UV Science and Instrumentation Workshop
On the Way to the NASA Habitable Worlds Observatory and Beyond
May 7-9, 2024
Jet Propulsion Laboratory, Pasadena, CA

Agenda

Tuesday May 7th

Talk Begins (PDT)	Talk Duration	Questions/Discussion	Chair	Talk	Speaker	Comment
8:00 AM		0:25		Coffee and Check-in	All	
8:25 AM	0:10			Welcome and Goals	Shouleh Nikzad (JPL)	
8:35 AM	0:05		Shouleh Nikzad (JPL)	JPL Director for Astrophysics Welcome	Todd Gaier (JPL)	Invited
8:40 AM	0:10	0:05		Opening Remarks and NASA Context by Astrophysics Division Director	Mark Clampin (NASA)	Invited
8:55 AM	1:35	1:10	Allison Youngblood (GSFC)	**Session 1: Science Through UV Observations - I**		
8:55 AM	0:10	0:05		Three Roads to UV Astrophysics at NASA	Peter Kurczynski (NASA)	Contributed
9:10 AM	0:10	0:05		Report on joint SIG talks Jan. 2024	Rachael Beaton (STScI)	Invited
9:25 AM	0:10	0:05		Report on AAS Mind the Gap session	Stephan McCandliss (JHU)	Invited
9:40 AM	0:10	0:05		The Hardware Path to HWO: The Ultraviolet	Sarah Tuttle (UofW)	Invited
9:55 AM	0:10	0:05		Report on START work	Courtney Dressing (UC Berkeley)	Invited
10:10 AM		0:25		Coffee		
10:35 AM	0:15	0:05		The Ultraviolet Explorer Mission	Fiona Harrison (Caltech)	Invited
10:55 AM	0:10	0:05		Modeling UV Emission from Cosmological Simulations	Cameron Hummels (Caltech)	Contributed
11:10 AM	0:10	0:05		Mapping multi-phase mixing of metals in Star Forming Galaxies: Insights from spatially-resolved UV and optical observations	Valentina Abril (STScI)	Contributed
11:25 AM	0:10	0:05		The Case for Stellar Chemical Abundances from Medium- to High-Resolution UV Spectroscopy	Rachel Beaton (STScI)	Contributed
11:40 AM		0:45	Evgenya Shkolnik (ASU)	**Panel 1 : Science through UV Observations**	Leonardo de Santos (STScI), Sarah Tuttle (UofW), Sanch Borthakur (ASU)	
12:25 PM		1:15		Lunch		
1:40 PM	0:50	0:20	Bertrand Mennesson (JPL)	**Session 2: Instrument Architectures & Technology**		
1:40 PM	0:10	0:05		Report on TAG work	Aki Roberge (GSFC), John Ziemer (JPL)	Invited
1:55 PM	0:15	0:05		A standalone UV coronagraph instrument for the Habitable Worlds Observatory	Roser Juanola-Parramon (GSFC)	Invited
2:15 PM	0:05			JPL Director Welcome	Laurie Leshin (JPL)	
2:20 PM	0:10	0:05		Enabling Technologies and Emerging Designs for Integral-Field Spectroscopy in the Far-UV	Brian Fleming (LASP)	Contributed
2:35 PM	0:10	0:05		A Brief Review of UV Multi-Object Spectrograph Technologies Relevant to HWO and other Concepts	David Schiminovich (Columbia)	Invited
2:50 PM	0:00	0:45	Sona Hosseini (JPL)	**Panel 2: The many approaches to UV Spectroscopy**	Paul Scowen (GSFC), David Schiminovich (Columbia), Brian Fleming (LASP)	
3:35 PM		0:25		Coffee		
4:00 PM		1:00		Posters		
5:00 PM				Adjourn		

Wednesday May 8th

Talk Begins (PDT)	Talk Duration	Questions/Discussion	Chair	Talk	Speaker	Comment
8:00 AM		0:25		Coffee		
8:25 AM	0:10			Housekeeping announcements	Shouleh Nikzad (JPL)	
8:35 AM	1:00		Lynne Hillenbrand (Caltech)	**Poster flash talks: 90 sec**		Contributed
9:35 AM	1:00	0:50	Erika Hamden (UofA)	**Session 3: Science Through UV Observations - II**		
9:35 AM	0:15	0:05		UV time domain - Rapid Response - Transient Objects	Mansi Kaliswal (Caltech)	Invited
9:55 AM	0:10	0:05		The Circumgalactic Medium through UV-colored glasses	Yakov Faerman (UofW)	Invited
10:10 AM	0:10	0:05		UV/Optical/IR AGN Reverberation: Trading Cadence for Spatial Resolution to Study Accretion Disks	Varoujan Gorgian (JPL)	Contributed
10:25 AM		0:25		Coffee		
10:50 AM	0:10	0:05		UV morphology and morphometrics of galaxies	Kyle Cook, Benne Holwerda (UofL)	Contributed
11:05 AM	0:15	0:05		The Role of UV Spectroscopy in the Direct Imaging Characterization of ExoEarths	Renyu Hu (JPL)	Invited
11:25 AM		0:45	Rachel Beaton (STScI)	**Panel 3: Humans in the Loop: Training and Mentoring the Next Generation**	Drew Miles (Caltech), Evgenya Shkolnik (ASU), Leonidas Moustakas (JPL)	
12:10 PM		1:30		Lunch + Mentoring		
1:40 PM	1:00	0:55	Anahita Alavi (IPAC)	**Session 4: The need for a balanced UV portfolio**		
1:40 PM	0:10	0:05		The MANTIS Cubesat: Science Background and Objectives	David Wilson (LASP)	Contributed
1:55 PM	0:10	0:05		Technological advancements for far-ultraviolet spectroscopy with the SPRITE CubeSat	Maitland Bowen (LASP)	Contributed
2:10 PM	0:10	0:05		FIREBall and beyond: UV science and technology via suborbital instruments	Drew Miles (Caltech)	Contributed
2:25 PM		0:25		Coffee		
2:50 PM	0:10	0:05		The Early Star and Planet Evolution Explorer mission concept	Neal Turner (JPL)	Contributed
3:05 PM	0:10	0:05		Power of UV+X-ray high-resolution spectroscopy for probing AGN outflows	Missagh Mehdipour (STScI)	Contributed
3:20 PM	0:10	0:05		Eos: a FUV spectroscopic mission to observe the molecular hydrogen lifecycle in molecular clouds	Erika Hamden (UofA)	Contributed
3:35 PM		0:45	Kevin France (LASP)	**Panel 4: Balancing the UV Portfolio**	Chris Martin (Caltech), Carlos Vargas (UofA), Harry Teplitz (IPAC)	
4:20 PM		0:40		Posters		
5:00 PM				Adjourn		

