Proposal Category: SNAP
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17696
Program Title: Can NUV Flares Kickstart Prebiotic Chemical Chains on M Dwarf Planets?

Principal Investigator: France, Kevin

PI Institution: University of Colorado at Boulder

Recent laboratory experiments have identified prebiotic chemical chains driven by NUV photons (200 - 300 nm) that can produce the nucleotides, amino acids, and lipid precursors required to form RNA. On potentially habitable planets, these NUV photons are delivered by the host star, suggesting that the stellar NUV irradiance is a key ingredient for the development of an Earth-like biosphere. Of immediate astrobiological interest are rocky planets orbiting M dwarfs, which are likely our only opportunity to search for atmospheric signs of life in the next 20 years. However, it has been demonstrated that the quiescent NUV flux from M dwarfs is insufficient to initiate this prebioetic cycle, primarily because their cool photospheres do not provide the necessary NUV luminosity to initiate these photochemical reactions. Alternative paths to RNA precursors, where bio-activation proceeds during periods of intense NUV flaring, have been suggested, but the flare behavior of M dwarfs over the full NUV spectral range is poorly constrained by both observation and theory. We propose to measure the NUV flare characteristics of M dwarfs and assess if temporal variability provides sufficient flux to catalyze these chemical reactions. The proposed STIS SNAP program will 1) measure the NUV flare frequency and amplitude distribution of a carefully selected sample of M dwarfs with a range of ages and 2) combine the quiescent and flare data to determine if stellar flares and variability raise the average NUV flux from M dwarfs to the experimental threshold for initiating prebiotic chemical chains on temperate, rocky planets.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17697
Program Title: A far-UV treasury survey for hot subdwarf stars

Principal Investigator: Dorsch, Matti

PI Institution: Universitat Potsdam

While 95% of all stars will eventually become white dwarfs, their paths to this endpoint are diverse. This is most evident in the population of hot subdwarf stars: mostly helium-core stars that lack any hydrogen envelope. They occupy the HRD region between the main sequence and white dwarfs, covering a vast temperature (10kK to 100kK) and luminosity range (1 to 10^4 times solar). Besides canonical post-AGB evolution, they are formed by close binary evolution with mass transfer, common envelope episodes, and mergers. Their peculiar chemical compositions, magnetism, and stellar winds allow us to test nucleosynthesis and atomic diffusion calculations. Several subdwarf binaries have orbital periods <1h and some are among the best candidates for the progenitors of supernovae Ia and qualify as calibration sources for gravitational wave detectors like LISA. Links between the subclasses of hot subdwarfs can only be understood by detailed far-UV abundance studies, because most metals become accessible only through their UV lines. We have designed a sample of prototypical hot subdwarfs to cover all types and phenomena with FUV spectroscopy with STIS/COS. They will be used to: (1) Identify stars formed by merger channels, as well as stable and unstable Roche lobe overflow evolution, and thus constrain binary evolution in general. (2) Obtain observational constraints to test theoretical nucleosynthesis, atomic diffusion, stellar wind, and evolutionary model calculations. (3) Construct a legacy sample of high-quality spectra covering this uncharted territory in stellar evolution, which provides templates for stellar population studies and atomic physics.

Proposal Category: SNAP
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17698
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: 17699
Program Title: Can Lyman-alpha transits quantitatively test atmospheric escape models?

Principal Investigator: Schreyer, Ethan

PI Institution: University of California - Santa Cruz

The loss of sub Neptune H/He envelopes is believed to be a key mechanism for forming super Earths and producing the bimodal radius distribution of small planets. The two leading hypotheses, photoevaporation (PE) and core powered mass loss (CPML), both produce results consistent with the observed exoplanet population, yet imply dramatically different atmospheric histories of small planets. Thus, escape models need to be validated with direct observations. Recently, it has been suggested that Lyman-alpha tail lengths provide such a test. Before they can be used to analyze escape processes across a large population of planets, these tail models must be validated. In this framework, the Lyman-alpha tail length decreases with increasing EUV flux. We will test this hypothesis by extending the range of EUV flux probed by full-duration Lyman-alpha transits with an additional planet.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17700
Program Title: Separating Accretion and Magnetic Activity in Young Brown Dwarfs

Principal Investigator: Johns-Krull, Christopher

PI Institution: Rice University

Several recent studies have begun to explore accretion physics on planetary mass objects orbiting young stars; however, many of these studies highlight uncertainties in the accretion models used to interpret the observations. The models have been developed and calibrated for stellar accretion. Do they apply to planetary mass objects? Young brown dwarfs provide a natural bridge for connecting accretion studies from stars down to planetary mass obejcts. A key difficulty in diagnosing excess emission produced by accretion is to properly account for emission produced by magnetic activity. This is particularly true for line emission. We will study the FUV and blue optical emission of a sample of a dozen young brown dwarfs spanning the mass range from near the stellar limit down to near the planetary mass limit. Half of our sources show evidence for accretion while half do not. We will use these data to separate out the role of accretion and magnetic activity in producing the observed excess emission in order to test the applicability of models of stellar accretion to very low mass objects such as young giant planets.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17701
Program Title: Confirming Onion-Shell Accretion in T Tauri Stars

Principal Investigator: Thanathibodee, Thanawuth

PI Institution: Boston University

Accretion from disks onto low-mass, pre-main sequence stars (T Tauri stars) is an important process in star and planet formation. Close-in, rocky planets form in an environment affected by magnetospheric accretion in T Tauri disks. Numerical simulations have been used to study this dynamic process, confirming key observable results. In recent years, advances in numerical methods and increases in computational power have enabled detailed studies of accretion by simulating the interaction between the star, its magnetosphere, and an MRI-active inner disk. New simulations suggest the existence of inner filaments, where mass proceeds horizontally and accretes onto the star in an onion-shell-like structure. Observational evidence of such a structure exists as a low-velocity redshifted absorption feature in the H-alpha profiles of T Tauri stars accreting at very low rates, but an independent verification is required. Here, we propose to confirm onion-shell accretion in five low accretors with joint HST/STIS and Gemini/GHOST observations. Modeling the accretion shock emission can help to distinguish between models with inner filaments and models where accretion occurs strictly through high-latitude flows. Our results will provide insight into young stars' immediate environment -- a region crucial for close-in planet formation.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17702
Program Title: Exploring the unexpected interplay between Lyman-alpha and C IV emission using spatially resolved imaging

Principal Investigator: Gazagnes, Simon

PI Institution: University of Texas at Austin

The synergy between Lyman-alpha and C IV 1548,50A is among our most promising UV diagnostics for understanding the escape of ionizing photons across all energy levels. Lya probes the properties of low-ionization gas (~13.6 eV), while C IV probes higher-energy levels (>54 eV), corresponding to photons capable of ionizing two hydrogen atoms each. Notably, both HST and JWST observations have uncovered targets with significant C IV emissions in galaxies at redshifts around 5--11. Thus, to disentangle the role of star-forming galaxies in the overall ionizing budget across various energy levels, our models must reproduce both the Lya and C IV emissions. Recent low-z observations of C IV and Lya emitters have revealed intriguing trends: galaxies with substantial C IV emission tend to exhibit larger damped Lyman-alpha absorption, whereas those with prominent Lya emission often display weak or no C IV absorption. This contrasting behavior challenges our current understanding of the interplay between hard ionizing fields and the escape of ionizing photons. It suggests that galaxies with hard ionizing sources may not significantly contribute to reionization due to being embedded in large opaque H I clouds. Here, we propose 25 orbits of HST ACS/SBC observations to spatially resolve the Lya, C IV, and UV emission in a sample of 8 star-forming galaxies at a redshift ~ 0. Four galaxies exhibit strong C IV emission and damped Lya absorption and four have weak C IV emission and dominant Lya emission. The requested observations are essential for improving our understanding of the Lya and C IV synergy and determining the contribution of C IV emitting galaxies to reionization.

Proposal Category: GO (GO-Archival)
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17703
Program Title: STIS-ISM: STIS ISM Survey in the Milky Way

Principal Investigator: De Cia, Annalisa

PI Institution: European Southern Observatory (ESO)

The Interstellar Medium (ISM) is key to the chemical evolution of our Galaxy. Until recently, the metallicity of the neutral ISM could not be measured and was assumed to be perfectly mixed, motivated by Galactic rotation. Today, the chemical properties of the neutral ISM are hotly debated, with some papers claiming the presence of low-metallicity gas due to gas infall on the disk and others measuring solar-metallicity gas, independent of galactocentric distance. Above all, the complexity of the chemical properties of the ISM is becoming striking. About half of the abundance patterns show deviations from the norm, likely caused by the superposition along the sightline of multiple ISM 'clouds' with different chemical properties (metallicity and/or depletion of metals into dust). STIS-ISM aims at observing OB stars in the Galaxy with the main scientific goals of: 1) Measure the cloud-to-cloud variations of metallicity in the neutral ISM along 20 sightlines. This requires highest-resolution spectroscopy covering different metals and we build a dedicated sample to complement existing archival data. The metallicity dispersion has an impact on phenomena related to gas mixing in galaxies. 2) Measure the metallicity gradient in the neutral ISM. This requires mid-resolution spectra of targets at large Galactocentric distances, currently limited to a dozen targets. STIS-ISM will study the ISM along 39 Gaia targets at > 9 kpc from the Galactic Center, an uncharted territory. We will also study the stellar metallicities and compare with the gas. STIS-ISM will leave behind an unparalleled UV legacy, as the high resolution of the STIS spectra will remain unmatched for decades to come.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17704
Program Title: Mapping the iron abundances and winds of the OB population across the Magellanic Bridge

Principal Investigator: Sander, Andreas

PI Institution: Astronomisches Rechen-Institut Heidelberg

The study of massive stars (M > 8 Msol) in low-metallicity (low-Z) environments is crucial for understanding their role in galaxy formation and chemical enrichment during the early high-redshift Universe. However, empirical data of stars in environments with metallicities lower than in the Small Magellanic Cloud (SMC, ZSMC ~ 0.2Zsol) are scarce. Our proposal addresses this gap by conducting the first comprehensive spectroscopic UV analysis of the OB population in the Magellanic Bridge, a unique nearby laboratory with sub-SMC metallicity (Z~0.1Zsol). Leveraging HST's unique capability to observe iron lines of hot stars in the UV, we will systematically measure the iron abundances of the OB stars to identify the most iron-poor massive stars, the best resolvable analogues to massive stars in the early Universe. Covering 21 targets, our study has the potential to at least triple the population of known OB stars with sub-SMC iron abundance. The proposed data will enable us to constrain stellar evolution models, mass-loss rates, and feedback at low Z. In addition, the UV spectra will give a unique handle to identify possible hot, envelope-stripped companions of our sample stars and thereby enhance our understanding of binary interaction in low-Z environments. Mapping the abundances of early-type stars across the Bridge will further provide crucial insights into the chemical enrichment history of the Magellanic Bridge.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17705
Program Title: UV STIS Spectroscopy of the MgII nebula around Eta Carinae

Principal Investigator: Smith, Nathan

PI Institution: University of Arizona

This proposal seeks to obtain deep STIS spectra of the extended ultraviolet Mg II emission recently discovered around the supermassive star Eta Carinae, with the longslit oriented across the flow direction, in both poles of the bipolar Homunculus Nebula. This will measure the expansion speed and velocity dispersion of this warm neutral gas, which will be combined with published proper-motion measurements to determine its tilt angle and deprojected outflow speed, and thus the 3D outflow structure. While density and mass-loss rate from Mg II emission alone are uncertain, spatially resolved velocity structure can be translated to approximate relative density and outflow speed as a function of latitude. These provide a unique probe of the radius, surface gravity, temperature, and rotation rate of the star that launched this wind. This is critical information for piecing together the physical properties of the unstable LBV star in the decades leading up to its eruption, and vital for constraining the physical interaction if it was a stellar merger event. LBVs more generally are hypothesized to be the products of mass transfer and mergers, but Eta Car is the only one for which this detailed pre-eruption information can be derived observationally. Understanding outer material into which ejecta expand is critical for the extended Eta Car system and hydrodynamics of bipolar nebulae more generally.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17706
Program Title: Finding Supernova Progenitor Stars in HST and JWST Imaging

Principal Investigator: Kilpatrick, Charles

PI Institution: Northwestern University

Many open questions in supernova (SN) physics rely on the connection between SNe and their progenitor stars. HST and now JWST provide a vast imaging archive of galaxies in the local Universe in which individual supernova progenitor stars can be isolated soon after they explode. Each new such event is a rare and unique opportunity in which we can compare a supernova explosion to the mass, metallicity, and local environments of the star that exploded. In many cases however, it is only possible to isolate the supernova progenitor star with high-resolution imaging follow up where local astrometric calibrators can be used to precisely align the supernova position with <0.1 arcsec precision. When adaptive optics imaging is not possible due to a lack of available guide stars, HST is the best available resource to obtain such follow-up imaging of the supernova. We propose a target-of-opportunity program to obtain such imaging with HST for 2 nearby (<40 Mpc) supernova targets during Cycle 32 that have pre-explosion HST or JWST imaging and precisely isolate the progenitor systems of these stellar explosions.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17707
Program Title: Mutual events of Transneptunian Binaries

Principal Investigator: Proudfoot, Benjamin

PI Institution: University of Central Florida Board of Trustees

The population of transneptunian objects (TNOs) is a key tracer of the early solar system's formation and evolution. By looking at the binaries within the TNO population, convincing evidence of planetesimal formation by the Streaming Instability has been found. Further study of these bodies is sure to reveal more insights into the earliest moments of our solar system. One ideal way to study binaries at unprecedented resolution is to observe mutual events, periodic dimming events where one binary component occults/eclipses another. Currently, four TNO binaries are (or will soon be) undergoing mutual events. In this proposal, we ask for 8 orbits to precisely determine the times of these mutual events. Current event timing uncertainties are >24 hours, and are impossible to use for planning observations. Our proposed observations will reduce uncertainties to <4 hours, allowing for precise observations from ground-based telescopes. We will also use state-of-the-art non-Keplerian orbit fitting techniques which will allow for far better predictions. Capturing mutual events will provide immense opportunity for discovery, and are impossible without our proposed observations.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17708
Program Title: The Black Hole Mass - Stellar Mass Relation with Reverberation Mapping AGNs at 1<z<1.8

Principal Investigator: Shen, Yue

PI Institution: University of Illinois at Urbana - Champaign

Scaling relations between supermassive black hole (SMBH) mass and host galaxy stellar properties measured in the local universe are the cornerstone for the prevailing picture of co-evolution of SMBHs and galaxies. Testing co-evolution scenarios, however, requires measurements of these correlations as a function of lookback time. Beyond the nearby universe, both the SMBH mass and the stellar properties of the host are challenging to measure. So far, there is no definitive evidence of such correlations at z>1. JWST observations are starting to measure host galaxy properties for AGNs at z>6, revealing a surprising population of over-massive black holes relative to their hosts. However, without robust measurements of these scaling relations at intermediate redshifts, it is difficult to assess the significance of these z>6 results and their broad implications for SMBH seeding scenarios at cosmic dawn. This proposal aims to measure the Mbh-Mstar relation at 1<z<1.8 for a sample of 40 broad-line AGNs with direct reverberation mapping black hole masses. With 3-band HST WFC3 (UVIS+IR) imaging, this program will decompose the nuclear AGN light and host starlight to measure the host stellar population. The sample covers two orders of magnitude in black hole mass, has ample multi-wavelength data already, and is best-suited for HST imaging observations to constrain the host stellar masses in this redshift regime. By measuring the Mbh-Mstar relation (as well as its intrinsic scatter) up to z~2 and comparing with z<1 results, this program will fill this redshift gap and significantly advance the study of SMBH-galaxy co-evolution, and pave the way for JWST studies at higher redshifts.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17709
Program Title: Measuring Lyman-alpha Propagation in Planet-Forming Circumstellar Disks

Principal Investigator: Arulanantham, Nicole

PI Institution: Space Telescope Science Institute

Lyman-alpha emission makes up ~88% of the total FUV flux irradiating the circumstellar gas disks surrounding young stellar objects (YSOs). Radio and infrared observations along with advanced physical-chemical models indicate that the FUV radiation fields play a critical role in regulating the abundances and spatial distributions of water and organic molecules in disk regions where planet formation is ongoing. We propose to use the G140M mode on STIS to spectrally image resonantly scattered Lyman-alpha in a sample of six systems. The spatial coverage provided by this novel dataset, combined with 3-D radiative transfer models, will allow us to: 1) Measure the radial propagation of Lyman-alpha photons through the disks and winds; 2) Isolate the contribution of scattered flux from the disks alone, to measure the total radiation available to catalyze photochemistry; and 3) Constrain the spatial extents and opening angles of stellar and/or disk winds, which contribute the largest component of scattered flux. This technique has so far only been applied to TW Hya, a face-on disk with three prominent gaps in its dust continuum emission. The targets in our sample span disk inclinations from 20-88 degrees and have dust gaps, spiral arms, and dust clumps and traps, allowing us to further explore the propagation of Lyman-alpha photons in asymmetric and dust-free disk environments. These results will provide new UV information that is required to analyze increasingly deep, spatially resolved data from ALMA and ongoing observations of warm molecular gas with JWST.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17710
Program Title: Establishing quasar-host scaling relations with strong gravitational lensing

Principal Investigator: Millon, Martin

PI Institution: Stanford University

We aim to characterize the evolution of the supermassive black hole - host galaxy correlations using the unique power of strong gravitational lensing. We employ a pioneering technique that leverages strong gravitational lensing by quasars to probe the SMBH mass-galaxy mass relation at intermediate redshift. Our proposal seeks to potentially triple the number of known quasars acting as gravitational lenses. With HST's superior spatial resolution, we aim to detect faint Einstein rings hidden in the glare of 10 carefully selected quasars. The mass modelling of these lenses will provide highly precise measurements (<5%) of the host galaxy's mass. Our findings will offer crucial insights into galaxy evolution scenarios, help resolving current controversies in the evolution of the scaling relations with redshift, and be a precious benchmark for cosmological simulations.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17711
Program Title: Imaging a Giant Intragroup Filament associated with a Damped Lyman-alpha System

Principal Investigator: Howk, Jay

PI Institution: University of Notre Dame

Streams of gas in dark matter halos are critical to galaxy evolution, as they bring matter into halos (accretion) and carry matter out (outflows), while "intergalactic transfer" from satellites and group members can be important for building up the gas mass of galaxies. Such streams may be responsible for a significant number of the metal-enriched QSO absorption lines used to study circumgalactic gas. We propose to study a giant (~100 kpc) intragroup filament identified through its association with a z=0.31 damped Lyman-alpha (DLA) system. The filament overlaps the background AGN and shares kinematics with the DLA gas. Thus this structure gives us the opportunity to directly image the gas giving rise to a damped absorber. We will obtain ACS/SBC imaging to study the spatial distribution and intensity of Lyman-alpha emission from this filament+DLA, constructing a synthetic narrow band filter through difference imaging in two ACS longpass filters. This will allow us for the first time to image the *gas* of a DLA and assess the processes that form and energize it. We will obtain a COS FUV spectrum of the background AGN to precisely measure the metallicity of the gas, search for H2 absorption associated with this very high column density system, and probe its physical properties (density, temperature, ionization). This filament is one of the few opportunities we have to image intergalactic gas prior to the next generation of UV telescopes and is a unique opportunity to compare absorption and emission line observations of a DLA.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17712
Program Title: Elucidating the Nature of a 'Starless' Dark Matter Halo Near M94

Principal Investigator: Benitez-Llambay, Alejandro

PI Institution: University of Milano-Bicocca

Observations with the FAST radio telescope recently detected a marginally resolved 21 cm HI cloud (named Cloud-9) near the M94 galaxy without an optical counterpart down to the surface brightness limit of the DESI Imaging Legacy Survey (~29.5 mag/arcsec^2 in the g band). Unlike previous candidate "dark" HI clouds, all known properties of Cloud-9 are consistent with RELHICs, namely starless dark matter halos filled with gas in hydrostatic equilibrium and thermal equilibrium with the cosmic ultraviolet background. However, the main doubts about its true nature concern the relatively poor angular resolution of the FAST data and the uncomfortably large upper limit in the stellar mass of any luminous stellar counterpart, M_* <= 10^5 Msun, a value comparable to the stellar mass of nearby HI-rich dwarfs. We thus propose to carry out deep photometric observations (8 orbits) with the HST/ACS instrument to bring down constraints to the stellar mass of this object to M_* < 10^4 Msun (and possibly 10^{3.5} Msun) and elucidate the true nature of Cloud-9. Either outcome will be important: (i) if we do not detect a stellar counterpart, we will reinforce the RELHIC interpretation for this system while confirming a cornerstone prediction of the LCDM model, namely the existence of starless collapsed dark matter structures on sub-galactic mass scales; (ii) if we do detect a stellar counterpart, we will have uncovered the faintest HI-rich dwarf galaxy known outside the Local Group.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17713
Program Title: Observing the Merger-induced Formation of a Nuclear Star Cluster in UGC 7346

Principal Investigator: Sanchez-Alarcon, Pablo

PI Institution: Instituto de Astrofisica de Canarias

The formation of Nuclear Star Clusters are a key ingredient to understand fundamental aspects in galaxy evolution, such as super massive black hole growth, physics of dense stellar systems and galaxy morphology evolution. However, direct observational evidence of NSC formation is still lacking. Roman et al. (2023; R23) proposed that the dwarf galaxy UGC 7346 is an exceptional first case in which the formation of a Nuclear Star Cluster (NSC) is caught in the act of forming. This dwarf galaxy, located in the outskirts of the Virgo Cluster, appears to be a merging system of two dwarf galaxies. R23 postulate that the dynamical friction produced by a 1:5 merger would be the mechanism triggering the collapse of the globular clusters (GCs) towards the centre. Ground-based imaging hints that the GC surface density is much higher in the centre of the galaxy than other dwarfs galaxies in the Virgo cluster with a bright tail in the GC luminosity function which could be explain as already merged GC. Our proposed observations will have the resolution and depth needed to resolve the full GC population and study the complete GC luminosity function, critical and sufficient requirements to prove this scenario. With the resolution of HST, we will be able to resolve the GCs and estimate the morphological components of the point sources improving the detection and filetring of GCs while reducing the fraction of interlopers. The proposed observations would constitute the first observational evidence of ongoing NSC formation, which could serve as a unique prove for the feasibility of dwarf mergers as a mechanism to produce an NSC.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17714
Program Title: Understanding the Role of Massive Stars in Galaxies at Cosmic Noon in a Legacy Spectroscopic Field

Principal Investigator: Miller, Tim

PI Institution: Northwestern University

We propose to use new HST/ACS imaging in F606W and F814W to create high spatial resolution rest-UV maps for z~2 star-forming galaxies in the field surrounding luminous quasar Q2343+125. This field stands out in terms of spectroscopic investment, with deep (~10 hr) rest-UV spectra from Keck/LRIS, deep (~2-10 hr) rest-optical spectra from Keck/MOSFIRE, and ultra-deep (~30 hr) rest-optical and rest-NIR spectra from JWST/NIRSpec. This unique combination enables a detailed accounting of the ionizing spectra of massive stars using direct observations of their rest-UV continua and myriad HII emission lines spanning rest-frame ~0.3-1.1 micron. The proposed imaging will allow us to study the rest-UV morphology of these galaxies for the first time, thereby addressing two outstanding questions related to the distribution of massive stars in high-z galaxies: First, we will investigate the connection between ionization conditions and galaxy morphology. This study will serve as a bridge to understanding this connection at even higher redshifts, where knowledge of how the clustering of massive stars affects galaxies' ionizing output is urgently needed to determine their contribution to cosmic reionization. Second, we will use these data to provide improved guidance to the community about how best to combine space- and ground-based spectroscopy, which are often observed at very different spatial scales. A comparatively small investment of HST time will significantly enhance the legacy value of one of richest spectroscopic datasets of distant galaxies ever assembled and provide novel constraints on the properties of massive stars--and their impact on galaxies--at Cosmic Noon and beyond.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17715
Program Title: The curious case of SDSS J1000+2233: a recoiling SMBH, a sub-parsec SMBH binary, or an unusual disk emitter?

