supergiant stars and their explosive demise as type II supernovae (SNe II) remain to be active areas of inquiry in astrophysics. Recently, late-time (t > 900 days) observations of SNe II 2013ej and 2017eaw revealed a prominent excess of UV emission beyond what is predicted from radioactive decay, consistent with theoretical predictions for on-going interaction between the SN shockwave and intervening circumstellar material. Furthermore, these SNe II display bright JWST IR luminosities, both indicating the presence of large reservoirs of dust and confirming shock interaction as the power source. Now that theory and observations have coalesced, it is essential to target a larger sample of SNe II at very late-times in order to confirm the theoretical prediction that all SNe II should be UV bright at t > 900 days. Here we propose an HST snapshot program to target 38 nearby SNe II in F275W (UV) and F555W (optical) filters. This program seeks to build the largest sample to date of late-time SNe II UV observations in order to (1) constrain the fraction of kinetic shock power thermalization, (2) determine the uncertain rate of red supergiant mass loss in the final centuries before explosion, and (3) confirm ejecta-CSM interaction as a mechanism for heating dust formed in the SN ejecta.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17507
Program Title: Going Up on a Thursday: Flash Spectroscopy of Type II Supernovae with HST

Principal Investigator: Jacobson-Galan, Wynn

PI Institution: University of California - Berkeley

The ultraviolet (UV) phase space of type II supernovae (SNe II) in the first week after explosion is almost entirely unconstrained. Intriguingly, the UV contains some of the most crucial information about both the most local circumstellar environment around the red supergiant progenitor prior to explosion as well as encodes the complexities of density, ionization and temperature in the outermost SN ejecta. Ultra-rapid or "flash" spectroscopy of young core-collapse supernovae (t < 1 week) enables the detection of narrow emission lines that arise from shock ionization of local circumstellar material (CSM), a direct tracer of the progenitor environment (<10 R_star). Here we propose UV/optical spectral observations with the HST STIS CCD through the Flex Thursday ToO program to obtain up to 7 spectra of SNe II in the first week after explosion. This program will increase the sample size of extremely young SN II with UV spectroscopy by more than a factor of 3, thus enabling robust constraints to be made on the diversity of red supergiant atmospheres and mass loss as well as SN II ejecta structure through spectral modeling with radiative transfer code CMFGEN. Furthermore, these observations have the potential to detect the UV narrow line signatures (aka. IIn-like or "flash" features) of CSM interaction in a SN II.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17508
Program Title: HST imaging of a newly discovered many-ringed galaxy

Principal Investigator: Pasha, Imad

PI Institution: Yale University

We have identified a relatively nearby (z~0.039) collisional ring galaxy (CRG), formed by an impulsive impactor with a massive perturber, likely in a head-on collision. This object, dubbed the "Bullseye," is a special case among CRGs: it has not one or two, but as many as seven candidate rings, three of which are confirmed; the existence of so many predominantly symmetric rings indicates we have caught this galaxy in a short (~few hundred Myr) window during its post-impact evolution. Several of the ring candidates both in the interior and at large radii require HST resolution to confirm. Beyond being the best laboratory thus far discovered to test collisional theory, the system also appears to have a low surface brightness component in the outskirts with candidates for star-forming clumps at large radii (R~60-75 kpc). Simulations have suggested that the expansion and fading of collisional rings might produce Giant Low Surface Brightness Galaxies (e.g., Malin I), but this theory has lacked the key transition object displaying strong evidence of both a collision and a low surface brightness disk. Here we propose to obtain F475W and F814W imaging of the system, leveraging the resolution of HST to definitively characterize the small (<0.5") substructures in the galaxy, confirm whether the emission in the outskirts is a faded ring, and investigate candidates for the impactor whose collision produced the ring structure in the system. If confirmed as a transition object, this system would open the door to new investigations of an almost entirely unexplored galactic evolutionary pathway in forthcoming deep all-sky surveys.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17509
Program Title: Winging the SMC: 3D Structure of the Interstellar Medium in the Tidally Distrupted Wing of the SMC

Principal Investigator: Lindberg, Christina

PI Institution: The Johns Hopkins University

We propose to use resolved stellar populations to constrain the dynamical state of the interstellar medium (ISM) in star-forming regions N83/N84 of the Small Magellanic Cloud (SMC). Our proposal will use 15 orbits and 12 hours of HST and JWST time to cover a 12.5'x7.5' area of the SMC in 6 broad-band filters from near ultra-violet (NUV) to the near-infrared (NIR). By fitting the spectral energy distributions (SED) of resolved stars with broad wavelength coverage, we can simultaneously probe distance and line-of-sight extinction, enabling us to constrain distances to diffuse gas structures. The broadband SEDs will provide stellar and dust extinction physical parameters to complement existing observations of molecular gas (ALMA), ionized gas (Spitzer-IRS), and atomic hydrogen (GASKAP) in the region. With these results, we can map the 3D gas distribution in the region to see whether gas flows are colliding or diverging. These results will help us understand how tidal interactions between interacting galaxies are capable of fostering bursts of star formation. We aim to achieve the following objectives: (1) measure the definitive distance to the ISM in the SMC wing, providing vital model constraints for understanding the collision history between the SMC and LMC; (2) determine the relative distance between molecular clouds to gain insight into the dynamical state of the ISM in the region; (3) investigate the correlation between extinction and various phases of the ISM in low-metallicity environments.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17510
Program Title: The Origin of the Virgo Intergalactic Population

Principal Investigator: Gregg, Michael

PI Institution: University of California - Davis

The intracluster light (ICL) is a major component of galaxy clusters, and contains a record of the galaxies destroyed during hierarchical assembly of the cluster. This proposal addresses three issues critical to understanding the origin and evolution of intergalactic populations, using resolved star WFC3/IR photometry of intergalactic fields in the Virgo cluster. Foremost, we will probe the age distribution of Virgo's intracluster stars via the period distribution of bright AGB variable stars, a tool successfully deployed to study stellar populations in elliptical galaxies. By spreading the observations over 8 epochs and two HST cycles (4+4), we can determine periods and reveal the age spread of the intracluster stars, opening a new window on their origin and evolution. Second, IR color magnitude diagrams from the stacked imaging will establish the metallicity distribution function of the ICL, constraining the luminosity function and abundances of the galaxies that have been dismembered in assembling the intracluster population. Third, by observing five fields around the core of the cluster, we will trace how spatially well-mixed the ICL population is and how its age and metallicity vary across diverse environments, and thus measure its evolutionary state. While JWST will extend photometric work on the Virgo ICL, period determination of LPVs with JWST is very difficult because of its restricted visibility window in Virgo. It is therefore critical to begin these multi-cycle observations while time permits before the end of HST's lifetime.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17511
Program Title: A Major Overhaul of Ultraviolet-Based Black Hole Mass Prescriptions

Principal Investigator: Maithil, Jaya

PI Institution: Center for Astrophysics | Harvard & Smithsonian

We propose obtaining UV spectra of 18 bright reverberation-mapped AGNs with Eddington ratio greater than 0.3 in order to overhaul single-epoch black hole mass prescriptions using the C IV and Mg II emission lines. Combining the new spectra with archival data, we will cover a complete range of Eddington ratio seen in AGNs and quadruple the number of high accretion rate AGNs than previously used. Samples deficient in highly accreting AGNs led to significant overestimation of single-epoch (SE) black hole mass formulations for both optical and UV-based methods. Studies show that these mass overestimations are correlated with the Eddington ratio. Recently the Hbeta-based SE masses have been corrected using features in the optical spectra, and we want to use a similar approach for UV prescriptions. Our efforts will significantly improve both the accuracy and precision of black hole mass estimates based on single-epoch UV spectra. This project has wide application given the hundreds of thousands of rest-frame UV spectra of high-redshift quasars produced by large spectroscopic surveys.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17512
Program Title: Probing SMBH/Galaxy Co-Evolution with Dual and Binary AGN

Principal Investigator: Mueller-Sanchez, Francisco

PI Institution: University of Memphis

A fundamental role is attributed to major mergers and supermassive black holes in the evolution of galaxies. But theoretical models trying to explain the role of galaxy mergers in the fueling and evolution of active galactic nuclei (AGN) have to make broad assumptions about the physical processes involved, and the prescriptions used are poorly constrained. Dual AGN, which are kpc-scale separation AGN pairs in galaxy mergers, offer the unique opportunity to investigate complex processes that are rarely detected simultaneously: vigorous star formation, two AGN, outflowing winds of ionized gas and tidal distortions. To provide the much needed guidance on these relevant processes, we propose [O III] and Halpha imaging of the complete sample of confirmed dual AGN at $z < 0.05$ and the only confirmed binary AGN, 4C+37.11, using ACS narrow-band filters. HST imaging is the only way to achieve the angular resolution and sensitivity required to study the detailed morphologies of faint tidal tails, narrow-line regions (NLRs), gas clouds between the two nuclei and compact star-forming regions. With a minimal investment of 15 orbits for such astrophysically important objects, we will be able to answer the following key questions: (i) how does merger dynamics contribute to the onset of star formation and AGN? (ii) how do the NLRs from the two AGN combine during the merger process? and (iii) what are the relative timescales and energetics of AGN- and star formation-driven outflows during different phases of the merger sequence? HST has observed only one dual AGN with narrow-band filters. This program will deliver a legacy of morphological data of dual AGN for studies of galaxy evolution.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17513
Program Title: Proper Motions of Galaxies in the M81 Group: Unleashing the Full Power of HST's 20-year Time Baseline

Principal Investigator: Bennet, Paul

PI Institution: Space Telescope Science Institute

We propose, for the first time, to measure the bulk proper motions (PMs) of a galaxy group outside the Local Group (LG). We will do this by obtaining bulk PMs of the three most massive central galaxies of the M81 group at 3.6 Mpc: M81, M82 and NGC 3077. These galaxies are some of the most studied objects in astronomy, with M81 being a canonical grand-design spiral galaxy and M82 the prototype for starburst-driven outflows. These features are driven by an ongoing major merger between these galaxies. We will reimage archival HST fields with a 20-year baseline. Combined with the existing position, distance and radial velocity this will yield 6D position-velocity information. This will allow us to precisely determine the galaxy orbits, shedding light on their past interactions during the ongoing major merger as well as their future trajectories. This will allow us to answer key questions, not only for the M81 Group but also broader universe: (1) how can the observed tidal features be understood dynamically? (2) What is the future of the group, and will either M82 or NGC 3077 be ejected by the three body interaction? (3) What is the mass of the dark matter halos of M81 and M82? (4) What is the transverse velocity of the M81 group, relative to the LG, and how does this compare to our cosmological understanding? The answers will inform simulations and models of galaxy mergers and local flows. We will obtain the first galaxy PMs outside the LG, as well as the first 6D dynamical constraints on an ongoing major merger. These innovations show how HST's longevity allows us to open up new windows on the universe previously considered inaccessible.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17514
Program Title: Three new isolated, faint and star-forming dwarf galaxies beyond the Local Group

Principal Investigator: Mutlu-Pakdil, Burcin

PI Institution: Dartmouth College

The Local Group satellite dwarf galaxies are frequently used as benchmarks for testing galaxy formation and evolution theories on the smallest scales because they are the lowest-mass galaxies for which we have detailed observations. However, the vast majority of these dwarfs have been affected by the Local Group environment. If we want to understand the physical mechanisms driving the evolution of low-mass galaxies, it is essential to study pristine isolated dwarf galaxies beyond the Local Group as a control sample. Unfortunately, identifying such galaxies in the field is extremely challenging due to their extreme faintness. To date, Leo P is the only known isolated, star-forming galaxy that is independent of group dynamics in an extremely low-mass regime (<10^6 Msun) but close enough at 1.6 Mpc to be studied with resolved stars. With only one system, it is challenging to draw broad conclusions about low-mass star-forming galaxies evolving in isolation. We request three orbits of HST/ACS imaging (F606W+F814W) to follow up three new nearby isolated, faint, star-forming dwarf galaxies discovered in ground-based surveys. The galaxies are likely just beyond the edge of the Local Group, with apparent morphologies and colors strikingly similar to Leo P. HST imaging is essential to the determination of secure distances, measurement of basic physical properties, and measurement of star formation histories of these three newly discovered dwarfs. The requested observations will put these three galaxies into context with other dwarf galaxies in and beyond the Local Group, providing a rare opportunity to assess the impact of environment on low-mass systems.