Thursday May 9th

Talk Begins (PDT)	Talk Duration	Questions/Discussion	Chair	Talk	Speaker	Comment
8:00 AM		0:25		Coffee		
8:25 AM	0:10			Housekeeping announcements	Shouleh Nikzad (JPL)	If needed
8:35 AM	1:25	0:35	Paul Scowen (GSFC)	**Session 5: Science Through UV Observations - III**		
8:35 AM	0:15	0:05		Ultraviolet Insights into Supermassive Black Hole Growth	Niel Brandt (PennState)	Invited
8:55 AM	0:10	0:05		Direct Detection of Ionizing Radiation with HWO	Stephan McCandliss (JHU)	Contributed
9:10 AM	0:10	0:05		UV observations of atmospheric escape in exoplanets	Leonardo Dos Santos (STScI)	Contributed
9:25 AM	0:10	0:05		A study of near-ultraviolet and optical properties of M dwarf flares	Allison Youngblood (GSFC)	Contributed
9:40 AM	0:10	0:05		Under the Influence of the Host Star: UV Impact on Rocky Planet Atmospheres and Habitability	Raissa Estrela (JPL)	Contributed
9:55 AM	0:15	0:05		Understanding the first galaxies in ultraviolet: a roadmap from JWST to HWO	Peter Senchyna (Carnegie)	Invited
10:15 AM	0:15	0:05		An overview of the Hubble ULLYSES-low mass program	Nuria Calvet (UofM)	Invited
10:35 AM		0:25		Coffee		
11:00 AM	1:20	2:10	Leonidas Moustakas (JPL)	**Session 6: Additional Mission Concepts**		
11:00 AM	0:10	0:05		Development of the Spectroscopic Ultraviolet Multi-object Observatory (SUMO) Prototype	Dmitry Vorobiev (LASP)	Contributed
11:15 AM	0:10	0:05		Contamination Control for the Aspera FUV SmallSat	Nicole Melso (UofA)	Contributed
11:30 AM	0:10	0:05		The Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID): Instrument and Technology	Nicholas Nell (LASP)	Contributed
11:45 AM	0:10	0:05		The Polstar FUV Spectropolarimetry Explorer Mission	Paul Scowen (GSFC)	Contributed
12:00 PM	0:10	0:05		Nox: A Mission Concept for All-Sky Far-Ultraviolet Background Mapping	Haeun Chung (UofA)	Contributed
12:15 PM		1:30		Lunch		
1:45 PM	0:10	0:05	Chas Beichman (Caltech)	Life-environmentology, Astronomy, and PlanetarY Ultraviolet Telescope Assembly (LAPYUTA) mission	Go Murakami (JAXA)	Contributed
2:00 PM	0:10	0:05		HWO Exoplanet Observations in the UV using a Starshade	Stuart Shaklan (JPL)	Invited
2:15 PM	0:10	0:05		High-cadence observations of galactic nuclei by the future two-band UV-photometry mission QUVIK	Michal Zajacek (Masaryk U.)	Contributed
2:30 PM	0:30	0:45	David Ardila (JPL)	**Session 7: DIY for Space Missions**		
2:30 PM	0:10	0:05		STM Development	Sabrina Feldman (JPL)	Invited
2:45 PM	0:10	0:05		Proposal Development	Paul Propster (JPL)	Invited
3:00 PM	0:10	0:05		Learning opportunities	Erika Hamden (UofA) / Tiffany Kataria (JPL)	Invited
3:15 PM		0:30		**Panel 5: DIY Space Missions**	Sabrina Feldman (JPL), Paul Propster (JPL), Erika Hamden (UofA), Tiffany	
3:45 PM		0:25		Coffee		
4:10 PM	0:15	0:50	Shouleh Nikzad (JPL)	**Session 8: Looking Towards the Future**		
4:10 PM	0:15	0:05		Space-Based astronomy in the 2030/2040s	Rob Petre (GSFC)	Invited
4:30 PM		0:30		**Panel 6: Open Mike: What did we miss?**	All participants	
5:00 PM		0:15		**Report, conclusions, and assignment**	Shouleh Nikzad (JPL)	
5:15 PM				Adjourn		