Principal Investigator: Shen, Yue

PI Institution: University of Illinois at Urbana - Champaign

SDSS J1000+2233 is a broad-line quasar at z~0.4 with the peaks of its broad low-ionization lines blueshifted from the systemic velocity by ~8000 km/s, without obvious double-peaked broad line profiles characteristic of disk emitters. It represents one of the few best cases where a recoiling SMBH or a sub-parsec binary SMBH could be a viable interpretation of the blueshifted broad lines. We propose joint HST and Chandra observations to elucidate the nature of SDSS J1000+2233. HST WFC3 optical and IR imaging will potentially resolve spatically-offset nuclei supporting the scenario of a recoiling SMBH, and allow image decomposition to measure the properties of its host galaxy. HST STIS NUV spectroscopy will probe the broad UV emission line profiles to rule out (or confirm) the disk emitter scenario. Chandra X-ray imaging will pinpoint the location of the active SMBH to facilitate the HST imaging observations. The rejection or confirmation of the disk emitter hypothesis would provide valuable guidance for the searches of recoiling or binary SMBHs with kinematically-offset broad emission lines. Alternatively, detailed multi-wavelength coverage and host galaxy measurements will help understand the physical conditions leading to extreme broad line profiles that are rare even for disk emitters. The observations will have general implications for gravitational wave and multi-messenger astronomy, the understanding of galaxy evolution and SMBH formation, and/or astrophysical objects under extreme physical conditions. With a small investment of 6 HST hours and 25 ks of Chandra, the program could potentially confirm the general relativistic prediction of recoils from SMBH mergers.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17716
Program Title: Probing Multiphase Cooling Via OVI Emission in the Cores of the Most Extreme Cooling Flows

Principal Investigator: McDonald, Michael

PI Institution: Massachusetts Institute of Technology

The cores of galaxy clusters represent one of the few places in the Universe where large-scale cooling and feedback processes can be readily observed. Unlike isolated galaxies, where some of the energy injected into the ISM from the AGN often escapes into the low-density IGM, the denser ICM in cluster cores retains an imprint of this feedback in the form of bubbles or ripples. Similarly, the accretion of hot gas from the IGM onto isolated galaxies is challenging to observe due to the very low densities, while such phenomena have been studied in depth for decades in galaxy clusters. These so-called "cooling flows" in galaxy clusters, which were once thought to be massive flows of cool gas on the order of hundreds of Msun/yr, are now understood to be considerably less massive, with AGN feedback preventing the majority of the gas from cooling. Despite significant progress, the details of the cooling/feedback cycle still elude us. One of the most promising paths forward is the use of the OVI emission line, probing 10^5.5K gas, to detect the multi-phase cooling flow. This line should be especially sensitive to the instantaneous cooling rate of the hot gas, compared to lines in the X-ray. Here we propose to target the three most strongly cooling clusters in the known universe that do not also harbor central QSOs, with a goal of measuring the instantaneous cooling rate in these clusters. This program would double the number of OVI detections in non-QSO clusters, providing critical constraints for subgrid models of AGN feedback in simulations, providing a measurement of the level of turbulence in the cooling gas, and constraining the age of the cooling-fed starburst.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17717
Program Title: Resolving the Origins of Extraplanar Dust using UV Reflection Nebulae

Principal Investigator: Boettcher, Erin

PI Institution: University of Maryland

Dusty outflows from star-forming regions trace the circulation of mass and metals between galaxy disks and their gaseous environments. As much as half of the dust in the local universe may be found outside of galaxy disks, but we do not know what physical mechanisms dominate the dust transport. The morphology of the extraplanar dust is a key indicator of dust transport by ejective feedback through galactic chimneys (clumpy/filamentary) or by radiation pressure (smooth). However, the dust morphology is unknown at distances of more than a kiloparsec from the disks of normal, star-forming galaxies. At these distances, UV light scattered by dust grains provides a powerful tool for detecting the dust, but these reflection nebulae are unresolved by GALEX and Swift observations. We propose to resolve these nebulae using HST/WFC3 F225W imaging of six nearby, normal ~L* galaxies (five new observations, one archival). These observations will determine whether ejective feedback or radiation pressure dominates the dust transport out of galaxy disks with and without active chimney-mode feedback, as seen in H-alpha images. This pilot program will also enable efficient and precise measurements of the metal mass found in the expelled dust in a future program. These objectives are essential for understanding the physical processes that regulate star formation by coupling the mass and metal reservoirs of the interstellar and circumgalactic media.

Proposal Category: SNAP
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17718
Program Title: Uncovering the host galaxy and BH mass of a large sample of radio-loud narrow-line Seyfert 1 galaxies

Principal Investigator: D'Ammando, Filippo

PI Institution: INAF Istituto di Radioastronomia

Several studies indicate that powerful jets in AGN are only produced by the most massive black holes, M_BH = 10^8 - 10^10 solar masses, found in elliptical galaxies. This idea has been challenged by the discovery of gamma-ray emission from a few radio-loud narrow line Seyfert 1 galaxies (RL NLSy1). Estimates based on the width of their broad lines indicate M_BH = 10^6 - 10^7 solar masses, suggesting that RL NLSy1 might be the manifestation of a new mechanism to produce relativistic jets. However, these values of the M_BH might be largely underestimated due to projection and/or radiation pressure effects. A different approach to estimate M_BH in RL NLSy1 must be adopted, based on the close connection of M_BH with the infrared bulge luminosity. We propose to obtain deep and high angular resolution HST observations of a sizeable sample of 104 RL NLSy1 with a redshift z < 0.5 with WFC3 with the broad F140W filter. This will enable us to derive the brightness profiles of their host in order to determine the morphology of the host galaxy (separating bulge and/or disk contributions) and to measure M_BH from their luminosity. It is crucial to determine the properties of the host galaxy and the BH mass of a large sample of RL NLSy1 for achieving a better understanding of the necessary conditions and mechanisms to produce relativistic jets, and the connection between host galaxy and relativistic jets. The proposed observations will significantly increase the number of RL NLSy1 for which the host mass and morphology has been determined. This will definitely unveil the impact of the host galaxy properties on the production of relativistic jets.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17719
Program Title: Brighter than GN-z11? Grism Observations of the brightest z~11 Candidates found in COSMOS-Web

Principal Investigator: Franco, Maximilien

PI Institution: University of Texas at Austin

We have searched in the widest-field JWST survey (>0.5deg2) for rare, extremely bright high redshift candidates and we have identified several dozen candidates at z>10. Among these, two candidates could potentially surpass the brightness of GN-z11 (Oesch et al. 2016), the archetype "extremely bright" galaxy which happens to be the most luminous and distant galaxy ever found by HST with an absolute magnitude (M_UV) of -21.50 and a spectroscopic redshift of 10.6 (Bunker et al. 2023). We have found two spatially compact and isolated candidates at z~11 that we propose to target for WFC3/IR G141 grism observations. They are extremely bright, 10-50x brighter than other JWST sources at similar redshifts. With these observations we expect to distinguish between possible low-z interlopers (with strong emission lines) and a genuine z>10 source (via a Lyman break). This would allow us to ascertain the extent to which GN-z11 is unique or representative of these galaxies, and to unravel how these galaxies could form such substantial stellar mass only 500 million years after the Big Bang, challenging our current cosmological models. The confirmation of even one of these candidates is vital for testing these scenarios. However, without spectroscopy, definitive conclusions remain elusive, as the possibility of contamination from a low-redshift source with unusually strong emission lines cannot be entirely ruled out.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17720
Program Title: Confirming the first strongly asynchronous polar

Principal Investigator: Caiazzo, Ilaria

PI Institution: Institute of Science and Technology Austria

We have discovered a new exotic binary system containing an accreting highly magnetized white dwarf. The peculiar variability in the hydrogen emission lines and the high magnetic field of the white dwarf hint to a very exciting explanation for the current observations: we might have caught the system in a rare evolutionary stage, in which the highly magnetized white dwarf has only recently started accreting from the companion and therefore its rotation period is not yet synchronized with the orbital period of the binary. We here propose a joint HST-XMM program to confirm the nature of this system as a strongly asynchronous polar, to constrain the magnetic field strength and temperature of the white dwarf, and to measure the accretion rate of the system. If confirmed, this system promises to become a keystone for our understanding of the evolution of cataclysmic variables and of binary evolution in general.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17721
Program Title: Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Principal Investigator: Hinkle, Jason

PI Institution: University of Hawaii

Due in large part to the rapid growth of all-sky transient surveys, a rich diversity of nuclear transients has been discovered. The two most common such transients are tidal disruption events (TDEs) and active galactic nucleus (AGN) flares. However, it has become increasingly clear that there is a growing class of nuclear flares with characteristics distinct from typical TDEs and AGNs, currently known as ambiguous nuclear transients (ANTs). These ANTs likely represent a window into a hitherto unseen or poorly understood mode of accretion onto supermassive black holes, possibly a TDE occurring within an AGN disk. Here we propose to obtain 2 epochs of STIS UV spectroscopy each for 2 newly-discovered UV-bright ANTs in Cycles 32, 33, and 34 for a total of 12 spectra of 6 ANTs. For each ANT, emission lines in the UV spectra will identify if the source is more TDE-like or AGN-like in nature, providing physical insight into the complex interplay between the existing AGN disk and the disrupted tidal debris. The UV spectra will also allow for crucial insights into outflows launched by ANTs through measurements of broad absorption lines, photoionization physics from measurements of low- and high-ionization lines, and properties of circumnuclear gas through multi-ion curve of growth analysis. Obtaining two spectra per ANT separated by roughly 100 days will probe the temporal evolution of the emitting region, which will be compared with predictions from theoretical models of TDEs in AGN disks.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17722
Program Title: Seasonal and latitudinal variability of C2H2 in Uranus' stratosphere

Principal Investigator: Giles, Rohini

PI Institution: Southwest Research Institute

Acetylene (C2H2) is formed in Uranus' stratosphere from the solar photolysis of methane, which means that its abundance is highly dependent on both season and latitude. Photochemical models have been developed to predict the spatial and temporal variability of C2H2, but there have been limited observations to date that can be used to test these models. Spatially-resolved mid-infrared observations have recently been used to study the C2H2 distribution, but at those wavelengths there is a degeneracy between chemical abundances and stratospheric temperatures. Far-ultraviolet spectroscopic observations can be used to retrieve the disk-averaged C2H2 abundance and are not sensitive to the atmospheric temperature, providing complementary information to the infrared observations. In 2014, Uranus was observed by HST during its northern spring using the COS G140L grating. These observations show the clear spectral signature of C2H2 and have not yet been published. We request one HST orbit in order to repeat this observation during the 2024/2025 cycle, as Uranus approaches northern summer solstice. We will compare the C2H2 abundances obtained from these HST COS spectra, and from Voyager UVS spectra obtained during southern summer, with predictions from seasonal photochemical models. A difference between the model predictions and the observations could suggest that atmospheric circulation plays a significant role.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17723
Program Title: The first UV investigation of a massive stripped-envelope core-collapse progenitor at high metallicity: The WO star WR 102

Principal Investigator: Lefever, Roel

PI Institution: Astronomisches Rechen-Institut Heidelberg

The WO-type Wolf-Rayet stars of the oxygen sequence represent the final stage in the life of a massive star. These stars offer a unique window to the evolutionary stages right before going supernovae and collapsing into black holes (BHs). A WO star is dominated by a strong stellar wind that further strips its outer layers. This large mass loss ultimately determines how much mass is left for a BH to form. Given the discrepancy between observed BH masses and final masses from stellar evolution, determining the wind structure and mass-loss rate is paramount. Moreover, the evolution of these stars and their winds is poorly constrained: whether some WO stars will undergo a stripped-envelope supernova (SNIbc) is currently under debate. Optical analyses exist but cannot reveal the whole picture: mayor wind drivers and nucleosynthesis indicators can only be observed in the UV. Yet, UV spectra of WO stars at Galactic metallicities are absent. Looking at the most evolved WO star in the Milky Way, WR 102, we propose to obtain pioneering UV data to understand massive, stripped core-collapse progenitors at high metallicity and shed light on the SNIbc puzzle. Being highly evolved and stripped objects, the abundances of WO stars also yield a unique insight into the highly uncertain C-O nuclear reaction rate. Using stellar atmosphere models with an inherent solution of the hydrodynamic equation, we will further be able to obtain consistent density stratifications for our targets and get a unique handle on the so far uncertain stellar mass. Thereby, we will be able to provide a crucial testbed for the circumstellar emvironment of highly stripped stars undergoing core collapse.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17724
Program Title: An ultraviolet time-domain survey of the compact binary population in 47 Tucanae

Principal Investigator: Mo, Geoffrey

PI Institution: Massachusetts Institute of Technology

The cores of globular clusters are among the densest stellar environments in the Galaxy, facilitating dynamical interactions which promote the formation of compact object binaries. We propose a UV time-domain survey of 47 Tucanae, one of the brighest and most massive globular clusters in the sky, using WFC3/UVIS to uncover and characterize its compact binary population. Due to confusion noise resulting from the crowding of giants, the cores of globular clusters are difficult to study with ground-based observations. The unique UV capabilities of HST, with its high angular resolution, are necessary for obtaining robust photometry of faint stars and compact objects. We will use these observations to extract hundreds of thousands of high-quality light curves and perform periodicity searches to discover and characterize ultracompact systems, binary pulsars, and other exotic binaries. This survey will contribute significantly to our understanding of binary evolution, gravitational wave progenitors, and stellar populations in globular clusters.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17725
Program Title: Tomographic mapping of a super-luminous quasar in the Epoch of Reionization

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 69 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 (GO-Archival)
Scientific Category: Large Scale Structure of the Universe
ID: 17726
Program Title: Time delay cosmography with strong cluster lenses

Principal Investigator: Dahle, Haakon

PI Institution: University of Oslo

We propose to assemble a complete data set of HST and JWST imaging for the complete known sample of 8 gravitational lens systems where a variable quasar is multiply lensed by a cluster of galaxies. Such lens systems produce image separations and time delays an order of magnitude larger than the much more common galaxy-scale lensed quasars. All these systems are targets of completed or ongoing photometric monitoring programs, allowing us to measure time delays between the lensed quasar images. Time delay values with 1-2% uncertainty have already been measured in half of these lens systems, and preliminary time delays are available for all; similar precision will be reached in the remaining systems within ~2 years. The long time delays, coupled with space-based imaging which provide a large number of additional lensing mass constraints from image families of lensed sources at different redshifts, make these cluster-lensed quasars spectacular targets for determining the Hubble constant H0. The Refsdal method, based on measuring time delays between multiple, strongly gravitationally lensed images of variable sources can provide unique insight into the origin of the intriguing "Hubble tension" between local distance ladder and cosmic microwave background-based determinations of H0. To enable such H0 measurements for the full sample of 8 lensed quasars, we request HST imaging for three systems with no prior space-based data, complemented by JWST imaging at longer wavelengths for the full sample of 8 lenses, as well as modest archival support, to construct precise and accurate models of the lensing mass distribution across the entire sample and derive a joint H0 measurement.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17727
Program Title: STIS spectroscopy of Amalthea and Thebe: Surface composition and interactions with Jupiter's magnetosphere and rings

Principal Investigator: Molyneux, Pippa

PI Institution: Southwest Research Institute

Jupiter's inner moons are an important aspect of the Jupiter system, acting and sources and sinks for the rings and providing clues to the evolution of the system as a whole. However, very few spectral observations of the inner satellites have been performed to date, and the only previous observations by HST, which were obtained using the Faint Object Spectrograph, suffer from instrumental artifacts that hamper their interpretation. We propose new STIS observations of the largest inner moons, Amalthea and Thebe, to investigate their surface compositions and search for signatures of interactions with the Jovian magnetospheric plasma. We will also constrain their grain sizes, providing insight on the contribution of electrostatic lofting to Jupiter's gossamer rings. We plan to observe Thebe using the G230L and G430L gratings, to search for absorption features related to sulfur species and reflectance peaks associated with small grains. At Amalthea, we will perform similar observations and also use G750L to search for a 0.7-micron absorption related to hydrated silicates, constraining the origin of a 3-micron absorption feature previously observed on the trailing hemisphere. The proposed observations are highly relevant to future observation of the Jupiter system by JUICE, providing the opportunity to investigate temporal variations and filling a gap between the JUICE-UVS and MAJIS spectrographs.

Proposal Category: GO (GO-Archival)
Scientific Category: Galaxies
ID: 17728
Program Title: Spatially Resolving Highly Ionized Channels of Lyman Continuum and Lyman Alpha Escape on 10's of Parsecs Scales In A Strongly Lensed Galaxy

Principal Investigator: Bayliss, Matthew

PI Institution: University of Cincinnati Main Campus

Our understanding of the EOR will be limited by our ability to directly study the physical mechanisms that regulate LyC escape in galaxies where LyC escape can be directly measured. However, revealing the physics of LyC requires resolving the relevant physical scales, which are increasingly believed to be small, i.e. on the order of the size of individual compact star clusters (~10-100 pc). This work can only be performed with detailed studies of bright, highly magnified LyC leaking systems, but currently there is only one such system known (the Sunburst Arc). We propose UV/blue HST imaging of LyC and LyA of SGAS1110, an exceptionally magnified strongly lensed galaxy at z=2.48. The proposed data will spatially resolve escaping LyC and LyA radiation down to ~30 pc scales, identifying channels of extremely low HI column density. The target galaxy has a double-peaked LyA emission profile observed from galaxy-integrated ground-based spectroscopy, as well as JWST/NIRSpec IFU spectroscopy that identifies multiple compact star forming regions with extreme ionization (O3/O2 >11 and Ne3/O2 > 1.5; implying log(U) of ~ -1). These regions have nearly identical properties to the extreme LyC leaking region in the Sunburst Arc, which is associated with a single compact star cluster, ~<10 pc in size. This program would provide the crucial missing piece (direct imaging of spatially resolved LyC and LyA escape) to use SGAS1110 as a new laboratory for understanding the relationship between ionizing photon escape and spatially resolved physical properties on the physical scales of individual star clusters, as well as role that complex galaxy and ISM geometries play in enabling LyC escape.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17729
Program Title: Decoding Reionization Era using UV and IR spectral features

Principal Investigator: Kumari, Nimisha

PI Institution: Space Telescope Science Institute - ESA - JWST

JWST and ALMA are revolutionizing the study of reionization-era galaxies by providing spectra of galaxies in the ultraviolet+optical and far infrared (FIR), respectively. Hence, it is urgent and crucial to establish a local reference sample of high-redshift "analog" galaxies covering UV, optical, and FIR. The UV and FIR carbon spectral features are seen in both low and high redshift galaxies with extreme properties. We build this proposal upon a multiwavelength pilot study of a reionization-era analog galaxy, Pox 186, showing extreme FIR [OIII]88/[CII]158 and high equivalent width of CIII]1909; and request HST/COS medium resolution FUV and NUV spectroscopy for three dwarf galaxies with high [OIII]/[CII] (>2) line ratios and high equivalent widths of [OIII]5007+Hbeta (>200 Angstrom) - the properties commonly observed in high-redshift galaxies. The requested COS/UV spectroscopy of these three galaxies will thereby double a sample of three Herschel dwarf galaxies with existing multiwavelength data and will allow us to characterize the properties of the pristine interstellar medium, massive stars, and infer parameters such as escape fraction of Lyman continuum and production efficiency of ionizing photons in a sample of reionization era analogs. These data will hence present a complete multiwavelength local reference sample and templates for rest-frame UV, optical, and FIR spectroscopy of early galaxies accessible by JWST and ALMA, and is a unique opportunity to decode puzzles of the reionization era.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17730
Program Title: Fulfilling the UV Legacy of the Hubble and Webb Deep Public Frontier Field

Principal Investigator: Whitaker, Katherine

PI Institution: University of Massachusetts - Amherst

Hubble Frontier Field Abell 2744 is one of the most powerful known gravitational lensing clusters, with the largest high magnification area among HST observed clusters. In Cycles 1-3, JWST programs are obtaining >300 hours of imaging and spectroscopy over Abell 2744, mapping the entire high magnification area, constituting the mission's deepest, and crucially, fully public extragalactic dataset. With JWST imaging reaching 29-30AB in 20 filters at 1-5 micron (not counting the extra lensing boost), ultradeep JWST NIRISS+NIRSpec+WFSS spectroscopy, plus deep ALMA dust continuum, MUSE datacubes, and Chandra X-ray observations, Abell 2744 is a peerless legacy field. This treasure trove of data presents an unprecedented opportunity to answer high-profile reionization questions only addressable with HST UV imaging. Here, we propose an immediately-public HST program to supplement currently-inadequate HST coverage by providing ultra-deep WFC3/UVIS (F336W) imaging over a 4x wider area, matching the full coverage of the JWST spectroscopy. The proposed F336W data enables measurements of Lyman continuum and ionizing photon escape fractions in z=3-4 sources (analogs to epoch of reionization galaxies) to unambiguously determine the role of galaxies in reionization. This data will also improve constraints on the UV luminosity function, star formation in quiescent galaxies, the metallicity of globular clusters within A2744, and the origin of the UV upturn in foreground cluster galaxies. These observations must be taken now to leverage the unique and time-limited UV capabilities of HST and maximize the potential of a remarkable suite of observations from HST, JWST, ALMA, and Chandra.

Proposal Category: SNAP
Scientific Category: Stellar Physics and Stellar Types
ID: 17731
Program Title: Are All Type IIn Supernovae Terminal Explosions?

Principal Investigator: Filippenko, Alex

PI Institution: University of California - Berkeley

There is evidence that some Type IIn supernovae, whose diverse spectra and light curves exhibit signs of interaction between the ejected material and circumstellar matter (CSM), are actually nonterminal outbursts of massive evolved stars such as luminous blue variables (LBVs); such objects are thus "SN impostors," at least until they undergo a terminal explosion. An outstanding example is SN 2009ip, which was classified as an SN IIn but three years later experienced an even larger, terminal explosion; the 2009 event was an SN impostor. In other cases of SNe IIn, it is possible that the initial outburst was an impostor, and the terminal explosion has not yet occurred. We propose to obtain deep, two-filter HST snapshot images of the sites of confirmed SNe IIn (> 9 years after outburst), in order to see whether the progenitor did indeed disappear and thus likely suffered a terminal explosion. The precise position of each of our targets will be known from post-eruption archival HST images. If instead we find an object at the site of the SN IIn, it is likely either the surviving progenitor, a companion star, or long-lived emission from the shocked CSM. The color of the star, obtained from the HST snapshot images, will provide a strong clue: LBVs are generally blue, ejecta-CSM interactors (with H-alpha emission) and RSG companions are red. The detection or nondetection of an object at the SN site will already provide fundamental information. However, to further explore the nature of any detected object, we will subsequently obtain essentially guaranteed, ground-based complementary spectra to search for medium/broad H-alpha emission characteristic of shocked CSM.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17732
Program Title: UV spectroscopy of the complete sample of Wolf-Rayet stars in the low-metallcity galaxy NGC 6822

Principal Investigator: Oskinova, Lidia

PI Institution: Universitat Potsdam

We propose the first UV spectroscopic study of the complete sample of four Wolf-Rayet (WR) stars in the low-metallicity galaxy NGC6822. WR stars are rare objects which represent the final evolutionary stage of most massive stars short before their collapse into black holes, and are important feedback sources. Low-metallicity WR stars are emigmatic but, arguably, the most important testbeds of the final stages of massive star evolution in conditions resembling those in the early Universe. The new COS spectra of the strategically important sample of low-metallcity WR stars are urgently needed to complement existing optical spectra, which by themselves are not sufficient to fully characterize these objects with strong winds. The HST data will be exploited to measure stellar and wind parameters using modern stellar atmosphere models. The determined mass-loss rates and wind velocities will be compared to those of WR stars in different galaxies, such as the Milky Way, the LMC, and the SMC, and used to anchor the metallicity dependence of WR wind strengths. The derived stellar parameters will test massive-star evolution models and allow a comparative study of low-metallicity WR stars in the SMC and NGC6822. If we find that WR stars in NGC6822 resemble the so far unique population of WR stars in the SMC (which fundamentally differs from the WR stars in galaxies with higher metallicity), it will disrupt the standard picture of black hole progenitors and stellar feedback at low metallicities, and by proxy in the young Universe. Obtaining the UV spectra of WR stars in NGC6822 is a necessary addtion to the HST legacy and will resonate across many areas of astrophysics.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17733
Program Title: When Clouds Collide: Observing Gas Accretion onto the Milky Way's Disk

Principal Investigator: Zheng, Yong

PI Institution: Rensselaer Polytechnic Institute

Despite it being the reference L* galaxy for extragalactic studies, our Milky Way (MW) seems to host a circumgalactic medium (CGM) with far less ionized gas content than their low-redshift counterparts. This program is designed to investigate the MW's CGM anomaly by examining whether there are large streams of ionized gas being accreted onto the MW's disk in a co-planner manner at low Galactic latitudes, which may elude previous studies that were limited to QSOs at high-latitude regions. We will observe 4 new QSO sightlines toward the anti-Galactic center direction, where a large population of infalling HI clouds are present. We will quantify the physical properties of the ionized gas associated with the infalling HI clouds, including ionization states, ion ratios, metallicity, neutral and ionized masses, and infalling time scales and mass rates. Detections of high ion column densities in our proposed observations will confirm that there are indeed large streams of ionized gas flowing from the MW's CGM to the disk, resolving the debate surrounding the MW's CGM anomaly. Null detection of ionized gas would also be extremely informative: it would indicate that the MW's CGM is truly different from those of other L* galaxies, with insufficient amounts of ionized gas in all directions.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17734
Program Title: A clean view of the CGM for well-characterized galaxies

Principal Investigator: Wakker, Bart

PI Institution: Eureka Scientific Inc.

The properties of galaxies are linked to the gas that surrounds them, but the details of this linkage remain unclear. There are very few galaxies whose internal structure has been resolved while their circumgalactic medium has also been sampled. We have created a sample of 34 AGN-galaxy pairs (25 new and 9 archival) consisting of isolated and highly-inclined (i>60) galaxies included in the MaNGA survey, with AGN impact parameters <0.5 R(vir). The mass, star-formation rate, and kinematics of all these galaxies have been mapped in detail. Selecting isolated and highly-inclined galaxies minimizes confusion due to environmental and projection effects. The sightlines cover a range of azimuths and are at low impact parameters, where the detection rate of Lya is >80% and that of metals >50%, allowing us to characterize the azimuthal and radial variations of the velocities, column density, volume density, metallicity, and linewidths, using absorption lines of hydrogen (HI), low-ions (CII/SiII) and intermediate ions (SiIII). We will correlate these properties with galaxy mass and star-formation rate. We will further compare the CGM measurements with simulations of similar galaxies, also projected edge-on. This sample will provide the cleanest test to-date of whether CGM absorbers exhibit the expected bimodality associated with outflows along the major axis and inflows along the minor axis. Further, we will be able to compare the motions of the CGM absorbers with the host galaxies to assess if the gas is co-rotating and if so, out to what distance.