Proposal Category: GO (GO-Archival)
Scientific Category: Galaxies
ID: 17515
Program Title: Chasing Lyman Continuum Leakers in the Local Universe

Principal Investigator: Hernandez, Svea

PI Institution: Space Telescope Science Institute - ESA - JWST

When and how did reionization occur? This will be one of the questions JWST will seek to address in the coming years. The main challenge, however, is the fact that direct measures of the leaking Lyman continuum (LyC) radiation from the same galaxies that reionized the Universe are not possible due to the high opacity of the intergalactic medium (IGM). To fully understand the mechanisms enabling the escape of LyC photons into the IGM, and to uncover the main contributors to the cosmic reionization, it is imperative that we: (1) Test and develop tools to indirectly infer the LyC escape fraction, and (2) compile a sample of nearby LyC leakers allowing us to exploit the ease of fully resolving these objects in the context of LyC escape. We propose a pioneering program to do exactly that. Building on archival observations of eleven local star-forming galaxies (SFGs), we request COS/FUV G130M/1291 spectroscopic data of five additional targets, all of which are expected to have f_esc(LyC)>10% based on cosmological radiation hydrodynamics simulations. Our study will test a much-needed indirect signpost of LyC leakers based primarily on the saturated CII 1334.5A line, allowing us to understand the physical process making LyC leakage possible, and probing the contribution of low-mass SFGs to the epoch of reionization.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17516
Program Title: Dust extinction at its extremes - from the smallest to the largest dust grains

Principal Investigator: Decleir, Marjorie

PI Institution: Space Telescope Science Institute

We propose to observe a carefully selected sample of 23 stars in the Milky Way with STIS to measure extreme dust extinction curves from 1150 Angstrom to 1 micron. This sample of sightlines has very low or very high total-to-selective extinction ratios, probing the smallest or largest dust grains, respectively. The proposed observations will put strong constraints on dust grain sizes and dust grain evolution including growth and destruction in extreme environments. In addition, they will enable us to provide a much more accurate R(V)-dependent extinction curve that can be used to account for dust extinction in all types of environments.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17517
Program Title: CONTACT: Circumgalactic Observations of Nuv-shifted Transitions Across Cosmic Time

Principal Investigator: Chen, Hsiao-Wen

PI Institution: University of Chicago

The circumgalactic medium (CGM) is the principal reservoir for gas accretion. Its kinematics, ionization state, and metal enrichment place vital constraints on the baryon cycle, including the amount of metals produced by previous generations of stars and the dispersal of metals though feedback processes. The CIV doublet is a strong tracer of warm-ionized outflows. It is also the strongest ionic probe at z>2 and the only high-ionization transition available at z>6, but poorly constrained at z<2 when the cosmic star formation rate density declines rapidly. This proposal will fill a prominent gap between low- and high-redshift CGM studies by targeting CIV with STIS E230M, which offers higher spectral resolution and higher efficiency than the COS NUV channel. It leverages existing FUV spectra and deep galaxy surveys to provide the most comprehensive census of cosmic enrichment to date. The proposed STIS NUV E230M data (which trace 2 ionization states of C and 3 of Si) combined with archival FUV spectra will resolve the complex, multiphase CGM. The program will deliver a legacy galaxy-absorber sample, covering more than four decades in stellar mass and two decades in projected distance, for studying the cosmic baryon cycle. It will (1) establish the census of heavy elements (C and Si) in warm-ionized gas from z~0 through the epoch of reionization, (2) characterize CGM chemical enrichment and its connection to galaxy properties over the full cosmic history, and (3) resolve the ionization states and thermodynamics of the turbulent CGM. JWST has just begun to unravel the CIV CGM properties at z~6, highlighting the urgent need to complete the census of metals across cosmic time.

Proposal Category: SNAP
Scientific Category: Galaxies
ID: 17518
Program Title: PIE+: Identifying LyC leakers through improved photometry of the PIE survey fields

Principal Investigator: Beckett, Alexander

PI Institution: Space Telescope Science Institute

The Parallel Ionizing Emissivity (PIE) Survey is an ongoing program that will measure the average escape fraction of ionizing radiation (f_esc) at 3.1<z<3.5 using a sample of ~600 galaxies across 65 independent fields, thereby minimizing the effect of correlated IGM absorption. The initial 3-band coverage of the PIE fields (F336W, F625W, and F814W) can be used to select U-dropout galaxies in our target redshift range, for which F336W probes only the Lyman continuum (LyC) radiation. To confirm redshifts and properties, these galaxies will be followed-up using granted and guaranteed time on multi-object spectrographs. However, this color cut will also select a large number of lower-redshift (and some higher-z) galaxies. With limited slits available per field, the spectroscopy will therefore miss numerous LyC candidates. We propose SNAP observations of these fields using WFC3/UVIS F475W, enabling additional color cuts that will dramatically reduce the number of interlopers, thereby maximizing the number of galaxies confirmed in our target redshift range and hence the science return of the PIE survey. We will confirm 50% more 3.1<z<3.5 galaxies in each field observed. HST is required to ensure our photometry is not contaminated by nearby foreground galaxies and, using dithered exposures, to improve morphology measurements over the original 3 filters. Aided by our increased sample, we will calibrate f_esc indicators out to z~3.5 by measuring f_esc as a function of improved stellar mass estimates and morphologies, as well as star formation surface density, Ly-alpha properties, UV luminosity, and UV colors, helping to understand the role of LyC leakers in galaxy evolution.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17519
Program Title: Chasing the tail: measuring a proper motion of the Coma cluster dwarf ram-pressure-stripped galaxy GMP2640 with its extraordinary star cluster population.

Principal Investigator: Chilingarian, Igor

PI Institution: Smithsonian Institution Astrophysical Observatory

GMP2640 is the most luminous diffuse post-starburst galaxy in the Coma cluster (D=99Mpc) identified using data mining. Despite relatively low stellar mass (2.4*10^9 MSun), it hosts a strikingly large population of 450+ massive intermediate-age star clusters detected in an archival HST image in its disk and hundreds of additional clusters in its spectacular 270kpc-long ram-pressure-blown tail. Measuring age gradient of clusters along the tail opens a unique opportunity to measure a velocity of GMP2640 in the plane of the sky, i.e. its proper motion at the striking distance of 100Mpc. We propose to collect high-resolution HST images of GMP2640 and its tail using WFC3 in prime orbits and ACS/WFC in coordinated parallel fields. We will detect star cluster populations and measure their ages, metallicities, hence mass and luminosity functions, and assess the plausibility of the formation of central star clusters in a dEs via mergers of in-situ formed star clusters. Our project will address the question of rich star cluster systems in low-mass galaxies as well as the question of dE/UDG formation via ram pressure stripping in galaxy clusters.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17520
Program Title: A 1% cross-calibration of Cepheids, TRGB, and JAGB in five nearby galaxies with HST

Principal Investigator: Breuval, Louise

PI Institution: The Johns Hopkins University

The current tension between the Hubble constant (H0) measured from the empirical Cepheid-SNIa method and its value inferred from the Cosmic Microwave Background has now reached 5 sigma (Riess et al. 2022) and questions the completeness of the Lambda-CDM model, suggesting the need for new physics. However, the accuracy of the H0 measurement based on Cepheids has recently been challenged by an alternative method based on the Tip of the Red Giant Branch (TRGB), which resulted in a wide range of H0 values (Freedman et al. 2020, Anand et al. 2022). We propose to investigate the consistency of these different methods by measuring 202 Cepheids in the disks of 5 nearby galaxies (distance modulus from 23 to 27 mag) while simultaneously measuring the TRGB in the halo of these galaxies, together with J-region Asymptotic Giant Branch (JAGB) stars in the disk fields. Standard NIR and optical HST filters have been adopted consistently across the entire distance ladder, from the local geometric anchors to SNIa host galaxies, to measure H0. The proposed observations will more than double the number of galaxies where Cepheid, TRGB and JAGB distances can be compared in this homogeneous HST photometric system and will allow us to bypass crowding contamination that affects ground-based measurements. By directly cross-calibrating to the 1% level the distances to these 5 galaxies using 3 independent standard candles in a consistent system, we will obtain a deep understanding of the systematics behind each method and offer a clean way to investigate the Hubble tension, independently from any assumptions on supernovae host galaxies.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17521
Program Title: A multiwavelength study of protoplanetary disk ionization

Principal Investigator: Espaillat, Catherine

PI Institution: Boston University

We aim to determine whether the magnetorotational instability (MRI) could be the elusive driver of turbulent accretion in protoplanetary disks. To accomplish this, we will measure the amount of X-ray induced disk ionization in a sample of three protoplanetary disks, leveraging the unique synergy provided by Chandra, HST, and JWST to simultaneously measure X-ray through UV luminosities and the fluxes of mid-infrared [Ne II] and [Ne III] fine structure lines. When combined with thermochemical modeling, these simultaneous Chandra, HST, and JWST observations will characterize the high-energy radiation spectrum impinging on the disk and lead to a measurement of the disk ionization fraction, which will test if the MRI is responsible for accretion in protoplanetary disks.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17522
Program Title: Betelgeuse: The Great Dimming Redux?