Friday May 10th

Talk Begins	Talk Duration	Questions/Discussion	Talk
9:00 AM	3:00		Tours
12:00 PM			Adjourn

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8:40 AM	0:10	0:05		Opening Remarks and NASA Context by Astrophysics Division Director	Mark Clampin (NASA)	Invited	
8:55 AM	1:35	1:10	Allison Youngblood (GSFC)	**Session 1: Science Through UV Observations - I**			
8:55 AM	0:10	0:05		Three Roads to UV Astrophysics at NASA	Peter Kurczynski (NASA)	Contributed	Ultraviolet astrophysics at NASA falls within three thematic programs: Cosmic Origins, Physics of the Cosmos, and Exoplanet Exploration. These themes encompass both science and technology. UV technology development activities include coatings and detectors for future missions. Science themes seek to answer three fundamental questions: How did the universe come to be? How does the universe work? Are we alone? Science interest and analysis groups, and working groups are actively advancing ultraviolet astrophysics in each of these areas. Understanding the breadth of these activities and, how you can become involved with them, will lead to more effective engagement with NASA, and create opportunities to advance your science and career.
9:10 AM	0:10	0:05		Report on joint SIG talks Jan. 2024	Rachael Beaton (STScI)	Invited	
9:25 AM	0:10	0:05		Report on AAS Mind the Gap session	Stephan McCandliss (JHU)	Invited	I will review the Science, Technology and Mission presentations given at the AAS 243 Joint Splinter Session of the Mind the Gap grassroots community group and the Ultraviolet/Visual Science and Technology Interest Group (UVSTIG) of the Cosmic Origins Program Analysis Group (COPAG).
9:40 AM	0:10	0:05		The Hardware Path to HWO: The Ultraviolet	Sarah Tuttle (UofW)	Invited	
9:55 AM	0:10	0:05		Report on START work	Courtney Dressing (UC Berkeley)	Invited	
10:10 AM		0:25		**Coffee**			
10:35 AM	0:15	0:05		The Ultraviolet Explorer Mission	Fiona Harrison (Caltech)	Invited	The Ultraviolet Explorer (UVEX) mission, scheduled for launch in 2030, advances three scientific pillars: exploring the low-mass, low-metallicity galaxy frontier; providing new views of the dynamic universe, and leaving a broad legacy of modern, deep synoptic surveys adding to the panchromatic richness of 21st century astrophysics. The UVEX instrument consists of a single module with simultaneous FUV and NUV imaging over a wide (10 sq. deg) FOV and sensitive R>1000 spectroscopy over a broad band from 1150 - 2650 Angstroms. In this talk I will describe the UVEX scientific program and provide an overview of the instrument and mission.
10:55 AM	0:10	0:05		Modeling UV Emission from Cosmological Simulations	Cameron Hummels (Caltech)	Contributed	Cosmological hydrodynamics simulations like FIRE and IllustrisTNG are increasingly able to produce accurate representations of galaxies and the material between galaxies. By forward modeling the radiation transfer in these simulations, one can generate synthetic observations to predict the observable characteristics of galaxies and their gas in the real world. The open-source code Trident is currently able to model absorption-line spectra in these simulations, mimicking the sightlines to distant quasars that probe various ions present in the simulated interstellar, circumgalactic, and intergalactic media (ISM, CGM, & IGM). In preparation for the Habitable Worlds Observatory (HWO), I am now upgrading Trident to include line emission from rest-frame UV and optical lines to allow for the generation of synthetic observations of emission spectra, narrow-band photometry, and IFU data. These predictions will inform the design of next-generation instruments like HWO to ensure science goals related to the ISM, CGM, and IGM are met.
11:10 AM	0:10	0:05		Mapping multi-phase mixing of metals in Star Forming Galaxies: Insights from spatially-resolved UV and optical observations	Valentina Abril (STScI)	Contributed	Metals are fundamental components of galaxy evolution, they regulate the cooling of gas and the transport of momentum, enhancing/quenching star formation. Despite this essential role, we have a poor understanding of how metals are distributed among different gas phases through a galaxy. Chemical inhomogeneities have been detected in the ionized gas of numerous star-forming galaxies (SFGs) via optical spatially resolved studies, with large implications for the flow of metals within and around galaxies. Spatially resolved UV observations in SFGs are fundamental to characterize the complex mechanisms present in the Interstellar Medium (ISM) as outflows, stellar feedback and chemical enhancement. Currently, we are limited to single aperture UV spectrographs so multi-aperture studies are the only available method to access to spatially resolved UV properties. Nevertheless, the extension of the apertures (e.g., HST-COS 2.5'') targeting local galaxies cover multiple star-forming regions obtaining integrated average properties. This poses difficulties to resolve the different stellar populations, the kinematics of the gas and the intervening gas clouds, properties that can be only mapped through Integral Field Units (IFU). In this talk I present the first spatially-resolved multi-phase gas abundance study of a metal poor high-z local analogue, targeting 10 star-forming (SF) regions (ranging between 1 – 15 Myr) with HST-COS and co-spatial optical VLT-MUSE observations. We obtained neutral gas abundances for 13 different ions sampling 8 elements (N, O, S, P, Ni, C, Fe and Si) by analyzing UV spectroscopic data and compared them with the ionized gas abundances (O, N, Fe and S) measured along the same sightlines with the optical IFU data. By exploring metal distribution as a function of age, radius and gas phase, we have pinned down the mixing timescales between the neutral and ionized gas phases. The findings of this remarkable study are applicable to both nearby and high-z SFGs, expanding the potential of multi-phase analysis to the high redshift universe (z>6) in the era of JWST. As a follow-up to this study, conducting spatially resolved analysis in the UV regime through a new generation of UV-IFU spectrographs is essential. This approach is crucial to account for the multiple thermal, dynamical and chemical mixing processes involved in the evolution of the ISM, particularly at a high spatial resolution. Future UV facilities such as Habitable Worlds (HWO) and UVEX will play a fundamental role in this endeavor.
