Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17907
Program Title: One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

Principal Investigator: Schwab, Michaela

PI Institution: Rutgers the State University of New Jersey

Type Ia supernovae (SNe Ia) play a central role in cosmology, stellar evolution, and cosmic chemical enrichment. Nonetheless, their progenitors and explosion mechanisms remain uncertain. The classic model -- a Chandrasekhar-mass white dwarf (WD) accreting mass from a non-degenerate companion -- may not explain normal SNe Ia, but aligns well with observations of the peculiar Type Iax supernova (SN Iax) subclass. Intriguingly, pure deflagration (subsonic) explosion models of SNe Iax predict that the WD may not be completely disrupted, potentially leaving behind a bound remnant. SN Iax 2012Z offers an exceptional opportunity to stringently test this scenario. Deep pre-explosion HST ACS/WFC imaging of its host galaxy, NGC 1309, revealed a luminous, blue helium star thought to be the companion of the exploding WD. Subsequent ACS/WFC imaging at the location of SN 2012Z in 2016 and 2019 revealed that, remarkably, this source is still visible with a persistent flux excess beyond that expected from the companion star alone. We propose one final ACS/WFC observation, six years after the last, allowing for image subtraction to conclusively determine whether this mysterious flux excess originates from a bound remnant driving a radioactive wind or from shock-heating of the ejecta-blasted companion star. This observation will cement the legacy of HST in elucidating the origins of SNe Iax.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17908
Program Title: To the Frontiers of Time Domain: Supermassive Black Holes and Exotic Stellar Transients in the Early Universe

Principal Investigator: Hayes, Matthew

PI Institution: Stockholm University

We propose to obtain deep WFC3/IR images of the two strongest galaxy cluster gravitational lensing fields, and to match the depth and pointing obtained 10 years ago in the Hubble Frontier Fields (HFF) program. Both clusters were recently observed with the deepest JWST programs, and in concert have 20 band imaging from the two telescopes. The new images will leverage HST's legacy data and anchor HST-JWST photometry at a single epoch. We will begin the assembly of a time-series dataset that could ultimately extend over three decades, in a campaign that is closely aligned with the bridge program philosophy. The program will focus on a survey of the universe at redshifts above 6 to search for variable AGN and exotic supernovae. The AGN campaign will identify supermassive black holes (SMBHs) in galaxies of luminosities that hitherto could not be tested at these redshifts, and measure the number density of SMBHs in the reionization epoch. Its results will determine (or place the strongest practical constraints on) SMBH formation mechanisms, which are critical to our theoretical understanding of galaxy evolution. The SN campaign is optimized to identify and monitor the rarest transients including super-luminous SNe and pair-instability SNe, as well as a foreground of lensed SNe at lower-z. The progenitor stars of these SNe represent the very highest masses, and will facilitate unique tests of the upper end of the IMF at an epoch when there are contested claims regarding its evolution.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17909
Program Title: Rest-Frame [O III] Imaging of Post-Starburst TDE Hosts with Extended Emission Line Regions

Principal Investigator: Hinkle, Jason

PI Institution: University of Hawaii

Post-starburst galaxies, with little current star formation but evidence of a recent large burst, are promising probes of the transition between star-forming and quiescent galaxies. The cause of the rapid quenching of star formation is debated, with gas-rich mergers, stellar feedback, and active galactic nucleus (AGN) feedback all plausible explanations. Recent studies have discovered extended [O III] emission line regions (EELRs) in several post-starburst galaxies, inconsistent with current AGN activity but compatible with AGN activity over the past several thousand years. Interestingly, many post-starburst galaxies with EELRs have also been hosts to recent tidal disruption events (TDEs), a transient class for which post-starburst galaxies are highly overrepresented as host galaxies. Here we propose to obtain an epoch of narrow-band rest-frame [O III] (FR505N) and medium-band continuum (FR647M) imaging of three post-starburst TDE hosts with observed EELRs to more finely map their spatial distribution. These observations require the use of the ramp filters on ACS/WFC. The high spatial resolution [O III] images will address important questions about the interplay between AGN activity and the nature of post-starburst galaxies. We will (1) test the possibility that TDEs power the EELRs through a search for shells of emission, (2) constrain the AGN active lifetime from the most distant EELR, and (3) provide insight into the connection between diverse forms of nuclear SMBH activity like AGNs, TDEs, and quasi-periodic eruptions.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17910
Program Title: Silicates vs Carbon dust in NGC 6822: determining stellar dust types with WFC3/IR's unique filters