Principal Investigator: Dupree, Andrea

PI Institution: Smithsonian Institution Astrophysical Observatory

The historic Great Dimming of the red supergiant Betelgeuse in 2020 was initiated at a propitious confluence of maximum outflow of the 400-day fundamental mode of pulsation and the 2200-day Long Secondary Period. This condition will occur again sometime between Fall 2024 and Spring 2025. We propose to follow its behavior. Spatially resolved ultraviolet spectra of the star achievable with STIS can provide the connecting link between the convective activity on the stellar surface and the formation of a dust cloud in the outer atmosphere. This campaign will probe the entire atmosphere, from the photosphere to the circumstellar environment, with a combination of ground-based interferometric/AO imaging, radio observations, and optical and UV spectroscopy, creating a comprehensive contemporaneous sampling of the star, its variation with time, and the effects on its extended atmosphere. We should learn whether the event of 2019-2020 was a 'random' occurrence or results from oscillation phase superposition. Two visits are requested during Cycle 31, and 4 visits during Cycle 32 to obtain spatially resolved ultraviolet spectra at this unique time.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17523
Program Title: Determining the broad line region continuum contribution in NGC 7469

Principal Investigator: Cackett, Edward

PI Institution: Wayne State University

In the last decade, significant progress in understanding the sizescale and structure of the inner regions of Active Galactic Nuclei has been brought about by high cadence continuum reverberation mapping campaigns. Measuring time lags between light curves at different wavelengths probes sizescales not possible through imaging. Results from these campaigns are now seriously challenging the scenario where X-rays drive variability in a standard optically thick, geometrically thin accretion disk at UV/optical wavelengths. Observational evidence suggests the presence of significant continuum emission from the broad line region (BLR). An 8-month multiwavelength continuum reverberation mapping campaign of the nearby bright Seyfert 1 NGC 7469 is on-going, utilizing NICER, Swift and ground-based monitoring. The UV and optical filter bands used for photometric monitoring include significant contamination by reprocessed emission from the broad-line region, including broad emission lines, Balmer continuum, and Fe II emission. To properly interpret the measured photometric lags therefore requires a careful assessment of the strength of each of these spectral components through the UV and optical. This can only be achieved with HST/STIS spectra covering from 1150 - 10000 Angstrom.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17524
Program Title: A Deep Search for Moons around Contact Binary Trans-Neptunian Objects.

Principal Investigator: Thirouin, Audrey

PI Institution: Lowell Observatory

A close/contact binary can be a small body with a bi-lobed shape (like 67P/Churyumov-Gerasimenko visited by the European Space Agency's Rosetta mission) or two objects touching in one point, as well as two objects with a small separation of less than a few hundred kilometers. The flyby of the trans-Neptunian object Arrokoth (a.k.a (486958) 2014 MU69) by the NASA New Horizons spacecraft has left us with no doubt that contact binaries do exist in the trans-Neptunian belt. Unfortunately, it is still unclear how these objects can form at the edge of our Solar System. Several models have been proposed, but none have been thoroughly tested with observations as the contact binary population remained elusive until recently. We propose a deep search for moon(s) around likely/confirmed contact binary identified through lightcurve and stellar occultation observations. The fraction of systems with/without a moon will allow us to infer which proposed formation model (if any) is more likely to reproduce the current contact binary population. These observations will (1) provide context for the New Horizons flyby of Arrokoth, (2) provide constraints for planetesimal formation, and (3) challenge the current formation models for binary/multiple systems.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17525
Program Title: Improving the Orbit of Queta: Enabling Observations with the Lucy Spacecraft

Principal Investigator: Noll, Keith

PI Institution: NASA Goddard Space Flight Center

(3548) Eurybates will be the first Trojan asteroid to be explored in situ when the Lucy spacecraft flies by it in August 2027. The possibility of close-up study of Eurybates' satellite, Queta, offers a unique opportunity to test whether Eurybates' unusual properties are tied to its collisional history and, more broadly, how collisional evolution shapes small body populations. It is critical to reduce the orbital uncertainty and improve knowledge of the relative position of Queta as soon as possible to enable planning for the best angular resolution and lighting conditions in the brief window when spacecraft observations can be made. With a single orbit we can reduce the positional uncertainty for Queta by almost a factor of two - which translates to a roughly equivalent gain in resolution for observations with a given angular coverage. As a secondary objective, we will collect astrometric information from trailed stars in the full UVIS aperture to improve predictions for future stellar occultations. HST is required because Queta is 8.7 magnitudes fainter than Eurybates and will be observed at a separation of approximately 0.5 arcsec - an observational regime that is unique to Hubble.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17526
Program Title: Mega-deep UV spectroscopy of star-forming galaxies: completing the picture of the extremely metal-poor massive stars underlying high-ionization UV nebular emission

Principal Investigator: Senchyna, Peter

PI Institution: Carnegie Institution of Washington

Local star-forming dwarf galaxies provide the only laboratory in which extremely metal-poor stellar populations like those encountered at the highest redshifts can be studied in detail. Over hundreds of orbits, Hubble has completely revolutionized our view of young star-forming systems, extending our ultraviolet vision to substantially younger ages and lower metallicities than previously seen. This exploration has revealed a rare population of extremely metal-poor systems dominated by massive stars that power UV nebular emission lines at strengths approaching that encountered in the first JWST spectra at z>~9. Unfortunately, the existing local UV spectra leave the faint continuum signatures of these massive stars effectively unconstrained in the lowest-metallicity and most extreme nebular emitters. Here we propose to remedy this by completing extraordinarily-deep 40-50 orbit spectra for the two brightest star forming regions known that are likely to harbor massive stars at or below 5% solar. These spectra will directly constrain the stellar photospheric and wind signatures imprinted on the FUV continuum which hold the key to understanding the hot stars that dominate high-ionization nebular line emission. Comparing these galaxies to stellar population synthesis prescriptions will provide our best hope of empirically calibrating the models that will continue to be used routinely at high-redshift in the coming years. Without these crucial UV observations, our understanding of the highest-redshift and lowest-mass systems that JWST and the ELTs will uncover will suffer from substantial systematic model uncertainties unaddressable without a UV space telescope.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17527
Program Title: Weighing the Most Massive Binary

Principal Investigator: Massey, Philip

PI Institution: Lowell Observatory

Understanding massive star evolution requires understanding massive binaries, as many massive stars are members of binary systems. In addition, orbit solutions provide the one direct measurement of a star's most fundamental property, its mass. We are proposing to measure accurate masses for NGC3603-A1, the most massive binary known, and the most luminous star in its rich cluster. Although identified as an eclipsing binary in 1984, the extreme crowding in the center of the cluster has made follow-up work difficult. An orbit using AO in the NIR on the VLT found masses of 116 Mo and 89 Mo for the two components. If correct, the primary would have a mass 50% larger than that of any other directly measured unevolved star. However, the uncertainties on these masses are quite large as the spectral features are mainly very broad, blended emission lines. An attempt to get better velocities was carried out by a competing group in Cycle 19, but the data were never published. We have analyzed these spectra, discovering that the upper Balmer lines are in absorption, and that at orbital phases near quadrature, the lines are readily resolved into two components: one from the primary and one from the secondary. Only two of their observations were taken at such phases, and the data have poor S/N. Here we propose to obtain much better data on the upper Balmer lines taken at times where we know the two components will be well resolved. This provides an efficient way to obtain accurate orbital parameters and masses for the most massive binary known. Such a system is the unevolved progenitor of the sort of merging massive black hole pairs indicated by recent gravitational wave detections.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17528
Program Title: Ultradiffuse Galaxies in the Virgo Cluster

Principal Investigator: Mihos, Chris

PI Institution: Case Western Reserve University

The "ultradiffuse galaxies" (UDGs) found within galaxy clusters present challenges to models of galaxy formation and evolution. They may be diffuse field galaxies only now falling into the cluster, post-infall galaxies undergoing rapid transformation, or long-lived cluster galaxies stabilized against disruption by massive dark halos. Recent observations also suggest systematic differences between their globular clusters (GCs) and those of normal galaxies. Unfortunately, large uncertainties in the distances, dynamics, and GC populations of UDGs continue to complicate our understanding of these galaxies. We propose deep imaging of five Virgo Cluster UDGs to pinpoint their positions within Virgo via accurate tip of the red giant branch (TRGB) distances, allowing us to quantify their local environments: in the Virgo core, the cluster outskirts, or intervening field. Coupled with published kinematic data, we will determine if they are infalling objects or ones that have already passed through the Virgo core. Using imaging that probes three magnitudes below the GC luminosity function turnover, we will construct larger and cleaner GC samples than possible from the ground, allowing us to measure the physical sizes and luminosities of their GCs to test for systematic differences between GCs in UDGs and those in normal galaxies. Finally, we will compare the properties of their compact nuclei to ultracompact dwarf galaxies (UCDs) in Virgo to test the evolutionary link between UDGs and UCDs. The information provided by HST will be used in conjunction with simulations to study cluster-driven evolution and transformation of low density galaxies.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17529
Program Title: Adding the Stripped-Envelope Supernova iPTF 13bvn to the Ongoing Search for Surviving Companion Stars

Principal Investigator: Fox, Ori

PI Institution: Space Telescope Science Institute

The mass-loss mechanism for stripped-envelope supernovae (SESNe) remains debated, but evidence is starting to mount in support of binary star mass-transfer. There are now five direct post-explosion detections of surviving companions. A statistically complete sample of companion-masses can provide important constraints on the underlying physics used in binary evolution models, which have implications on many stellar systems, including merger sources for gravitational waves. The sample is still too small. Every additional data point is impactful. But building the proper dataset is a tedious and painstaking process given the small number of reasonable candidates each year. We confirm that all other viable nearby SESNe at <20 Mpc have already been targeted. Here we propose optical+UV observations of the next most feasible and interesting target, iPTF 13bvn at 22 Mpc, to detect (or place meaningful limits on) any surviving companion. iPTF 13bvn was the very first SN Ib to have a progenitor identification, but the details have remained shrouded in ambiguity. A follow-up search for a surviving companion was never fully explored because the distance initially seemed prohibitive. We show that despite these limitations, deep UV/F336W imaging can now offer an optimum detection strategy for the expected hot, blue stellar companion, while optical imaging can constrain the companion star model, rule out shock interaction contributions, and probe less likely, but possible, cooler star companions. Given HST's time horizon and the requisite waiting period to allow new SNe to fade before conducting a companion search, now is the time to take full advantage of HST's unique UV capabilities.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17530
Program Title: Hot and cool - hot companions as probes of red supergiants

Principal Investigator: Patrick, Lee

PI Institution: Centro de Astrobiologia (CSIC/INTA) Inst. Nac. de Tec. Aero.

Most massive stars are born in binary systems, with 70% expected to interact with a companion within their lifetimes. The consequences of these interactions for subsequent evolutionary stages and for the endpoints of stellar evolution are still not well understood, particularly in both low-metallicity environments and for the red supergiant (RSG) phase: the final evolutionary stage before supernova for the majority of massive stars. Ultra-violet (UV) photometric observations of the Small Magellanic Cloud (SMC) have identified almost 100 RSGs with UV bright companions. As UV photometry alone can not independently determine stellar parameters of the companion or constrain the level of circumstellar extinction, we propose a unique survey of these RSG binaries in the UV using STIS spectroscopy. We have selected 22 binary systems that contain the most massive RSGs, the brightest companions and the dustiest binary systems. These observations will allow us to accurately determine the ages and masses of the hot companions and the extinction towards these systems to provide an independent calibration to RSG luminosities and masses and determine the frequency of interactions in RSG binary systems. These results will break degeneracies in the mass estimates of RSGs and their hot companions in the low-metallicity environment of the SMC, in orbital configurations and mass ranges that may result in hot Wolf-Rayet stars, stripped envelope supernovae and ultimately double compact object binary systems. Parallel observations focus on obtaining uniquely deep UV images of the SMC to identify the blue core helium burning sequence.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17531
Program Title: Planetary Nebulae in Star Clusters: Testing Membership with High-Precision Proper Motions