Proposal Category: SNAP
Scientific Category: Large Scale Structure of the Universe
ID: 17735
Program Title: Confirming Spectroscopic Strong Lens Candidates from the DESI One-Percent Survey

Principal Investigator: Bolton, Adam

PI Institution: NOIRLab - (AZ)

We propose an HST-WFC3 Snapshot imaging survey of 127 high-probability strong gravitational lens candidates selected from within the public Early Data Release of the Dark Energy Spectroscopic Instrument (DESI) project, to confirm their lensing nature and to extract lens-galaxy masses and mass-density profiles through lens modeling. These lens candidates have been selected for the appearance of higher-redshift emission lines in the spectra of lower-redshift massive galaxies targeted by DESI. This is the first major spectroscopic strong lens sample from this next-generation redshift survey, which promises to deliver of-order 10,000 new strong lens candidates by its completion. This new lens sample will be highly complementary to existing strong lens samples, particularly those selected from ground-based imaging surveys. Combined with existing samples, these observations will enable an improved determination of the evolution of the mass-density profile of massive elliptical galaxies, a trend for which observation and theory are currently in tension. Our observations will also deliver a significant increase in the number of known lenses that can be monitored for lensed supernovae by the current and forthcoming generations of wide-field time-domain surveys. We request zero proprietary period for our observations, and will publish our derived data products and lens models online through the STScI-MAST high-level science product framework.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17736
Program Title: Early Ultraviolet Spectroscopy of a Nearby Supernova in the TESS Footprint

Principal Investigator: Meza Retamal, Nicolas

PI Institution: University of California - Davis

We propose an ultra-disruptive ultraviolet (UV) spectroscopic sequence of one nearby SN discovered within ~24 hours of explosion. We will fully complement this observations with a rapid response, high cadence Swift UV light curve, along with a optical+near-infrared (NIR) ground-based campaign. Our observations will provide an unprecedented view of the shock-breakout of SN explosions and the SN interaction, with either a stellar companion or circumstellar medium (CSM), and it will give key insights on the last phases of stellar evolution. At early times, our view of the SN is incomplete, as our optical observations cover less than ~1% of the total emission. Only UV spectroscopy will allow us to put firm constraints on the physical conditions of the explosion and properties of the progenitor, like metallicity. For core-collapse SNe, the early temperature evolution can constrain the progenitor outer density profile. The UV light, or the SN ejecta, can ionize the CSM and can constrain the progenitor wind speed and CSM extent. For type Ia SNe, recent very early light curve excesses point to interaction with a companion star, CSM interaction or an unusual nickel distribution, but models cannot reproduce UV light curves. Only spectroscopy will reveal the progenitors of these essential cosmological tools. For this UV spectroscopic sequence, a concurrent TESS light curve will pinpoint the moment of explosion with great precision, and act as an additional probe of CSM/companion star interaction. Very early UV spectroscopy of a nearby SN is a completely unique observation that only HST can provide, and the SN community may not have this opportunity again for the foreseeable future.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17737
Program Title: Seasonal dependence of Uranus' upper atmosphere: Tapping 26 years of HST Ly-alpha observations

Principal Investigator: Roth, Lorenz

PI Institution: Royal Institute of Technology

The upper atmospheres of giant planets play key role in various processes such as solar wind interaction, atmospheric escape, magnetosphere-ionosphere coupling, and interaction with ring particles. Voyager2 revealed a largely extended upper atmosphere of Uranus, devoid of hydrocarbons - unique among the solar system's giant planets. It is not yet well understood how the upper atmosphere varies seasonally and Uranus' orbital period of 84 years makes it generally difficult to obtain observational evidence for seasonal changes. However, IR monitoring of ionospheric H3+ emissions suggest a decrease in temperature of the ionized upper atmosphere since 1992. The abundance of H, H2 and H3+ in the upper atmosphere are strongly coupled and indeed HST Ly-alpha observations before (1998) and close to equinox (2011) revealed a similar trend with shrinking and decreasing emissions. Imaging the H Ly-alpha emissions from Uranus with STIS now in cycle 32 - more than a decade after equinox - offers the unique possibility to test the puzzling cooling trend. The new STIS Ly-alpha images together with the archived STIS images will determine if Uranus' neutral upper atmosphere is indeed undergoing continuous cooling. Additional STIS G140M slit spectra provide precise measurements of Raman shifted features for a characterization of the H2 component. With only 8 orbits in 2024 this program will complete a unique archive of FUV data on the only ice giant planet with Ly-alpha emission signal observable from Earth and inform a possible large Uranus Orbiter and Probe mission as recommended by the NASA decadal survey.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17738
Program Title: Probing Magnetar Energy Input with the First Sample of Late-Time Superluminous Supernovae

Principal Investigator: Blanchard, Peter

PI Institution: Northwestern University

Since the discovery of hydrogen-poor superluminous supernovae (SLSNe) over a decade ago, research has focused on identifying the source of their enormous luminosities that can reach up to a hundred times brighter than normal supernovae. Early on, it was realized that the standard radioactive decay model that powers normal supernovae is unable to explain these events. Since then, light curve modeling of large samples, spectral modeling of both early and late-time nebular spectra, and analyses of their dwarf host galaxies have pointed towards a scenario in which the spin-down of a newly-formed magnetar central engine provides energy that is thermalized in the SN ejecta and radiated in the UV/optical. Perhaps the best evidence in favor of this model are the recent HST observations of two events at 400-1100 days after peak that match the power-law decline predicted by magnetar energy input. These observations strongly motivate new observations of a large and diverse sample to measure the distribution of power-law slopes and assess whether the diversity evident in the early light curves of SLSNe correlates with diversity at late times. We therefore propose to observe 8 new SLSNe each at three epochs spread accross Cycles 32, 33, and 34 (plus one template observation of an old event). As the late-time optical light curve is highly sensitive to the thermalization of the magnetar's energy, a key goal is to compare our observations with recent radiative transfer simulations to infer properties of the magnetar wind nebulae, the region where the magnetar's energy is transfered to the ejecta. This will be the most comprehensive test to date of the magnetar model for SLSNe.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17739
Program Title: A UV eclipse test for Callisto's atmosphere, plasma interaction and water ocean

Principal Investigator: Roth, Lorenz

PI Institution: Royal Institute of Technology

Jupiter moon Callisto might have a subsurface ocean as well as the fourth densest atmosphere of all solar system moons. The primary O2 atmosphere was inferred indirectly through sensitive HST/COS observations of electron-excited UV oxygen emissions. Because the interaction of Callisto's atmosphere-ionosphere leads to a strong diversion of the magnetospheric electrons, the UV emissions were interpreted to be from photo-electrons. However, optical oxygen emissions were detected in 2021 when Callisto was in eclipse of Jupiter and thus must be excited by magnetospheric electrons and not photo-electrons. Archival COS observation of Callisto in sunlight can not resolve the question of the excitation, but interestingly they suggest O or H2O must be abundant in addition to O2. After a 3-year period without eclipses, Callisto will be again eclipsed by Jupiter in the coming HST cycle. We propose sensitive COS observations of the diagnostic 1304 A and at 1356 A emissions from before ingress, through the eclipse passage until after egress. The changes in UV emissions over eclipse will reveal the excitation mechanism and provide constraints on the composition of the atmosphere. If the UV emissions disappear in eclipse, a strong plasma diversion and dense ionosphere are confirmed, which challenges the necessity of a subsurface ocean to explain magnetic induction. ESA's JUpiter Icy Moon Explorer and NASA's Europa Clipper mission will carry out several flybys at Callisto. An improved understanding of the moon's atmosphere and ocean delivers important information for optimal science planning and addressing the habitability goals for these milestone missions.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17740
Program Title: Gravitational-arc tomography of the circumgalactic medium at z~0.7: Identifying the host galaxies of three MgII absorbers

Principal Investigator: Erb, Dawn

PI Institution: University of Wisconsin - Milwaukee

The dynamic circumgalactic medium (CGM) is the site of gas flows into, out of, and around galaxies, and thus plays a central role in regulating star formation over cosmic time. Many of its properties remain unconstrained, however, particularly on a spatially resolved basis. Extensive statistical studies of the gas around galaxies have been performed using the absorption it produces in background sources, usually quasars that probe a single line of sight. In particular, absorption from singly-ionized magnesium (MgII) has been shown to trace the outflow and accretion of cool, enriched gas surrounding galaxies. More recently, a handful of MgII-absorbing galaxies have been studied with gravitational-arc tomography, which uses the fortuitous alignment of an intermediate redshift galaxy and a background lensed arc to probe the gas around the foreground galaxy in unprecedented detail over tens of kpc. We here propose to use WFC3/IR grism spectroscopy to identify the galaxies responsible for spatially varying foreground MgII and FeII absorption observed at z~0.7-0.8 in Keck Cosmic Web Imager (KCWI) integral field spectroscopy of three gravitationally lensed galaxies. The proposed observations will provide spectroscopy at high spatial resolution of the entire field surrounding each arc, targeting H-alpha emission at the redshifts of the absorbers. Identification of the absorbing galaxies will enable measurement of the impact parameters of the absorption and the correlation of the strength, structure and kinematics of the absorption lines with the morphologies, star formation rates, and star formation rate surface densities of the absorbing galaxies.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17741
Program Title: Monitoring for Collisions in the Beta Pictoris Debris Disk to Enable JWST Follow-Up Spectroscopy

Principal Investigator: Wagner, Kevin

PI Institution: University of Arizona

Debris disks are readily detectable tracers of planetesimal collisions within young planetary systems; however, few collisions have been observed in detail. Among the earliest and most noteworthy JWST results of debris disks was evidence of major (Ceres-mass) collisions having occurred over the past century within Beta Pictoris. This indicates that the chance to observe a major planetesimal collision shortly after it occurrs may be non-neglegible over decade timescales, and the chance of observing lower-mass collisions, which should be more frequent but visible only for months to years, may be substantial. Observing such a collision shortly after it occurs and tracking the evolution of its dust cloud would open a major window into the dust produced via planetesimal collisions -- including measurements of planetesimal composition, grain-size constraints, collisional frequency estimates, and dust production rates, to name a few possibilities. Additionally, recent time-differential HST/STIS imaging has demonstrated that multi-epoch observations have the capability to push orders of magnitude lower in collisional mass detection limits compared to single-epoch imaging. Here, we propose to build off of 27 years of HST/STIS observations of the Beta Pictoris system in order to monitor for collisions over the next three cycles. Regular re-visits allow detecting collisions shortly after they occur, enabling follow up proposals for JWST to place unique constraints on the resulting dust. In the absence of such a detection, we will continue to place meaningful constraints on the frequency of collisions and the distribution of major planetessimals within the Beta Pictoris system.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17742
Program Title: A new laboratory for fundamental AGN physics

Principal Investigator: Vestergaard, Marianne

PI Institution: University of Copenhagen, Niels Bohr Institute

A bona-fide AGN in the 1990s, Mrk 590 now flares repeatedly in a low flux state. This offers a very rare opportunity to follow in real time the onset of AGN activity that can lead to better insights on the AGN central engine physics. While directly impacting galaxy evolution through energetic feedback, the AGN structure and physics are still poorly understood. We wish to catch the early onset of AGN activity to test details of AGN accretion physics that cannot be constrained in any other way. We propose a ToO program to obtain up to five COS spectra of Mrk 590 at different X-ray/UV flux levels as its AGN builds up. We will measure UV broad-line fluxes, constrain the UV and EUV ionizing continuum emission from the accretion flow, and test theoretical model predictions for the broad-line region physics. The efficient strategy we employ ensures that instructive constraints are obtained with a very modest HST program - yet, the full time request may not be needed. HST is the only telescope that can obtain spectra of the far-UV emission below 1900A that are crucial to reach our science goals. By combining this HST program with (new and archival) observations obtained with Swift, NuSTAR, LCO and VLT we will provide a comprehensive account of the black hole accretion state changes during the early onset of AGN activity. These HST/COS data will contribute with unique information to the legacy database on this intriguing object that will undoubtedly spawn new insight on AGN physics, including the extreme variability seen in some objects.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17743
Program Title: Which dust is it? Unveiling Cosmic Mysteries by Redefining Dust and Distance in the Universe

Principal Investigator: Riess, Adam

PI Institution: The Johns Hopkins University

Observations of standard candles are essential in modern cosmology for obtaining precise distance measurements. They form the foundation of our understanding of dark energy, local structures, and the perplexing "Hubble Tension". Nevertheless, the accuracy of these measurements is limited by the prevalent assumption of universal Milky Way dust properties and conflicting indications regarding extragalactic dust. In particular, empirical estimates from SN Ia indicate a far lower total-to-selective extinction ratio (R_V) and thus different dust compared to galaxy-based indicators for the same hosts. This inconsistency and the uncertainties surrounding the nature of the dust obstructing standard candles limits the precision in determining fundamental cosmological parameters such as the Hubble constant and the dark energy equation of state. To address this, we propose an innovative approach to use the wavelength span enabled by JWST and HST to directly and precisely measure the individual reddening laws of the hosts of SN Ia and widely used distance indicators. Our program will observe over 1200 Cepheids in eight key galaxies, using HST to sample the blue side SEDs at 0.4 microns, tripling the present leverage, achieving R_V precision of 0.1 in the mean to resolve the existing discrepancy between SN Ia and galaxy-based measures. Cepheids, with their well-known spectral energy distributions and great luminosity, are ideal "standard crayons" for this purpose. By broadening the wavelength range and doubling the sampling of the reddening curve, we will elucidate the nature of the dust in each host to substantially improve our understanding of its role in cosmological measurements.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17744
Program Title: Reflections of a Violent Past: Using Light Echoes to Survey Historical Supernovae in M82

Principal Investigator: Lawrence, Stephen

PI Institution: Hofstra University

Messier 82 (M82, NGC 3034) is the famous "Cigar Galaxy" undergoing a starburst just 3.5 Mpc away. A spectacular mosaic of the entire galaxy was created by ACS 20 years ago. Here we propose to search for undiscovered light echoes from supernovae (SNe) that exploded as much as 500 years ago. M82 is an active star-forming galaxy expected to host, on average, one SN every ten to twenty years (and has hosted 3 since 2004!). Dust is important for generating light echoes, and M82 has dust distrubuted throughout and above its stellar disk. Even supernovae hidden from our direct view by dust can reveal themselves by illuminating dust in unobscurred directions. Three confirmed SN eruptions have been detected in M82 in the past 20 years. The most recent Ia event, SN 2014J, has a well detected light echo and provides an excellent proof-of-concept for our proposed survey. Our goal is to use HST to detect 15--20 light echoes in M82 via their resolved shapes and rapid proper motions, following Rest et al. (2005). The proper motion vectors will allow us to pair a sub-set of them with known X-ray, optical and radio supernova remnants in M82. Our survey will effectively double the sample of recent extragalactic SNe echoes, and potentially quadruple the number of echoes from historical SNe that erupted prior to the 20th century. This LE sample is the necessary first step to then use HST or ground-based telescopes to obtain spectra of the brighter LEs and thereby classify their parent SNe, creating an unprecedented demographic survey of SNe in a starburst galaxy over the last few centuries---a survey not obtainable by any other means.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17745
Program Title: It Takes Two Planets to Tango: Constraining the Orbit of a Planetary-Mass Binary

Principal Investigator: Theissen, Christopher

PI Institution: University of California - San Diego

We aim to measure the orbit of the plantary-mass (M < 13 M_Jup) binary WISE J135501.90-825838.9, the second-lowest mass (unresolved) binary currently known. This binary was first identified as a "spectral binary," a composite object of two unresolved near-infrared spectra which have the features of two ultracool (T < 1300 K) objects combined into one spectrum. A preliminary RV and parallax solution place WISE 1355-8258 within the AB Doardus kinematic association (150-200 Myr). The WISE parallax + proper motion solution also shows a periodic astrometric signal in the residuals, which is likely due to the orbital motion of the binary. However, higher precision astrometry is needed to constrain the orbital parameters, which has an estimated period of P ~ 1116 days. Using HST/WFC3-UVIS we will obtain a precise astrometric solution for the parallax and proper motion, and constrain the orbital solution in the periodic motion of the astrometric residuals using 10 orbits over the next 2 cycles (6+4 orbits). These measurements will provide the first ever direct mass measurement of a planetary-mass binary. This system will be a touchstone benchmark system for models of planet formation and evolution.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17746
Program Title: Locating Clouds in the Milky Way's Nuclear Outflow

Principal Investigator: Fox, Andrew

PI Institution: Space Telescope Science Institute - ESA

Recent HST/COS observations have discovered outflowing cool gas clouds in the Milky Way's nuclear wind. While their chemical compostion, covering fraction, and kinematics have been characterized, their distance is largely unconstrained, so we do not know where along each line of sight the cool gas clouds are located. Without the distance to the clouds, we cannot definitively associate them with the Fermi or eROSITA Bubbles (the giant gamma-ray and X-ray structures created by a nuclear outburst) or reconstruct the history of the nuclear outflow. We have designed a novel experiment to determine the distance to the cool clouds using HST/COS observations of a sample of six blue horizontal branch (BHB) stars projected onto the Fermi and eROSITA Bubbles. The targets are chosen to lie at a range of distances from 4.7 to 9.5 kpc, with two targets inside the Bubbles and four in the foreground. By bracketing the location of high-velocity clouds (HVCs) seen in UV metal absorption lines (Si II, Si IV, C IV, Fe II) in the BHB spectra, we will determine whether the clouds arise inside or in front of the Bubbles. A detection of HVCs in both the foreground and background sightlines would place the clouds in front of the Bubbles. A detection in the background but not the foreground sightlines would place the clouds within the Bubbles or at their boundaries. We also request deep H I 21 cm spectra of each direction from the Green Bank Telescope to constrain the velocities and locations of the neutral gas in the HVCs, which directly aids our science goals. This experiment provides a method for mapping the spatial distribution of high-velocity gas in the Galactic halo.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17747
Program Title: Tracing star cluster motions from their birth to dispersal in the barred spiral galaxy M83

Principal Investigator: Koda, Jin

PI Institution: State University of New York at Stony Brook

We propose to image the nearby barred spiral galaxy M83 with WFC3 in NUV (F275W; 3x3 tile). The new NUV imaging, in conjunction with the substantial archival coverage in multi-bands (U, B, V, I & Halpha), is an established tool to accurately measure star cluster ages and masses by overcoming the age-extinction degeneracy. In addition, new ALMA CO(1-0) data of the full galactic disk detected 5,724 molecular clouds to their lowest mass of 10^4Msun, and set a stage for substantial statistical analyses at every subregion within the disk. Combined with this largest and most complete cloud catalog in any external galaxy, the cluster distribution, and their spread with age, will reveal the emergence of star clusters in molecular clouds -- where and which molecular clouds can form clusters, what the cloud-cluster mass relation is, whether young clusters disperse their parental clouds or they simply drift away from the clouds, and how they disperse and merge into large-scale galactic structures and dynamics. The last point will be analyzed in relation to the debate on the origin of spiral arms --whether spiral arms are steady, long-lived structures supported by the classic density-wave theory, or transient, short-lived structures continuously generated and dispersed by swing amplification.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17748
Program Title: HST Observations of the Most Energetic and Luminous Optical Transient AT 2021lwx aka Scary Barbie

Principal Investigator: Subrayan, Bhagya

PI Institution: Purdue University

AT 2021lwx (aka "Scary Barbie") is an ultraluminous, long-duration (500 days in rest frame), energetic transient of unclear origin at a redshift of 0.9945. With an estimated pseudo-bolometric peak luminosity of log (L/[erg/s]) = 45.7 and a radiative energy of over 10^53 erg, AT 2021lwx represents one of the most energetic and luminous transients ever observed, and, impressively, is still evolving. Modeling of AT 2021lwx suggests that it is associated with the tidal disruption of a 14-15 solar mass star by a supermassive black hole (SMBH) of order 10^8 solar masses, or accretion of a giant molecular cloud (GMC) onto a dormant 10^8 to 10^9 solar mass SMBH. AT 2021lwx is an excellent laboratory to understand extreme accretion scenarios associated with SMBHs, yet intriguingly no host galaxy has been detected. We request two orbits of HST/WFC3 observations and one orbit of NUV spectroscopy with STIS, to image AT 2021lwx, search for its host galaxy, and map signatures of outflows. These observations will resolve any extended galaxy structure surrounding the transient, further enabling characterization of its properties. Pinpointing the location of AT 2021lwx relative to its host galaxy is a fundamental test of current interpretations. Our time-sensitive observations are necessary during Cycle 32 because the transient is fading consistently. The NUV spectroscopy will provide much needed diagnostics of outflowing material from accretion processes. Extending coverage to rest-frame Ly alpha is especially important, since the total power emitted at this line can significantly constrain radiative transfer models.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17749
Program Title: A UV IFU in Space: Observations of AGN Feedback and Star Formation in NGC 1068

Principal Investigator: Fischer, Travis

PI Institution: Space Telescope Science Institute - ESA - JWST

Energetic feedback from Active Galactic Nuclei (AGN) is a key influence on galaxy formation, but the physical processes that transport energy and matter from the black hole to the nearby interstellar and circumgalactic gas are highly uncertain. This proposal will use the unique powers of HST to directly address several complex, outstanding questions about AGN feedback. With 70 orbits of STIS G140L, and a long slit, we will produce a comprehensive pseudo-Integral Field Unit (IFU) map of NGC 1068, the prototypical Type 2 Seyfert galaxy. Our observational objectives are to (1) uniformly map key emission lines for detailed diagnostics of highly ionized and excited gas that are only visible in the far-UV, (2) simultaneously map the radiation field from the AGN and the young stellar populations, source by source, and (3) build a multi-dimensional ionization/kinematic map over 0.5 x 1 kpc at 10 pc resolution. This map will resolve the dynamic interplay between radiation and kinematic feedback from AGN and star formation and enable several interrelated scientific outcomes. We will (1) quantify the budget of kinetic energy and radiation flowing into the interstellar medium, (2) validate and calibrate *resolved* emission-line diagnostics that are used to trace AGN vs. star formation in unresolved galaxies seen by JWST, (3) provide a ground truth for models and simulations of AGN feedback at higher spatial resolution than state-of-the-art simulations, and (4) pioneer far-UV IFU-like mapping of nearby galaxies, a key science instrument capability expected for the future Habitable Worlds Observatory.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17750
Program Title: Tracing the Formation Mechanism Behind the BZ Cam' Bow Shock

Principal Investigator: Ilkiewicz, Krystian

PI Institution: Astronomical Observatory of the University of Warsaw

BZ Cam is one of only three cataclysmic variables with bow shocks known. Recent observation revealed that the morphology of the BZ Cam bow shock is more complicated than previously thought, posing a challenge to the models of formation and structure of bow shocks. While the BZ Cam bow shock was detected in the UV range, it was never observed with UV spectroscopy. Here we propose to obtain HST STIS spectroscopy of the bow shock, which could reveal the emission mechanism of UV radiation. This will reveal the nature of its complex morphology, and in turn enhance our understanding of bow shocks in general. Depending on what the observations will reveal, the HST spectrum could shed light on the energy/mass release processes in cataclysmic variables outflows, impacting our models of binary evolution and accretion physics. Alternatively, it may provide insights into the impact of cataclysmic variables on the nearby interstellar medium, influencing our understanding of galactic chemistry and the broader context of galaxy evolution.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17751
Program Title: Imaging a monster: HST observations of the asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito)

Principal Investigator: Monsch, Kristina

PI Institution: Center for Astrophysics | Harvard & Smithsonian

We propose the first sub-arcsecond imaging campaign of the giant, asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito/DraChi) to study its dust grain structure and evolution from 0.4-1.7 microns. DraChi is enormous: spanning ~14" on the sky, it is far in excess of any average protoplanetary disk extents, making it the largest protoplanetary disk thus far discovered. Moreover, this disk is highly asymmetric, yet has only been imaged at low resolution from the ground with Pan-STARRS. These images show not only two faint filaments in the disk's northern part that extend well beyond 20", but also various brightness asymmetries. We propose the imaging of this enigmatic disk in only three HST orbits using the WFC3/UVIS broadband filters F438W, F606W and F814W and the WFC3/IR broadband filters F105W, F125W and F160W to map at unprecedented angular scales the wavelength dependence of the disk's midplane thickness, determine the dust grain properties and the degree of their vertical settling and ultimately probe the extent to which ongoing planet formation is driving DraChi's asymmetric substructures.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17752
Program Title: Exploring the Origin of Gas in Debris Disks around A and B-type Stars

Principal Investigator: Brennan, Aoife

PI Institution: University of Dublin, Trinity College

Debris disks, which evolve from protoplanetary disks, were traditionally thought to be dust-poor and devoid of gas. However, recent ALMA surveys have revealed that at least 20 debris disks contain gas. Understanding the prevalence, origin, and evolution of this gas is crucial for studying the planetary systems' formation and evolution. The two leading origin theories propose that either the gas is primordial and therefore a remnant of the previous protoplanetary stage or second-generation and produced by the collisional cascade process. Thus far, the only detected molecule is CO, which quickly photodissociates if unshielded, producing neutral carbon (C I). In a primordial scenario, H2 shields CO against photodissociation, while in a secondary scenario, C I plays a pivotal role as a shielding agent. Our proposal aims to conduct a comprehensive survey of CO and C I gas in edge-on debris disks orbiting A and B-type stars, targeting seven disks not already observed by HST at sufficient sensitivity. Leveraging the sensitivity of HST/STIS far-UV absorption spectroscopy, we seek to detect cold gas co-located with dust disks at tens of AU. By detecting multiple transitions of CO and C I, we aim to accurately constrain their column densities and temperatures along the line of sight. We will then explore the systematic relationship between the C I/CO ratio and C I column density to determine whether C I is shielding CO in the high CO debris disk population, thereby confirming or refuting a secondary origin for the high CO mass disk population.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17753
Program Title: Binarity and Accretion Processes in AGB Stars: A UV Study of pi1 Gru

Principal Investigator: Sahai, Raghvendra

PI Institution: Jet Propulsion Laboratory

The dramatic changes in the geometry and dynamics of the mass-ejection during the death throes of most stars that evolve in a Hubble time (i.e., with initial masses ~1-8 Msun), are widely believed to be due to binarity-induced formation of bound disks that power high-speed collimated jets. But observational evidence of this process are lacking. We propose to obtain multi-epoch UV spectra of the nearby (160 pc) late-spectral-type AGB star, pi1 Gru, that belongs to a newly-discovered class of AGB stars showing strong (and often variable) FUV fluxes -- suggestive of variable accretion of matter onto an accretion disk in a binary system. A STIS spectroscopic study of the prototype of this class, Y Gem, showing the presence of flickering and high-velocity infall and outflows, supports this hypothesis. ALMA observations of pi1 Gru reveal strong departures from spherical symmetery in its dusty molecular wind (spiral structure, fast polar bubbles) and the presence of a close companion at ~6 AU, confirmed by optical imaging using SPHERE/ZIMPOL. We will use the UV spectra of pi1 Gru to fit the UV continuum and derive the temperature and size of the accretion hot-spot. Using CLOUDY modelling, we will fit the emission lines to provide constraints on the physical parameters of the accreting flow. The line profiles, if resolved, will reveal the nature of the companion star. Our study will probe the early formation phase of bound disks in binary AGB stars, and provide valuable insights into the binary-induced accretion processes that make such disks, which have long been theorized to drive collimated outflows that produce aspherical morphologies in post-AGB objects.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17754
Program Title: Hydrogen-deficient central stars of planetary nebulae: testing the post-AGB evolution and s-process production

Principal Investigator: Todt, Helge

PI Institution: Universitat Potsdam

Asymptotic-giant-branch (AGB) stars are the primary production sites for carbon and s-process elements in the Universe. After leaving the AGB, such a star eventually becomes the central star of a planetary nebula (CSPN). In most cases the nuclearly processed material remains trapped beneath a hydrogen-rich envelope. However, about 20% of CSPNe display H-deficient and helium- and carbon-rich atmospheres. They have emission-line spectra, resembling those of massive Wolf-Rayet stars, and are classified as [WC] objects. Their spectra indicate strong mass-loss, delivering carbon and heavy elements to the interstellar medium and future stellar generations. How these [WC]-type CSPNe lost their hydrogen, by blowing off their envelopes, and/or by ingesting them, is still poorly understood. Various evolutionary scenarios, involving helium-shell thermal pulses, predict very distinct chemical compositions. Spectroscopic analyses are needed to decide between these scenarios, and to quantify chemical feedback from these stars. Such analyses are best carried out using UV spectra, which are crucial both for stellar-wind modeling and for quantitative determination of chemical abundances. However, UV data of sufficient quality exist only for a very few [WC]-type CSPN. We propose to obtain UV spectra for a comprehensive sample of 13 [WC]-type CSPNe, using COS and STIS (23 HST orbits), and covering all of the subtypes of [WC] stars. For the analysis, we will use state-of-the-art non-LTE model-atmosphere codes, which account for complex model atoms, and will provide abundances for key chemical elements. The UV data will be complemented by optical spectra, already available.