Principal Investigator: Nally, Conor

PI Institution: University of Edinburgh, Institute for Astronomy

Asymptotic Giant Branch (AGB) stars are important drivers of the chemical enrichment of the interstellar medium (ISM) in galaxies. They can form carbonaceous and silicate dust at metallicities as low as 0.6% solar, and can potentially inject mass into the ISM of galaxies 30 Myr after they form. The two species (C- and M-type) are split by different dominant surface chemistry (carbon- and oxygen-rich respectively) which affects the dust grains formed, dust mass, opacity and mass-loss efficiency and in turn, causes them to evolve at different rates. Disentangling these two species is key to understanding the effects they have on their environment. JWST imaged the local dwarf galaxy NGC 6822 and identified ~1200 candidate AGB stars. However, it has been shown that JWST medium- and wide-band photometry is not effective at identifying the chemistry of these stars, especially in low metallicity environments. HST can rectify this. With WFC3/IR F127M, F139M and F153M imaging of the same area, we can reliably constrain the stellar chemistry for SED fitting using the broad baseline (1-21 micron) photometry from JWST. This ensures accurate dust mass and type measurements to assess the contribution that AGB stars have to the dust budget in the early Universe. In addition this will provide validation to the method of identifying AGB species with JWST SED models.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17911
Program Title: Building the Last Bridge Between the PHAT & PHATTER Surveys and Carbon Star Cosmology

Principal Investigator: Li, Siyang

PI Institution: The Johns Hopkins University

The Hubble Tension refers to a >5 sigma difference between local and cosmological measurements of the present expansion rate of our universe, the Hubble constant (H0). This tension hints at the possibility of undiscovered physics undermining the canonical standard model of our universe. Probing the Hubble Tension necessitates intense scrutiny of the Cepheid-based distance ladder, which currently provides the strongest constraints on direct H0 measurements. Possibly the most powerful approach to test systematics in the Cepheid-based steps of the distance ladder is to develop and use independent standard candles to measure distances to galaxies. To date, agreement with another candle, the tip of the red giant branch (TRGB), has been elusive. The J-region Asymptotic Giant Branch (JAGB) is a new standard candle that can provide independent relative distances between nearby systems, as well as crosscheck Cepheid systematics at > 30 Mpc. The Panchromatic Hubble Andromeda Treasury (PHAT) and PHAT Triangulum Extended Region (PHATTER) were HST multi-cycle programs that mapped a third of the star forming disk in M31 and central ~0.1 deg2 region of M33 and are unequivocally the best testing grounds for characterizing and standardizing the JAGB via cross calibration with other standard candles. However, there currently exists no F110W observations of the outer disk in NGC 4258 that can be used to measure JAGB distances with PHAT & PHATTER. We propose to fill in this gap and observe the outer disk of NGC 4258 in the HST WFC3/IR F110W filter. This cycle is the last that will enable tying the PHAT & PHATTER legacies to Carbon star cosmology.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17912
Program Title: Mapping Spatially Resolved Neutral H In Strongly Lensed Quasar Host Galaxies With Narrowband Lyman-alpha

Principal Investigator: Bayliss, Matthew

PI Institution: University of Cincinnati Main Campus

Large-separation (r>10") lensed quasars are extremely rare, but provide opportunities to zoom in maximally on quasar host galaxies. With magnification factors of ~20+, these systems enable studies that are impossible with quasars in the field, or even lower magnification galaxy-quasar lens systems. Lyman-alpha emission scatters resonant off of neutral hydrogen, and so its physical extent and distribution therefore provides a direct tracer of the neutral H gas content in galaxies. We propose to leverage the uniquely powerful combination of HST optical narrowband imaging (to isolate Lyman-alpha) and strong gravitational lensing to directly image the spatial distribution of neutral H on ~<100-200 pc physical scales within five quasar host galaxies at z=1.9-3.3. Archival HST+JWST broadband imaging constrains the spatially resolved stellar populations, providing maps of ionizing photon production from the stars so that we can robustly compare Lyman-alpha production against the Lyman-alpha narrowband imaging to quantity spatially resolved Lyman-alpha escape. The extreme magnifications allows for a clean separation of quasar vs host galaxy light to within ~100-200 parsecs of the central AGN engines. The resulting high resolution narrowband Lyman-alpha imaging data will unobtainable with any near term facility once HST ceases operations, and will hold substantial legacy value that will enhance future spatially resolved NIR spectroscopic studies of these quasar host galaxies.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17913
Program Title: The False positive in the Lyman Continuum escape fraction estimation