Principal Investigator: Bond, Howard

PI Institution: The Pennsylvania State University

Planetary nebulae (PNe) mark the rapid transition of low- to intermediate-mass stars from the AGB to the white-dwarf (WD) cooling sequence. PNe provide information on nucleosynthesis, mixing, mass loss, and the relation between a star's initial mass and that of its WD remnant. Even the very existence of a PN shows that its central star will not end life as a core-collapse supernova (CCSN). Unfortunately, for the vast majority of PNe, the masses and compositions of their progenitor stars are unknown. The only exception is in the case of a PN belonging to a star cluster. We propose to use precise astrometry, made possible by high-resolution HST imaging, to measure proper motions (PMs) of the central stars of three PNe that are candidate cluster members, and verify that the PMs agree with those of the clusters. Two of the PNe may belong to young open clusters, and one to an ancient globular cluster (GC). One of the open clusters, NGC 6067, is only 90 Myr old, implying an ususually high progenitor mass of 5.6 Msun (and a firm lower mass limit for CCSN progenitors). Another PN is a possible member of the GC Pal 6. Single-star evolution theory does not predict the existence of PNe in GCs, so that interacting-binary scenarios are needed--if the PN can be shown to be a cluster member. For two of our targets, there are archival first-epoch HST images available. In these cases, a one-orbit second-epoch observation will allow determinations of extremely precise PMs, and thus stringent tests of membership. For the PN candidate in NGC 6067, we propose first-epoch WFC3 images in Cycle 31, and a second epoch in Cycle 33, making it possible to confirm its unusually massive progenitor.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17532
Program Title: High-Velocity Cloud Complex M: Precise Constraints on the Conditions, Abundance Patterns and Dust Content, and the Physics of Circumgalactic Gas in the Disk-Halo Interface

Principal Investigator: Tripp, Todd

PI Institution: University of Massachusetts - Amherst

The Milky Way high-velocity cloud (HVC) Complex M offers several advantages for investigation of gas physics in the disk-halo interface of the Galactic circumgalactic medium (CGM). First, there are three UV-bright objects that are in the direction of Complex M that are closely spaced in the sky: two stars (HD93521 and BD+38d2182) and an extragalactic AGN (MRK421) that constrain the location of the gas: absorption lines at the velocity of the HVC are not detected in the spectrum of the closest object (HD93521, Gaia distance = 1.2 kpc), but the HVC is detected in absorption toward the more distant star (BD+38d2182, Gaia distance = 3.8 kpc) and the extragalactic sightline. The targets are at high latitudes, so the gas is constrained to be at z-heights > 1.1 kpc. Second, the targets are extremely bright, so they can be observed with the highest-resolution STIS E140H grating with good S/N. Third, the close projected spacing constrains the transverse dimensions of the gas clouds. We propose to use new STIS E140H observations of BD+38d2182 and MRK421, combined with archival HD93521 data to study CGM gas physics in this important region. With these data we will: (1) constrain the dimensions and kinematics of the HVC, (2) constrain the line-broadening mechanism, (3) derive the physical conditions in the HVC as well as the lower-velocity IVCs, (4) constrain important gas-physics time scales, (5) study abundance and dust-depletion patterns, and (6) investigate the ionization and origin of the highly-ionized gas including non-equilibrium and interface models.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17533
Program Title: Identifying a New Source of r-Process Nucleosynthesis with HST

Principal Investigator: Rastinejad, Jillian

PI Institution: Northwestern University

The origin of the Universe's heavy r-process elements is a fundamental issue which affects chemical enrichment across cosmic time and the development of complex life. It is now confirmed that neutron star mergers are responsible for at least some of the r-process budget, but there is gaining observational and theoretical support for an additional and faster production channel: the core-collapse of rapidly-rotating, massive stars. In particular, energetic supernovae with associated long-duration gamma-ray bursts (GRB-SNe) are the strongest candidates for a fast channel. Here, their massive neutronized accretion disks mix with the outer, Ni-dominated ejecta producing dramatic reddening at late times (~50-200 days). Even for the most nearby events, HST is necessary to detect the SN at these epochs when the color of an r-process enriched SN will be distinguishable from an event with no r-process, especially against the background light of a star-forming host galaxy. Yet, as these GRB-SNe r-process models gain traction, no tailored observations with the relevant sensitivity or wavelength coverage exist. We propose a first-of-its-kind study to monitor the late-time evolution of one nearby (z<0.3) GRB-SN as a crucial test of current models. We will obtain 12 HST orbits over 5 epochs in F606W and F160W. The detection of r-process nucleosynthesis in a GRB-SN would be transformative for our understanding of when and where heavy elements enter galaxies like our Milky Way. Given both the long time baseline and rarity of neary LGRBs, we request long-term and carry-over status.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17534
Program Title: A young burping planet: characterizing the variable atmospheric escape of the exciting AU Mic b

Principal Investigator: Rockcliffe, Keighley

PI Institution: Dartmouth College

Atmospheric escape is the prevailing evolutionary theory that explains current exoplanet demographics - pertaining to the most common exoplanet types, short-period sub-Neptunes and super-Earths, in particular. Two planets have been detected around the 23 Myr pre-main sequence M dwarf AU Mic; their known age makes them good probes for early stages of exoplanet evolution. AU Mic b is the 4.2 Earth radius inner planet orbiting with a period of 8 days. The planet's youth, high levels of X-ray and UV radiation, and proximity to its bright host indicate this planet is likely experiencing atmospheric mass loss. Previous STIS UV observations of this planet show a highly variable Lyman-alpha transit, going from no detected planetary outflow to detected. Even more strange, the detection occurs before the white-light transit of the planet, meaning the neutral hydrogen outflow is moving ahead of the planet. This could be explained by 1) variable photoionization of the outflow, or 2) turbulent interactions with the stellar wind environment that cause a "burping" of the outflow. We propose for two additional transits of this planet to test this hypothesis. Observing the extreme behavior of this young planet will provide critical constraints on atmospheric escape models.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17535
Program Title: Dust in Galactic Winds and Fountains: A Near-UV Survey of Nearby Highly Inclined Starburst and Active Disk Galaxies

Principal Investigator: Veilleux, Sylvain

PI Institution: University of Maryland

The amount of dust outside of galaxies, inferred from reddening measurements of background quasars and galaxies by foreground galaxy halos, is comparable to that within galaxies. The recent discoveries of dusty winds driven by stellar or SMBH processes that extend on 100-kpc scales suggest that winds are one source, and possibly the main source, of the enriched circumgalactic medium (CGM), although the processes by which the dust is launched, entrained, and possibly altered in these winds remain uncertain. This is due to the fact that the angular resolution (5") of present-day observations is insufficient to extract the dust signal at the base of the wind against the bright galaxy, and allow to pinpoint where the dust lies relative to the cool, warm, and hot gas phases of the winds. We propose to map, for the first time on sub-arcsecond scale (<10-100 pc), the ultraviolet light reflected off of extraplanar dust in 10 nearby highly inclined disk galaxies with well-known galactic winds or fountains, spanning a range in stellar masses, energy sources (stellar or AGN), and dust erosion processes (shocks, stellar or AGN photoionization). The dust maps, derived from deep WFC3 F225W and F336W images, will be compared with existing sub-arcsecond maps and velocity fields of the ionized gas to determine the mechanisms by which the dust is launched and carried into the halos of these galaxies, and whether the dust experiences any evolution on its journey to the halos. The <10-100 pc resolution is critical since the processes that can alter or even destroy the dust and the clouds in which it resides operate on such scales. The results will inform future modeling and IR observations.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17536
Program Title: Probing the Cool, Warm, and Hot Gas at the Center of the Perseus Cluster with Deep Far-Ultraviolet Spectroscopy

Principal Investigator: Veilleux, Sylvain

PI Institution: University of Maryland

The Perseus Cluster is an ideal laboratory to study the physics of radio-mode AGN feedback which prevents large-scale cooling flows and prodigious star formation at the centers of galaxy clusters. Remarkably, the engine at the heart of the Perseus Cluster, the jetted AGN NGC 1275, has never been spectroscopically observed below 1500 A with the high-resolution grating of COS. This is truly a missed opportunity. This spectral region is rich in spectroscopic diagnostics of the neutral, low-ionization, and high-ionization gas that sample a temperature range (10^4-10^7 K) largely inaccessible to the optical and X-rays. COS is an order of magnitude more sensitive than the previously used FOS and STIS. We propose to obtain a deep COS G130M spectrum of this object covering 1140-1430 A to study the central AGN, its outflow, and the multi-phase circumgalactic and intracluster media along the light of sight to the core of the Perseus Cluster. The new data will allow us to derive the ionization, total column densities, metal abundances, and locations of metal-line absorbers from the wind and circumgalactic medium. The strengths and widths of the emission lines from the cooling intracluster medium, including [Fe XXI] 1354, will be measured with unprecedented precision and compared with the Hitomi X-ray measurements as well as predictions of the ionization state and turbulent pressure support in simulations of AGN feedback in clusters. Finally, the new data will be compared with a contemporaneous (<1 week) optical spectrum and on-going monitoring in the gamma-rays, high-frequency radio, hard X-rays, and optical to test recent claims that SMBH fueling regulates jet power in this system.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17537
Program Title: How shiny is HD209458b in the NUV?

Principal Investigator: Fu, Guangwei

PI Institution: The Johns Hopkins University

Recent CHEOPS detection of reflected light on HD209458b indicated a geometric albedo consistent with a clear atmosphere and Rayleigh scattering from hydrogen. However, broadband photometry could not provide any additional spectral information. We propose to follow up with eclipse observation using STIS G430L in spatial scan mode to measure the Rayleigh scattering slope in the blue part of the spectrum and search for any aerosol spectral features.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17538
Program Title: The Next Interstellar Interloper

Principal Investigator: Jewitt, David

PI Institution: University of California - Los Angeles

The recent detection of two interstellar interlopers (1I/Oumuamua and 2I/Borisov) in the solar system has generated enormous scientific and popular interest. Of particular surprise, in addition to the unexpected discovery of these objects, are their extreme physical differences, with 1I appearing asteroid-like and 2I being much more similar to a normal outgassing, solar system comet. These differences remain unexplained, although speculation abounds. In this proposal we request a 4 orbit disruptive ToO with WFC3 to carry out the earliest possible high resolution assessment of the next interloper object, "3I", so that more intensive follow-up observations can be rationally planned. Nucleus isolation, coma morphology assessment, and initial search for nucleus rotation, are the objectives. We request a 0 month proprietary period so the observations can be of maximum benefit to the community.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17539
Program Title: Cometary Disruption

Principal Investigator: Jewitt, David

PI Institution: University of California - Los Angeles

Comet nuclei are volatile rich products of accretion in the protoplanetary disk of the Sun, preserved since formation at about 10 K in the Oort cloud and 40 K in the Kuiper belt. They include some of the most primitive macroscopic objects in the solar system. We now know that comet nuclei spontaneously and suddenly disintegrate and that disintegration probably dominates sublimation as the main destructive process operating on these bodies when in the inner solar system. Crucially, disintegration may account for the long-recognized ``fading problem'' discovered by Oort in 1950: long-period comets fade because they fall apart, not because they run out of ice. Unfortunately, our growing confidence that disintegration is important is not matched by an understanding of the process or its cause. This is because disintegrations are unpredictable, sudden, and difficult to observe. Proposed models center around internal pressure build-up, explosion of amorphous ice, and centripetal disruption caused by outgassing torques, but we do not possess the high quality (resolution, sensitivity and temporal resolution) data needed to determine what is really happening. In this ToO proposal we request 3 orbits with WFC3 to characterize the photometry and dynamics of fragments produced by the next cometary disintegration.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17540
Program Title: Fragmented Asteroid 331P/Gibbs