Proposal Category: SNAP
Scientific Category: Solar System Astronomy
ID: 17755
Program Title: An HST Snapshot test of a long-standing mystery in the outer Solar System

Principal Investigator: Trilling, David

PI Institution: Northern Arizona University

The outermost region in our Solar System retains pristine signatures of planetary system formation and evolution. Centaurs -- objects on dynamically unstable orbits between Neptune and Jupiter -- show, not a continuum of colors, but two distinct surface colors: more red, and less red or "blue." Two rival hypotheses can explain this Centaur color dichotomy. The first hypothesis is that a thermal gradient in the protoplanetary disk led to a compositional gradient for primordial bodies. The second hypothesis is instead that the color dichotomy is a result of recent surface evolution. In this case, for some Centaurs, sublimation of volatile material may have resulted in the accumulation of fresh "blue" material that has buried ancient radiation-reddened surfaces. Here we propose a novel method to test the idea that activity is responsible for the two color groups of Centaurs. We will use the exceptional angular resolution and sensitivity of HST to detect or set stringent upper limits on the presence of activity for Centaurs, far exceeding limits that can be achieved from ground-based telescopes. We will observe up to 62 Centaurs in a snapshot (SNAP) program. If we find activity only among blue Centaurs, we will confirm that activity is responsible for this color. If we find activity among both red and blue Centaurs at approximately the same rate, the interpretation points instead to an explanation relating to cosmochemical formation in the protoplanetary disk. This program will contribute significantly to the total number of known active Centaurs. This project can only be carried out with HST, and SNAP is an ideal mechanism to collect this data.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17756
Program Title: Quantifying the Link Between the UV Upturn in Elliptical Galaxies and Multiple Stellar Populations In Globular Clusters

Principal Investigator: Goudfrooij, Paul

PI Institution: Space Telescope Science Institute

Recent spectroscopic studies of nearby early-type galaxies (ETGs) revealed unexpected stellar population properties, with light-element abundance ratios [N/Fe] and [Na/Fe] that increase with galaxy mass. This galaxy mass dependence is reminiscent of the "UV upturn" at far-UV wavelengths in ETGs, which is produced by very hot (Teff > 20,000 K) extreme horizontal branch stars that likely have supersolar helium abundances. We propose to test the hypothesis that these mass-dependent light-element abundance varations in He, N, and Na within and among ETGs are physically connected and produced by dissolution of relatively massive, metal-rich globular clusters (GCs), since the latter objects represent the only galactic environment where mass-dependent enrichment of He, N, and Na is known to occur (the "multiple stellar populations" phenomenon). To this end, we propose to obtain deep WFC3/UVIS images of a representative sample of nearby ETGs, spanning the observed range of UV upturn strengths. We will use the F275W and F390W passbands, which provide sensitive probes of the abundances of He and N in integrated-light measurements. When combined with existing archival ACS optical photometry of the same galaxies, we will be able to characterize the enrichment of He and N as a function of galactocentric radius and ETG mass, and in their GC populations themselves as well. This study will be the first to evaluate the level of He- and N-enrichment of the inner regions of ETGs by stars that escaped from massive GCs, which could provide an eye-opening, yet simple, explanation of both the UV upturn and the non-solar abundance ratios of light elements seen in the central regions of ETGs.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17757
Program Title: Probing the front-side of the Circumgalactic Medium of the Large Magellanic Cloud

Principal Investigator: Mishra, Sapna

PI Institution: Space Telescope Science Institute

Recent simulations and observations have provided evidence for a warm-hot phase of the Large Magellanic Cloud (LMC)'s circumgalactic medium (CGM), known as the Magellanic Corona. This Corona shields the LMC from the effects of ram pressure stripping by the Milky Way (MW), but to date, all observations of the Corona have been on the back-side of the LMC CGM. Here we propose 29 orbits of HST/COS G130M/G160M spectroscopic observations of 5 recently-discovered low-latitude (|b|<30 degrees) UV-bright quasars to observe the front-side of the LMC CGM. Aiming to explore both warm-hot and cool phases of the LMC CGM through high and low ion UV metal absorption lines, our goals are to: (1) Detect and characterize the LMC CGM on the uncharted front-side. (2) Compare the LMC CGM between its backand front-sides, providing novel insights into the dynamics of interacting galaxies. (3) Combine these observations with hydrodynamical simulations to constrain the properties of MW CGM, Megellanic CGM, and bow shock region. This research promises to advance our understanding on the ongoing evolution of the interacting galaxies within the Local Group.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17758
Program Title: Radio Jet-driven AGN Feedback in Dwarf Galaxies: A Pilot Study

Principal Investigator: Liu, Weizhe

PI Institution: University of Arizona

It is still under debate whether stellar feedback can effectively shape the evolution of dwarf galaxies as expected. There is growing evidence, both observational and theoretical, that feedback from active galactic nuclei (AGN) may also contribute to the evolution of dwarf galaxies. Indeed, energetic outflows have been discovered in some dwarf galaxies with AGN, which can provide feedback to their dwarf hosts. In addition to such outflow-driven feedback, radio jet-driven feedback is the other one of the two fundamental forms of AGN feedback. Radio jet is also deemed an important mechanism for the launch of some powerful outflows. A close examination of the radio jet-related feedback is essential for a more comprehensive understanding of AGN feedback in dwarf galaxies. So here we propose to map the [O III]-emitting gas and examine radio jet-driven feedback and its relation to the rapid outflow in a dwarf galaxy with the most extended radio jet known in such systems, using high spatial resolution (~50 pc) ACS imaging and STIS long-slit spectroscopy. Our main objectives are: (1) characterize the role of the radio jet in driving the outflow; (2) examine the interaction between the radio jet and the interstellar medium; (3) obtain the dynamics of the outflow; (4) evaluate the overall impact from the radio jet and the outflow on the evolution of dwarf galaxies.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17759
Program Title: Discovery of Extremely Faint Galaxy Candidates out to the Edge of the Local Group

Principal Investigator: McQuinn, Kristen

PI Institution: Space Telescope Science Institute

The smallest galaxies in the universe play an important role in understanding structure formation at all scales. They inform us about the the build-up of more massive galaxies, test our understanding of the coupling of baryon and dark matter physics, and can place critical constraints on our understanding of the epoch of reionization. Yet, because of their paltry stellar content, these systems are incredibly faint and difficult to find. To date, nearly all ultra-faint dwarfs that have been detected are in close proximity to the Milky Way (making them easier to find) or are satellites of another massive galaxy (where searches can be targeted). This has limited our understanding of ultra-faint dwarfs to a single type of environment, which rarely turns out to be representative. We have discovered 6 ultra-faint dwarf candidates within the Local Group that appear to lie at distances from the MW and M31 that are beyond the virial radius, the traditional definition of "satellite" (i.e., > 400 kpc). If confirmed, these systems will provide unique insights into the growth and evolution of ultra-faint dwarfs that reside in relatively isolated environments and that are not satellites. We request 1-orbit of HST imaging per candidate to confirm and characterize these systems. The data will enable robust measurements of distances, structural parameters, integrated magnitudes, and star formation histories.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17760
Program Title: Far Ultraviolet Doppler Tomography of a T Tauri Dipper Disk

Principal Investigator: Gaidos, Eric

PI Institution: University of Hawaii

To understand the formation of the thousands of planets discovered on close orbits around other stars, protoplanetary disks kindred to the ones which gave rise to these systems must be studied at <1 au scales. The inner regions of most disks cannot be spatially resolved, but they can be studied by their line-rich UV spectra, and with time-series observations that capture variability on the timescale of orbits in the inner disk. We propose multi-epoch far ultraviolet (FUV) spectroscopy of the T Tauri ``dipper'' star EP Chamaeleontis (RECX-11) with HST and COS when the Transiting Exoplanet Survey Satellite monitors the star in the optical for 27 days during Cycle 32. RECX-11 exhibits persistent quasi-periodic dimming due to dusty structures close to the star; these may also shadow the disk, producing its observed infrared variability. An FUV spectrum of EP Cha contains Lyman alpha-pumped fluorescent lines from molecular hydrogen in the inner disk gas, and the profiles of these lines contain velocity information uniquely resolvable by COS. Partial shadowing of the disk will induce periodic shifts and distortion of line profiles detectable in time-series spectra, and spatial information about the shadows and disk geometry can be retrieved by a ``tomographic'' analysis. By performing these observations in parallel with TESS this shadowing can be related to the structures responsible for dimming. We will also use the line intensities to reconstruct the Lyman-alpha irradiation and any variation due to intervening gas. This investigation will harness the unique capabilities of HST and build on the Ultraviolet Legacy Library of Young Stars as Essential Standards (ULLYSES).

Proposal Category: GO
Scientific Category: Galaxies
ID: 17761
Program Title: Mg II maps to reveal how ionizing photons escape local LyC emitting galaxies

Principal Investigator: Leclercq, Floriane

PI Institution: University of Texas at Austin

Upcoming observations aim to constrain the soures of cosmic reionization, but the high-redshift intergalactic medium precludes direct observations of ionizing photons (or LyC photons). Alternative methods must indirectly estimate the escape of ionizing photons from high redshift galaxies. The extragalactic community has invested vast resources to amass a collective sample of 90 nearby galaxies with ionizing continuum observations. However, these reveal an unsettling fact: while the observed LyC escape fraction correlates with indirect indicators, there is substantial scatter. Indicators cannot infer the escape fraction of individual galaxies. Here, we propose 31 orbits of HST/ACS ramp-filter imaging to determine if geometry drives this scatter. We will map the Mg II, [O II], and [O III] at <250 pc resolution in 5 galaxies with LyC observations and pre-existing seeing-limited ground based IFU. Our targets show compact/unresolved configurations of both neutral and ionized gas, span similar ranges in [OIII]/[OII] line flux ratio and Lyman alpha peak separation, but have a factor of 30 difference in the observed LyC escape fractions (fesc(LyC)~3-90%). The spatial resolution of the IFU data does not probe the location where the LyC is detected and therefore cannot explain such a high factor difference. Higher resolution HST observations must reveal the impact of the HI geometry on LyC leakage. These maps will (1) stringently explore the role of geometry in the escape of LyC, (2) uncover the origin of the scatter in indirect LyC indicators, and (3) guide how JWST can use indirect tracers to infer the LyC escape fraction at high redshift.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17762
Program Title: Contribution of Non-thermal H to the Martian Water Loss at Solar Maximum

Principal Investigator: Bhattacharyya, Dolon

PI Institution: University of Colorado at Boulder

Determining the total amount of water lost by Mars over its ~4.3 billion year history has been the subject of contention in the Mars community for the past few decades. Recent advances led to the discovery of a magnitude change in water escape rate during the perihelion season every Mars year. This has increased the initial estimates of the total amount of water lost by Mars from 3.6m of Global Equivalent Layer (GEL) to 23m, an increase by a factor of 5. Another recent discovery with HST has been detecting the observational signature of non-thermal/hot H in the exosphere of Mars. The escape rate of such atoms was found to be ~26% of the thermal escape rate at solar minimum, further elevating the water loss estimates from Mars. Data analysis revealed that solar wind is the major driver in the creation of this population. At present the effect of solar activity on the creation of hot H at Mars and the consequence on water escape rate is unknown. Hence the proposal is to determine the correlation between non-thermal H escape rate and solar activity at Mars. Characterizing this population is critical as hot H atoms are present in the exospheres of all solar system planets and likely exoplanets as well. Because the younger Sun was more active, and there are many exoplanetary systems with active star hosts, escape of hot H could have important implications on the habitability and water escape history of planets. This proposal supports the HST UV initiative.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17763
Program Title: Calibrating the white dwarf cooling chronometer: the effect of residual thermonuclear burning

Principal Investigator: Ferraro, Francesco

PI Institution: Universita di Bologna

White Dwarfs (WDs) are electron-degenerate structures commonly assumed to evolve via a pure cooling process, with no stable thermonuclear activity at work. Their cooling rate is adopted as cosmic chronometer to constrain the age of several Galactic populations, including the disk, globular clusters (GCs) and open clusters. Indeed, hundreds of HST orbits have been invested to explore the WD cooling sequence in Milky Way stellar systems. However, the investigation of the brightest portion of the WD luminosity function (LF) in a few GCs (M3, M13, NGC 6752 and M5), has recently unveiled an unexpected over-abundance of WDs in M13 and NGC 6752. Theoretical models suggest that, consistently with the blue-tail horizontal branch morphology of these clusters, the observed overabundance is due to a population of slowly cooling WDs, i.e., WDs fading more slowly than in a pure cooling process thanks to an extra-energy source provided by stable thermonuclear burning in their residual hydrogen-rich envelope. Of course, the presence of WDs fading at a different (slower) rate than usually assumed has a crucial impact on the use of the cooling sequence as cosmic chronometer. Theoretical models predict that the cooling time delay reaches its maximum value in the extreme metal-poor regime ([Fe/H]=-2.3), where it is expected to reach values as large as 1.5 Gyr. To empirically verify this prediction, and thus provide a direct calibration of the WD chronometer in the most critical metallicity regime, here we ask to secure ultra-deep UV observations to sample the WD cooling sequence in M15, an extremely metal-poor GC with pronounced blue tail horizontal branch.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17764
Program Title: Unraveling Red Supergiant Mass Loss with Early FUV Spectra of a Type IIP/L Supernova

Principal Investigator: Bostroem, Kyra

PI Institution: University of Arizona

During the red supergiants phase, the progenitors of hydrogen-rich Type IIP/L supernovae undergo substantial mass loss. However, there is no first principle theory that predicts the mass-loss rate. Furthermore, prescriptions based on observations vary by orders of magnitude. Additionally, observations of supernovae during the early evolution, can show evidence of even higher mass-loss rates occurring just prior to explosion, although it is unknown what fraction of supernovae this occurs in. While optical spectra can detect the highest mass-loss rates via narrow high-ionization lines that disappear within 2 weeks of explosion, the ultraviolet is sensitive to the full range of possible mass loss, with the majority of strong resonance lines occurring in the far ultraviolet (FUV) as well as continuum emission from the ejecta's interaction with circumstellar material. In this way, FUV spectra can be used to characterize the density, location, and composition of the circumstellar material. Despite these strong indicators, only one Type IIP/L supernova has been observed in the FUV within a week of explosion. This is because only about one Type IIP/L supernova per year is discovered young, unextincted, and close enough for FUV study and these observations require a disruptive ToO to execute. We propose a disruptive ToO to obtain FUV and NUV observations of an infant, nearby, Type IIP/L supernova to understand the red supergiant mass loss and the diversity of supernovae in the UV. Beyond the local universe, these observations are critical for understanding the high redshift supernovae, which may be some of the first single objects observable in the early universe.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17765
Program Title: GHOSTBUSTERS: Determining the origin of tidal disruption events with a high-resolution survey of their host galaxies

Principal Investigator: Nicholl, Matt

PI Institution: The Queen's University of Belfast

Tidal disruption events (TDEs) of stars by supermassive black holes offer an unprecedented opportunity to map the properties of otherwise quiescent (and intermediate mass) black holes, including their mass distribution, occupation fraction, and growth over cosmic history, as well as studying disk formation, accretion and the launching of jets in real time. However, the observed properties of TDEs have posed several challenges, chief among which is the unexpected nature of their host galaxies. Up to 30% of TDEs occur in quiescent Balmer-strong (or post-starburst) galaxies - a class that makes up ~1% of the general galaxy population. Explanations include disturbed radial density profiles, nuclear starbursts, and recent mergers, but distinguishing between these channels is only possible by resolving structure on scales <100 pc. We propose a new survey, Galaxies HOSting Tdes: BUlges, STarbursts and mergERS (GHOSTBUSTERS), to fully map the properties of TDE hosts with a volume-limited sample out to ~200 Mpc, increasing by a factor 6 the TDE host sample with HST imaging and halving the median distance. Maximising the UV and high-resolution abilities of HST uniquely allows us to (i) measure the radial density profiles and stellar mass within <100pc of the SMBH, determining whether central over-densities drive the TDE rate; and (ii) map the spatial distribution of star formation to determine whether it shuts off from the inside-out or outside-in, and whether any residual star-formation is important to the rate of TDEs, and (iii) detect low surface-brightness features (shells, tails) indicating past mergers, while deliver a legacy data set with high value to the community.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17766
Program Title: Direct imaging of a catastrophic exosolar planetesimal collision in real time with HST/STIS

Principal Investigator: Kalas, Paul

PI Institution: University of California - Berkeley

A fundamental process in the formation and evolution of planetary systems involves constructive and destructive collisions. These are rarely observed in real time except in the solar system. Otherwise, collisional processes are invoked theoretically and numerically to explain observations. For exosolar planetary systems, dusty debris disks are the outcome of destructive collisional processes among planetesimals. In the Fomalhaut system, the HST-detected source known as Fomalhaut b has been interpreted as a direct imaging observation of a fresh dust cloud produced by a catastrophic planetesimal collision in 2004. Various studies examined its dimming over time, changes in morphology, and radial acceleration. Here we show observations of Fomalhaut made with HST/STIS in 2023 that reveal a new source similar in brightness to Fomalhaut b appearing along the inner edge of the dust belt at 133 au. If the catastrophic collision hypothesis is correct, Fomalhaut "b2" is predicted to expand in size due to radiation pressure and Keplerian shear, become fainter, and follow a trajectory that initially appears Keplerian and evolves to radial. We propose a multi-cycle HST/STIS campaign to measure changes in Fomalhaut b2's position, brightness, and morphology over three years, as well as to monitor for any new collisions. Because the phenomenon is extremely faint in the optical, HST is the only observatory capable of tracking the evolution of a catastrophic planetesimal collision in real time. The findings will provide exceptionally rare empirical data for distinguishing between different theories on the dynamics of Fomalhaut's planetary system and collisional processes in general.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17767
Program Title: Unveiling TDE Accretion Disks at Late Times with UV Spectroscopy and XMM-Newton

Principal Investigator: Chornock, Ryan

PI Institution: University of California - Berkeley

The tidal disruption of a star by a supermassive black hole produces broadband emission as the debris forms a disk and accretes. Most previous work has focused on observations near maximum light when the accretion disk may be obscured by a reprocessing layer. However, recent observations have shown that long-lived UV plateaus may be common in these events at late times as the unobscured accretion disk becomes visible. We propose the first STIS UV spectroscopic observations on these timescales combined with XMM-Newton observations to diagnose the properties of the accretion disk, the spectral shape of the ionizing continuum, and how these are reflected in the broad emission lines. These observations will open a new window of investigation into late-time multiwavelength properties of TDEs and will strengthen connections between previous work on AGN accretion and newly formed TDE accretion disks.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17768
Program Title: Detecting the UV Accretion Signatures from PDS-70b

Principal Investigator: Flagg, Laura

PI Institution: Cornell University

Accretion is an essential step in gas giant planet-building and measuring the accretion rate illuminates the nature of planet-disk interactions as well as the timescale for and the process of planet formation. While there are numerous models for how planets may accrete material from the circumstellar disk in which they form, there is little consensus about the specifics given the lack of direct observational evidence. PDS-70b (a ~5 Myr-old giant planet) has had its accretion luminosity measured at H-alpha and in the continuum at 335 nm. However, the accretion rates derived from these measurements range over 2 orders of magnitude. For stars, the most accurate accretion indicators are shortward of 300 nm, as these more directly probe the accretion shock where infalling material impacts the surface. Similar observations of accreting planets are needed to better test whether an analogous process occurs in planet formation. We propose to observe PDS-70b between 120 nm and 300 nm at low resolution to search for accretion signatures in the UV to better constrain the accretion process on PDS 70b and measure a reliable accretion rate. We will observe PDS-70b at H-alpha both before and after each UV observation so we can calibrate the relationship between accretion signatures at H-alpha versus the UV, as is done for stars. We will also observe PDS-70b at medium resolution from 276 to 285 nm to measure the accretion line profile and constrain the planet's mass, a key quantity needed to reliably measure the accretion rate. These observations will provide some of the first UV observational data of planet accretion and will result in new and important insights into planet formation.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17769
Program Title: The UVOIR portrait of PSR J0030+0451, the key millisecond pulsar

Principal Investigator: Pavlov, George

PI Institution: The Pennsylvania State University

PSR J0030+0451 is a nearby single radio, X-ray and gamma-ray millisecond pulsar, which has never been studied in the UV-optical-IR (UVOIR). This pulsar turned out to be the best target for measuring neutron star mass and radius with the X-ray NICER mission, using the effects of bending of photon trajectories in a strong gravitational field. Such measurements are very important for understanding the equation of state of the superdense matter in neutron star interiors, determined by strong interactions of hadrons. The mass and radius are obtained from the analysis of the pulsations of thermal soft X-ray emission coming from ``hot spots'' on the neutron star surface, heated by relativistic particles precipitating from the pulsar's magnetosphere along the magnetic field lines. The pulse shape (hence the inferred mass and radius) critically depend on the positions of the heated regions and the temperature distribution over the neutron star surface. To understand this distribution, one should analyze not only soft X-ray but also far-UV (FUV) pulsations. Such pulsations could be detected with HST, but one should know the average thermal FUV flux to determine the needed exposure. We propose a short exploratory program to estimate the average neutron star surface temperature from measuring UVOIR fluxes in three bands. The estimated temperature will be compared with the predictions of neutron star cooling/heating models, which will give us independent constraints on properties of the superdense matter.