Principal Investigator: Lin, Yu-Heng

PI Institution: California Institute of Technology

When calculating the reionization history, the Lyman Continuum escape fraction (fesc) cannot be measured directly at high redshift and therefore remains severely unconstrained. The fesc can only be referred from the indirect fesc indicators derived from the low-z studies. However, the indirect fesc indicators are only derived from spatially integrated properties, neglect the false positives in the regression, and imply an overproduction of ionizing photons that would lead to a very early reionization history. This proposal aims at understanding the discrepancy between observed reionization constraints and the local Lyman Continuum emitters. We propose imaging 4 galaxies with resolved maps of escape fraction proxies derived from optical emission lines to identify for the first time their spatial variations in these galaxies. These 4 galaxies are exclusively selected from the false positive sample in the Lyman Continuum escape fraction estimation. Their emission line maps can only be produced by the ACS/WFC ramp filters. This will allow us to understand whether the global (integrated) properties of these galaxies (star formation rate density, [OIII]/[OII] ratio, and dust extinction) are a good indicator of their estimated Lyman Continuum escape fraction. The applicability of these results to faint z>6 galaxies will become increasingly important for studying galaxies in the epoch of reionization.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17914
Program Title: The UV-Optical-IR Spectral Energy Distribution of Quasi-Periodic Eruptions

Principal Investigator: Patra, Kishore

PI Institution: University of California Santa Cruz

Quasi-Periodic Eruptions (QPEs) are a new class of soft X-ray sources that exhibit high-amplitude flares with recurrence times ranging from a few hours to days. They are associated with low-mass massive black holes (MBHs) at galactic centers, but their nature and origin remain mysterious and strongly debated. Many theoretical frameworks invoke a compact accretion disk around the MBH to explain the origins of QPEs. We propose to obtain high-resolution images of 3 QPE host galaxies to create a comprehensive UV-optical-IR spectral energy distribution (SED) of their nuclear regions on the scale of 0.1 arcsec. Our scientific goals for constructing the SED are to test the compactness of the accretion disk, and study the nuclear star clusters (NSCs) in these QPE sources. These observations have the potential for redefining the burgeoning QPE field by testing the various models for the origins of QPEs and the broader context of MBH accretion disks and their evolution. Beyond our immediate science goals, the broad-band images of QPE hosts proposed here will have long-term value in studying their star-formation history, central stellar concentration, and morphology, providing a comprehensive understanding of the environments that facilitate QPE occurrences. Only HST can provide sufficiently high-resolution imaging across a wide range of wavelengths to resolve out the majority of the stellar light in the QPE hosts. QPEs are quickly becoming an exciting probe of low-mass SMBHs, making this proposal timely in the pursuit of understanding these puzzling phenomena.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17915
Program Title: Completing the HST+Gaia Reference Sample to Optimize the Measurement of the Hubble Constant

Principal Investigator: Riess, Adam

PI Institution: The Johns Hopkins University

The Hubble tension, a >5 sigma discrepancy between the measured and cosmologically-predicted value of the Hubble constant (H0), is one of the most exciting developments in cosmology in decades. Having withstood scrunity and crosschecks, it is a clue we must now pursue with maximum signal-to-noise while establishing a route to future improvements. The leading determination of H0 relies on photometric observations collected over 10 years and 5 WFC3-IR programs of Milky Way Cepheids geometrically calibrated by parallaxes from Gaia. These are used to calibrate Cepheids in the hosts of 42 local SN Ia, canceling zeropoint errors through consistent use of WFC3-IR. The best MW Cepheids for this purpose have good Gaia parallax solutions (i.e., non-binaries), high parallax SNR (>10), are unsaturated in Gaia (G>6 mag), have low reddening (V-I < 2) and long periods (P>5 days), a modest-sized sample of 115 objects. In this last opportunity to use WFC3-IR, we propose two goals to both optimize the HST measurement of H0 now and simultaneously calibrate the developing effort from JWST: (1) Complete the sample of ``high-leverage'' MW Cepheid calibrators by observing the last 25 with WFC3-IR, (2) obtain WFC3-IR NIR grism spectrophotometry of these MW Cepheids at 0.8-1.7 microns to synthesize their magnitudes in the JWST filter system (F090W,F115W,F150W) to empirically calibrate JWST's developing distance ladder. This data will optimize the measurement of H0 from Gaia now and in future releases. Collecting these observations will lay a cornerstone for a 1% determination of H0 and continue to steadily advance our knowledge of what appears to be a new feature in the cosmological model.