11:25 AM	0:10	0:05		The Case for Stellar Chemical Abundances from Medium- to High-Resolution UV Spectroscopy	Rachel Beaton (STScI)	Contributed	The evolution of the elements with time is central to our cosmic origins. With initial conditions set by Big Bang Nucleosynthesis, nearly all periodic table elements are formed via the myriad physical processes surrounding stellar evolution. Elements up to the ``Iron Peak'' are generally formed through Core-Collapse Supernovae (CC SNe) or Type Ia Supernovae (SNe Ia). Heavy metals (Z > 28), elements above the ``Iron-Peak'', are formed via neutron capture, generally either in kilonovae (r-process) or in the environs of evolved low-mass stars (s-process). Roughly 80% of heavy metals have known ultraviolet (UV) spectral features, and roughly 25% are exclusive to the UV. The UV is an information-rich region of the electromagnetic spectrum because of the sheer number of chemical species and the breadth of nucleosynthetic pathways represented. However, a search through the literature will turn up only a modest number of such measurements over the 30+ years of high-resolution spectroscopy in the UV. In part, this is due to the complexity of the spectra, but we argue that advancements in the chemical abundance measurements in the optical/infrared within the last 15 years to realize "industrial scale stellar spectroscopy" provide a tractable path forward. We will demonstrate how these techniques can be applied to HST (STIS and GHRS) archival data to motivate the potential scientific and architecture questions for the Habitable Worlds Observatory. We have identified over 500 stars for whom sufficient data exists for some measurements, in particular a great deal of data at solar-like metallicities that are more-or-less unprobed to date.
11:40 AM		0:45	Evgenya Shkolnik (ASU)	**Panel 1 : Science through UV Observations**	Leonardo de Santos (STScI), Sarah Tuttle (UofW), Sanch Borthakur (ASU)		
12:25 PM		1:15		**Lunch**			
1:40 PM	0:50	0:20	Bertrand Mennesson (JPL)	**Session 2: Instrument Architectures & Technology**			
1:40 PM	0:10	0:05		Report on TAG work	Aki Roberge (GSFC), John Ziemer (JPL)	Invited	
1:55 PM	0:15	0:05		A standalone UV coronagraph instrument for the Habitable Worlds Observatory	Roser Juanola-Parramon (GSFC)	Invited	The near-ultraviolet wavelength range contains a valuable Ozone absorption feature for characterizing the atmospheric composition of Earth-like exoplanets. Both the LUVOIR and HabEx decadal mission concept studies baselined instrumentation for obtaining photometry of directly imaged exoplanets down to wavelengths of 200 nm. Both of their proposed implementations present challenges: in the case of the HabEx starshade occulter, a separate spacecraft is required; in the case of a UV channel within the main coronagraph instrument, non-UV-optimized optics limit the performance. Yet, the science requirements allow the relaxation of some of the trades of a dedicated near-UV coronagraph. Here we present the preliminary design of a standalone UV coronagraph instrument for the Habitable Worlds Observatory concept based on the science requirements. We describe the trades and rationale behind the decision of separating the UV coronagraph from the main instrument and show the evaluation of several coronagraph designs in the UV. We assess the effect of polarization aberrations and describe potential UV detectors and wavefront sensing and control strategies.
2:15 PM	0:05			JPL Director Welcome	Laurie Leshin (JPL)		
2:20 PM	0:10	0:05		Enabling Technologies and Emerging Designs for Integral-Field Spectroscopy in the Far-UV	Brian Fleming (LASP)	Contributed	Astronomy in the Far-UV (100 - 200 nm) is primarily the study of nearby objects, from stars and nebulae in the Milky Way to galaxies at redshift z < 1. At these distances, especially with the large aperture and exquisite angular resolution of the future Habitable Worlds Observatory (HWO), most of the non-stellar sources are brilliant and beautiful objects, yet the tools that have existed to-date are not suited to extended source spectroscopy. This has been in-part due to the science drivers of the 80's and 90's, where quasar absorption-line and stellar ("point-source") spectroscopy dominated, but also due to the limitations of the technology of the times. With the development of large format, photon-counting detectors, advanced broadband mirror coatings, micro-mirror devices, and efficient aberration-correcting gratings, this technology-limited paradigm has changed. This talk presents several new instruments in development that test designs for integral-field spectroscopy, including the recently launched INFUSE program that successfully demonstrated the technique in the Far-UV for the first time, and the upcoming UMIS demonstrator for both large FOV and high angular resolution. We focus on the technologies that make these prototypes possible, and what is required to scale to enable an IFS mode on HWO similar to the JWST-NIRSpec companion IFU.
2:35 PM	0:10	0:05		A Brief Review of UV Multi-Object Spectrograph Technologies Relevant to HWO and other Concepts	David Schiminovich (Columbia)	Invited	In this 'instrument architecture tutorial' I will briefly review a broad suite of UV spectrograph architectures---past, present and proposed---with an emphasis on multi-object and integral field concepts applicable to HWO. I will describe key design parameters, relevant technologies and tradeoffs in light of several science cases envisioned for such an instrument, and will also offer thoughts on directions for community advancement of a suite of designs and technologies in the coming years.
2:50 PM	0:00	0:45	Sona Hosseini (JPL)	**Panel 2: The many approaches to UV Spectroscopy**	Paul Scowen (GSFC), David Schiminovich (Columbia), Brian Fleming (LASP)		
3:35 PM		0:25		**Coffee**			
4:00 PM		1:00		Posters			
5:00 PM				Adjourn			