Proposal Category: SNAP
Scientific Category: Stellar Physics and Stellar Types
ID: 17770
Program Title: Unveiling the Progenitors of Interacting Supernovae with Resolved Host Galaxy Imaging in the Rest-Frame UV

Principal Investigator: Hiramatsu, Daichi

PI Institution: Harvard and Smithsonian Center for Astrophysics

Core-collapse supernovae (SNe) exhibit broad observational diversity that relates to the state of the progenitor stars and their environments at the time of explosion, as well as to the predominant source of energy. Progenitors include supergiants that retain their hydrogen envelopes (Type IIP/L SNe) and stars with various levels of envelope stripping (Types IIb, Ib, Ic, superluminous SNe, and long gamma-ray bursts), while energy sources include hydrogen recombination, radioactive decay, central engines, and interaction with a circumstellar medium (CSM). In this context, the progenitors of Type IIn SNe are of particular interest, but remain poorly characterized. Type IIn SNe are powered by SN-CSM interaction, and their diverse light curves point to a broad range of progenitor mass-loss histories. Only a handful of Type IIn SNe have pre-explosion images, and thus like other SN types, we must gain insight into their progenitors using high-resolution rest-frame UV imaging of their host galaxies to probe the environments that give rise to their progenitors. Similar HST-based studies of other SNe and gamma-ray bursts have led to samples of ~100 events per class, but no such data set is available for Type IIn SNe. Here we propose the first HST WFC3/UVIS snapshot program to alleviate this gap, targeting 222 Type IIn SN hosts (with an anticipated completion rate of ~70%). This data set will allow us for the first time to: (i) situate the environments of SNe IIn in the context of other SN types, and (ii) explore correlations between the environments, SN properties, and progenitor mass-loss histories. Both will provide critical insight into the unknown progenitors of Type IIn SNe.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17771
Program Title: Completing the picture of high-ionization UV emission powered by the most metal-poor massive star populations

Principal Investigator: Senchyna, Peter

PI Institution: Carnegie Institution of Washington

With JWST spectroscopic samples expanding at z>6, a mysterious class of object is becoming ever more commonplace. Several extremely prominent CIV emitters (>20A equivalent width) glimpsed prior with ground-based facilities have been confirmed; and alongside this emission, JWST has revealed peculiar emission in NIV] suggestive of nitrogen enhancements. Even more surprisingly, similar signatures have now been established in other galaxies including the two most luminous systems spectroscopically confirmed at z>10. This emission has invoked significant debate and its origins remain unclear; but HST is poised to shed light on this mystery. After over a half-decade long search, HST/COS has finally identified two nearby galaxies that power CIV >20A, at the lowest metallicities (<5% solar) and youngest ages (<~2 Myr effective ages). These galaxies represent our best hope of understanding the processes underlying this emission at z>6, but only limited conclusions can be drawn from a sample of two. Here we propose to target the brightest remaining sources known at these youngest ages and lowest metallicities, and increase the sample of these best reionization-era analogues to five. By extending observations to targets at similar ages and metallicities but with a range of gas conditions, we will place the firmest possible statistical constraints on the ionizing spectrum and enrichment powered by the youngest extremely metal-poor stellar populations. These observations will complete the baseline critical for interpreting the spectra of the highest-redshift galaxies, and cement this sample as legacy benchmarks for the next generation of stellar population synthesis model development.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17772
Program Title: Probing Red Supergiant Mass Loss 100-200 Years Before Explosion using UV Spectra of the Extraordinary SN 2023ixf

Principal Investigator: Bostroem, Kyra

PI Institution: University of Arizona

Mass loss in red supergiants is currently a topic of much debate, with proposed rates between 10^-7 and 10^-1 solar masses per year and hints of periods of enhanced mass loss which may be more prevalent as the red supergiant approaches explosion. However, observations of red supergiants tend to probe thousand of years prior to explosion while optical observations of the supernova probe the final 5 years and are only sensitive to the highest levels of mass loss. About 50 days after explosion, Lyman-alpha and Mg II emission lines form when there is interaction between the supernova ejecta and circumstellar medium, even when the optical is indistinguishable from a non-interacting supernova. These lines are extremely sensitive to all levels of circumstellar interaction, however, as the UV is very faint, obtaining these observations requires a very nearby supernova. On May 19, 2023, SN 2023ixf was discovered at 6.9 Mpc. Early spectra showed narrow, high-ionization emission lines characteristic of dense, confined circumstellar material which disappeared within a week. With a non-detection less than 24 hours before and rapid classification, this very nearby supernova was observed in exquisite detail from gamma rays to radio, including with HST in the UV starting just 3.5d after explosion and continuing through ~300d after explosion. With these observations, we can map out the mass-loss history of the red supergiant progenitor out to 75 years before explosion. Here, we ask for two epochs of FUV and NUV spectra, taking our mass-loss history of the progenitor star to ~200 years before explosion, giving us an unprecedented and detailed view of mass loss in a red supergiant.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17773
Program Title: Searching for Once-Oceanic Salts on Charon with HST/STIS

Principal Investigator: Trumbo, Samantha

PI Institution: Cornell University

The New Horizons mission revealed that Charon could be an example of an "extinct ocean world", whose once liquid layer has completely frozen. The extensive tectonism and smooth plains on Charon are consistent with the pressure-driven resurfacing of a freezing subsurface ocean, and suggest that once-oceanic materials could have reached the surface. Intriguingly, Charon's infrared spectrum shows evidence for widespread ammoniated material suggested to be possible ammonia hydrates or, most recently, ammonium salts like NH4Cl, both of which could have become concentrated as the subsurface liquid froze. While this interpretation from just the infrared data is ambiguous, visible-wavelength spectra sensitive to absorptions from irradiation-induced crystal defects known as "color centers" provide a diagnostic means of salt detection that has been successfully implemented for Europa, Ceres, and Mars. Both the proposed NH4Cl on Charon and the NaCl detected on these other bodies should form during the freezing of NH4-, Cl-, and Na-bearing brines and, thus, are plausible surface materials for Charon. Both salts exhibit strong color-center absorptions across the 300 - 550 nm wavelengths that have remained totally unexplored for Charon in the nearly 50 years since its discovery. We propose a simple, single-orbit program with HST/STIS that will provide the first-ever spectral coverage of Charon across these wavelengths and enable a robust search for these salt color-center absorptions. This single-orbit request has the potential to transform our understanding of the connection between Charon's long-changed internal structure and its modern-day surface.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17774
Program Title: Multiphase gas in eROSITA-detected galaxy groups and clusters

Principal Investigator: Burchett, Joseph

PI Institution: New Mexico State University

Galaxy groups and clusters can be brutal environments for galaxies' star formation, as the hot (>10^6 K) gas permeating these massive halos can readily remove galaxies' cool (<10^4 K) gas reservoirs and prevent fresh cool gas from fueling. However, studying these inherently multiphase environments from a multiphase perspective, i.e., systematically characterizing the diffuse cool and hot gas in groups and clusters, has remained elusive due to the relatively small numbers of X-ray detected halos to target in UV absorption line experiments. The eROSITA All Sky Survey (eRASS) is dramatically changing the landscape with an order-of-magnitude increase in the number of X-ray detected groups and clusters after only the first year of observations. We propose to obtain HST/COS spectra of quasars probing a sample of eRASS-detected galaxy groups and clusters spanning two orders of magnitude in X-ray luminosity, representing the first study of its kind and tripling the previously existing samples. First, we will track the cool gas, traced by H I Ly-alpha and Si III, contents in and around these halos as a function of the X-ray derived properties. Using ongoing follow-up spectroscopic surveys for these groups/clusters, we will characterize the CGM contents of galaxies near the sightlines to investigate the impact of increasing hot gas density and temperature (via the X-ray measurements) on these galaxies. Hydrodynamical simulations have been highly inconsistent in reproducing the few existing observations, and the dataset from our program will stand as a critical benchmark for state-of-the-art models that attempt to capture the salient multiphase gas physics in massive halos.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17775
Program Title: Double Trouble: Understanding the Origins of Double Peaked Tidal Disruption Events

Principal Investigator: Angus, Charlotte

PI Institution: Queen's University Belfast

Tidal disruption events (TDEs), the flares produced when a star is disrupted by supermassive black hole, present a unique opportunity to study the accretion processes around black holes, and to probe their fundamental properties. For partial TDEs (pTDEs), events where only a small fraction of the star is disrupted, some cases can exhibit multiple peaks within the light curve, where the star undergoes repeat disruptions as its orbit cyclically brings it back within the vicinity of the black hole. Such events are the holy grail of TDE studies, as their intrinsic set-up provides strong constraints upon the disrupting system. However, they are expected to be extremely rare: approximately 0.1% of the TDE population. Long term monitoring from modern transient surveys have now revealed 5 TDE events whose light curves exhibit two distinct peaks. This unprecedented sample of repeating pTDE candidates is troubling, as it implies repeating pTDEs are far more frequent than theory suggests. Here we propose joint HST WFC3 and Gemini GMOS-IFU observations of the host galaxies of repeating pTDEs, to explore their structure, kinematics and gravitational potential on scales of ~100pc. With these data we will determine if the properties of the host galaxy environment are enhancing the likelihood of repeating pTDEs, and thus elucidate why such a large sample of double peaked TDEs exists.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17776
Program Title: A Precursor Survey of the Roman Galactic Bulge Time Domain Fields

Principal Investigator: Terry, Sean

PI Institution: University of Maryland College Park

We propose a coordinated parallel HST imaging survey of the upcoming Roman Galactic Bulge Time Domain Survey (RGBTDS) field. Precursor imaging of this area with HST several years before the start of the Roman Galactic Exoplanet Survey (RGES) will greatly strengthen Roman's ability to characterize a majority of detected exoplanet systems, as well as provide a rich and wide-field archive for use as a Legacy dataset toward the Galactic bulge for the broader community. The campaign proposed here will secure HST's lasting impact on the high-precision study of stellar populations, dynamics, exoplanet systems, interstellar extinction, metallicities, cluster associations, and many more toward the center of the Galaxy. This HST survey will complement what will effectively be one of the deepest exposures ever taken of the sky; the RGBTDS.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17777
Program Title: Confirming the first progenitor candidate of a rare type Ibn supernova

Principal Investigator: Taggart, Kirsty

PI Institution: University of California - Santa Cruz

Type Ibn supernovae (SN Ibn) are hydrogen-poor SNe that interact with their hydrogen-poor circumstellar medium (CSM). They probe the advanced and little-understood stage of mass loss that strips helium from a massive star. SN 2023fyq is the closest SN Ibn to date at 18.2 Mpc. The explosion site of SN 2023fyq was imaged with HST in several filters (UV through NIR) 12 years before explosion, revealing a blue (B - V = 0.2) and luminous point source with M = -9.5 mag, consistent with either a WC/O-type star or a young cluster with a turnoff mass of >20 Msun. We propose to obtain 4 orbits of deep HST imaging approximately two years after explosion to confirm the progenitor of SN 2023fyq and to discern its cluster or single stellar system nature -- yielding the first progenitor identification for a SN Ibn. Such a discovery would be crucial to understanding the mass loss mechanism responsible for stripping 1/3 of all core-collapse supernova progenitors of their hydrogen and/or helium, and to understanding what a stripped star looks like before its explosion.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17778
Program Title: Revealing the closest hidden white dwarfs in post-common envelope binaries

Principal Investigator: O'Brien, Mairi

PI Institution: The University of Warwick

When a white dwarf is in a close binary with an M dwarf, they will have undergone a common envelope phase, making the system a post-common envelope binary. The common envelope phase of binary evolution is poorly understood, and the numbers of post-common envelope binaries in the local volume need to be constrained to improve predictions of the space density of binary stars. Despite the high spectroscopic completeness of local samples of single white dwarfs, white dwarfs in post-common envelope binaries are notoriously difficult to detect, as the M dwarf dominates the system's optical spectrum and colours. We request to observe the three closest candidate post-common envelope binaries to the Sun, all of which are M dwarfs with close unconfirmed white dwarf companions that were detected via radial velocity measurements. STIS is the only instrument that can confirm the white dwarf companions as they are brighter than the M dwarf in the near-UV. The mass and effective temperature of the white dwarfs will be constrained by fitting the UV spectra with white dwarf models. Confirming three of these systems that are within 17 parsec of the Sun will place vital constraints on the space density of close binary systems.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17779
Program Title: A massive protocluster at z=4.3 selected by the South Pole Telescope

Principal Investigator: Chapman, Scott

PI Institution: University of British Columbia

We request deep imaging of an SPT-selected protocluster, SPT2349-56 located at z=4.3, using HST and JWST in F435W through F1800W filters. SPT2349 possesses a very large ~10^13 Msun halo mass for any structure at z>4. Selected via millimeter-wavelength dust emission in the 2500 square degree South Pole Telescope (SPT) survey, it has been resolved by ALMA into more than 30 gas-rich galaxies, with a surrounding overdensity of LBGs and LAEs. Sensitive observations of carbon monoxide and ionized carbon with ALMA, allow assessment of the obscured star formation and gas masses of bright cluster members. The goal of this proposal is to obtain HST ACS imaging to uncover the overdensity of faint LBGs, and constrain the extincted UV properties of the SMGs. HST WFC3 + JWST NIRCam/MIRI will be used to measure the stellar properties and galaxy morphologies. The proposed HST+JWST observations leverage HST to minimize this initial JWST required to provide the imaging and photometric information for a complete picture of the obscured and unobscured stellar components of the ALMA galaxies, and the overdensity of LBGs, revealing the structure in the gas-rich galaxies that host rapid star formation and the less luminous galaxies which trace the filaments of an early collapsing structure. The combination of high resolution ALMA datasets with the proposed HST observations will allow a full characterization of the stars, gas, and dust in this cosmologically important protocluster of primordial starburst galaxies. From an outreach perspective, the high spatial resolution of the identifications of protocluster galaxies will complement the ALMA data in publicizing these high impact results.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17780
Program Title: Testing The Refractory Sulfur Reservoir Hypothesis with the Next Interstellar Object

Principal Investigator: Noonan, John

PI Institution: Auburn University

Comets are the leftovers of the era of solar system formation and, as such contain some of the most primitive materials available for study. Interstellar comets allow us to probe the volatile and organic composition of a protoplanetary disk's cold midplane, where sub-mm and IR observations cannot penetrate. Within those disks, sulfur reservoirs are currently a major source of interest in the astrophysics community as less than 0.1% of the cosmic abundance of sulfur can be traced in gas species. Recent studies imply that the missing sulfur is trapped in refractory components, but which minerals are not yet clear. Ejected icy planetesimals offer unique opportunities to investigate sulfur-bearing species that would be locked in ice or dust in the midplane of these protoplanetary disks, revealed by an interstellar object's heating as it enters our solar system. With the imminent first light of LSST it is highly anticipated that several more will be discovered in the next few years. The time domain observations measured with HST COS during the apparition of the first active interstellar comet, 2I/Borisov, resulted in a first picture of the chemical composition of those volatiles present in another planetary system, but were not sensitive to sulfur or sulfur-bearing species. We propose a Target of Opportunity program to observe the next active interstellar object, which has yet to be discovered. We will quantify its CS, S2, and atomic sulfur reservoirs, a combination of species that is unique to HST's far-ultraviolet (FUV) capability, and measure the sulfur-to-oxygen ratio while providing unparalleled sensitivity to the commonly occurring cometary species CO and OH.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17781
Program Title: A superluminal jet in 3C264: the view at 30

Principal Investigator: Meyer, Eileen

PI Institution: University of Maryland Baltimore County

3C264 is a nearby radio galaxy with a prominent optical jet. Previous HST observations from the 1990s through the 2010s discovered not only the fastest-ever superluminal speed (on kpc scales) of 7c for a knot in the jet, but also captured the motion of this knot through the start of a collision with slow-moving material downstream, with concomitant brightening indicating in-situ particle acceleration. This remarkable discovery represents the first direct evidence for the "internal shock" model for particle acceleration, a mechanism proposed to explain variability and particle acceleration in sources as diverse as gamma-ray bursts, microquasars, and jetted AGN. The collision is expected to manifest in brightening and hardening of the optical spectrum and increasing polarization over the next several years to decade, and this unprecidented source gives us the unique opportunity to directly evaluate the applicability, efficiency and physical characterization of the internal shock mechanism.Following previous HST/VLA/Chandra observations in 2018/2019 showing a continued rise in flux and polarization in the shock region, we propose a new epoch of imaging to monitor the spectral evolution of the colliding knots and continue spatial proper motion measurements of the jet features, for comparison to the expectations from theoretical models. In keeping with past monitorig we request 2 orbits with WFC3/UVIS (near-UV, B, and I band), 1 orbit with the ACS/WFC polarizers in F606W, as well as K-band VLA and Chandra ACIS observations.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17782
Program Title: A First Attempt to Detect Extragalactic Antimatter: Positronium Lyman alpha toward M31*

Principal Investigator: Darling, Jeremy

PI Institution: University of Colorado at Boulder

We propose to attempt the first direct detection of antimatter outside the Galaxy by observing the positronium Lyman-alpha transition toward M31*. The existence of antimatter in the form of positrons has been observed in the Galaxy via 511 keV annihilation photons for half a century, but the astrophysical engines producing the positrons have yet to be identified. Numerous plausible sources of positrons have been proposed, some of which are distributed and some of which are pointlike such as massive black holes, stellar-mass black holes, and compact X-ray binaries. Studies of the annihilation gamma-ray spectrum show that nearly all annihilation events are preceded by the formation of an electron-positron bound state called Positronium (Ps), a hydrogen-like "atom" where the proton is replaced by the positron. Positronium has quantum transitions with half the energy of hydrogen: its Lyman alpha line has a wavelength 243 nm. There will therefore be Ps "recombination" emission lines that precede annihilation. These are faint but within the reach of HST, and ground-based observations have thus far been unable to adequately remove terrestrial atmospheric spectral features, despite custom-built spectrometers. We propose to expand the study of the sources of antimatter beyond the Galaxy by observing M31* in the Ps Lyman-alpha transition. Successful detection will provide important insight into positron production mechanisms and the general physics of high-energy phenomena. Theory alone has so far been unable to identify the dominant mechanism for antimatter production.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17783
Program Title: HST Polarimetry and Proper Motions of the Pictor A Hotspot

Principal Investigator: Meyer, Eileen

PI Institution: University of Maryland Baltimore County

The X-ray emission mechanism and particle acceleration mechanism in kpc-scale AGN jets is still poorly understood. Nearby radio galaxy Pictor A hosts one of the nearest and brightest X-ray emitting jets, and is a highly valuable target for long-term monitoring and study. The jet has been deeply observed in the X-rays with Chandra, with a total exposure of nearly 0.5 Ms over 14 years. These observations revealed that the X-ray jet and hotspot unexpectedly vary on timescales as short as a few months to years in both the soft and hard X-rays, which places extreme constraints on the particle acceleration mechanism. The western hotspot of Pictor A, as the brightest in the sky with sufficient spatial separation from the core, has been recently detected in the hard X-rays with NuSTAR and was also approved for a large 2 Ms observation with IXPE in the first GO cycle, to measure its X-ray polarization. We propose HST optical/UV and polarization imaging of the jet and western hotspot of Pictor A. The proposed observations are highly complimentary and will extend the longest time baselines of optical imaging to nearly 30 years, enabling a range of investigations into variability, proper motions, and spectral evolution of the source.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17784
Program Title: AT2019krl: Did a star die?

Principal Investigator: Fitzpatrick, Beth

PI Institution: University College Dublin

AT2019krl is gap transient which exploded in 2019 in M74. Originally classified as an LBV, recent HST observations suggest that it may have dimmed to a luminosity fainter than that of the progenitor. This implies a terminal explosion, i.e., AT2019krl is a peculiarly faint core collapse supernova. AT2019krl would in fact be the faintest core collapse supernova ever observed. To explain such a low luminosity, AT2019krl must be a "failed supernova", the result of the collapse of a massive star to a black hole. This would be the first observational evidence of a "failed supernova", which have been theoretically predicted and are a solution to the "Red Supergiant Problem" (the lack of supernova progenitors above 16 solar masses, despite red supergiants existing with these masses). Unfortunately, AT2019krl was located near the edge of the chip in this recent image, meaning that the apparent dimming may not be genuine. We have conducted an analysis of the magnitudes of other sources in close proximaty to the chip edge and conclude that it is likely that our observations are real and AT2019krl was a "failed supernova". New HST observations at the site of the transient are required for confirmation.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17785
Program Title: Anchoring the Diversity of Cold Worlds With HST Spectra

Principal Investigator: Faherty, Jacqueline

PI Institution: American Museum of Natural History

Using cold brown dwarfs to understand Jupiter-like atmospheres hinges on defining and explaining their diverse properties. As such a recently accepted JWST cycle-1 GO proposal used the parallax sample of the reddest/faintest brown dwarfs to define 12 sources that share a common mid infrared color -- an excellent proxy for temperature -- but show meaningfully different Spitzer [4.5] micron absolute magnitudes. Each source is to be followed up with JWST NIRSPEC G395H high resolution (R~2700) spectra as well as MIR F1000W, F1280W, and F1800W photometry to measure bolometric luminosities and differentiate what causes the sample diversity in the mid-infrared. However two of the 12 sources in this legacy JWST proposal lack NIR information therefore can not be maximized for their scientific output. For this HST proposal we request 9 orbits to obtain WFC3 Grism spectra for 2 cold brown dwarfs that are already slated to be definitional for cold world science.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17786
Program Title: Tracing the beginnings, endings, and rarity of Blue Ring Nebulae to a rare stage in post-stellar merger evolution

Principal Investigator: Hoadley, Keri

PI Institution: University of Iowa

We catch stellar mergers in the act as luminous red novae (LRNe), peaking several orders of magnitude at optical wavelengths, then decaying exponentially and reddening. LRNe are incredibly difficult to study immediately afterwards. Outflows launched by a merger expand quickly and cool rapidly, forming obstructing dust and molecules that block our view just days-weeks afterwards. Even suspected ancient mergers, like CK Vul, are still embedded in dusty envelopes. We have no observational evidence for what happens to stars after they merge. What do systems look like after merging? What are the long-term ramifications of stellar mergers? The Blue Ring Nebula (BRN) is a rare example of an outflow, produced by a thousands of years old stellar merger, that has virtually no obstructing dust in it, thus revealing the star that created it, TYC 2597-735-1 (TYC). We propose to use HST-COS G130M and G160M spectra to characterize the BRN by observing a fortuitously-positioned background galaxy to probe it using absorption line spectroscopy. Far-UV observations are exclusively able to cover molecules, neutral, and ionized gas at a wide range of temperatures. Absorption line depths are sensitive to how much matter is in the sightline, so H2, HI, and residual gas in the BRN will stick out against the continuum source. The BRN is quickly expanding towards us, so lines traditionally washed out by airglow or interstellar absorption (e.g., HI) will be velocity-shifted away from these contaminants. This powerful technique will uncover the composition, density, temperature, and motions of the BRN gas, answering key points about its origins, its lifetime, and the number of BRNs we might see.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17787
Program Title: DELVE 1: The Least Massive Galaxy?

Principal Investigator: Cerny, William

PI Institution: Yale University

The Milky Way satellite DELVE 1 may be the faintest, smallest, and least-massive galaxy known. However, the alternative possibility that DELVE 1 is a chemically-peculiar, very metal poor star cluster has thus far proven impossible to rule out through spectroscopy; this is because the system has too few bright stars to enable definitive velocity or metallicity dispersion measurements capable of distinguishing between these scenarios. Classifying the system as a dwarf galaxy or star cluster will therefore require an independent avenue that does not rely on ground-based spectroscopy. Here, we request 12 orbits of HST/ACS F606W+F814W imaging to construct a deep color--magnitude diagram of DELVE 1 and test whether the system displays stellar mass segregation. The presence of mass segregation would imply short dynamical times in DELVE 1 consistent with a star cluster, while its absence would provide strong evidence that DELVE 1 is a dark matter dominated dwarf galaxy. Our proposed observations will either confirm DELVE 1 as the least-massive galaxy yet discovered or would suggest that DELVE 1 is the first known example of a uniformly carbon-enhanced star cluster formed directly out of gas enriched by Population III supernovae. Whatever the outcome, these results will have important implications for the nature of dark matter and the formation of the lowest mass galaxies and most metal-poor star clusters.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17788
Program Title: Building a legacy UV data set for supernovae

Principal Investigator: Howell, Dale

PI Institution: Las Cumbres Observatory Global Telescope Network

We plan to make use of the "Flexible Thursdays" disruptive ToO mode, obtaining early STIS UV spectra of 10 supernovae. This program will more than double the number of low-z supernovae with STIS UV spectra taken less than a week after explosion. Four triggers are planned to be Type Ia supernovae, whose UV spectra may reveal the long-elusive progenitors, especially if the supernova ejecta collide with the secondary star. Six triggers are planned for core-collapse supernovae, whose spectra will help determine the radius of the progenitor through shock cooling, and probe the late-stage mass loss of the progenitor star through "flash spectroscopy" of circumstellar material. For other SN subtypes, we will obtain the first-ever early UV spectrum. This data set will improve supernovae as cosmological tools by helping to train lightcurve fitters, and help us prepare for upcoming facilities like the Legacy Survey of Space and Time and the Nancy Grace Roman Telescope.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17789
Program Title: NUV observations of transiting exoplanetary debris in a 10-hr orbit around a white dwarf

Principal Investigator: Guidry, Joseph

PI Institution: Boston University

The atmospheres of white dwarfs that are accreting a tidally disrupted planetesimal are powerful tools for deriving the bulk chemical composition of exoplanets. Ultraviolet (UV) spectroscopy is necessary to extract the most accurate abundances of these polluted white dwarfs, due to the high temperatures of most white dwarfs and the higher density of metal lines in the UV compared to the optical. Recent studies have discovered several metal-rich white dwarfs that show transits from tidally disrupted debris, but only two such systems have been extensively studied in the UV. We propose near-ultraviolet spectroscopy of ZTF J0328-1219, a newly discovered remnant planetary system that shows persistent transits from a planetary debris disk that repeat every 10 hours. Our proposal is designed to obtain the near-UV (NUV) spectra required to most accurately derive the abundances of the disrupted rocky material in orbit around the white dwarf and create a time-tagged NUV light curve to constrain the possible wavelength dependence of the transit depths. Our observations will put ZTF J0328-1219 into the broader context of other transiting debris systems, marking a crucial step in understanding the relationship between the orbital periods and eccentricities and observed properties.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17790
Program Title: The C/Fe and dust-to-ice ratios in Beta Pictoris exocomets

Principal Investigator: Vrignaud, Theo

PI Institution: CNRS, Institut d'Astrophysique de Paris

Exocomets are small icy bodies analogues to comets in our solar system, placed on eccentric orbits and producing extended tails of dust and gas near their periastra. When transiting in front of their host star, the exocometary tails can be detected using photometry and absorption spectroscopy, as already done in several systems. The most iconic case is undoubtedly Beta Pic, which continuously displays variable absorption in many spectral lines (e.g. Fe, Ca, C, O) due to the high rate of exocometary transits in this system. Despite decades of observations, we still have very few information on the composition of these objects, depriving us of valuable knowledge for understanding their formation processes and history. However, significant progress was recently made with the development of the "exocomet curve of growth" technique, which allows realiable measurements of exocometary column densities using absorption spectroscopy. Here we propose to take advantage of this new tool to estimate, for the first time, 1) the ionisation state in several Beta Pic comets and 2) their C/Fe ratios, by targeting very specific UV lines with STIS and COS. The ionisation state will be characterized by measuring the column densities of many refractory species (Fe, Ni, Mn...) with different ionisation energies. The C/Fe ratio will be measured through the study of the C I and Fe II lines accessible with STIS. This ratio will directly lead to the estimate of the dust-to-ice ratio in several Beta Pic comets, yielding valuable insight on the role played by exocomets in the evolution of planetary system and allowing for comparison between solar and extrasolar comets.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17791
Program Title: A Race Against the Clock: Too Much Nitrogen, Too Early?