Proposal Category: GO
Scientific Category: Large Scale Structure of the Universe
ID: 17916
Program Title: Dark matter, the Hubble tension, and the stellar IMF from HST imaging of quadruply imaged quasars

Principal Investigator: Treu, Tommaso

PI Institution: University of California - Los Angeles

What's dark matter? What's the source of the "Hubble tension"? Is the stellar initial mass function universal? What's the structure of accretion disks? How do the correlations between quasar black hole mass and the properties of their host galaxies evolve over cosmic time? HST images of quadruply imaged quasars (quads) have been demonstrated to provide unique ways to address all these fundamental questions. Unfortunately, quads are very rare in the sky, and only a few tens are known. Thus, all the studies based on quads are limited in their precision by small number statistics, as only a subset can typically be used for each application, owing to the diversity of configurations. We propose to image 17 recently discovered quads with WFC3-IR to cement the HST legacy and build a bridge to the future, when 100-1000s of lenses will be known from Euclid/Rubin/Roman. WFC3-IR images are essential to detect the stellar light of the lens galaxy and the lensed QSO host. With its well known PSF WFC3-IR, this sample will be the foundation of future lens modeling with Roman and JWST. In the immediate future, this sample will enable, e.g., the determination of H0 at <2% fully accounting for the mass sheet degeneracy; distinguishing Salpeter and Chabrier IMF at 99% CL for massive ellipticals, and detect a potential turnover in the subhalo mass function down to 10^6.5 solar masses (corresponding to a thermal dark matter mass of 7.7 kev).

Proposal Category: GO (GO-Archival)
Scientific Category: Stellar Physics and Stellar Types
ID: 17917
Program Title: ACS WFC [O III] Imaging of the Iconic Young SNR 1E0102.2-7219 in the SMC

Principal Investigator: Morse, Jon

PI Institution: California Institute of Technology

We propose to obtain a final Advanced Camera for Surveys (ACS) Wide-Field Channel (WFC) image in the light of [O III]4959,5007 emission of the young, oxygen-rich supernova remnant 1E0102.2-7219 (E0102) in the Small Magellanic Cloud (SMC). When combined with prior ACS/WFC images from 2003 and 2013, this will establish a 20+ year baseline of multi-epoch ACS imaging for measuring proper motions of the pristine supernova ejecta and detecting temporal changes in flux and velocity. E0102 has low line-of-sight extinction, represents the core-collapse explosion of a massive star in a low-metallicity environment akin to the high redshift universe, and has copious supporting data from extensive observations across the entire electromagnetic spectrum. This investigation of E0102 requires <0.1 arcsec spatial resolution in order to measure precise proper motions of the ejecta and resolve important physical scales at the distance of the SMC. Even with the multi-decade time baseline, the ejecta motions to be measured are still only one to several 50 mas ACS pixels in magnitude. We thus emphasize the importance for very precise image registration of obtaining a final ACS image epoch so that images obtained through the same optical system -- with the same image scale and geometric distortions -- can be compared.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17918
Program Title: Unveiling the unseen: a HST first (and only) view of extremely obscured Galactic globular clusters