Principal Investigator: Jewitt, David

PI Institution: University of California - Los Angeles

Extraordinary asteroid 331P/Gibbs consists of a rapidly rotating primary body about 1.6 km in diameter, a debris trail, and an embedded chain of 19 fragments, evidently all produced by a breakup in 2012. It is the best and most accessible example of rotational instability in the asteroid belt. HST observations in the 2015 - 2018 period have established the basic properties, revealing that one fragment has a large amplitude lightcurve consistent with a contact binary, that the fragments combined carry about 1 percent of the mass of the primary, and have an incredibly small (10 cm/s) velocity dispersion. Here, we propose follow-up observations with HST to define the fragment dynamics by extending the observational arc from 3 to 8 years. The new data will allow accurate orbital elements to be computed for each resolved object and, from these, accurate determination of the time and speed of release from the primary. The degree to which the release times are staggered, the speeds of release, and speed-size correlations, will enable the first comparisons with numerical models of asteroid rotational breakup. The longer astrometric arc will yield sensitive limits to non-gravitational acceleration, as might be caused by the sudden exposure and sublimation of previously buried asteroid ice. If present, ice could spin-up the primary by sublimation torques, rather than radiation (YORP) torque as presently assumed; this new mechanism would have implications for rotational destruction timescales across the asteroid belt. These high resolution, high sensitivity observations lie far beyond the realm offered by even the largest ground-based telescopes, requiring the use of HST.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17541
Program Title: Completing the uncharted baryon cycle at the ISM/CGM interface to determine how galaxies get their gas

Principal Investigator: Kacprzak, Glenn

PI Institution: Swinburne University of Technology

COS has not yet been fully exploited to address the crucial and unanswered question of galaxy formation and evolution theory: how do galaxies acquire their gas? However, COS UV initiatives have drastically increased our knowledge of this multi-phase circumgalactic medium (CGM), where gas geometrically prefers to reside along the major and minor axes of galaxies while exhibiting co-rotation/accretion and outflow kinematics along these axes respectively. Here, we propose a survey of the inner CGM, which targets 9 star-forming disk galaxies where a background quasar lies 15-35 kpc from the galaxy along the major axis of the disk -- directly probing gas accretion across the CGM/extra-planar/disk interface. The proposed COS/G130M spectra covering a range of low to high metal ions and HI. Using the CGM absorption line data, along with in-hand galaxy spectra, we will quantify relative gas-galaxy kinematics, internal absorption kinematics, gas-phase metallicities, and multi-phase gas physics. When combined with the existing outer CGM (35-100 kpc) major axis sample, for which we have the same COS and ground-based data all in-hand, we will finally close the loop on what may be the primary channel of gas accretion. Our low-risk, high-yield observing sample will be complemented by the theoretical insight of the latest cosmological hydrodynamic simulations to interpret this unique and rich dataset. Our proposed program will reveal an uncharted regime of the baryon cycle: gas accretion across the boundary between the CGM and the galaxy, which represents the final phase of how galaxies get their gas.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17542
Program Title: Emission-Line Imaging of the M 82 Wind: Moving from Phenomenology to Physics

Principal Investigator: Heckman, Timothy

PI Institution: The Johns Hopkins University

Galactic winds play an essential role in the evolution of galaxies and the IGM. Despite an abundance of data and improving simulations, deep mysteries remain. The most widely-used probes of winds are UV and optical data that measure outflows of warm ionizied gas. However, we still do not understand how this gas is created, heated, and accelerated. Such understanding is required to use these probes to elucidate the underlying physics of galactic winds. More specifically, the emission from this gas may dominate the radiative cooling of the wind, draining away kinetic energy, and hence determining the wind's dynamical evolution and large-scale impact. This is a proposal to obtain a set of narrow-band images tracing four different emission-lines in the warm-ionized gas in the proto-typical wind driven by M 82. With these data, we can map out key diagnostic line ratios on scales as small as a pc, where complex structures dominate the exisiting HST image of the emission. This will make it possible to fully disentangle the relative contibutions of collisional ionization (which drains energy from the wind) vs. photoionization by the light leaking out from the starburst. The data will also allow us to test competing models for the origin and acceleration of warm ionized gas in M82 and galactic winds in general. We will compare these data to new JWST images of the M 82 wind, to state-off-the art high-resolution numerical simulations, and to exisiting IFU optical spectra. By addressing the key questions on the origin, heating, and acceleration of the warm ionized gas, we will move our understanding of galactic winds along the path from phenomenology to physics.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17543
Program Title: Unveiling the nightside of ultra-short period ultra-hot Jupiter TOI-2109b

Principal Investigator: Fu, Guangwei

PI Institution: The Johns Hopkins University

TOI-2109b is an ultra-hot Jupiter on a 16-hour orbit recently discovered by TESS. It has a measured dayside temperature of 3631K which makes it the second hottest exoplanet ever discovered. The extremely hot dayside and short period make it the perfect target for immediate follow-up phase curve observation. We propose to measure two full phase curves including two eclipses each visit with WFC3/G141 to obtain longitudinally resolved emission spectra from the day to night side of the planet. This dataset will allow us to measure the planet's nightside spectrum and constrain the day-to-night heat circulation. We expect to detect strong hydrogen dissociation/recombination effects and increases H- abundance. TOI-2109b will fill the ultra-hot Jupiter population gap between KELT-9b and the rest of the planets in the ~3500K temperature range.

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17544
Program Title: Quantifying Systematics in the JAGB Method Distance Scale in M33

Principal Investigator: Lee, Abigail

PI Institution: University of Chicago

JAGB stars, a subset of carbon-rich AGB stars, have well-defined, low-dispersion absolute magnitudes in the near infrared, making them excellent standard candles. The JAGB star extragalactic distance indicator has been shown to be as precise and accurate as the Cepheid and TRGB methods in measuring distances to nearby galaxies (Lee et al. 2021, 2022). However, because the JAGB method is still relatively novel, it has not undergone the same level of comprehensive testing across diverse stellar environments as the Cepheid and TRGB distance indicators. Lee (2023) was the first to empirically quantify environmental effects on the JAGB method by using archival HST data of M31 from the PHAT survey to show that while internal reddening had a significant effect on the mode of the JAGB star luminosity function, metallicity and age had negligible effects. We now propose to leverage archival data from the PHATTER survey in M33 to extend this analysis to a wider range of stellar environments as M33 has a lower metallicity and 10x higher SFR than M31. The JAGB method has already been shown to be highly precise; understanding the systematics of even these small effects will further increase its precision. Once the potential systematics of the JAGB method have been thoroughly investigated, the JAGB method can be used to provide an independent local measurement of H0, and cross-check TRGB and Cepheid distances. As a bonus, this proposal will help provide observational constraints on the carbon star luminosity function in different stellar environments, directly guiding theoretical models of carbon star evolution which includes winds, dredge-ups, and hot-bottom burning.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17545
Program Title: The Role of Galaxy Mergers and Interactions in Fueling Star Formation and Black Hole Activity

Principal Investigator: Kartaltepe, Jeyhan

PI Institution: Rochester Institute of Technology

We propose to use HST-WFC3 IR grism data to construct a sample of spectroscopically confirmed galaxy pairs and advanced stage mergers in the CANDELS fields over the redshift range $0.4 < z < 2.3$ and investigate how star formation and morphology depend on a pair's redshift and separation. We will use photometrically identified galaxy pair candidates over this redshift range and with separations from 1-150 kpc and stellar mass ratios spanning the range 1-10 and identify new pairs that are blended in our photometry. Along with this sample of galaxy pairs, we will also use a sample of advanced stage and post-mergers selected from the CANDELS an COSMOS ACS/WFC3 imaging to piece together the entire merger timeline, from first passage, to coalescence, to merger remnant. We will then measure the star formation rate for each galaxy to look for trends along this merger sequence, relative to a control sample of mass- and redshift-matched isolated galaxies. We will address the question of how much enhancement is seen in the star formation rate of a galaxy during a merger and whether this changes as a function of redshift. How much does this enhancement contribute to the overall decline of the cosmic star formation rate density?

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17546
Program Title: The Local Gaseous Cosmic Web

Principal Investigator: Wakker, Bart

PI Institution: University of Wisconsin - Madison

A fundamental prediction of cosmological simulations is that dark matter and baryons condense into multi-Mpc filamentary structures, forming the Cosmic Web. At low redshift the Cosmic Web is traced by the distribution of galaxies. However, the photoionized gas outside galaxies, observed as the Lyman-alpha Forest, contains three times as many baryons, and is more widespread. We propose a direct comparison of the locations and properties of Lyman-alpha absorbers in relation to local Cosmic Web filaments. We will do this by (a) creating a catalogue of ~130,000 galaxies in the local universe (cz<10,000 km/s; mostly complete down to ~0.2 L*); (b) creating a catalogue of ~1000 galaxy groups; (c) delineating ~50 local Cosmic Web filaments; (d) identifying all ~150,000 absorption lines in ~700 AGN spectra (in order to remove lines from other intergalactic systems that can seem to be low-redshift Lyman-alpha); (e) using the CAMELS suite of simulations, providing models with a range of AGN feedback strength and various models for the Extragalactic UltraViolet BackGround. Combining these datasets and models, we can compare the detection fraction, column density, and linewidth as function of filament impact parameter. This allows us to (a) for the first time use data to measure the transverse extent and kinematic structure of gas in filaments, as set by the dark matter potential, and (b) determine the origin of the ionization of the Lyman-alpha Forest - comparing our data to the CAMELS simulations allows us to resolve the degeneracy between ionization caused by AGN feedback vs by UV radiation.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17547
Program Title: Teasing Apart the Effects of Radiation and SN Feedback in Simulated Observations of Dwarf Galaxies

Principal Investigator: Munshi, Ferah

PI Institution: George Mason University

With the advent of new, fast radiative transfer solvers, the full cosmological history of dwarf galaxies can be simulated at high resolution. We propose to conduct a campaign of simulations with a novel, efficient method for radiative transfer to uncover the impact of radiation feedback on dwarf galaxies. We aim to answer three key questions by tying new simulations to HST observations: (1) How does radiation feedback change the star formation histories in dwarf galaxies? (2) How does radiation feedback change the DM response to SN feedback? (3) How does radiation feedback alter the baryon cycle and the state of the ISM & CGM? Our proposal will result in a publicly available database for the new simulations, which contains mock HST CMDs, simulated SFHs and mock CGM absorption maps available to both constrain both observations and future simulations.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17548
Program Title: Reanalysis of the core-collapse supernova rate at cosmic noon in the archival HST imaging

Principal Investigator: Chen, Wenlei

PI Institution: University of Minnesota - Twin Cities

Observations of galaxies show that the volumetric comic star-formation rate peaks at cosmic noon (redshift z~1-2). Since progenitors of core-collapse supernovae (CCSNe) are short-lived massive stars, the CCSN rate yield an independent measurement of the rate at which new massive stars (>8 solar masses) are formed. Hence, discoveries of CCSNe at z=1-2 provide an avenue to study star-formation history and the initial mass function at cosmic noon. The most extensive and reference analysis of the core-collapse SN rate at above z=1 was performed as part of the CLASH and CANDELS survey programs. The inferred CCSN rate was in tension with the expectation given the Madau & Dickinson (2014) star-formation history and a Milky Way upper-end initial mass function. However, the dust prior used in the CANDELS + CLASH SN analysis was not consistent with low-redshift measurements. Here we propose to reanalyze the archival CLASH + CANDELS programs to determine whether a dust prior consistent with observations of low-redshift SNe can resolve the apparent tension, or if evidence remains for an initial mass function at z=1-2 that is different from that of the Milky Way.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17549
Program Title: Predicting Dwarf Galaxy Evolution in Resolved Milky Way Halos