Principal Investigator: Berg, Danielle

PI Institution: University of Texas at Austin

Chemical abundances encode the integrated star formation over the lifetimes of galaxies. Since stars produce different metals, e.g., nitrogen and oxygen, at different times, the relative abundance of N/O acts as a clock to determine the star formation history. Specifically, N/O describes the relative ratio of moderately old stars(>100 Myr) to very young stars (<10 Myr). Recently, JWST observations of an extreme star-forming galaxy only 440 Myr after the big bang have found extremely high-energy N IV] and N III emission lines. These lines suggest that the galaxy has a super-solar N/O ratio, implying a contradiction: this galaxy has existed for < 440 Myr but still has a substantial older stellar population that is responsible for the N enrichment. This galaxy has too much N too early in the universe. However, few galaxies at any redshift have similar high-ionization N emisison. Unearthing the mechanism that produces these emission lines is required to reveal the chemical enrichment of the first galaxies. We propose 20 orbits of COS G160M + G185M spectroscopic observations of 7 local high-ionization galaxies. We will measure the FUV high-ionization emission lines (NIV], NIII, CIV, HeII, OIII], OIV), as well as describe their stellar populations. This will test the ionizing source within these galaxies and determine if the strong high-ionization emission arises from exotic non-stellar sources. These observations will map out the ionization structure of these galaxies to accurately determine their N/O values. Combined, these observations will construct a blueprint to interpret observations of the most extreme early galaxies to reveal the primitive relative abundance patterns.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17792
Program Title: STIS Analysis of the metal-poor r-element-rich star TYC 3814-1598-1

Principal Investigator: Ernandes, Heitor

PI Institution: Lund University

The formation site of rapid neutron-capture ('r-process') elements is still uncertain. The two most accepted mechanisms are magneto-rotational MHD-jet supernovae and neutron-star mergers, with the latter channel confirmed by observations of the kilonova counterpart of the gravitational-wave event GW170817. However, predictions from the latest nucleosynthesis models argue that neutron-star mergers cannot be the main contributor to r-process enrichment, and we require further empirical constraints on the r-process abundance pattern from early nucleosynthesis in the Galaxy. Here we propose STIS E230M echelle spectroscopy of TYC~3814-1598-1, a metal-poor ([Fe/H]~-3.0), actinide-enriched ([Eu/Fe] > 1.3) star that will provide new observational constraints on r-process enrichment. The STIS observations will provide the first abundance determinations for at least seven elements for this star, as well as much improved abundances for more than ten other heavy elements that have better diagnostics in the space ultraviolet than from optical spectroscopy. As the brightest known star of this rare class, the proposed analysis of TYC~3814-1598-1 will be a benchmark case for the abundance pattern of the so-called 'actinide boost' stars and provide much needed constraints on galactic chemical-evolution models.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17793
Program Title: Stellar Rotation and Winds for Old Sun-like Stars

Principal Investigator: Wood, Brian

PI Institution: Naval Research Laboratory

We propose to use STIS to study the H I Lyman-alpha spectra of four nearby old Sun-like coronal GK stars, to search for signs of astrospheric absorption. The Lyman-alpha astrospheric absorption signature is currently the only means of detecting the coronal winds of cool main sequence stars, and HST is the only observatory that has ever been capable of observing it. The project will allow us to explore the future of our own Sun's wind. In addition, one of our targets, HD 166620, appears to have an interrupted activity cycle, possibly analogous to the "Maunder minimum" state that the Sun went through in the 1600s. Thus, the HD 166620 data could tell us what the solar wind was like then. A particular area of scientific interest is the phenomenon of "weakened magnetic braking", recently discovered from analyses of Kepler data, indicating a significant change in stellar rotation evolution at late stellar ages. All of our chosen targets have existing or expected ground-based spectropolarimetric constraints, which when combined with HST mass loss measurements will allow us to determine if the weakened magnetic braking is due to dramatically weaker winds or fundamental changes in stellar magnetic morphology.

Proposal Category: SNAP
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17794
Program Title: FUV flux of nearby exoplanet host stars in the Ariel target list

Principal Investigator: Boro Saikia, Sudeshna

PI Institution: University of Vienna

Stellar extreme ultraviolet (EUV) radiation drives atmospheric photochemistry and loss in orbiting planets. Hence, knowledge of EUV fluxes of exoplanet host stars is essential in the interpretation of exoplanet transmission spectra, as shown by the recent discovery of SO2 in gaseous exoplanets observed by JWST. In the absence of an instrument observing in the EUV wavelength and the known problem of instellar absorption in this wavelength range, far ultraviolet (FUV) flux acts as a proxy for the EUV flux. We aim to estimate the EUV flux of a volume-limited sample of Ariel target stars within 100 pc from FUV spectra taken by HST/COS in the G140L grating. Planned to be launched in five years (2029), the Ariel mission will carry out transit and eclipse spectroscopy of ~1000 exoplanets and determine their atmospheric chemical abundances. The Ariel target list contains 154 exoplanet host stars within 100 pc out of which 17 have prior FUV data. We ask for a snapshot survey of the remaining 137 Ariel targets for which no FUV spectra exist. Our sample is divided into three groups, with the top priority given to common Ariel and JWST targets, followed by high-priority and medium-to-low priority Ariel targets. The estimated EUV fluxes will be used as input in atmospheric photochemical models and in the target refinement of Ariel. The results will also be useful to the community in future JWST proposal preparations. Since snapshot programmes do not guarantee observations of all 137 targets, a completion rate of 13% (17 new stellar spectra) will double the current archival sample. This will enable us to perform a robust statistical analysis on the combined new and archival data.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17795
Program Title: Active, but at What Cost? Determining Temporary Jupiter Co-orbital Comet P/2023 V6's Size and Probing The Gateway Region

Principal Investigator: Noonan, John

PI Institution: Auburn University

The discovery of the transient Jupiter co-orbital comet P/2019 LD2 (ATLAS) drew significant interest. Not only will LD2 transition between being a Centaur and a Jupiter Family Comet (JFC) in 2063, the first time this process can be observed as it happens, it is also very active for its large heliocentric distance. We propose HST WFC3 observations of the newly discovered transient Jupiter co-orbital comet P/2023 V6 (PANSTARRS), the second such object known. Despite similar modern orbits, V6 is significantly (15x) less active than LD2 and most JFCs as determined via dust production measurements at the same heliocentric distance. As such, this suggests a correspondinly smaller nucleus size. If the nuclei are similar in size, we interpret these differences in activity as evolutionary, with V6 having lost a significant fraction of its near-surface ice compared to LD2 by previously being warmer. We will observe P/2023 V6 witht F350LP filter for two orbits of HST (a total of 2000s of exposure) to measure the nucleus size using HST's stable PSF and separate the weak dust coma from the nuclear contribution. If our hypothesis about V6's size is proven, this would be more evidence that LD2 is a pristine and ice-rich object, and thus it may display very strong activity when it becomes a JFC. We will use our observattion to delineate the differences between V6 and LD2 to discuss the interpretation of cometary activity at large heliocentric distances. This has significant repercussions for our understanding of the end state of JFCs, as well as the small end of the cratering record of the Galilean Satellites.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17796
Program Title: Tracing the mass-loss history from type II supernova explosions back through the red supergaint phase.

Principal Investigator: Valenti, Stefano

PI Institution: University of California - Davis

We are requesting 21 orbits of HST WFC3 UV photometry to observe 10 non-interacting hydrogen rich Supernovae (SNe II) from 50 to 300 days after explosion. This endeavor aims to yield invaluable insights into the mass loss history preceding the explosion, a phase of stellar evolution notoriously challenging to model. Recent observations of type II supernovae have revealed indications of significant circumstellar medium (CSM) interaction, suggesting red supergiant (RSG) progenitor stars experienced mass loss rates ranging from 10^-3 to 10^-1 solar masses in their final years before explosion, significantly higher than the 10^-6 solar masses per year typically observed in RSGs. To reconcile these findings, it is imperative to investigate mass loss from the progenitor star decades prior to the explosion, a task that requires observations within the 50-300 day timeframe post-explosion. Ultraviolet (UV) observations are the best way to trace CSM interaction via strong MgII emission, as predicted by models. This model's validity has been underscored by recent observations of SN2023ixf in M101 (~6.4 Mpc). Consequently, this non-disruptive Target of Opportunity (ToO) initiative aims to observe 10 SNe II post-explosion, to extend this investigation beyond a single object to encompass a larger sample of SNe II, thereby broadening our understanding of mass loss in red supergiants through the CSM interaction in typical type II supernovae. Given the limited lifespan of HST, this is the time to advance our knoledge on mass loss in RSG.

Proposal Category: SNAP
Scientific Category: Galaxies
ID: 17797
Program Title: Galactic Underdogs: Assessing the True Satellite Galaxy Population in the Local Volume

Principal Investigator: Bell, Eric

PI Institution: University of Michigan

This proposal's goal is to advance our knowledge of the low-mass dwarf galaxy population around nearby massive (>10^10 M_sun) central galaxies. Dwarf galaxies are our primary probe of the nature of dark matter and are sensitive to stellar feedback and reionization; the luminosity functions, spatial distributions and star formation activity of satellites are sensitive tests of this physics. Deep ground-based surveys have made major advances in cataloging satellites, yet even deep ground-based data has left 106 candidate satellites without conclusive distance information; they may be group members or background contaminants. We propose an economical SNAP survey to resolve (or fail to resolve for background galaxies) the candidate satellites into stars; those with resolved stars will give TRGB distance with <10% accuracy, revealing also ongoing star formation and any star clusters. The candidates have somewhat smaller size, lower luminosity, and are in more distant groups than already confirmed ones, and this survey will rectify this bias and quantify completeness for the random subset of candidates left without SNAPs. This survey will reveal how satellite properties (luminosity functions, star formation history, structures) vary jointly with central galaxy mass and other important drivers of satellite evolution, e.g., group merger history or environment. The improved fidelity of catalogs will permit a truer picture of the prevalence of planes of satellites and asymmetries. This proposal will make an important contribution to our census of the Local Volume (D<12Mpc) galaxy population, without any cost to HST's, JWST's or the Roman Space Telescope's primary science time.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17798
Program Title: Two new isolated, faint dwarf galaxies beyond the Local Group

Principal Investigator: Mutlu-Pakdil, Burcin

PI Institution: Dartmouth College

The Local Group satellite dwarf galaxies are often used as benchmarks for testing galaxy formation and evolution theories on the smallest scales because they are the lowest-mass galaxies for which detailed observations are available. However, most 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, we must 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, Tucana B is the only known isolated, ultra-faint dwarf galaxy that is independent of group dynamics but close enough at 1.4 Mpc to be studied with resolved stars. With only one system, it is challenging to draw broad conclusions about the lowest-mass galaxies evolving in isolation. We request two orbits of HST/ACS imaging (F606W+F814W) to follow up two new nearby isolated faint dwarf galaxies (Cetus B and Hydrus A) 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 Tucana B. HST imaging is essential to the determination of high-precision distances, measurement of basic physical properties, and measurement of star formation histories of these two newly discovered faint dwarfs. The requested observations will put these two 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
Scientific Category: Stellar Physics and Stellar Types
ID: 17799
Program Title: Ultraviolet properties of the heavy-metal hot subdwarf in the long period binary: SB 744

Principal Investigator: Nemeth, Peter

PI Institution: Astroserver.org

Hot subdwarfs are evolved low-mass stars found at the blue end of the Horizontal Branch, typically formed through binary evolution scenarios. These stars undergo significant mass loss, either through common envelope interactions or Roche lobe overflow (RLOF) evolution during the red giant branch phase. Alternatively, they may form via the merger of two helium core white dwarfs. One such star, SB 744, was chosen for radial velocity follow-up from a sample of long-period composite spectrum subdwarf binaries, to explore its RLOF evolution, orbital characteristics, masses and chemical compositions of the components. Our spectral analysis revealed prominent F and Pb lines in the optical spectrum and suggested a rich UV spectrum of the sdOB type primary. The presence of fluorine, a rare observation in stellar spectra, is linked to the nucleosynthesis processes in asymptotic giant branch stars and subsequent convective mixing in their atmospheres. Alternatively, the merger of two white dwarfs can induce flash nucleosynthesis, producing fluorine that is then mixed into the atmosphere. The binarity of SB 744 and the detection of fluorine and heavy metals in the spectrum of the sdOB star suggest a possible triple system progenitor where the inner binary experienced a merger. Although supported by binary evolution models, such a scenario has yet to be directly observed. A comprehensive UV spectral analysis of the sdOB star could confirm this hypothesis, with HST STIS observations offering precise measurements of metal abundances (including C, N, O, F, Si, and Fe) and the search for lines of heavy elements.

Proposal Category: SNAP
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17800
Program Title: Diagnostics of AGN Feedback with the first UV atlas of obscured quasars

Principal Investigator: Johnson, Sean

PI Institution: University of Michigan

Feedback from active galactic nuclei (AGN) and quasars plays a vital role in regulating galaxy evolution and supermassive black hole growth. Over the last decade, spatially resolved studies of ionized gas emission around obscured (Type 2) quasars demonstrated that the radio-quiet quasars that dominate the AGN population can drive galactic-scale outflows. However, the mechanisms that enable AGN to couple to the surrounding interstellar medium (ISM) remain unclear. Outflows driven by quasars could result from direct radiation pressure on ISM clouds or entrainment in a fast, hot wind created near the nucleus. Highly ionized emission lines only available in the rest-frame UV are uniquely sensitive to the relative importance of radiation pressure and hot wind pressure in confining emitting clouds in the narrow-line region. Recent surveys of the five obscured quasars with available UV COS spectra reveal that some systems exhibit line ratios indicative of radiation pressure dominating dynamics of UV emitting clouds, but one shows signatures of additional pressure from a hot wind. Larger samples of obscured quasars with UV spectra are necessary to determine the global importance of these two feedback mechanisms as a function of other quasar properties. Here, we propose a 147 object snapshot survey of the UV spectra of luminous obscured quasars to measure emission line fluxes and profiles in OVI, HI Lya, NV, CIV, and HeII. The survey will result in a >10x increase in the availability of UV spectra of obscured quasars, cementing the UV legacy of HST for this important AGN class and enabling comparison with obscured quasars uncovered at z>2 by surveys from the ground.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17801
Program Title: Characterizing the Detected Atmospheric Escape of a Pair of Small Sub-Neptunes

Principal Investigator: Loyd, R. O.

PI Institution: Eureka Scientific Inc.

HST recently discovered a neutral hydrogen outflow from a planet in the transitional space between the sub-Neptune and super-Earth populations, TOI-776 b. Its nearby sub-Neptune sibling, TOI-776 c, also exhibits hydrogen loss. These two planets represent a crucial link between the sub-Neptune and super-Earth populations, long theorized to be the result of an initially continuous population of planets that evolved into two branches, with one losing their primordial H/He atmospheres, shrinking to the size of their rocky cores. Within its remaining life, TOI-776 b has a roughly 15% chance of completing the transition into a super-Earth by losing most of its remaining H/He atmosphere, whereas TOI-776 c will stably reside in the sub-Neptune population. The proposed program builds upon this recent discovery, moving from detection to a thorough characterization of the planetary outflows. These observations have two primary objectives: imposing an added constraint on outflow models by observing the Lyman-alpha transit egress and measuring the neutral O and singly-ionized C content. The results will provide insight into how small planets are shaped and how their atmospheres are chemically enriched by atmospheric escape.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17802
Program Title: CLUTCH: The COSMOS Legacy UV-Optical Treasury Campaign with Hubble

Principal Investigator: Kartaltepe, Jeyhan

PI Institution: Rochester Institute of Technology

We propose CLUTCH: The COSMOS Legacy UV-Optical Treasury Campaign with Hubble. CLUTCH is a Multi-Cycle Treasury program to image 0.5deg^2, overlapping the areas observed by COSMOS-Web and COSMOS-3D. CLUTCH will observe the rest-frame UV to optical emission for galaxies from z<7.5 utilizing WFC3-UVIS F225+F275W, ACS F435W+F606W+F814W, and WFC3-IR F098M, all of which are inaccessible by JWST. While JWST is a fantastic resource for obtaining rest-frame UV emission out to the very highest redshifts, obtaining equivalent information below z~3, encompassing over three-quarters of the universe's history, requires Hubble. JWST also relies on deep Hubble observations for redshift estimates of sources near the end of the Epoch of Reionization (5.5<z<7.5). Though extragalactic surveys of other fields have obtained deep Hubble UV observations, the critical wide-area level of the `wedding cake' is missing. CLUTCH will cover an area 4.2x larger than UVCANDELS and 3.4x larger than other UV surveys combined. This layer is essential for probing environmental effects on large scales, obtaining robust samples in several redshift and other physical property (e.g., stellar mass, morphology) bins, mitigating cosmic variance, and studying rare sources. With CLUTCH, we will be able to: 1) Investigate the history of stellar mass assembly and the impact of local environment on galaxies' evolutionary pathways, 2) Study dust attenuation in low-z galaxies and constrain the 2175 A absorption feature, 3) Map large scale structure out to z~7.5 and use LAEs to trace reionization bubbles using vastly improved photozs, and 4) Create a large training sample for the latest generation weak lensing surveys.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17803
Program Title: The first multi-phase survey of the circumgalactic medium of quasar hosts at z<1

Principal Investigator: Johnson, Sean

PI Institution: University of Michigan

Feedback from quasars plays a vital role in galaxy evolution, but the relationship between quasars and the circumgalactic medium (CGM) that dominates baryon reservoirs and provides a record of feedback is not well constrained. The cool CGM of quasar hosts observed on 100 kpc scales is strongly correlated with the quasar luminosity and exceeds that of non-AGN galaxies by 2x, even though BH accretion occurs at <1 pc. These observations provide evidence for a connection between AGN activity and the CGM despite the large difference in scale. The observed CGM-quasar connection can result from (1) winds associated with quasar feedback or (2) debris from interactions thought to trigger luminous quasars. If the correlation is due to feedback, the observed low-ionization gas results from entrainment or cooling in a hot wind, predicting significant highly ionized absorption and high metallicity. Lower ionization species will dominate if the correlation is driven by debris from interactions. We propose testing these possibilities through a multi-phase study of the CGM of the only nine quasars at z<1 with NUV-bright background probes at d<160 kpc. The proposed UV spectra will cover the HI Lyman series and a suite of low-to-high ions including CII, CIII, and OVI to enable: (1) accurate measurements of N(HI) and metallicities, (2) comparison of the kinematics of gas in different ionization states, and (3) a multi-phase CGM comparison of the eight quasars with inactive galaxies in the literature. The proposed UV spectra will test the quasar feeding vs. feedback scenarios through ionization analysis and kinematic comparison with nearby galaxies revealed in ongoing ground-based surveys.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17804
Program Title: STELa: Survey of Transiting Exoplanets in Lyman-alpha

Principal Investigator: Loyd, R. O.

PI Institution: Eureka Scientific Inc.

Atmospheric escape is a key process that sculpts the exoplanetary population, especially for planets smaller than Neptune. Transit observations in the Lyman-alpha line allow for direct studies of atmospheric escape, but progress is reaching the limit of what is possible with small programs targeting one or two new planets at a time. To advance atmospheric escape studies into a new statistical regime, we propose the Survey of Transiting Exoplanets in Lyman-alpha (STELa), a Multi-Cycle Treasury program aimed at efficiently probing atmospheric escape across the entire exoplanetary population using a proven reconnaissance-detection-characterization strategy. STELa's statistical sample will map the role of mass loss throughout the population of known exoplanets, investigate the nature of "transitional" worlds such as those in near radius valley, and probe the physical mechanism driving the atmospheric erosion of sub-Neptunes. A wide array of treasury science will be possible with the STELa dataset, including a new 3D map of the local interstellar medium, the first survey of stellar wind strengths within the astropause, an atlas of host star XUV spectra in the mass-rotation plane, and investigations of exosphere-thermosphere-lower atmosphere connections through synergies with He 10830 and JWST observations. Implementing a broad Lyman-alpha transit survey now is essential to enable the scientific leap from ``stamp collecting'' to population science within the limited remaining life of the only observatory capable of these observations.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17805
Program Title: Ultra-rapid observations of a gravitational wave source

Principal Investigator: Troja, Eleonora

PI Institution: Universita di Roma Tor Vergata

The discovery of GW170817 ushered in a new era of multi-messenger astrophysics, in which gravitational waves and light are used to explore the most extreme phenomena, such as gamma-ray bursts and kilonovae. We propose to use the unique sensitivity and spectral UV coverage of HST to probe the earliest phases of a young kilonova, promptly (< 4 hr) localized through gravitational waves and light. A similar event, although rare, would offer us the unique opportunity to open a new window into the physics of kilonovae and probe an unexplored stage of their life. These observations would constrain the physical properties of the emitting ejecta (e.g. temperature, expansion velocity) and critically distinguish between competing models (e.g. radioactivity, shock interactions, magnetar) to power the luminous blue kilonova.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17806
Program Title: R-process kilonovae associated with merger-driven gamma-ray bursts

Principal Investigator: Tanvir, Nial

PI Institution: University of Leicester

The discovery of AT2017gfo, both prompt gamma-rays and a thermal kilonova (KN), associated with a binary neutron star (BNS) merger detected by aLIGO/AdV, GW170817, heralded the era of GW+EM multi-messenger astronomy. This landmark event confirmed both the association of some GRBs with compact binary mergers, and that neutron star material can be ejected in sufficient quantities to power a detectable radioactive transient. It opened a new window on long-standing problems in astrophysics, cosmology and fundamental physics, including the possibility that BNS and NSBH compact binary mergers are the dominant source of heavy r-process elements in the universe. However, the lack of success in identifying similar events in the O3 and O4a runs of the gravitational wave detector network highlighted that their rate is low in the nearby universe (e.g. $z<0.1$), thus opportunities for study of the kilonova population, crucial to understanding their range of behaviour and heavy element yields, for example, will be infrequent. Here we propose a ToO campaign to follow the light curve of a kilonova discovered during cycle 32, coincident with a well localised GRB at $0.1<z<0.4$ but not a GW signal (which are the target of other proposals). HST has already made unique contributions to the follow-up of AT2017gfo and its off-axis relativistic jet, and also provided the primary evidence for the most compelling cases of KNe following short-GRBs. Our HST+XMM program is flexible to adapt for different possible scenarios, and will be crucial for understanding the diversity of EM emission from neutron star compact binary mergers, and providing the data to test increasingly sophisticated KN models.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17807
Program Title: Flash Thursday: Early-time UV Spectroscopy of Type II Supernovae with HST

Principal Investigator: Jacobson-Galan, Wynn

PI Institution: California Institute of Technology

Ultraviolet (UV) spectroscopy of type II supernovae (SNe II) in the first week post-explosion remains a largely uncharted observational phase space. Following red supergiant shock breakout, early-time UV emission harbors unique information on the structure and composition of the most local progenitor environment; this being detectable through narrow emission lines (aka. IIn-like or "flash features") that arise from shock ionization of local circumstellar material (CSM). Furthermore, UV spectroscopy of young core-collapse SNe encapsulates the interplay of density, ionization, and temperature within the outermost layers of SN ejecta. 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 number of SNe II with early UV spectroscopy by more than a factor of 2, enabling precise constraints to be placed on the diversity of red supergiant atmospheres and SN II ejecta structure through the use of radiation hydrodynamics and nLTE radiative transfer codes (e.g., HERACLES, CMFGEN). Furthermore, this program will be essential preparation for the planned launch of the Ultraviolet Explorer (UVEX) telescope and its study of SNe II through UV spectroscopy.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17808
Program Title: Ice giant atmospheres, rings and moons - physics of the macroscopic to the microscopic