Principal Investigator: Loriga, Martina

PI Institution: Universita di Bologna

Globular clusters (GCs) are among the oldest known stellar systems in our Galaxy. They are regarded as tracers of the early evolution of the Milky Way (MW), providing important insights into its formation and assembly history. Recently, two peculiar stellar systems in the MW bulge, Terzan 5 and Liller 1, have been found to exhibit properties that are not typical of genuine GCs, such as the presence of multi-iron and/or multi-age subpopulations. Their properties suggest that they could be fossil remnants of more massive structures that contributed to the formation of the bulge. Such outstanding discoveries reinforce the urgency to extend the investigation of the GC population in the MW to include several GCs that have been poorly studied because located in observationally challenging regions. Here we propose a program aimed at an accurate photometric characterization of a sample of 12 clusters located in the most extinct regions of the MW disk and bulge. We plan to observe 12 clusters for the first time with HST, taking advantage of the near-IR capabilities of the WFC3/IR camera to characterize their stellar populations in terms of age, reddening, distance and photometric metallicity. This will allow us to infer whether they are genuine GCs or more exotic systems such as Terzan 5 and Liller 1. In the latter case, these systems would provide invaluable insights into the formation and evolution of the MW. These observations would also have important archival value, as these clusters are not observable with WFC3/UVIS due to their extreme extinction, while their stellar populations would promptly saturate in JWST observations due to their relatively small distances from Earth.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17919
Program Title: A legacy epoch for Hubble's optical jets: a reference for the future

Principal Investigator: Meyer, Eileen

PI Institution: University of Maryland Baltimore County

While we have long known that jets from super-massive black holes exhibit highly relativistic speeds on parsec scales from radio interferometry, it is not generally known how the jet evolves on kpc to Mpc scales, where the jet leaves the host galaxy and begins to interact with the intergalactic medium, with implications for our understanding of jet structure and quantifying the energy carried by the jet into the external environment. With the development of state-of-the-art astrometry techniques and new data from the Gaia mission, it is now possible register images of nearby jets first observed by HST in the 1990s to extremely high precision, reaching accuracies on proper motions of better than 0.3 mas/year. This enabled the dramatic finding of colliding superluminal knots in the jet of 3C264 and helical motions of plasma on kpc scales in M87. We propose a new epoch of joint HST/JWST observations on the 12 nearby optical jets which are essentially a legacy sample of monitored sources with observations spanning nearly 3 decades. This sample is an extremely unique one, and only HST and JWST can provide the precision astrometry and sensitivity needed to track the motion of plasma in jets on kpc scales.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17920
Program Title: Constraining Composition, Clouds, and Hazes in a Long-Period Giant Planet

Principal Investigator: Vissapragada, Shreyas

PI Institution: Carnegie Institution of Washington

With TSM = 243, TOI-2134 c is by far the best known temperate (Teq < 400 K) planet for transmission spectroscopy with a precise mass constraint, largely because the host star is exceptionally bright (Ks = 6.1). We propose to measure the transmission spectrum of this uniquely important planet between 1.1-1.7 micron with WFC3/G141, where all available JWST observation modes would otherwise saturate. We expect that a WFC3/G141 spectrum of this planet will constrain the planet's NH3 abundance to a precision of 0.6 dex, providing unprecedented constraints on planet formation and evolution models. If the atmosphere of this temperate planet is cloudy, our data would instead provide the first constraints on water clouds in a planet or brown dwarf outside the Solar System. Finally, if the planetary atmosphere is hazy, this would be the coldest exoplanet for which hazes have been detected, allowing us an opportunity to bridge Solar System haze studies (e.g. in Titan) with the hazes detected in warmer exoplanets. Only WFC3/G141 can enable these exciting advances in exoplanet atmosphere studies, and it can do so in only 8 orbits.

Proposal Category: GO
Scientific Category: Intergalactic Medium and the Circumgalactic Medium
ID: 17921
Program Title: In-flight calibration of the stray-light blocking efficiency of HST/ACS

Principal Investigator: Serrano Borlaff, Alejandro

PI Institution: NASA Ames Research Center

Stray-light contamination is the most critical component of the sky background in optical and near-infrared images obtained with HST. Its presence in science images generates unwanted background artifacts, reducing their scientific impact and erasing the dim signal from astronomical sources. Currently, there is no methodology to predict, model, or correct the stray-light background in Hubble images due to the lack of precise measurements of the stray-light blocking efficiency of the observatory, described through a function called Normalized Detector Irradiance (NDI). The diffuse emission in the outskirts of galaxies such as stellar tidal streams, intracluster light (ICL), or the low surface brightness galaxies provides crucial evidence for the cosmological evolution of the Universe. However, these extended, low surface brightness (LSB) features are thousands of times dimmer than the sky background (SB = 29-30 AB mag arcsec-2, at 0.7 um) and very sensitive to the presence of gradients of stray-light. Unveiling this informative, yet hidden, emission with the Hubble Space Telescope thus requires an exquisite control and correction of large scale background gradients in the images. The goal of this proposal is to measure the stray-light blocking efficiency (NDI) of HST by obtaining a series of calibration exposures near extremely bright objects (Jupiter and the Moon). The proposed observations will enable to create models of the stray-light from out-of-field stars around the HST/ACS detector, allowing for the first time to correct artificial gradients in Archival HST imaging products, generating pixel-by-pixel stray-light models from bright stars for each observation.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17922
Program Title: The Final Frontier: Exploiting Hubble's Unique Capabilities with Polarization Imaging of the Hubble Deep Field