Principal Investigator: Wright, Anna

PI Institution: The Johns Hopkins University

We propose to run a new suite of high-resolution cosmological simulations optimized to study dwarf satellite galaxies as they interact with their hosts. Hubble has played a pivotal role in revealing the rich diversity of dwarf galaxies in the Local Group, with the key finding that the fraction of satellite galaxies that are quenched approaches 100% at low mass, a phenomenon rarely if ever seen in the field. This is known as 'environmental quenching'; the gas contents of satellite galaxies are modulated by their interactions with the larger host and its gas halo. However, evidence is mounting that Local Group dwarf galaxies are more commonly quenched relative to satellites of other nearby L* hosts. While cosmological zooms have addressed these issues, no simulation has yet achieved the fine mass and time resolution on which gas stripping occurs when it is seen directly in observations. We will implement novel techniques to focus computational resources on the dwarfs and the host halo through which they travel, rather than on the host's disk, allowing us to reach 10-100x gains in mass and time resolution for a large sample of simulated satellites. These simulations will allow us to track the main physical mechanisms - ram-pressure stripping/compression, heating from shocks, turbulence, and tidal forces - in sufficient detail to quantify their relative influence on the gas content and star formation of an accreting dwarf throughout its lifetime. We will release derived catalogs from these dwarf simulations so that other groups can test them against the observed star formation histories and quenched fractions of satellite populations in the Milky Way and nearby galaxies.

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17550
Program Title: Interpreting Age Gradients in Dwarf Galaxies

Principal Investigator: Brooks, Alyson

PI Institution: Rutgers the State University of New Jersey

Many dwarf galaxies appear to have "outside-in" age gradients, with the oldest stellar populations extending to the largest radii and younger stellar populations in the centers. In this proposal, we use the largest-ever simulated sample of dwarf galaxies to study the origin of age gradients in dwarfs across a range of mass, morphology, and environment. We demonstrate that the simulations reproduce observed age gradients in dwarf galaxies, and that they produce a diverse range of morphologies as a function of mass, as well as the observed trend in size-luminosity. We have identified a clear signature of age gradient variation as a function of star formation history. This signature is already being tested by archival HST resolved star observations. We will identify both the formation radius and final radius of every star particle, and disentangle re-shuffling of stars due to, e.g., mergers vs feedback mechanisms. A direct test of the theoretical age gradients against existing HST data has the potential to be a critical test of feedback, including the strength of the feedback model between different galaxy formation simulations. Thus, this theory work will both advance our understanding of the formation of observed dwarf galaxies, and a comparison against HST data will work to constrain galaxy formation models.

Proposal Category: AR
Scientific Category: Stellar Physics and Stellar Types
ID: 17551
Program Title: Unlocking the Stellar Treasure Trove: A Legacy Library of Stellar Hosts' Heterogeneities, Activity, and Spectral Contributions from HST Exoplanet Data

Principal Investigator: Rackham, Benjamin

PI Institution: Massachusetts Institute of Technology

Opening windows into the atmospheres of other worlds is undoubtedly among the most pivotal contributions to HST's scientific legacy. Exoplanetary transmission spectra have yielded insights into the their composition, temperatures, and pressures, providing a foundation for the new era of atmospheric characterization with JWST. However, it has recently become clear that host-star photospheric heterogeneities may limit the exoplanet legacy of HST - and even JWST - by giving rise to spectral features that mimic or mask those of planetary atmospheres, leading to erroneous inferences. Fortunately, the very same HST datasets provide exquisite out-of-transit stellar spectra that can be leveraged to mitigate this effect. While a few recent studies have shown the utility of studying out-of-transit HST stellar spectra, most remain untouched. Here we propose to thoroughly tap this stellar treasure trove via a large, uniform analysis of all 25,000 archival HST transit exposures to reveal the properties of hosts' photospheres. Through this analysis, we will establish an HST Legacy Library of time-dependent spectra of exoplanet host stars, constraints on their photospheric spectral components and covering fractions, and estimates of their spectral contributions to exoplanet transmission spectra. As Legacy Data Products, we will also release the tools we develop for the data reduction, stellar heterogeneity modeling, and transmission spectra corrections as open-source Python libraries. The insights and tools developed through this work will cement HST's legacy of revealing the properties of both exoplanets and their host stars and pave the way for future studies with both HST and JWST.

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17552
Program Title: Identifying X-ray Binaries with High-Mass Donor Stars in Nearby Spiral Galaxies

Principal Investigator: Chandar, Rupali

PI Institution: University of Toledo

X-ray binaries with high-mass (>8 solar) donors play a critical role in several high-stakes astrophysics questions, including the re-ionization of the universe and the nature of advanced-LIGO sources. Addressing these questions requires knowledge of high-mass X-ray binary (HMXB) demographics (their scaling with host SFR) and environments that are unattainable from current state-of-the-art studies of X-ray luminosity functions. We aim to produce the first homogeneous catalog of HMXBs by classifying bright, Chandra-detected X-ray point sources based on their optical counterparts in multi-band HST imaging. We focus on a sample of 8 nearby spiral galaxies with publicly available, high-fidelity compact cluster and OB association catalogs produced by the PHANGS-HST survey and complete Chandra Source Catalog coverage. The results of this investigation will enable us to address fundamental questions about HMXBs formation efficiency, age distribution, and natal kicks.

Proposal Category: AR
Scientific Category: Stellar Physics and Stellar Types
ID: 17553
Program Title: The Nature of a Newly Discovered Wolf-Rayet Binary: Archetype of Stripping?

Principal Investigator: Massey, Philip

PI Institution: Lowell Observatory

Understanding massive star evolution is important for a variety of astrophysical processes, from the formation of the elements to the generation of gravitational waves as their remnants merge. Wolf-Rayet (WR) stars are evolved stars, where the hydrogen has been removed from a massive OB star, and its nuclear burning products revealed at the surface. This stripping can occur either by stellar winds or by interactions in close binaries. Although we expect the latter to be an important mechanism, there are few examples where one can argue which mechanism has been responsible, as single WRs may have formed through binary interaction, but merged with its companion. Given the large number of massive stars in binaries, we expect stripped remnants to be common. Binary models suggest these should look like WRs, but they are curiously absent where we expect to find them. However, the recent discovery of a WR binary in the LMC matches many of the properties expected for a stripped binary WR. We have obtained extensive ground-based photometry and spectroscopy of this object, and have carried the analysis as far as it is possible. The WR component is of WN4-type, but with intrinsic hydrogen and helium absorption lines. The companion is an "impossible" star, with a sub-solar mass and radius but a very high temperature. We suggest that this is the result of an Algol-like system, with both components having been donors and recipients at some point. This could be the archetype of binary-produced WRs. ULLYSES obtained UV spectra of this star, and analysis of these data will allow us to determine CNO abundances, stellar wind properties, and other physical properties of this unique star.

Proposal Category: AR
Scientific Category: Large Scale Structure of the Universe
ID: 17554
Program Title: Galaxy Parallax Preparatory Science

Principal Investigator: Croft, Rupert

PI Institution: Carnegie Mellon University

The Earth's motion with respect to the cosmic microwave background frame means that galaxies outside the Milky Way will be subject to an ever-growing parallax shift, cosmic secular parallax. A measurement of this would be the first in the field of real-time cosmology (detection of changes in the Universe on human timescales). We propose to use multi epoch HST archival data to carry out extended source astrometry of 4434 galaxies with redshift z=0.05. The long lifetime of HST has allowed an amazing dataset to build up in the HLA, with these nearby galaxies observed for between 10 and 10000 times each, over a period of up to 32 years (the mean interval between epochs for our targets is 17.1 years). This baseline, combined with the tens of thousands of resolved elements per image and many images per galaxy will allow us to attempt measurements of the apparent proper motions due to cosmic parallax. We have developed an analysis pipeline, and tests on example galaxies reveal that the precision of WCS coordinates for absolute astrometry is at the 10 mas level. This should allow us to make detection of cosmic parallax, even at the current level of accuracy for absolute astrometry. We will also attempt over the course of the project to go further and carry out differential astrometry, making use of the multiple galaxies that are present in most frames. Preparatory science for the Roman Space telescope is also our goal.

Proposal Category: AR
Scientific Category: Stellar Physics and Stellar Types
ID: 17555
Program Title: The UV Future is Now: Tapping Hubble's UV Spectral Archive to Drive Current and Future Type Ia Supernova Science

Principal Investigator: DerKacy, James

PI Institution: Virginia Polytechnic Institute and State University

Type Ia supernovae (SNe Ia) are foundational objects in modern astronomy. The energy they release drives galactic evolution, the elements synthesized in their explosions enrich their surroundings, and their high intrinsic luminosities make them the most accurate cosmological distance indicators. Yet almost a century of in-depth study has failed to reveal the progenitor systems or explosion mechanisms of SNe Ia. Ultraviolet (UV) spectra are an under-utilized, but valuable resource to answer these lingering questions. UV spectra probe the outermost layers of the SN, where the differences produced by various explosion scenarios are largest, but are inaccessible at other wavelengths. HST's extensive archive of SNe Ia UV spectra, totaling more than 500 orbits and 281 individual spectra, has been severely under-used by studies analyzing the physics of SNe Ia. Here, we propose to use this archive to study the complete sample of HST UV spectral observations in order to catalog and characterize the observed diversity of SNe Ia in the UV, and connect spectral measurements back to the fundamental physics that drive UV spectral formation and SN Ia explosions. Previous UV spectroscopic population studies have only used ~10 objects and are too small to draw robust conclusions about the UV in SNe Ia. This study will serve as the foundation upon which rest-frame UV studies using Rubin/LSST, Roman, and JWST data will be built, and will ensure that the last years of Hubble's UV spectral capacity are maximized by the SN community in the pursuit of new discoveries with SNe Ia.

Proposal Category: AR
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17556
Program Title: Quasar outflows in the HST/UV archive: Measuring major contributors to AGN feedback

Principal Investigator: Arav, Nahum

PI Institution: Virginia Polytechnic Institute and State University

There has been major progress recently in the study of quasar absorption outflows and their potential contribution for AGN feedback. HST spectral observations of the 500A-1050A rest-frame (hereafter, EUV500) in medium redshift objects (z~1) uncovered a rich phenomenology of absorption troughs. The quality and quantity of EUV500 diagnostic troughs allow us to probe the very high ionization phase, which carries 90% or more of the outflowing material, as well as determine the distance of most outflows from the central source (R). The first objective is impossible to achieve with the thousands of available ground-based spectra, and R can be measured in only ~1% of them. The EUV500 effort yielded the most energetic outflows measured to date with enough kinetic luminosity to be major agents of AGN feedback processes. The HST spectral UV archive includes observations of more than 900 quasars. These observations were taken for studying intervening absorption systems, and quasar outflows detected in these spectra were rarely analyzed. WE PROPOSE an archive program to study the EUV500 outflows found in these spectra. Based on previous studies, we expect to find 20-30 very high ionization outflows (tripling the existing sample), and 10-15 outflows with measurable distance (doubling the existing sample).