Principal Investigator: Sparks, William

PI Institution: SETI Institute

Uranus is the highest priority destination for a future NASA flagship mission in the Origins, Worlds and Life planetary science decadal survey. With Neptune, these two are the solar system ice giant siblings, representative of a multitude of kindred exoplanets. We propose to obtain imaging polarimetry of Uranus and Neptune at unprecedented spatial resolution with ACS in order to advance our knowledge of the macroscopic and microphysical character of the scattering atmospheres of these two worlds. With HST resolution, we can separate polar hazes, storms and bands, revealing the global scattering properties in unprecedented detail while identifying for the first time the scattering properties of features impossible to determine from the ground. The polarization depends on the altitude of the scatterers, their chemical composition, and microscopic shape and size. Given the plethora of ice giant exoplanets, high quality empirical measurements and modeling of the polarization distribution of these local archetypes and their varied hydrocarbon hazes will facilitate extrapolation to one of the most commonly found exoplanet populations. We will also obtain polarization measurements of the rings of Uranus and moons of both Uranus and Neptune. This is particularly critical to the top priority Uranus Orbiter and Probe flagship mission, as further knowledge is needed to enable safe passage through the upper atmosphere and dusty ring environment.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17809
Program Title: Decoding stellar feedback in action with an HST+MUSE+JWST full-disk survey of starburst galaxy prototype NGC 253

Principal Investigator: Thilker, David

PI Institution: The Johns Hopkins University

We propose to survey UV-visible emission from the whole disk of the closest massive, star-forming southern galaxy: the prototypical spiral NGC 253. We will pair these proposed data with a unique full-galaxy 100 pointing VLT/MUSE map, public JWST/MIRI coverage, and a deep collection of other multiwavelength data. Critically, these other observations resolve and measure the impact of feedback within $>6,500$ star forming regions across the galaxy, and our new HST/WFC3 observations will identify, resolve, and provide a detailed physical characterization of the stellar populations powering each of these regions. Combined these surveys will provide an unique paired view of the stellar feedback input (from this proposal) and its effect (from the existing surveys). This will put us in position to measure the efficiencies, timescales, and dominant modes of stellar feedback across the whole area of a Milky Way analog, thus addressing some of the largest current uncertainties related to the matter cycle in galaxies. The combination of HST UV-visible photometry with forthcoming NIR data from Euclid+Roman will firmly break age/redenning degeneracies and capture the full range of stellar populations (unobscured and embedded). Beyond addressing major mysteries related to stellar feedback, our measurements will serve as templates for unresolved studies at of galaxies at greater distances. Parallel imaging with ACS/WFC will produce a transformative Roman-like view of the inner stellar halo and its substructure, while calibrating systematics in TRGB distance measurement.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17810
Program Title: (Slit-)Stepping into the future with Haro11: Spatially Resolving UV-Properties and Devising the Ideal UV-IFU Benchmark Dataset

Principal Investigator: James, Bethan

PI Institution: Space Telescope Science Institute - ESA - JWST

Spatially resolved UV properties across star-forming galaxies (SFGs) is a key, yet missing, component of our galaxy evolution knowledge. Limited to single aperture UV spectrographs, we are simply unable to fully characterize outflows, understand how massive stars shape their surrounding gas, and decipher the physical conditions behind nebular UV emission. Now, with JWST's rest-UV coverage of high-z systems at our disposal, it is more important than ever that we understand how UV properties change across a system and the subsequent biases involved in globally integrated UV spectra. To this end, we have designed a revolutionary program to obtain spatially resolved UV spectra via STIS 0.2" slit-stepping across Haro11. This nearby high-z analogue is the perfect specimen for these groundbreaking observations, being composed of three separate knots that cover a wide parameter space in metallicity, ionization, stellar populations, and outflow kinematics. Key ISM+wind+nebular features (CIV, SiII, SiII*) from high spectral resolution G140M spectra, alongside the full UV ionizing continuum from medium resolution G140L, will be mapped at HII-region scales (<100pc). By combining these observations with optical MUSE-AO (0.13"/spaxel) data we will, for the first time, obtain robust 3D measurements of outflowing gas, map the structure of the neutral ISM, directly connect the properties of massive stars to the ISM, and decipher the diagnostic power of CIV. Moreover, by imitating UV-IFU observations on a real SFG, we will ultimately demonstrate the true scientific potential of a UV-IFU on HWO and explore its instrumental design - something that simulations alone simply cannot provide.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17811
Program Title: Host Galaxy Imaging of Luminous Supernovae: The Missing Link of Stripped Envelope Core-Collapse Supernovae

Principal Investigator: Gomez, Sebastian

PI Institution: Space Telescope Science Institute

Massive stars that have lost their hydrogen and helium envelopes generally end their lives as Type Ic (SNe Ic) core-collapse supernovae (CCSNe). However, a few percent of these stars can explode as Type I superluminous supernovae (SLSNe), which can have luminosities up to 100 times larger than SNe Ic. To date, the relationship between these two types of explosions and the connection between their progenitors remains unclear. Recently, an intermediate class of luminous supernovae (LSNe) has been unveiled, which bridged the gap between SNe Ic and SLSNe in terms of luminosity, spectroscopic properties, physical parameters, and rates. LSNe may prove to be the missing link we need to identify the progenitors of stripped-envelope CCSNe. Studying the host galaxy environments of SNe with HST has already proven to be the best way we have to infer their progenitor properties. Only HST has the depth, UV coverage, and resolution required to detect these galaxies, infer their star formation rates (SFRs) from their UV flux, and accurately pinpoint the location of the SN within their galaxies. Similar studies of about 100 SNe Ic and 80 SLSNe already exist, but only 12 LSNe have been imaged with HST, preventing a meaningful statistical comparison. Here we propose to obtain WFC3/UV imaging of all remaining 28 known LSNe to more than triple the existing sample into a statistically meaningful size, and compare with the existing population of SLSNe and SNe Ic to explore the properties of their progenitors across the entire population continuum of stripped-envelope CCSNe.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17812
Program Title: Unraveling a Decades-long mystery: Identifying the Atmospheric and Magnetospheric Drivers of the Jovian Hydrogen Ly-alpha Bulge

Principal Investigator: Rutala, Matthew

PI Institution: Dublin Institute For Advanced Studies

Jupiter's low-latitude ultraviolet emission is dominated by an unexplained feature which must be fundamentally connected to both the planet's atmosphere and magnetic field: the hydrogen Lyman-a (H Ly-a) bulge. The bulge is an increase in H Ly-a emission near magnetic longitudes of 100 deg., and is unique among such emission features for being fixed in longitude, rather than with respect to the Sun. Decades after its discovery, the physical processes driving the bulge remain a mystery. While many processes have been put forth to explain it, observations have so far been unable to distinguish between these. Presently, the best clues we have are two other curious structures colocated in magnetic longitude: an unusual equatorial magnetic anomaly discovered with Juno (the 'Great Blue Spot') and a dimming of ionospheric infrared emission. The physical underpinnings of the bulge and its connections to these nearby structures are key to understanding how Jupiter's equatorial ionosphere and inner magnetosphere interact. This interaction is fundamental to answering several open questions at Jupiter: How similar, or different, is Jupiter's equatorial interaction with the space environment to the Earth's? How does energy propagate through Jupiter's upper atmosphere? How do heavy ions populate Jupiter's radiation belts? Answering these questions has broad implications for the understanding the interactions between atmospheres and magnetic fields at all planets, including the Earth, Saturn, the ice giants, and exoplanets. The high spectral and spatial resolution observations required to finally understand the H bulge are possible only with HST. This program supports the UV initiative.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17813
Program Title: A Deep Search for the Surviving Companion to the SN 2016gkg Progenitor

Principal Investigator: Fox, Ori

PI Institution: Space Telescope Science Institute

Binary physics is an area of growing interest given the implications on a wide range of stellar systems, including merger sources for gravitational waves. Identification of progenitors to stripped-envelope supernovae (SESNe) offers a direct approach to constraining binary evolution scenarios. While the pathway by which SESN progenitor stars lose their envelope remains ambiguous (single vs. binary models), growing evidence suggests most SESN progenitors (>50%) are in binary systems. In just the past few years, the number of direct detections of surviving companions has grown to five. While exciting, the sample is still too small to make statistically meaningful conclusions about either the population or the binary physics itself. Increasing the sample size is slow given the small number of viable candidates, which means that each new data point is significant. Here we propose deep WFC3/UVIS optical+UV observations of the only relevant target for Cycle 32: SN 2016gkg at <26 Mpc. Similar to other companion searches, we aim to detect or place meaningful limits on any surviving companion. We also include one orbit to obtain F555W astrometry on the recent SESN 2023mut for potential future follow-up studies. This experiment will take advantage of HST's unique UV capabilities and will help build a statistically significant sample that will affect our fundamental understanding of binary evolution. The combined low likelihood of future events and HST's expected lifetime make these observations all the more critical.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17814
Program Title: Diversifying the UV Spectroscopic Sample of Fast Evolving Transients

Principal Investigator: Fox, Ori

PI Institution: Space Telescope Science Institute

Over the past decade, higher cadence all-sky surveys have uncovered a new, extreme class of transients with rapidly evolving light curves and high peak luminosities. The characteristics of these transients challenge our conventional understanding of massive star evolution and core-collapse supernovae (SNe). Most proposed models require a compact progenitor with extreme mass-loss, but the nature of both the progenitor and the mass-loss mechanism in these models does not often conform to conventional stellar evolution scenarios. UV spectra can offer important constraints on these models. They contain a significant fraction of the total energy output, uniquely probe thermal shock radiation that is not present at optical wavelengths, and directly trace the mass-loss history through P Cygni absorption profiles in the UV resonance lines. Over the past few years, the transient community has ramped up efforts to both collect UV spectra of fast transients and update spectroscopic modeling software (i.e., CMFGEN) to handle the physical scenarios associated with this subclass. Yet, to date, only a few UV spectra exist, and only the Type Ibn SN 2020nxt was successfully modeled by CMFGEN at UV wavelengths. Furthermore, within this SN Ibn subclass, there is known spectroscopic diversity amongst the events. Here we propose a disruptive ToO with HST/STIS to obtain 2 epochs of UV spectra of a fast transient that is within 250 Mpc. We will implement detailed CMFGEN modeling to constrain the progenitor system and pre-explosion mass-loss history. This program is not appropriate for ``Flex Thursday'' as the rates are too low.

Proposal Category: GO (GO-Archival)
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17815
Program Title: DISCS: Direct Imaging Survey of Circumgalactic Structure

Principal Investigator: Beckett, Alexander

PI Institution: Space Telescope Science Institute

The exchange of gas between galaxies and the surrounding circumgalactic and intergalactic medium (CGM and IGM) plays a vital role in galaxy evolution, regulating the fuel for star formation within galaxies. This recycling is found to manifest as disk-like accreting structures in the plane of some galaxies, and bi-conical outflows perpendicular to the galaxy disk. In absorption studies using background sources, this is seen as an increase in absorber incidence near to the major and minor axes of galaxies. Measuring galaxy orientations requires high resolution imaging only available from space, whilst associating gas and galaxies requires deep, high resolution galaxy and quasar spectra. Although many quasars have been observed with HST to-date, few have the imaging and galaxy spectroscopy required to measure CGM properties as a function of galaxy orientation. We propose a coordinated HST/JWST GO+archival program to ensure this high-resolution imaging covers 51 fields with existing QSO spectra and MUSE coverage. This data will allow HI absorption and galaxy redshifts to be found at $z<1.5$ for 37 fields (of which 20 currently lack HST imaging), and at redshifts 3-4 for 14 fields (which will require JWST imaging). We will measure how CGM properties vary with azimuthal angle, how these variations depend on galaxy properties, and how they evolve with redshift. This will provide the first high-z sample and the largest low-z sample compiled to-date, allowing us to measure how the presence of accreting and outflowing structures in the CGM varies with galaxy properties, morphologies, and redshifts, and thereby discriminate between models of stellar feedback and gas recycling.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17816
Program Title: The largest BAL acceleration: testing disk wind models

Principal Investigator: Arav, Nahum

PI Institution: Virginia Polytechnic Institute and State University

Quasar outflows are invoked as the major agent of AGN feedback and are crucial for the mass inflow/outflow balance in the vicinity of super massive black holes. Significant effort was invested over the past 3 decades in creating theoretical models for the formation and acceleration of these outflows. However, there is no decisive empirical test that confirms or refutes such models. These models have specific predictions for an outflow found in its acceleration phase. Recently, an outflow with the largest acceleration ever detected was found, and it is the ideal candidate to test acceleration models. Previous HST observations in 2011 and 2017 showed that the outflow's velocity shifted by -1550 km/s (the largest shift observed to date). Any one episode of acceleration can be accommodated by a disk-wind model solution. However, that solution predicts specific acceleration and distance values for future times and thus can be tested. We propose a 3rd epoch of observations, which will yield both the velocity and distance from the central source for the outflow. Thus, we will obtain a full empirical test for the acceleration models, and more generally, an unprecedented observational study of a broad absorption line outflow acceleration.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17817
Program Title: Tracing a hundred thousand kevin gas in the ram pressure stripped clouds

Principal Investigator: Sun, Ming

PI Institution: University of Alabama in Huntsville

The last decade has witnessed a burst of evidence for ram pressure stripping (RPS) in galaxy clusters in multiple bands, suggesting RPS as a major mechanism perturbing the evolution of galaxies in clusters. Stripped tails have been detected in multi-wavelength, tracing gas at different phases. With the synergy to circumgalactic medium/galactic winds and X-ray cool cores, stripped tails have emerged as ideal targets to study multi-phase media. There has already been some effort to study the energy transfer and connection between different phases in stripped tails, including the recent discovery on a tight correlation between the diffuse X-ray gas (tracing T ~ 10^7 K gas) and the diffuse Halpha gas (tracing T ~ 10^4 K gas). However, many outstanding questions on stripped tails remain unanswered, e.g., how strong is radiative cooling in stripped tails? how much gas is there at intermediate temperatures of T ~ 10^4 - 10^6.5 K in stripped tails? Are stripped tails strong UV emitters? In this proposal, we aim for the first ever detection of the C IV emission from a stripped tail to trace the T ~ 10^5 K gas, with the ACS/SBC data on two longpass filters. The data will provide important constraints on the T ~ 10^5 K gas in the stripped tail, which further constrain the strength of radiative cooling and energy balance in stripped tails.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17818
Program Title: Structure of the Extreme-UV Continuum Source in the Heavily Microlensed Quasar SDSS J1339+1310

Principal Investigator: Morgan, Christopher

PI Institution: United States Naval Academy

We propose to image the gravitationally lensed quasar SDSS J1339+1310 using a total of 12 orbits during HST Cycles 32 & 33. These regular monitoring observations of this heavily microlensed system with WFC3-UVIS in the F275W band will enable two primary science objectives: (1) We will analyze the microlensing variability in the resulting HST UV light curves in conjunction with existing optical light curves to make a measurement of the size of this quasar's continuum emission source at extreme-UV (EUV) wavelengths (83.7 nm in the rest frame). Only one other empirical measurement of a quasar's accretion disk size has ever been made at these extremely short UV wavelengths. (2) Coupling the new EUV size measurement with an existing measurement in the rest-frame near-UV will permit an empirical constraint on the temperature profile in this quasar's accretion disk. Empirical measurements of temperature profiles in other systems are quite discrepant from the predictions of basic thin disk models. We have also requested one deep observation with WFC3-IR in the F160W (H-band) to permit accurate modeling of the lens galaxy's mass profile. HST is the only existing telescope capable of making these UV observations with the angular resolution required to separate the flux from this lensed quasar's individual images and its lens galaxy.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17819
Program Title: WD0106-038: the first variable metal polluted white dwarf?

Principal Investigator: Rogers, Laura

PI Institution: University of Cambridge

This proposal aims to re-observe a white dwarf polluted with planetary material to confirm whether the amount of planetary material in the atmosphere has changed over time. This would be the first confirmed variable metal polluted white dwarf. Ground based observations revealed an increase of 35% in the equivalent width of the Mg II doublet over a timescale of 10 years. However, this is based off of one spectral line. A previous UV spectrum of WD0106-038 has been obtained which revealed a plethora of absorption lines; by obtaining a follow up UV spectrum we will confirm whether this is the first variable metal polluted white dwarf. Due to the short sinking timescales of approximately days-weeks depending on the element, we propose 2 observations to assess both the long-term (yearly) and short-term (monthly) variability of the absorption lines. This would be the first evidence for sporadic accretion and will have a significant impact on how we use metal polluted white dwarfs to measure bulk planetary compositions.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17820
Program Title: First mass measurement of black holes in a globular cluster

Principal Investigator: Lam, Casey

PI Institution: Carnegie Institution of Washington

We propose to perform astrometric follow-up of two black hole candidates in the Galactic globular cluster NGC 3201. Globular clusters are dense and dynamic stellar systems that are expected to harbor populations of stellar mass black holes. These black holes play an important role in the evolution of the cluster, as well as sourcing a variety of high-energy phenomena, such as binary black hole mergers. Two black hole candidates were identified through a radial velocity survey of the nearby globular cluster NGC 3201. However, because of a degeneracy between the orbital inclination and mass, only a lower limit on the black hole candidate masses can be derived from the existing radial velocities. In contrast, an astrometric orbit can break this degeneracy and enable a direct mass measurement of these black holes. We propose to use HST WFC3-UVIS imaging to obtain 10 measurements with an astrometric precision of 0.1 - 0.2 mas in order to map out the orbits of the two black hole candidates, measure their orbital inclinations, and most importantly, their masses. This will lead to the first mass measurement of black holes in a globular cluster, which will enable comparisons to the properties of black holes in field environments, insight into gravitational wave sources, and the dynamical evolution of globular clusters.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17821
Program Title: Anatomy of a Starburst: Spatially resolving Star Formation and Feedback in the nucleus of M83

Principal Investigator: Hernandez, Svea

PI Institution: Space Telescope Science Institute - ESA - JWST

Given that most of the stellar mass in the Universe was assembled in intense and powerful episodes of star formation (SF) at high-redshift, studies of local starburst galaxies provide us with the unique opportunity to investigate in detail a phenomenon with profound cosmic consequences. FUV spectroscopic studies, available only through the unmatched UV capabilities of HST, are the only venue to access a complete characterization of these young stellar populations formed in nearby highly star-forming galaxies. In an effort to improve our understanding on (1) the parameters that regulate galaxy evolution, (2) the link between pc-scale physics and galactic-scale mechanisms, and (3) the direct effects of young stellar populations onto their surrounding multi-phase ISM, we propose a unique spatially-resolved HST/STIS longslit study of 15 young massive clusters in the nuclear region of M83. With this program we aim to quantify for the first time the effects of these young stars, shaping the properties of the gas in extreme environments like those observed in starbursts. Our program will correlate the ionizing and mechanical feedback from these massive stellar populations with the observed properties of the ionized and warm molecular gas (from archival JWST/MIRI MRS observations) at the unprecedented spatial scales of ~5 pc. Our efficient project will take us one step forward to probing how young massive stars impact and influence galaxy evolution, and star formation at large.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17822
Program Title: The frequency and bulk composition of terrestrial exoplanets across Galactic history

Principal Investigator: Rogers, Laura

PI Institution: University of Cambridge

Chemically- and kinematically-distinct stellar populations, the thin disk, thick disk, and halo, record the assembly of the Milky Way. It is expected, but not confirmed, that their chemical variation affects planet formation and composition. It is challenging to investigate this using main sequence stars, as known exoplanets overwhelmingly reside in the thin disk, and measuring their occurence rate and compositions is essentially impossible. Metal-polluted white dwarfs, by contrast, not only allow the sensitive detection of planetary systems, but also give access to their bulk compositions. We will obtain UV spectra of a kinematically-selected sample of thick disk and halo white dwarfs using COS. We will then measure (or place stringent limits on) the abundances of rock-forming elements polluting their photospheres. Combining these with a sample of well-characterised thin-disk white dwarfs from archival HST observations, we will be able to measure (1) the frequency of planet formation, and (2) exoplanet iron and water mass fractions, and determine whether these quantities vary across Galactic history, as is theorised.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17823
Program Title: Linking Gas-Phase Element Depletions and Extinction Curves in the Small Magellanic Cloud

Principal Investigator: Van De Putte, Dries

PI Institution: Space Telescope Science Institute

We aim to investigate the relation between extinction curves and the composition of dust grains in the Small Magellanic Cloud (SMC). So far, 17 extinction curves have been measured for the SMC, and most of these deviate strongly from those observed in the Milky Way, being steeper and exhibiting a small or nonexistent bump feature at 2175 A. The dust could therefore be fundamentally different under the low-metallicity conditions (0.2 solar) of the SMC, and we aim to study how the composition of dust grains plays a role in these differences. Depletions of gas-phase metals are a key observable to infer constraints on the dust grain composition, and have been measured for 18 SMC sightlines. However, a systematic study of extinction curves and depletion is currently not possible, because the existing SMC extinction curve and depletion samples share only 3 sightlines. We propose COS/FUV and STIS/NUV spectroscopic observations at medium resolution towards 4 stars in the SMC, for which high-quality extinction curves are already available. These data will be used to measure the depletions of the key constituents of dust, and expand the depletion+extinction sample size from 3 to 7. With this increase in sample size, we will be able to explore the relation between UV extinction curves and the dust composition for the first time in the SMC. These sightlines also extend the existing SMC depletion sample to higher column densities (1e22 cm-2), thereby probing the accretion of gas-phase metals by dust grains at higher densities.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17824
Program Title: Examining the metal diverse interior composition of thick disk and halo planets using polluted white dwarfs

Principal Investigator: Williams, Jamie

PI Institution: The University of Warwick

Exoplanets are incredibly diverse objects and many are unlike anything we have in the Solar System, including hot-Jupiters, super-Earths and sub-Neptunes. The formation of these bodies depends on material available in the proto-planetary disk. Compositionally-different stars can therefore give rise to compositionally-different exoplanets. Thick disk and halo stars are metal-poor and alpha-enhanced and initial findings corroborate their exoplanets share the host star composition. However, observations of main sequence stars can only give densities and compositions are inferred using models, leading to large degeneracies. If an object is accreted onto a white dwarf, their pure hydrogen or helium atmospheres becomes polluted. This allows us to directly measure the composition of the accreted body using spectroscopic observations. This method had been incredibly sucessful when applied to thin disk stars and can reveal much more information about the interiors of exoplanets compared to only density, We propose targeting thick disk and halo polluted white dwarfs to investigate the chemical composition of exoplanets orbiting thick disk and halo stars. This study will probe their interiors using a method never applied to thick disk and halo exoplanets. We will be able to uncover the effects that galactic chemical evolution and galactic location have on what kind of exoplanets form.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17825
Program Title: Saturn's auroral energetics at equinox: support for JWST observations

Principal Investigator: Badman, Sarah

PI Institution: Lancaster University

Saturn's aurorae are displays of light in the planet's upper atmosphere, caused by the impact of charged particles funneled along the planet's magnetic field. These powerful displays reveal where energy flows through Saturn's space environment and are a major source of atmospheric heating. In late 2024, JWST will observe Saturn's northern atmosphere in the infrared to identify a hot spot postulated to drive Saturn's curious rotating aurora. The characteristics of these rotating aurorae and their control by the atmosphere are currently unique among all planets studied. The JWST observations are therefore extremely important in providing the only way to confirm that temperature controls the generation of the rotating aurora. To fully interpret the JWST observations, we will estimate the auroral electron precipitation energy and flux using spatially-resolved UV spectra from HST/STIS across the auroral oval to determine how much energy is deposited and whether it suppports an atmospheric hot spot. We will also identify rotational phases for Saturn's northern and southern auroral ovals to constrain where and when energy is input throughout a planetary rotation. HST provides the only way to obtain the necessary spatially-resolved UV spectra and to precisely track the rotational phase of the aurora. The understanding we gain from studying our solar system planets is valuable for interpreting other systems and interactions with stellar environments, such as how remotely-detected periodic emissions can identify characteristics of exoplanet magnetospheres.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17826
Program Title: Lyman alpha imaging of galaxies with the lowest mass and metallicity

Principal Investigator: Oestlin, Goeran

PI Institution: Stockholm University

The Lyman alpha (Lya) line is the intrinsically strongest recombination line from star forming galaxies, and is a key probe of the high redshift universe that been used to find tons of galaxies. However, being a resonant line, it scatters in the interstellar medium of galaxies and often comes out weaker than the dust content suggests, and the escaping Lya is commonly distributed over larger scales than the continuum, in the form of Lya halos. Hence, much of the Lya emission from galaxies may fall outside of spectroscopic apertures, requiring imaging to account for the full Lya budget. In the nearby universe, HST offer possibilties to study the physics regulating Lya escape from galaxies in detail, through imaging and spectroscopy. More than 80 galaxies in the low-z universe have been imaged in Lya with HST, but almost exlusively metallicities larger than 10% solar. JWST are now detecting sources at z>6 with lower metallicity and stellar mass than the existing low-z Lya samples. Here we propose to extend Lya imaging to a new regime of very low mass and metallicity that better overlaps with the new discovery space enabled by JWST. We propose to image a sample of 12 very metal-poor galaxies in Lya, Halpha, Hbeta and UV to i-band continuum filters to explore the Lya extent of galaxies in this yet unexplored mass and metallicity regime. Which such a sample size, provisional trends of the Lya escape physics vs galaxy physical properties could be obtained in this critical mass and metallicity regime of particular relevance for understanding galaxies in the epoch of reionisation, now being observed with JWST.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17827
Program Title: Weywot's rotational light-curve: searching for hints about the origin of small satellites in the trans-Neptunian region

Principal Investigator: Fernandez-Valenzuela, Estela

PI Institution: University of Central Florida Board of Trustees

This is a proposal to obtain the rotational light-curve of Weywot, the satellite of the TNO dwarf planet (50000) Quaoar. The study of trans-Neptunian binary and multiple systems provides valuable information about the formation and evolution of the icy bodies found beyond the orbit of Neptune. This, in turn, reveals the dynamical history of the outer solar system and the formation of planetary building blocks. The Quaoar-Weywot system is especially interesting because recent stellar occultation data shows a much larger satellite than expected and a significant difference in albedos between the primary and the secondary. The goal of this proposal is to obtain the rotational light-curve of Weywot. This will allow us to determine Weywot's rotation period and constrain the three-dimensional shape of the object by providing its rotational phase during two predicted stellar occultations by Weywot in July 2025. This is a unique opportunity not presented in the foreseeable future for any other TNO dwarf planet satellite. The combination of these data will provide important constraints for the formation scenario of Weywot and will inform about the formation mechanisms of similar systems.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17828
Program Title: An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar crusts?