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9:35 AM	1:00	0:50	Erika Hamden (UofA)	**Session 3: Science Through UV Observations - II**			
9:35 AM	0:15	0:05		UV time domain - Rapid Response - Transient Objects	Mansi Kaliswal (Caltech)	Invited	TBC
9:55 AM	0:10	0:05		The Circumgalactic Medium through UV-colored glasses	Yakov Faerman (UofW)	Invited	The circumgalactic medium (CGM), through which gas flows into the galaxy from the cosmic web, and where energy and metals are deposited by galactic feedback, is an important component of cosmic ecosystems, shaping how galaxies evolve and affect the large-scale structure of the Universe. UV observations from the last decade have revealed that the CGM is massive, multiphase, metal-rich, and in general much more complex than (theoretically) expected. In my talk I will present some open questions in the field, describe recent work on models connecting theory and observations, and show how future instruments and observatories can help us better understand the elusive CGM.
10:10 AM	0:10	0:05		UV/Optical/IR AGN Reverberation: Trading Cadence for Spatial Resolution to Study Accretion Disks	Varoujan Gorgian (JPL)	Contributed	Accretion disks are one of the key forms of energy generation in the Universe, but the details of their structure are still debated. Unfortunately accretion disks, whether they are around a nearby neutron star in our Galaxy or a supermassive black hole in a neighboring galaxy, are too small to be resolved. BUT, in most cases, bursts of light from close to the central compact object travel out and are reverberated (absorbed and re-emitted) from further out in the disk. The inner disk emission is usually hot and reverberates in the UV while the outer areas of the disk reverberate a time-delayed version of the shorter wavelength emission in the optical and then followed by the IR. Since the burst travels at the speed of light, by monitoring the reverberated time delay from the UV to the optical to the IR, we get a one dimensional measure of the size of the disk. To achieve the highest precision that reverberation mapping can provide requires carefully tailored cadences to the size of various disks and so needs a dedicated observatory. Smallsats can provide that customizable cadence, but to achieve the needed sensitivity requires UV detectors that are optimized for the needed wavelength coverage. So new technological developments that increase sensitivity of UV detectors will expand the possibilities of this unique science frontier.
10:25 AM		0:25		**Coffee**			
10:50 AM	0:10	0:05		UV morphology and morphometrics of galaxies	Kyle Cook, Benne Holwerda (UofL)	Contributed	To map the UV morphology of nearby galaxies, other information on the segmentation of the image are critical. Often the outermost parts of UV images of disk galaxies are fragmented making it difficult to identify if sources are part of the largest galaxy image or not. For computation of morphometrics, parameterization of morphology, it is especially of interest. I have used the HI contours of galaxies to map the area for use with GALEX. Ongoing HI programmes are slated to produce a large number of HI contour maps that can be used to quantify the UV morphology of galaxies, mapping where outermost star-formation lies in nearby galaxies.
11:05 AM	0:15	0:05		The Role of UV Spectroscopy in the Direct Imaging Characterization of ExoEarths	Renyu Hu (JPL)	Invited	Direct-imaging observations of terrestrial exoplanets will enable their atmospheric characterization and habitability assessment. The key atmospheric signatures for the biosphere on Earth are O_2 and the photochemical product O_3. However, this O_2–O_3 biosignature is not detectable in the visible wavelengths for most of the time after the emergence of oxygenic photosynthesis life (i.e., Proterozoic Earth). I will discuss the need for spectroscopic observations in the UV band for detecting and characterizing O_2 and O_3 in Proterozoic-Earth-like planets. For example, if an O_2 level 2–3 orders of magnitude less than the present-day Earth is not detectable in the visible wavelengths, but the corresponding O_3 level can be detected and measured precisely (within 1 order of magnitude) in the UV (0.25–0.4 µm), in addition to visible-wavelength spectroscopy. With modest spectral resolution (R=7) and signal-to-noise ratio (~10), the O_3 detection is robust against other potential gases absorbing in the UV (e.g., H_2S and SO_2), as well as the short-wavelength cutoff between 0.2 and 0.25 µm. While the O_3 detection does not rely on the near-infrared spectra, extending the wavelength coverage to the near-infrared (1–1.8 µm) would provide essential information to interpret the O_3 biosignature, including the mixing ratio of H_2O, the cloud pressure, and the determination of the dominant gas of the atmosphere. The UV capability should thus be considered a critical component for future missions aiming at imaging and characterizing terrestrial exoplanets, such as the Habitable Worlds Observatory.
11:25 AM		0:45	Rachel Beaton (STScI)	**Panel 3: Humans in the Loop: Training and Mentoring the Next Generation**	Drew Miles (Caltech), Evgenya Shkolnik (ASU), Leonidas Moustakas (JPL)		
12:10 PM		1:30		**Lunch + Mentoring**			
1:40 PM	1:00	0:55	Anahita Alavi (IPAC)	**Session 4: The need for a balanced UV portfolio**			
1:40 PM	0:10	0:05		The MANTIS Cubesat: Science Background and Objectives	David Wilson (LASP)	Contributed	With JWST now and HWO in the future, we are entering an era where detailed observations of exoplanetary atmospheres are possible. Correctly interpreting such observations relies on a comprehensive understanding of exoplanet host stars, and in particular the ultraviolet light emitted by stellar chromospheres and coronae. The ultraviolet light that a planet receives from its star influences the chemistry and structure of its atmosphere: Near- and Far-Ultraviolet (NUV, FUV) light power photochemistry in the upper atmosphere, whilst high-energy Extreme Ultraviolet (EUV) photons drive atmospheric escape processes. Stellar ultraviolet emission is also highly variable on timescales of minutes to decades. Unfortunately, characterizing host stars in the ultraviolet is difficult, limited by the high oversubscription of HST in the NUV and FUV and the complete lack of observatories in the EUV. MANTIS (Monitoring Activity of Nearby sTars with uv Imaging and Spectroscopy) is an advanced astrophysics cubesat designed to address this observational gap. Capable of simultaneous observations in EUV, FUV, NUV and optical bands, MANTIS will provide the most comprehensive view of stellar ultraviolet behavior to date. MANTIS will undertake two primary missions: First, it will observe planetary transits simultaneously with JWST, providing the real-time stellar ultraviolet inputs required to interpret JWST transmission spectroscopy; Second, it will undertake a survey of nearby stars chosen to cover a range of spectral types and ages, providing simultaneous, time series multi wavelength data. In this presentation I will overview the MANTIS mission and science goals, and discuss the consequences for future ultraviolet stellar astronomy.