Principal Investigator: Sparks, William

PI Institution: SETI Institute

The Hubble Deep fields are the best studied patches of sky in existence, providing critical insight into the evolution of the Universe through the growth of black holes, rise and fall of star formation and assembly of galaxies over cosmic time. Observations have been dedicated to this task across the electromagnetic spectrum each yielding specialized insights into the evolving populations of the Universe. Yet something is missing: optical polarimetry! We propose to explore the polarized sky at faint magnitudes, impossible from the ground, to augment our insights in the unique ways provided by polarimetry. Light is polarized by intrinsic non-thermal synchrotron emission, by dust and electron scattering, and by transmission through dust aligned by magnetic fields. With a deep polarized view of the HDF-N in the most sensitive ACS mode, we will determine the prevalence of polarized sources at faint magnitudes and determine their origin from the existing wealth of ancillary data. We anticipate identifying active nuclei, non-thermal sources, aligned radio galaxies, dusty star forming regions, deeply shrouded infra-red emitters, and luminous AGN hidden but revealed through their scattered light. An important corollary of the study will be an assessment of the degree to which polarization, a likely requirement for future exoplanet direct detection missions, may be relied upon at faint magnitudes to reveal planets against the crowded background of astrophysical sources. Only HST can make these observations, now and for the foreseeable future.

Proposal Category: GO
Scientific Category: Exoplanets and Exoplanet Formation
ID: 17923
Program Title: Correcting for the Effects of the Optical/Near-Infrared Interstellar Extinction Toward the Roman Galactic Exoplanet Survey Fields

Principal Investigator: Nataf, David

PI Institution: University of Iowa

The upcoming Roman Galactic Exoplanet Survey will revolutionize exoplanet studies: expected detections of up to 200,000 transiting and microlensing planets, including sensitivity to planets with masses as low as Mars for orbital radii of 3 AU. Meaningful interpretation of this bounty will require knowing the properties of the planet-host stars. But, as these stars lie toward the inner Galaxy, foreground extinction will typically be >10x higher than it is toward either of the Kepler or TESS fields. Worryingly, in addition to the high total extinction, the wavelength dependence of the extinction toward the inner Milky Way is known to be both spatially variable and different from the "standard" extinction curve. These factors necessitate a robust three dimensional mapping of the interstellar extinction and the interstellar extinction curve toward the inner Milky Way. We request 7 orbits to measure the interstellar extinction curve for a representative sample of 14 of these sightlines. To break the degeneracies that have previously limited study of this phenomenon, we propose to study the extinction in two bands that are not accessible from the ground (F098M, F139M), complemented with three other bands selected for efficiency and calibration purposes (F127M, F153M, F167N). We select sightlines that will already have deep optical photometry in Hubble's F606W and F814W filters. This program cannot be implemented with JWST due to numerous bright sources in these sightlines that will severely saturate the detectors, including our preferred targets. The results of this program will enable more robust preparation for observations with Roman.

Proposal Category: GO
Scientific Category: Galaxies
ID: 17924
Program Title: TREASURETROVE: Tracing the Growth of SMBHs and Spheroids through Variability and Transients in the JWST NEP Time Domain Field