Principal Investigator: Melis, Carl

PI Institution: University of California - San Diego

Recent JWST MIRI spectroscopic observations covering 5-12 microns unveil a dramatic excess of dusty debris over the well-characterized photosphere of three polluted white dwarf stars. The JWST spectra reveal solid-state emission features that require glassy silica (SiO_2) species associated with energetic impacts or differentiation processes that produced Earth-like crustal material. Ultraviolet spectroscopic observations will provide measurements and constraints on the elemental constituents of the debris, including those that dominate terrestrial rocks (Si, Mg, Fe), as well as other important tracers of planetary assembly and structure. The proposed experiment will distinguish between Fe-poor material in a planetary crust, where the high silica content has resulted from (past) differentiation, and silica resulting from highly energetic impacts between primitive material that may have occurred during the post-main sequence phase.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17829
Program Title: The Lyman alpha halo of the nearest Lyman continuum leaker

Principal Investigator: Oestlin, Goeran

PI Institution: Stockholm University

We propose to map Haro11, the nearest confirmed Lyman continuum leaking galaxy with ACS/SBC to determine the nature of its extended Lyman alpha emission. This galaxy is a key anchororing point for high redshift analogs with wealth of observation from X-rays to radio. Still it lacks an accurate measurement of its Lyman alpha extent.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17830
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. A particular surprise is the extreme physical difference between the two objects, 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 and activity 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: Supermassive Black Holes and Active Galaxies
ID: 17831
Program Title: Ionization Echoes of Fading AGN

Principal Investigator: Prescott, Moire

PI Institution: New Mexico State University

Understanding how and why Active Galactic Nuclei (AGN) vary in ionizing output can provide insight into the physics of AGN accretion and fueling. "Green Bean" nebulae at z~0.3 surround powerful AGN that show evidence of having ramped down in ionizing output by 3-4 orders of magnitude over the past 10,000-100,000 years; this significant variability will be imprinted as an ionization echo within the surrounding extended emission line gas. Leveraging a successful recombination balance approach demonstrated previously for a sample of lower redshift Seyfert-class systems, we propose to obtain HST ACS ramp filter Halpha and [OIII] imaging and WFC3 continuum imaging of Green Bean nebulae in order to constrain the ionization histories of luminous AGN at high spatial, and therefore time, resolution. In addition, when combined with existing HST Lyman-alpha and UV continuum imaging of the Green Beans, the proposed observations will provide insight into the importance of Lyman-alpha resonant scattering within extended emission line nebulae, while benefitting from lower surface brightness dimming than at higher redshifts and avoiding the issue of geocoronal Lyman-alpha contamination that can plague local galaxy studies.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17832
Program Title: Deciphering an Adolescent Warm Sub-Neptune to Unify Formation Models with Primordial Atmospheres

Principal Investigator: Louca, Amy

PI Institution: Universiteit Leiden

Prior observations of mature gas giants have shown evidence of metal-enhanced atmospheres with respect to their host-star. This enrichment could happen during the birth of the planet or it could be caused by atmospheric evolution. While formation and evolution models are able to provide various physical explanations, observational evidence to support any specific hypothesis is still missing due to an inability to distinguish the root-cause of metal-enhancement when studying evolved worlds. Atmospheric characterization of very young planets (<100 Myr), which are yet to experience significant atmospheric evolution, allows us to break the formation/evolution degeneracy and uncover the cause of metal-enrichment. We propose to observe the young (45 Myr) planet DS Tuc Ab using simultaneous transmission spectroscopy with HST WFC3 and JWST NIRSpec to measure the atmospheric metallicity and the carbon-to-oxygen ratio. Forward models show that water, methane, and carbon dioxide are the fundamental tracers of these characteristics, which are best distinguished by having a broad wavelength coverage. This can only be achieved by using both facilities. These data will also allow us to constrain the planet's mass which, in combination with the proposed STIS observations of the host star, will allow us to generate models of the planet's evolution to predict its final fate. Therefore, these observations will give us strict constraints on formation and evolution pathways for this adolescent world. By also using observations of analogue mature planets, we will be able to construct a timeline of atmospheric evolution and find the source of metal-enrichment in exoplanetary atmospheres.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17833
Program Title: Bringing HST to the VLA: The Interaction of Stars and Gas in the Local Group

Principal Investigator: Dalcanton, Julianne

PI Institution: University of Washington

We propose a wide-area, multi-wavelength survey of stars in IC 10, NGC 6822, WLM, & IC 1613. Along with M31 and M33, these Local Group galaxies now have unprecedented investments from the VLA, revealing indvidual gas clouds with sizes of 10-25 pc. The origin and fate of the ISM on these scales is shaped by stellar feedback; the addition of HST data allows an unprecendented opportunity to rigorously quantify the interaction between stars and gas. UV and optical photometry will provide: (1) comprehensive catalogs of massive stars; (2) spatially-resolved maps of the recent star formation history with ~5-10 Myr resolution; (3) stellar photometry for ~1 million stars; (4) measurements of T_eff, L_bol, and A_V for each of those stars -- all for stellar populations of much lower metallicity than available in comparable surveys of M31 or M33. We will combine these new data products with state of the art ISM data to: constrain the energetics of the ISM, by linking the history of stellar energy input (derived from the SFH) to the observed kinematics and phase of the ISM; calibrate new JWST ISM tracers by measuring the interstellar radiation field; constrain feedback efficiency by measuring the local ISM density where evolving massive stars deposit their energy; and constrain models of evolution for massive stars. All of these effects are likely to be strongly impacted by metallicity, adding to the importance of adding these four dwarfs as calibrators of ISM physics and stellar evolution. The resulting data set will be versatile and can support many other scientific objectives, cementing HST's legacy in the Local Group - the only location where physics on this scale can be resolved.

Proposal Category: GO (GO-Archival)
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17834
Program Title: Confirming Serendipitous Microlens Host Detections with New and Archival HST Imaging

Principal Investigator: Terry, Sean

PI Institution: University of Maryland College Park

We propose a GO-Archival program to study seven planetary microlensing events for which we identify serendipitous HST archival data that have observed these targets between 8 - 25 years prior to the gravitational microlensing events. We will couple this archival data with new HST observations in order to definitively confirm the candidate lens objects via their proper motions. Three of the seven targets likely represent very exotic lenses; two of the targets are candidate white dwarf (WD) hosts and one target is a free-floating planet (FFP) candidate. Successful confirmation of any of the proposed targets requires a second-epoch HST observation, and would represent a first of its kind precursor detection of a lens object prior to the microlensing event. Further, confirmation of either of the WD or FFP candidates will help inform planet formation and evolution theory for unbound FFPs as well as bound planets in stellar remnant systems.

Proposal Category: GO
Scientific Category: Solar System Astronomy
ID: 17835
Program Title: Improving the masses of the Pluto Small Satellites

Principal Investigator: Porter, Simon

PI Institution: Southwest Research Institute

This program would measure astrometry for the small satellites of Pluto to update and improve their dynamical mass estimates. All four small satellites of Pluto were discovered by HST, and WFC3 has been the primary source of astrometry for them both before and after the New Horizons flyby in 2015. Styx and Keberos have only ever been observed with WFC3 due their extreme faintness (V~26-27). The proposed observations, which would be no earlier than Spring 2025, six years after the last HST observations of Pluto, would enable significant improvement in the orbits of Styx and Kerberos. Recently published dynamical studies of the Pluto small satellites (Kenyon & Bromley, 2022, Porter & Canup 2023) show that the much smaller Styx and Kerberos are sufficiently perturbed by Nix and Hydra that Styx and Kerberos can be used to constrain the mases of Nix and Hydra. This improvement in the orbits of Styx and Keberos would then directly help to better constrain the masses of Nix and Hydra, while also enabling the long-term monitoring of Styx and Kerberos that is critical to determine their masses. The masses of the small satellites of Pluto provide important constraints on the formation of the Pluto system. This in turn helps to constrain the moon-forming process after a giant impact, critical to understanding planet formation in general. The proposed observations would use proven published techniques to measure the absolute astrometry of the small satellites relative to the background Gaia DR3 stars, eliminating the problem of historical anaylses that Pluto and Charon are barely resolved in WFC3 and make poor astrometric references.

Proposal Category: AR
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17857
Program Title: Detecting Stellar Counterparts for a Large Sample of Spatially Offset Active Galactic Nuclei

Principal Investigator: Barrows, Robert

PI Institution: University of Colorado at Boulder

Galaxy mergers are predicted to be efficient at triggering active galactic nuclei (AGN) and may play a role in the evolution of the massive black hole population. However, while theory suggests that AGN luminosities are strongly dependent on their host galaxy stellar masses, this dependence has not yet been tested on large samples of AGN in late-stage mergers due to AGN selection methods that are unable to spatially resolve their locations within mergers. To overcome this limitation, we have developed the first systematic, wide-area sample of spatially offset AGN by cross-matching sources from the VLA Sky Survey with galaxies from the Sloan Digital Sky Survey. The selection requires that the AGN be spatially located within the host galaxy and can quantify the merger stage down to small physical separations. Therefore, we propose to use archival HST imaging to detect the individual host galaxies associated with our sample of offset AGN to directly test the merger-AGN connection. The high sensitivity and spatial resolution of HST can detect the faint stellar cores of offset AGN, and the large body of archival HST imaging is expected to identify the galaxies of ~120 offset AGN (~10 times the size of previous samples). We will use this sample to test the role of galaxy mergers for enhancing AGN luminosities, the relative contributions of minor and major mergers, and the dependence on merger stage. This project will also have a larger impact on understanding the role of secular evolution of the massive black hole population and in the identification of precursors to potential binary black holes and hence future gravitational wave sources.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17858
Program Title: The Size and Shape of the Milky Way from HST pure-parallel low-mass starcounts

Principal Investigator: Holwerda, Benne

PI Institution: University of Louisville Research Foundation, Inc.

How many low-mass, ultracool dwarfs (UCD) are in the Milky Way? And where are these low-mass stars and free-floating planet-like objects in our Galaxy? We propose to use the SuperBoRG collections of WFC3 Pure-Parallel Observations to search for Galactic ultracool dwarfs (UCD: M, L, and T) to accurately model the 3D structure of the Milky Way disk in UCDs. Recent studies of Milky Way interlopers in high-redshift observations have revealed a 300 pc thick disk of these cool stars with 7% of the M-dwarfs in an oblate stellar halo. We propose to use all Pure-Parallel WFC3 observations to quadruple the number of sight-lines (340 fields, an order of magnitude more volume) through the Milky Way and expand the search to L- and T-dwarfs. Accurate typing has been shown to work on HST grism data using machine learning techniques. Such an approach has yet to be applied on HST photometry but could produce accurate photometric typing to within two subtypes. With enough statistics and the power of random sampling and volume of the Milky Way structure, we will be able to constrain the scales of the structural components of the Milky Way (thin and thick disks and halo) using an MCMC approach for M-, L- and T-dwarfs. This approach has the benefit to allow us to constrain scale-lengths, -heights, and densities as well as the relative position of our Sun with respect to the disk of dwarf stars of our Milky Way. The total number of each UCD type can then be inferred from each model, constraining the low-end of the Galaxy-wide Initial Mass Function (GIMF) for the first time and the fraction of stars in the halo, a prediction from cold dark matter structure formation.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17859
Program Title: Mocking Galactic Winds: A new approach to constraining feedback by modeling the UV spectra of galaxies

Principal Investigator: Henry, Alaina

PI Institution: Space Telescope Science Institute

Galactic winds, driven by intense star formation and supernovae, are essential for regulating galaxy growth and evolution. However, the mechanisms behind these outflows remain uncertain, leading to questions about whether they act by heating gas to prevent further accretion, or by expelling the fuel needed for star formation. We propose a new technique for constraining feedback from galactic winds, using semi-numerical models to create mock UV spectra. We will use high-resolution simulations of cool clouds interacting with a hot wind, post processing each cloud with radiation transport to build a library of absorption line spectra. The individual cloud spectra will be combined according to a flexible, physically motivated model, thereby simulating galaxy-wide outflows. With this new strategy, we can investigate how spectra are influenced by changes in physical parameters like the wind energy and mass loading, cloud sizes, and wind geometry. We will compare our simulated spectra with observations of nearby star-forming galaxies obtained with the Cosmic Origins Spectrograph. Through this method of forward-modeling galactic winds and analyzing their spectra, we aim to provide the most accurate constraints yet into the physics of outflows and their impact on the evolution of galaxies. This innovative approach represents a new way of bridging theory and observation to enhance our understanding of star formation feedback.

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17860
Program Title: Interface: A New Tool for Generating Absorption and Emission Spectra from Multi-Phase Mixing Layers

Principal Investigator: Oh, Siang

PI Institution: University of California - Santa Barbara

Multi-phase gas and turbulence are ubiquitous in astrophysics. In recent years, there has been remarkable progress in understanding how hot and cold gas phases exchange mass, momentum and energy at phase boundaries, or turbulent mixing layers (TMLs). This can enable the survival, growth and entrainment of cold clouds in galactic winds or turbulent gas, as well as provide a drag force for HVCs which exceeds standard hydrodynamic drag. Unfortunately, observational tests have been hampered by the fact that most hydrodynamic simulations do not resolve TMLs, or implement thermal conduction, which is crucial to predicting line ratios. We develop a new tool, Interface, which post-processes low resolution simulations (even without conduction) to generate predictions of TML absorption, emission and ion column densities in a matter of minutes or seconds. It leverages the success of semi-analytic models which match high-resolution TML simulations with conduction. TMLs can potentially explain the presence of high ions such as OVI (which peak at thermally unstable T ~ 10^5 K temperatures), the kinematic alignment of low and high ions, and tight correlation of soft X-ray and H-alpha surface brightness in various settings. The accuracy and low computational cost of our tool will enable more efficient and realistic comparisons of current low resolution simulations with observations of HVCs, ram-pressure stripped galaxies, and CGM absorption line measurements, amongst myriad applications. We will test Interface against high resolution hydrodynamic simulations where all relevant lengthscales are resolved, and release an open source Python module for all to use.

Proposal Category: AR
Scientific Category: Large Scale Structure of the Universe
ID: 17861
Program Title: Hubble's Legacy Fields: Maximizing Hubble's Legacy by Doubling the Combined MAST Datasets for the COSMOS, EGS and UDS Fields.

Principal Investigator: Illingworth, Garth

PI Institution: University of California - Santa Cruz

The wide/deep fields from Hubble have been a remarkable resource for studies of galaxy birth, assembly, buildup and transition over the first 2-3 Gyr. The HUDF, GOODS, CANDELS, CLASH, and the Frontier Fields, have been central to efforts to map galaxy growth in the universe. Yet much of the data taken with Hubble has not been available to the science community in a usable form. Far too little of the data taken has been delivered in a timely way to the MAST archive as High Level Science Products (HLSPs). Fortunately efforts in the last decade through the Hubble Legacy Fields (HLF) project have more than doubled the available fully processed, astrometric and photometric data on the GOODS-N & S regions by adding nearly a **year** of Hubble data as HLSPs in MAST. Yet still less than half of all Hubble UV and optical image data on three major wide/deep CANDELS fields (COSMOS, UDS, EGS) is available through the MAST archive in a form that is usable by any community member without a huge processing effort. A further 10% of the data on GOODS-N & S has also not been combined and delivered to MAST. The missing MAST data overall constitutes over 35% of a year of Hubble observations, representing a huge public investment. These Hubble imaging data provide unique high-spatial resolution UV and optical data for a vast array of ongoing programs using Chandra X-Ray, ALMA, current 8-10 m class observatories, future ELTs and SKA radio studies, as well as the results over COSMOS and UDS from numerous surveys: UKIDSS UDS, VIDEO, UltraVISTA, extended COSMOS and XMM (HSC survey and NIR surveys). We will deliver to MAST the missing data for COSMOS, UDS, EGS and GOODS-N&S as high-quality HLSPs.

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17862
Program Title: Illuminating the Dark Ages of Metal Evolution: An HST Legacy Survey at Cosmic Noon

Principal Investigator: Lehner, Nicolas

PI Institution: University of Notre Dame

Metals trace the complex interplay between galaxies and their gaseous surroundings, providing crucial insights into the processes driving galaxy evolution. While the metal content of the diffuse gas has been well-characterized at z<1 using UV spectra and at z>2.4 using optical spectra, a gap remains at 0.9<z<2.2, the peak epoch of star formation and black hole activity known as "Cosmic Noon." This era witnessed the most rapid growth of galaxies and the greatest output of ionizing radiation, metals, and feedback energy, making it a critical benchmark for galaxy evolution models. However, characterizing the diffuse gas at Cosmic Noon requires challenging observations, as the key absorption features fall in both the NUV (HST) and optical (ground-based) bands. Using a metal-unbiased HI-selected sample, we propose the first comprehensive census of metals in the diffuse gas at Cosmic Noon. By combining 30 high-resolution HST/NUV and optical QSO spectra, we will determine the metallicity distribution, estimate the metal budget, and constrain the physical state of gas across a vast range of overdensities for >200-300 absorbers, capturing the diversity of enrichment. State-of-the-art ionization modeling will reveal the multi-phase structure of the gas, providing unequaled tests of galaxy evolution and feedback models. This Legacy program will establish transformative insights into the metal enrichment history of the Universe and the complex interplay between galaxies and their gaseous surroundings during the most active phase of cosmic history. The resulting database will be a treasure trove for future studies, offering a new window into the peak epoch of galaxy assembly.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17863
Program Title: An Automated Pipeline for Modeling of Strong Gravi- tational Lenses Observed by HST

Principal Investigator: Storfer, Christopher

PI Institution: University of Hawaii at Manoa

To date there is no well validated end-to-end lens modeling pipeline which is scalable, robust, and uniform. To be generally applicable such a pipeline would need to be validated on a large sample of real strong lenses with extended background sources which have been imaged with HST. The goal of this HST Archival Program will be to develop and validate such a pipeline which will prove to be critically important in the pursuit of key strong lensing science objectives. This will be the first step towards population level inferences and robust statistical analyses for a wide range of strong lensing science including measuring cosmological parameters such as H0, testing the cold dark matter model via detection of low mass dark matter halos, and a wide variety of galaxy evolution studies.

Proposal Category: AR
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17864
Program Title: Measuring major contributors to AGN feedback: Quasar outflows in the HST/UV archive:

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 1000 quasars. These observations were taken mainly 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: Intergalactic Medium and the Circumgalactic Medium
ID: 17865
Program Title: Metal Lines as Clues: Confining the Shape of the Extragalactic UV Background

Principal Investigator: Khaire, Vikram

PI Institution: University of California - Santa Barbara

Understanding the properties of gas in the intergalactic and circumgalactic medium is essential for gaining insights into galaxy formation and evolution. However, accurately determining the characteristics of this gas is challenging due to the uncertain shape of the extragalactic ultraviolet background (UVB), which plays a vital role in the ionization and thermal state of the gas. In this proposal, we present a novel method to constrain the spectral shape of the UVB using absorption line systems with multiple metal lines. We will analyze a set of seven metal absorption systems featuring 6-10 species of metal ions and spanning a redshift range from z=0 to 0.62, as identified in the archival spectra observed with the Cosmic Origin Spectrograph on board the Hubble Space Telescope. To constrain the shape of the UVB, we will apply Voigt profile fitting techniques and utilize a comprehensive suite of Cloudy models. Our approach will involve considering a minimum of 25 sets of UVB models, comprising 14 new models specifically generated for this analysis. Through Bayesian inference analysis, we aim to determine the spectral shape of the UVB and its redshift evolution up to z=0.62. The results of this study will not only improve the accuracy of UVB synthesis models but also provide valuable insights into the quasar spectral energy distribution in extreme UV wavelength ranges, currently beyond the reach of existing instruments.

Proposal Category: AR
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17866
Program Title: Too Hot to Handle: Investigating the Mysteries Surrounding the Thermal State of the Intergalactic Medium Over the Last 10 Billion Years

Principal Investigator: Hu, Teng

PI Institution: University of California - Santa Barbara

One of the remarkable achievements of the current cosmology lies in the percent-level concordance between theory and observations of the intergalactic medium (IGM) at z > 1.7. Yet, the IGM at lower redshift (z < 1.7), which can only be studied via HST UV spectra, has unveiled puzzling discrepancies. Notably, the Doppler b-parameters of Lyman-alpha absorption lines are on average ~10 km/s wider than any existing simulation of the IGM. Furthermore, recent analyses at z~1 reveal an unexpected absence of IGM cooling. This contradicts the fundamental prediction that post-He II reionization (z < 2.5), the IGM should cool down owing to the Hubble expansion. Addressing these discrepancies, the wider b-parameters and the IGM temperature at z~1, require considering either non-standard heating mechanisms, exotic dark matter, or missing turbulence. To tackle this challenge, we aim to assess the thermal and ionization states of the IGM using 144 archival HST COS and STIS quasar spectra that probe the Lyman-alpha forest at 0 < z < 1.7. Our strategy includes a detailed measurement of the 2D b and H I column density distribution and the absorber density dN/dz, across ten redshift intervals through an automated Voigt profile analysis of all spectra. By comparing these observations with a large suite of hydrodynamical simulations via advanced machine learning-based inference, we intend to accurately measure the IGM's thermal and ionization history over the last 10 billion years. Our proposal will conclusively determine whether the low-z IGM thermal state conforms to theoretical expectations or if there is a need to explore the potential emergence of new physics at these cosmic times.

Proposal Category: AR
Scientific Category: Galaxies
ID: 17867
Program Title: A new theoretical spectral library across the upper-HRD for all metallicities

Principal Investigator: Hawcroft, Calum

PI Institution: Space Telescope Science Institute

An essential ingredient in the composition of galaxies are massive stars. This is highlighted by the fact that features arising directly from, or due to the impact of, massive stars are observed throughout the Universe, from our Local group to nearby star forming galaxies, through cosmic noon to the era of reionisation. Therefore massive stars must be accounted for in observational studies of galactic properties, the gold standard of which focus on spectroscopy. The model galactic spectra required for these investigations are produced through population synthesis approaches, which are built upon libraries of theoretical stellar atmospheres. However, these libraries are limited in their sampling of the upper Hertzsprung-Russell diagram, as well as their coverage in wavelength, metallicity, mass, abundance and their treatment of mass loss. We propose to establish a new spectral library, utilising recent advancements in stellar evolutionary and atmospheric modelling, that will provide improvements in all of these aspects. The spectral templates produced in this project will be made publicly available, with applications in stellar and photoionisation modelling, and will be an essential tool in tackling some of the most pressing open questions in galaxy evolution related to abundances, outflows, star formation rates and the nature of the initial mass function (including the presence of very massive stars).

Proposal Category: AR
Scientific Category: Galaxies
ID: 17868
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 archival imaging in F105W, F140W, and F160W to derive stellar mass maps and investigate the spatial distribution of the dominant baryonic components in main-sequence cluster galaxies at z~1.6. The 2 clusters with archival HST imaging contain galaxies in remarkable states of transformation and will be combined with analogous scheduled data on another cluster for a total sample of 29 galaxies 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: AR
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17869
Program Title: Molecular Winds in Protoplanetary Environments: Leveraging the HST-COS Archive to Study Disk Evolution

Principal Investigator: Kalscheur, Matt

PI Institution: University of Colorado at Boulder

We propose to use ultraviolet spectra from Hubble Space Telescope's Cosmic Origins Spectrograph (HST-COS) to characterize molecular hydrogen (H2) winds in the protoplanetary disks of a large sample of T Tauri stars for the first time. We will also use the growing archive of spatially-resolved James Webb Space Telescope (JWST) data to quantify mid-infrared H2 and [Ne II] emission in T Tauri stars common to our HST-COS sample. From the HST-COS data, we will measure H2 line kinematics and estimate molecular wind mass loss. We will compare the measured line kinematics to star and disk parameters (e.g., mass accretion rate and the infrared index), and to line kinematics measured from existing molecular and atomic tracers of the disk wind. From the JWST data, we will measure H2 and [Ne II] line kinematics, and the spatial extent of the wind. We aim to determine the physical launching mechanism of the wind (magnetohydrodynamic or photoevaporative) throughout the lifetime of the disk, and the degree to which atomic and molecular disk gas tracers probe different parts of the outflow. Together, these analyses will provide a new panchromatic framework for interpreting protoplanetary disk winds, a key input to the evolution and dispersal of the disk.

Proposal Category: AR
Scientific Category: Solar System Astronomy
ID: 17870
Program Title: Characterizing Uranus's Heat Balance Through Measurements of Bond Albedo w/ HST

Principal Investigator: Dahl, Emma

PI Institution: Jet Propulsion Laboratory

The lack of apparent heat release from deep within Uranus's interior is a major oustanding question in planetary science, and one a future orbiter/probe mission will likely seek to address. However, a current knowledge gap on the role of absorbed Solar radiation in Uranus's energy budget restricts our ability to determine an accurate determination of the amount of released internal heat, thereby restricting our ability to test solutions to this problem. We therefore propose to utilize archived HST observations of Uranus to derive new estimates of Bond albedo at regular 2-3 year intervals between 1994 and 2023, allowing us to inspect any possible temporal variability in reflectivity and place constraints on the true degree of heat release at Uranus.