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17557
Program Title: Mapping Localized, Feedback-Driven Outflows Across the Nearby, Low-Mass Galaxy Sextans A

Principal Investigator: Zheng, Yong

PI Institution: Rensselaer Polytechnic Institute

Stellar feedback is a multi-scale process that originates from individual star-formation sites and propagates through a galaxy's interstellar medium and into the circumgalactic medium. However, the delicate process of stellar feedback coupling to the gas within and around galaxies remains poorly understood. We propose a spatially resolved analysis of localized outflows down to ~pc scales in the nearby galaxy Sextans A using an unusually large sample of COS spectra of 8 massive O stars from the HST archive. The proximity and low inclination angle of Sextans A present a unique opportunity to quantify feedback efficiency in the low-mass, low-metallicity galaxy regime where this analysis has never before been possible. We will measure the physical properties of localized outflows in Sextans A (e.g., speed, ionization structure, outflow rate, and mass loading factor) and compare them with the galaxy's current and past star formation activity to construct a complete picture of how stellar feedback drives outflows on ~pc scales. This proposal will provide a timely constraint for galaxy formation simulations that aim to determine how feedback injection at local scales regulates star formation and drives large-scale outflows of gas and metals.

Proposal Category: AR
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17558
Program Title: Sulfur Vision! Refining our view of sulfur-containing UV opacities for exoplanet atmospheres

Principal Investigator: Hargreaves, Robert

PI Institution: Smithsonian Institution Astrophysical Observatory

While significant efforts have been made to provide molecular line lists at optical and infrared wavelengths, there is a critical gap in our knowledge of molecular opacities relevant to exoplanetary atmospheres, particularly at UV wavelengths. The lack of comprehensive UV line lists for many species and/or the absence of measured temperature-dependent opacities pose a significant threat to accurate interpretation of exoplanet atmospheres. This is particularly pressing for HST where nearly 300 orbits in Cycle 30 alone are devoted to MUV-NUV observations of transiting exoplanets. We propose to build a robust open-source accessible database of MUV-NUV opacities for a curated set of seven high-priority species that can be leveraged for the reproducible interpretation of past, current, and future HST UV exoplanet observations. We focus on seven sulfur-based species that: 1) are in dire need of higher fidelity opacities, 2) play an important role in the exoplanet atmospheric chemistry of hot gas giants, and 3) are expected to sculpt MUV-NUV HST observations of exoplanets. Ultimately, our work will be an asset the community and provide new methodology that can be further used to fill critical gaps in UV opacities relevant to exoplanet atmospheres.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17559
Program Title: Galactic Winds Unveiled: Leveraging Cloud Simulations with Radiative Transfer to Constrain Feedback

Principal Investigator: Henry, Alaina

PI Institution: Space Telescope Science Institute

Galactic winds, driven by intense star formation and supernova explosions, are crucial for regulating galaxy growth and evolution. However, the physics that governs these outflows remains uncertain, with open questions about whether they are primarily ejective, removing large amounts of mass, or preventive, heating circumgalactic gas to suppress further accretion. We propose a new method for constraining wind models using simulated galaxy spectra. We will model individual cool clouds as they interact with a hot wind, using high-resolution simulations that we will post-process with radiative transfer to build a library of mock absorption-line spectra. We will then combine these cloud spectra into galactic-scale outflows based on a flexible, physically consistent model. With this approach, we can explore how changes to physical parameters like the wind energy and mass loading, cloud sizes, and wind geometry impact the resulting spectrum. We will compare our mock spectra to observations of local star-forming galaxies obtained with the Cosmic Origins Spectrograph on the Hubble Space Telescope. By forward-modeling galactic winds and directly fitting their spectra, we aim to provide the most robust constraints to date on the physics of these multiphase outflows and their role in shaping galaxy evolution. Our method constitutes a new approach for understanding astrophysical phenomena through synthesis of theory and observation.

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17560
Program Title: Probing Patchy Reionization with Uniformly Measured Star Formation Histories of Ultra-Faint Dwarf Galaxies

Principal Investigator: Garling, Christopher

PI Institution: The University of Virginia

HST has been the premier observatory for deriving star formation histories (SFHs) based on resolved stars for the last two decades due to its unique combination of spatial resolution, photometric depth, and wavelength coverage. The resolved color-magnitude diagrams obtained by HST for the ultra-faint dwarf galaxies (M_V > -7; UFDs) of the Milky Way (MW) have indicated these galaxies were quenched around the epoch of reionization, making them fossil remnants of this important cosmological era. However, new SFH measurements of UFDs thought to have fallen into the MW's halo along with the Magellanic Clouds indicate that these UFDs may have been able to form stars for longer than those that were directly accreted onto the MW. This type of variation in SFH could be indicative of local differences in the ultraviolet radiation field during the epoch of reionization and therefore may provide an avenue for constraining models of inhomogeneous reionization. To enable these analyses, we propose to measure the SFHs of the 32 objects observed as part of HST Treasury Proposal 14734. These objects are primarily recently-discovered UFDs with no existing SFH measurements. We will perform a uniform analysis, enabling robust comparisons between SFHs within the sample. We will additionally use the few bright dwarfs in the sample with existing SFH measurements to constrain systematics (i.e., stellar model choice) and enable comparisons to other datasets. The Treasury data reach the oldest main sequence turnoff and were taken in the F606W and F814W filters, known as workhorses for resolved stellar populations -- the data are therefore supremely well-suited to our proposed goal.

Proposal Category: AR
Scientific Category: Stellar Physics and Stellar Types
ID: 17561
Program Title: The largest high angular resolution survey of ultracool dwarfs using the HST archive

Principal Investigator: Bardalez Gagliuffi, Daniella

PI Institution: Amherst College

We propose to leverage the HST archive in search for faint, close-in companions to all known ultracool dwarfs (UCD) previously imaged with HST with a post-processing technique. Our scientific goals are to (1) measure a robust close-in UCD multiplicity fraction at high angular resolution, (2) constrain the true peak of the UCD binary separation distribution, and (3) estimate the mass ratio distribution of the UCD population. To achieve unprecedented angular resolution The double-PSF technique has a proven record of detecting sub-pixel binaries, and it is adaptable and flexible across different instruments, pixel scales, and exposure times since it uses an empirical PSF from the image itself. Our proposal will effectively amount to be the largest high angular resolution survey ever carried out for UCD and revisit crucial measurements to piece together our understanding of brown dwarf formation.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17562
Program Title: The Spiral Galaxy Halo Gas Profile at z=0 and the Link to Satellite Quenching

Principal Investigator: Putman, Mary

PI Institution: Columbia University in the City of New York

The circumgalactic medium (CGM) of a galaxy is baryon and metal rich and extends out to its virial radius. Satellite galaxies must move through this halo medium as they orbit the galaxy, and can be quenched as their gas is stripped by the host's CGM. We have identified a sample of 25 spiral galaxies within 15 Mpc for which the properties of the gaseous baryons in their dark matter halos can be measured. 26 G130M and 17 G160M COS archival spectra pass through the virial radii of the halos and cover the entire range of impact radii. The COS observations will be combined to create a generic z=0 spiral galaxy CGM profile to compare to the Milky Way, M31 and other samples. This will help us understand what dictates the CGM properties and the deficit of CGM baryons found for the Milky Way. This local spiral galaxy sample was selected so that 60% of the spirals have their satellite population quantified and the rest will have their satellite population surveyed during the proposal period. The relationship of the CGM to the satellite population will inform galaxy evolution models of galaxy quenching via ram pressure stripping.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17563
Program Title: ArchExtract: Maximizing Hubble's Archival Legacy of Slitless Spectroscopy

Principal Investigator: Ryan, Russell

PI Institution: Space Telescope Science Institute

We propose a comprehensive (re-)analysis of the complete canon of Archival grism observations obtained with ACS/WFC (G800L) and WFC3/IR (G102 and G141) having multiple position angles. We will show that by employing modernized extraction algorithms and calibration methods/data (e.g. time-variable sky background estimates) the signal-to-noise and spectral resolution of the grism data (that have multiple position angles) can be improved by factors of up to 50%, but possibly exceeding this for select fields and source geometries. After a careful survey of the MAST Archive, we have identified 249 fields with multiple position angles, which are composed of ~8100 independent exposures constituting ~6.8 megaseconds (~2500 orbits) of HST time. The significant improvements in signal-to-noise and spectral resolution come simply from improved extraction techniques, but the homogeneous reprocessing of this enormous dataset have an invaluable legacy value to the Archive. Although every science topic that make use of grism observations will be enhanced by our reprocessing, we have identified several classes of astrophysical sources where the improvements will have an immediate impact: low-luminosity AGN, extreme-emission line galaxies, high-redshift galaxies, dusty galaxies at intermediate redshifts, and single/multi AGN. As with all Archival Legacy programs, we will deliver our data products (one-dimensional spectra, direct-image mosaics, and source catalogs) to MAST and publish/document our software/pipeline on GitHub, Zenodo, and refereed journals (as appropriate) on a timely basis.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17564
Program Title: The Best of Both Worlds: Bringing HST Resolution to SDSS Statistical Samples for the Study of Galaxy Quenching

Principal Investigator: Salim, Samir

PI Institution: Indiana University System

We will produce an HST/SDSS Atlas and Morphological Catalog of 7000 SDSS galaxies serendipitously imaged by HST and study a subset of 2000 galaxies at z<0.3 to elucidate the morphological transformation associated with star formation quenching. SDSS in conjunction with GALEX has revealed the different stages of galaxy evolution from star-forming to transitional to quenched. However, limits in resolution and depth prevent a full accounting of features like bars, rings, faint arms and merger signatures, leading to an overly simplified picture of late- to early-type transition as one from spiral-arm dominated disks to pure spheroids. An incomplete census of galaxy substructure as well as the imprecision in structural parameter estimation from ground-based images directly affects our understanding of quenching. To address these limitations while taking full advantage of SDSS's statistical power and the wealth of ancillary data, we will perform a large-scale optical study of HST/SDSS galaxies spanning the full range of activity from star-forming to quenched. We will lift the veil from ostensibly featureless galaxies, robustly quantify and qualify internal structure using various morphology software tools, and map the morphological transition from late- to early-type at resolutions 10x better than available from the ground. Combining HST-based morphologies with SDSS ancillary data, the relative importance of different quenching mechanisms will be constrained. The HST/SDSS Atlas & Morphological Catalog will also provide legacy value for a wide variety of studies that would benefit from the combination of the SDSS's statistical power and the HST's resolving power and sensitivity.