1:55 PM	0:10	0:05		Technological advancements for far-ultraviolet spectroscopy with the SPRITE CubeSat	Maitland Bowen (LASP)	Contributed	The Supernova remnants/Proxies for Reionization and Integrated Testbed Experiment (SPRITE) is a 12U Cube-Sat that will observe local galaxies and supernova remnants in the far-ultraviolet. SPRITE is the first orbital instrument capable of sub-arcminute imaging spectroscopy in the Lyman ultraviolet (91 < ¥ë < 120 nm), measuring ionizing radiation from massive stars escaping into the intergalactic medium. SPRITE will also observe the feedback processes from massive stars in nearby galaxies and map supernova remnants in the far-ultraviolet for the first time. To observe these processes, SPRITE¡¯s imaging spectrograph utilizes several advanced ultraviolet optics technologies. SPRITE¡¯s broadband mirror coatings, comprised of enhanced lithium fluoride over an aluminum deposition (eLiF) and overcoated with protective magnesium fluoride (MgF_2), operate with >70% reflectance to ¥ë > 1020 ¢ªA. The SPRITE instrument is an orbital testbed for these new coatings and an advanced microchannel plate (MCP) detector, both of which represent a significant improvement over those employed on the Hubble Space Telescope (HST) and the Far Ultraviolet Spectroscopic Explorer (FUSE), qualifying these technologies for potential use on future missions such as the Habitable Worlds Observatory (HWO). This poster will present on the SPRITE¡¯s novel technologies, their flight readiness development, and the prospects for scaling them to HWO.
2:10 PM	0:10	0:05		FIREBall and beyond: UV science and technology via suborbital instruments	Drew Miles (Caltech)	Contributed	The Faint Intergalactic-medium Redshifted Emission Balloon (FIREBall) project is a multi-institutional, multi-national UV science and technology collaboration. FIREBall uses a 1-m primary mirror, a slit-mask multi-object spectrograph, sub-arcsecond fine pointing, and an electron-multiplying CCD detector to detect and characterize emission from the circumgalactic medium around low-redshift (z < 1) galaxies and quasars. With years of NASA-funded development and several zero-pressure balloon flights, FIREBall has a long history of developing UV instrumentation and personnel. In this presentation we will discuss the FIREBall project, the significance of suborbital formats for developing UV science and technology, and ways in which the FIREBall concept can be used as a pathfinder for future NASA missions.
2:25 PM		0:25		**Coffee**			
2:50 PM	0:10	0:05		The Early Star and Planet Evolution Explorer mission concept	Neal Turner (JPL)	Contributed	Wide-field, time-domain optical photometry with Kepler and TESS has revolutionized the demographics of exoplanets around mature stars. A next logical step on this path is multi-band photometry. Simultaneous near-UV and optical measurements would make it possible to (1) find enough young transiting planets to determine from their radius distribution whether their atmospheres are mostly hydrogen or steam, (2) determine how young stars' flares drive chemistry in their planets' atmospheres, and (3) gauge how magnetospheric accretion sets up young stars' spin evolution. The two simultaneous wavebands would enable identifying specific oscillation modes in many young stars of spectral types A and B, yielding the stars' internal structure and thus reliable ages for the host star clusters. The two bands also would let us test whether low-mass young stars show solar-like or p-mode oscillations. Finding such oscillations would open a new window on low-mass stars' internal evolution. Achieving this suite of scientific objectives would require measurements across a field of view wide enough to encompass the dense cores of nearby young star clusters, an angular resolution finer than TESS or PLATO and better than 10 arcseconds to separate neighboring stars, and a photometric cadence faster than a minute to detect enough flares to assess their contribution to planetary atmospheres. We outline how these requirements can be met with a telescope around 30 cm in aperture and a two-band camera using commercially available detectors, on a standard spacecraft bus in low Earth orbit. Such a mission would be suitable for the Astrophysics Small Explorers program.
3:05 PM	0:10	0:05		Power of UV+X-ray high-resolution spectroscopy for probing AGN outflows	Missagh Mehdipour (STScI)	Contributed	Outflows in Active Galactic Nuclei (AGN) may have important implications for the co-evolution of supermassive black holes and their host galaxies in the Universe. However, crucial properties of outflows are currently poorly understood, which make it challenging to determine their role and impact in AGN. In this talk, I discuss the need for simultaneous UV+X-ray high-resolution spectroscopy, which would be facilitated by the proposed Arcus Probe, for tackling outstanding questions on AGN outflows. This multi-wavelength spectroscopy and timing would enable us to establish the kinematics and ionization structure of the entire outflow, extending from the vicinity of the accretion disk to the outskirts of the host galaxy. This would provide key diagnostics on the origin, driving mechanism, and energetics of the outflows, which are useful benchmarks for testing various theoretical models. To this end, the instrumental requirements for achieving the scientific objectives are discussed.
3:20 PM	0:10	0:05		Eos: a FUV spectroscopic mission to observe the molecular hydrogen lifecycle in molecular clouds	Erika Hamden (UofA)	Contributed	Eos is a mission concept to be proposed to the expected 2025 NASA Small Explorers Announcement of Opportunity. Eos observes molecular clouds in our galaxy to understand the link between star and planet formation and molecular hydrogen in galactic star forming regions. Eos does this using very long-slit, moderate resolution spectroscopy of UV emission from fluorescent molecular hydrogen, a powerful and underutilized FUV diagnostic. H_2 is the most abundant molecule in the universe, but is typically observed in the IR or observed via proxies such as CO. Eos will directly observe H_2 via fluorescence, which can be stimulated from a range of sources (shocks, external energy fields, bright stars, etc). Here we briefly describe the science objectives of Eos, as well as the instrument implementation.
3:35 PM		0:45	Kevin France (LASP)	**Panel 4: Balancing the UV Portfolio**	Chris Martin (Caltech), Carlos Vargas (UofA), Harry Teplitz (IPAC)		
4:20 PM		0:40		Posters			
5:00 PM				Adjourn			