Principal Investigator: Smith, Brent

PI Institution: Arizona State University

We propose F606W monitoring to m_AB < 28 mag of the JWST NEP Time Domain Field (TDF), an area of ~190 arcmin^2, with 1--5 additional epochs (depending on location within the field) to identify faint AGN through their variability on timescales of months through ~10 years and transients such as high-z SNe. F606W corresponds to rest-frame UV at redshifts 1<z<6, where the contrast of AGN variabilty and the host galaxy is greatest. Variability can augment the census of AGN that are missed by other techniques and allow tracing the buildup of SMBHs and the spheroids of their hosts. SNe trace the build-up of stellar mass and provide distances. The NEP TDF was designed for monitoring. It has deep ancillary data from X-ray to radio, including ACS/WFC F606W+F435W imaging to mAB~29 mag, WFC3/UVIS F275W, and partial coverage by JWST NIRCam (0.8--5 um). The prior HST images yielded 12 transients and 110 variable candidates in areas of overlap, and the combined data enable comprehensive study of host-galaxy SEDs. Future time-domain monitoring requires a careful cross-calibration of faint galaxy photometry between ACS/WFC and WFC3/UVIS. TREASURETROVE's main science goals are: (1) Discover/confirm ~600 AGN via variability and ~30 new SNe, using the efficient areal coverage and cadence that is possible only with ACS + WFC3 in parallel; (2) Trace SMBH/spheroid mass buildup from z<6.5 via structure functions and star-formation mass buildup via SNe rates from z<3. (3) Provide a census of low-luminosity AGN varying by >0.2 mag to m_AB<27.5. (4) Cross-calibrate faint-galaxy photometry between ACS/WFC and WFC3/UVIS in F606W to enable >10 year time-domain studies when ACS/WFC is turned off.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17925
Program Title: 20 Years of time baseline, The 3D kinematics of Centaurus A

Principal Investigator: Bennet, Paul

PI Institution: Space Telescope Science Institute

Centaurus A (Cen A, NGC 5128) is the nearest elliptical galaxy to the Milky Way (MW), the most massive galaxy in the Local Volume and the nearest galaxy to host an active galactic nucleus (AGN). Cen A's importance to astronomy is exemplified by it being one of the 20 most cited objects in the SIMBAD database. We propose to use ACS/WFC to measure the proper motion (PM) of Cen A and use this information to: (1) for the first time, measure the transverse velocity of a galaxy group relative to the Local Group (LG), allowing us totest cosmological expectations and simulations in a new way and on far larger scales, and, (2) begin the process of determining the long-term stability of the reported plane of satellites in the Cen A group. It is vital that the second epoch of observations needed to derive Cen~A's PM is taken before ACS/WFC is decommissioned. Second-epoch observations with any other instrument would produce PMs with significant systematics, and new observations would need over 20 years to achieve the precision possible now with ACS/WFC.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17926
Program Title: Enabling cross instrument proper motions with Draco dSph and NGC 2419

Principal Investigator: Bennet, Paul

PI Institution: Space Telescope Science Institute

An unexpected way that ACS/WFC has transformed our knowledge of the Universe is through kinematics, especially via the measurement of proper motions (PMs) for galaxies and star clusters across the Local Group (LG) and beyond. This work requires extremely high precision astrometry and relies on long time baselines. Together, these requirements have made ACS the best, and in many cases, the only instrument for this type of work. Through observations of the Draco and NGC 2419, this proposal aims to cross-calibrate ACS/WFC with WFC3/UVIS and JWST/NIRCam to enable this important science to continue after ACS/WFC is decommissioned. We will also improve the determination of the type of dark matter halo in the Milky Way satellite galaxy Draco dwarf spheriodal, core or cusp, to a limit of 10 sigma. This will be the best data to date for resolving the tension of the core-cusp problem in Lambda CMD. We will also investigate the kinematic properties of the known multiple populations in the distant massive Milky Way Globular cluster NGC 2419 , which will help constraints its formation and evolution.

Proposal Category: GO
Scientific Category: Stellar Physics and Stellar Types
ID: 17927
Program Title: Unveiling the origin of magnetars through a large proper motion sample