Proposal Category: AR
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17565
Program Title: HST+JWST: An Archival Survey of Variability-Selected Faint AGN at z=5-7

Principal Investigator: Tee, Wei Leong

PI Institution: University of Arizona

Recent JWST observations show that frequent AGN activities among high-redshift galaxies, further suggest strong connection between supermassive black hole (SMBH) growth and galaxy formation in the early universe. However, AGN selections in current deep surveys are highly incomplete due to both flux limit and color selection effects. Variability is an ubiquitous signature of AGN activity and has shown to be a powerful tool in AGN discovery acrros all redshift and luminosity. We propose to conduct a HST archival program to search for variable sources in deep field areas that have been observed in near-IR wavelengths with both HST and JWST Cycle-1 observations. These observations, covering a total area of 2500 squared degree, will sample the rest-frame UV wavelengths with an average time lag of seven years beteween HST and JWST observations, ideal for AGN variability search. We will search for variable sources using a combination of PSF matched photometry, SED fitting and imaging subtraction techniques. This archival program will focus on low-luminosity AGN in high-redshift galaxies, and we expect to find ~200 faint variable AGNs (m<27) at z=5-7 with high completeness. This will be the first variability selected faint high-redshift AGN sample. It will provide independent measurements of the faint end of AGN luminosity function, characterize the evolution of SMBH accretion activities by studying redshift dependence of variability, and uncover the relationship between AGN activities and their host galaxies in the early Universe.

Proposal Category: AR
Scientific Category: Solar System Astronomy
ID: 17566
Program Title: Deepest high-inclination pencil-beam survey for Trans-Neptunian objects

Principal Investigator: Burdanov, Artem

PI Institution: Massachusetts Institute of Technology

Observing small and distant TNOs poses a significant challenge owing to their faintness. To date, the deepest searches have been performed using dedicated HST programs reaching as deep as R=28. Searches have however been confined to pointings close to the ecliptic, up to inclinations of +-20 deg. Here, we propose to leverage our GPU-based shift-and-stack pipeline to mine the Hubble Ultra Deep Field data expanding previous studies in two ways. First, by becoming sensitive to objects 2 magnitudes fainter, objects which should be ~3 times more abundant. Second, by probing a higher inclination ~45 deg thereby providing new constraints on the inclination distribution of distant TNOs. In addition, our analysis will provide color constraints, helping disentangle between evolution theories (collision vs early formation).

Proposal Category: AR
Scientific Category: Solar System Astronomy
ID: 17567
Program Title: Mapping a new mid-UV absorption feature on Ganymede

Principal Investigator: Molyneux, Pippa

PI Institution: Southwest Research Institute

On 7 June 2021, NASA's Juno spacecraft flew over Ganymede's leading and sub-Jovian hemispheres with a closest approach altitude of 1046 km. During the flyby period, Ganymede's auroral emissions and surface reflectance were observed by the Juno-UVS instrument, which detected an absorption feature in the high latitudes at wavelengths longward of 190 nm. Since only part of this feature fell within the 68 - 210 nm Juno-UVS bandpass it was difficult to confidently identify the material responsible for the absorption, but Molyneux et al. (2022) [doi:10.1029/2022GL099532] suggested it may be the beginning of a known ozone absorption centered at 260 nm. However, a quick look at archival STIS G230L observations of the same surface regions indicates that this interpretation is incorrect and the feature observed by Juno-UVS is instead the start of a previously unknown ~190 - 240 nm absorption. In this proposed Archival Research program, we request funding to map the >190 nm absorption across the entirety of Ganymede's surface using STIS G230L data from Programs 7317 (Cycle 7) and 15925 (Cycle 27). Our proposed program will constrain the identity of the absorber, aid with the planning and interpretation of future observations by ESA's JUICE mission, and inform searches for related materials both on Ganymede and on other icy moons.

Proposal Category: AR
Scientific Category: Large Scale Structure of the Universe
ID: 17568
Program Title: Unveiling the connection between gas flows around galaxies and the cosmic web using QSO spectra

Principal Investigator: Hasan, Farhanul

PI Institution: New Mexico State University

The evolution of galaxies is driven by the flow of gas into and out of them, but how this process is connected to the diffuse gas in the large-scale cosmic web is poorly understood. QSO absorption lines can probe the gas in both the local and global surroundings of galaxies. We propose to leverage >770 archival QSO spectra observed with HST/COS to probe the filamentary gas in the cosmic web and study its impact on galaxy evolution. We will utilize 3D cosmic matter density fields reconstructed by the novel slime mold-inspired Monte Carlo Physarum Machine (MCPM) model using >600,000 SDSS DR17 galaxies at z<=0.5. These density fields will be fed into the DisPerSE cosmic web framework to extract the most detailed filament catalogs of the observed low-redshift universe to date. Using HST/COS QSO lines-of-sight, we will probe gas in different cosmic web environments characterized by matter density and distance to nearest filament, from dense filament cores to outskirts to voids. We will stack the spectra to measure average absorption signal in HI Lya and metals with respect to the cosmic web environment. We will also identify individual HI absorbers and measure their absorption strengths (equivalent width) and kinematics (velocity width) as functions of the cosmic environment. We aim to quantify the relationship between gas absorption strength and kinematics with specific star formation rate and gas mass of nearby galaxies in different cosmic environments. The key goals of our analysis are to 1) measure the change in gas properties from dense to diffuse cosmic environments, and 2) understand how these gas properties impact the gas flows onto galaxies at much smaller scales.

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17569
Program Title: Tracing the Origin of High-Velocity Clouds with UV Dust Depletions

Principal Investigator: Cashman, Frances

PI Institution: Space Telescope Science Institute

The halo of the Milky Way is home to numerous high-velocity cloud (HVC) complexes of uncertain origin. HVCs are multi-phase and trace a considerable mass flow rate onto and away from the Galaxy. Although multiple studies have attempted to determine the origin of these clouds based on their gas-phase metallicities and kinematics, no single model is able to explain the entire population. Here we propose a systematic analysis of another key property of HVCs -- their dust content. Dust is a separate and crucial piece of information on HVC origin. The presence of dust indicates the cloud has been (at least partly) processed through star formation, allowing us to rule out certain origin models, such as condensation of coronal gas and inflow of purely extragalactic gas. Outside of the Magellanic System, dust has only been found in 2 HVC complexes. We propose an archival program to determine the UV depletion of Si, Al, and Fe in 8 HVC complexes using COS G130M/G160M & STIS E140M spectra of 18 background AGN. If dust is present, this analysis would triple the number of clouds with measured UV dust depletions (from 4 to 12), thus significantly advancing our understanding of HVC chemistry and origin.

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17570
Program Title: A Novel Descriptive Parametric Model of Gaseous Atmospheres

Principal Investigator: Oppenheimer, Benjamin

PI Institution: University of Colorado at Boulder

We propose the creation of a descriptive parametric model for the circumgalactic medium (CGM) based on multi-waveband observations, centralized on Hubble's UV capabilities and extending to new probes observing the warm-hot gas phase around galaxies for the first time. Large databases of UV data measuring cool 10^4 K phase embedded in an "atmosphere" observed via high ionization UV lines now exist. These CGM measurements from Hubble are now being complemented by probes of the hotter CGM, including Fast Radio Bursts, Sunyaev-Zel'dovich detections, and X-ray emission. The novelty of our proposed model will be its flexible integration of multi-wavelength, multi-platform observations into a Bayesian framework for error propagation and parameter estimation. Conservative error propagation is essential for this model to return realistic profiles and their uncertainties. The accelerated timeframe upon which the model will be built and disseminated to the community is driven by its capability to generate easily usable models and even predictions for new observing endeavors. The base model is built upon observations of L* halos in the low-redshift Universe. However, the ultimate use will be a unified model that extends up to massive groups and back in time to redshift of one. The descriptive parametric model is built explicitly to 1) avoid rely on any single theoretical assumption and 2) to provide flexibility beyond cosmological simulations that are shown to fail to reproduce well-observed halo profiles.

Proposal Category: AR
Scientific Category: Stellar Physics and Stellar Types
ID: 17571
Program Title: PSF-DASH: The IMF to Planetary Masses via a New Forward-Modeling Analysis of DASH Mosaics

Principal Investigator: Kraus, Adam

PI Institution: University of Texas at Austin

The IMF is foundational to large swaths of astrophysics and offers a fundamental test of star formation models. There are strong theoretical arguments, and a growing number of observational clues, that the IMF should vary as a function of environment. These variations should be strongest at the high-mass and low-mass extremes, including the production of planetary-mass brown dwarfs (<15 MJup), but this remains untested since only modest numbers of planetary-mass BDs have been found, mostly in sparse nearby populations. HST has taken wide-field mosaics in five much denser and more massive clusters using WFC3-IR in Drift-and-SHift ("DASH") mode to completely encompass their entire spatial extent, and using multicolor imaging (F110W, F160W, and F139M) to distinguish young brown dwarfs from reddened field interlopers via water absorption in F139M. However, detection limits in these mosaics are currently >20 MJup due to a severe readnoise penalty inherent to the standard DASH analysis method. We propose to develop and publicly release a new method of analyzing WFC3-IR DASH images: PSF-DASH, which forward-models directly into drifting datacubes in order to optimally mitigate readnoise. This method will extend DASH surveys up to 1.5 magnitudes deeper, achieving a sensitivity boost that would be observationally prohibitive. We will then apply PSF-DASH to archival observations of these 5 clusters, identifying cluster members well into the planetary-mass regime (5-8 MJup), quantifying the slope/normalization/cutoff of the low extreme of the IMF, identifying IMF variations in comparison to local sparse associations, and selecting robust samples for JWST spectroscopic followup.

Proposal Category: AR
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17572
Program Title: A comprehensive survey of where stars explode in the interstellar medium

Principal Investigator: Sarbadhicary, Sumit

PI Institution: The Ohio State University

To address one of the most important but poorly constrained aspects of stellar feedback in galaxies, we propose to use existing HST multiband photometry of 38 nearby star-forming galaxies to create a major new catalog of red supergiant (RSG) stars, which represent the likely progenitors of core collapse supernovae (SNe). We will compare the locations of RSGs to public, high quality ALMA and JWST maps to trace the local interstellar medium (ISM) structure, and make by far the most complete observational assessment of the ISM density into which SNe explode in galaxies. This is necessary because SN feedback plays a major role in galaxy formation, producing metals, driving outflows and turbulence, heating gas, and destroying clouds, but the precise impact of the explosions depend very sensitively on the ambient gas density into which the SNe explode, and observational constraints on these densities remain incredibly scarce because SNe are rare. By measuring the gaseous environments of thousands of future SNe across a large set of incredibly well-studied local galaxies, this proposal will yield by far the largest sample of ISM measurements at likely SN explosion sites ever assembled. All of the critical data for this project are public and observed, and the output will be the largest catalog of RSGs assembled for local galaxies, measurements of the ISM at the site of each RSG, and a major new assessment of how these SN ISM environments depends on host galaxy and location within the galaxy. The results will serve as key benchmarks for numerical studies of star formation, galaxies, and the ISM, and will have profound implications for our understanding of galaxy evolution.

Proposal Category: AR
Scientific Category: Solar System Astronomy
ID: 17573
Program Title: An archival search for faint Trans-Neptunian Objects

Principal Investigator: Morgan, Anatasia

PI Institution: Northern Arizona University

Trans-Neptunian objects (TNOs) are a diverse population of small icy bodies that orbit the Sun beyond the orbit of Neptune, in the outer reaches of the Solar System. These objects are thought to be remnants from the early stages of the Solar System's development and hold valuable clues about its history and ongoing evolution. The distribution of physical properties of TNOs - colors, orbits, binarity - provide clues to understanding the history of the outer Solar System. We propose to search archival WFC3 and ACS data generated since 2009 to discover ~150 TNOs with equivalent V magnitude of at least 27. These objects will be at all ecliptic latitudes. Our measurement of the size distribution of the excited TNO population will provide strong constraints on the dynamical evolution of the outer Solar System.