UV Science and Instrumentation Workshop
On the Way to the NASA Habitable Worlds Observatory and Beyond
May 7-9, 2024
Jet Propulsion Laboratory, Pasadena, CA

Agenda

Thursday May 9th

Talk Begins (PDT)	Talk Duration	Questions/Discussion	Chair	Talk	Speaker	Comment	Abstract
8:00 AM		0:25		**Coffee**			
8:25 AM	0:10			Housekeeping announcements	Shouleh Nikzad (JPL)	If needed	
8:35 AM	1:25	0:35	Paul Scowen (GSFC)	**Session 5: Science Through UV Observations - III**			
8:35 AM	0:15	0:05		Ultraviolet Insights into Supermassive Black Hole Growth	Niel Brandt (PennState)	Invited	Supermassive black hole (SMBH) growth largely proceeds via the accretion of cold galactic gas, with SMBH mergers and stellar tidal disruption events having important secondary effects. The dominant accretion process primarily produces UV radiation, and I will discuss some topics where further UV observations should give key insights: (1) The strength/shape of the quasar UV-EUV-X-ray ionizing continuum remains mysterious, and investigation is needed of, e.g., surprisingly strong couplings over this broad range of wavelengths; (2) Large-scale UV plus multiwavelength variability monitoring will map accretion disks, probe outflows and feedback, identify notable AGN classes, and reveal extreme modes of AGN variability; (3) Ultimately, the Habitable Worlds Observatory will greatly improve our understanding of the galactic morphological correlates of cosmic SMBH growth.
8:55 AM	0:10	0:05		Direct Detection of Ionizing Radiation with HWO	Stephan McCandliss (JHU)	Contributed	I will review requirements for the direct detection of ionizing radiation escaping from galaxies with the goal of determining its evolution over cosmic time. Examples of yield calculations developed for previous Science and Technology Definition Team studies will be presented.
9:10 AM	0:10	0:05		UV observations of atmospheric escape in exoplanets	Leonardo Dos Santos (STScI)	Contributed	Two decades ago, ultraviolet (UV) observations with the Hubble Space Telescope spearheaded the discovery of atmospheric escape in hot, gas giant worlds outside of the Solar System. These observations ensued a wave of studies to understand the evolution of exoplanet atmospheres, but these efforts have been limited by the aging design of HST. The Habitable Worlds Observatory (HWO) will provide our community with an extraordinary opportunity to study the evolution of exoplanets through atmospheric escape. In this contribution, I will briefly go over the history of observations of exoplanet atmospheric escape, describe what are the best wavelength ranges and spectral resolutions for future UV instruments in this context, and discuss what kinds of exoplanets will be within the grasp of discovery with HWO in the UV.
9:25 AM	0:10	0:05		A study of near-ultraviolet and optical properties of M dwarf flares	Allison Youngblood (GSFC)	Contributed	Near-ultraviolet (NUV) stellar flares can drive photochemistry in the atmospheres of and harm any surface life on the exoplanets they host. We analyzed an extensive dataset of NUV and optical flares from young and old M dwarfs observed simultaneously with the Transiting Exoplanet Survey Satellite (TESS) and the Neil Gehrels Swift Observatory with supporting data from K2 and the Hubble Space Telescope. In total, we observed 213 NUV flares from 24 nearby M dwarfs, with ~27% of them having detected optical counterparts, and found that all optical flares had NUV counterparts. We explore the energy fractionation of flares between the two bandpasses and find a slight decrease in the optical/NUV ratio with increasing NUV energy, a trend in agreement with prior investigations on more energetic G-K stellar flares. We present an empirical relationship between NUV and optical flare energies and compare to predictions from radiative-hydrodynamic and blackbody models. We find that within error bars, the flare frequency distributions (FFDs) of both NUV and optical flares across all M dwarf subtypes exhibit comparable slopes.