Principal Investigator: Chrimes, Ashley

PI Institution: European Space Agency - ESTEC

We propose WFC3/IR imaging in F125W and F160W of 15 Galactic magnetars, closely matching observations taken in 2018 and 2020 in order to precisely measure the proper motions of their faint NIR counterparts. The origin of magnetars remains unclear. By re-measuring their positions with milliarcsecond precision ~6 years later, with the same instrument and using the 2018-2020 imaging as a reference, we will increase the number of magnetars with a precise transverse velocity measurement - or a strong upper limits on the velocity - by up to a factor of two. Combined with estimates for the magnetar ages, we can trace them back to an inferred birth site, to search for supernova remnants or star forming regions (or a lack thereof). Our proposed program will move us out of the realm of small number statistics, allowing a statistically robust comparison with the peculiar velocity distrbution of other neutron stars (namely pulsars). This programme will therefore reveal much about the nature and origin of magnetars. This cycle 32 call for bridge programs is the last chance to obtain HST proper motions for these systems; it also acts as pathfinder programme for broader JWST studies in future cycles which could target proper motion measurements of a wider array of Galactic systems.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17928
Program Title: Return to Eden: Massive Star Formation in the Time Domain

Principal Investigator: Fedriani, Ruben

PI Institution: Instituto de Astrofisica de Andalucia (IAA)

Massive stars announce their birth with accretion powered fireworks, piercing powerful jets through their natal clouds. Lower-mass sibling stars dance around the cradle, swirling and sparkling in its deep gravitational well. Here we propose to survey this activity with a return to four massive protostellar systems, first observed by HST WFC3/IR in 2016. Combined with existing archival data, this will then yield a total sample of seven sources with such two-epoch observations. Protostellar jets are expected to have terminal velocities similar to the escape speed of their launching region from the inner disk near the protostellar surface, which can be greater than 1000 km/s. We will accurately measure the plane of sky speeds and directions of jet knots, especially as traced by [FeII]. These measurements will be combined with ancillary NIR spectroscopic data to yield the most complete kinematic characterization of these massive protostellar outflows, providing powerful diagnostics of the massive star formation process. The flux variability of the jet knots, scattered light from the massive protostar, and from low-mass YSOs will also be studied, delivering crucial measures of outflow and accretion variability. To achieve these science goals requires precise photometric measurements with HST-WFC3/IR for direct comparison with the earlier epoch images.

Proposal Category: GO
Scientific Category: Stellar Populations and the Interstellar Medium
ID: 17929
Program Title: The true nature of Glimpse-C01: another star cluster hosting multi-age populations?

Principal Investigator: Cadelano, Mario

PI Institution: Universita di Bologna

Of the ~150 old globular clusters in the Milky Way, there are 3 outstanding systems that defy the globular cluster classification and show the presence of multi-age and multi-iron populations: Omega Centauri in the Galactic halo, Terzan 5 and Liller 1 in the bulge, which may be fossil witnesses to the past evolution and assembly of the Milky Way. The discovery of such systems provides a unique opportunity to gain deeper insights into the assembly history of the Milky Way. Analysis of archival HST observations of the Glimpse-C01 cluster suggests that it may be the fourth member of this emerging class of exotic clusters hosting multi-age, multi-iron stellar populations, and the first to be located in the Milky Way disk. To confirm this scenario, we require a second epoch of ACS and WFC3 observations to measure the proper motions of the stars in the direction of the cluster, which are the fundamental ingredient for distinguishing cluster members from field interlopers. Given the extreme crowding conditions and the severe reddening in the direction of the cluster, the proposed goal can be achieved by exploiting the high-resolution and stable astrometric optical/near-IR capabilities of the ACS/WFC and WFC3/IR cameras, while JWST observations would quickly saturate due to the target's relatively small distance from the Sun. The observations will be used to analyse and directly measure the age(s) of the stellar population(s) for the first time, and to reconstruct the cluster orbit in the Milky Way potential field, thus shedding light on its origin, the possible formation mechanism of its multi-age populations, and the role of the cluster in the Milky Way assembly history.

Proposal Category: GO
Scientific Category: Supermassive Black Holes and Active Galaxies
ID: 17930
Program Title: A Complete Sample of Ionization Echoes Around 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, discovered using a uniform color selection, were found to host powerful AGN that have ramped down in ionizing output by 3-4 orders of magnitude over the past 10,000-100,000 years; this significant variability should 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, an approved Cycle 32 program is targeting a limited subset of 6 Green Beans. In this proposal, we propose to obtain the crucial HST ACS ramp filter Halpha imaging for the remaining 11 Green Bean nebulae in order to constrain the ionization histories of luminous AGN at high spatial, and therefore time, resolution across the complete sample. This proposal is eligible for the Cycle 32 Bridge call because the ACS ramp filters are the only option for obtaining high resolution narrowband Halpha imaging at these redshifts.