9:40 AM	0:10	0:05		Under the Influence of the Host Star: UV Impact on Rocky Planet Atmospheres and Habitability	Raissa Estrela (JPL)	Contributed	The detection of multiple exoplanets around bright stars with NASA's TESS mission, combined with the precision of the NASA's James Webb Space Telescope (JWST) marks a revolutionary phase in our comprehension of small exoplanets (<3R⊕). Particularly, the prevalence of detected planets orbiting M dwarfs raises questions about their ability to maintain atmospheres amidst challenging conditions. JWST observations of rocky planets have yet to yield conclusive results regarding atmospheric existence. Hence, a comprehensive understanding of the influence of the host star is critical for interpreting exoplanets observations and for accessing their potential for habitability. Here we analyze a population of small exoplanets (<3R⊕) to delve into the evolution and erosion of their atmospheres. With two models—1-D stellar wind and photoevaporative mass loss— we estimate atmospheric mass loss over time. Out of 38 studied planets, 13 are predicted to have lost their primordial H/He envelope due to photoevaporation, while two lost it due to both stellar wind and photoevaporation. Next, we access habitability of living organisms on the surface Trappist-1 g-f and TOI-700d under different atmospheric conditions. Finally, we contextualize atmospheric observations within the scope of our findings.
9:55 AM	0:15	0:05		Understanding the first galaxies in ultraviolet: a roadmap from JWST to HWO	Peter Senchyna (Carnegie)	Invited	JWST is now providing an unprecedented view of some of the brightest galaxies at cosmic dawn; yet the rest-UV spectroscopy of these systems has proven extremely challenging to interpret. I will highlight some of these new findings and argue that many of these features are likely intimately linked to the poorly-constrained astrophysics of extremely metal-poor massive star clusters. Detailed UV observations of low-metallicity star-forming galaxies nearby are crucial to addressing these uncertainties; and I will describe how facilities from HST to UVEX to HWO will play a critical role in clarifying the picture of the earliest galaxies that will be assembled by JWST and the ELTs.
10:15 AM	0:15	0:05		An overview of the Hubble ULLYSES-low mass program	Nuria Calvet (UofM)	Invited	The ULLYSES program was a Director's Discretionary Time (DDT) initiative that allocated 1000 orbits of the Hubble telescope specifically for UV observations of young stars. The program divided these orbits into two halves: one dedicated to studying OB stars in the Magellanic Clouds, and the other focused on observing young, low mass stars that are still accreting mass from their surrounding disks. In this presentation, I will discuss the effects of UV radiation on low mass stars, their disks, and the planets forming around them. Additionally, I will provide an overview of some of the initial findings from the low-mass ULLYSES program, as well as its concurrent programs ODYSSEUS and PENELLOPE.
10:35 AM		0:25		**Coffee**			
11:00 AM	1:20	2:10	Leonidas Moustakas (JPL)	**Session 6: Additional Mission Concepts**			
11:00 AM	0:10	0:05		Development of the Spectroscopic Ultraviolet Multi-object Observatory (SUMO) Prototype	Dmitry Vorobiev (LASP)	Contributed	Multi-object and integral field spectroscopy are enabling technologies for the next generation of UV missions. We present the recent progress on the design, fabrication, and evaluation of Spectroscopic Ultraviolet Multi-object Observatory (SUMO) Prototype. The SUMO Prototype is part of the technology maturation program of SUMO, a mission concept designed for a small/medium-sized satellite platform; the SUMO Prototype will be the first DMD-based instrument is deployed in space. Our program builds on two previous NASA programs, aimed at developing the digital micromirror device (DMD) for use in the ultraviolet regime and in the space environment. Through these programs, we have demonstrated that commercial (and UV-extended) DMDs are TRL 5, and suitable for operation in the NUV/Optical (200 – 900 nm). The goal of the SUMO program is to develop the ancillary electronics needed to operate at DMD to TRL 5 and to extend their use into the FUV (100 – 200 nm), through the use of UV mirror coatings originally developed for monolithic mirrors by our collaborators at NASA GSFC and JPL. The ALE UV coating process developed at JPL is especially interesting for DMDs, because its selective nature (as opposed to PVD which simply coats everything surface in the line of sight) may help improve the contrast of re-coated DMDs. The SUMO Prototype is currently being built at LASP, with the telescope and optical bench expected to be completed in August 2024. The SUMO Prototype is scheduled for flight as a secondary payload on the sounding rocket INFUSE II in Spring 2025.
11:15 AM	0:10	0:05		Contamination Control for the Aspera FUV SmallSat	Nicole Melso (UofA)	Contributed	Aspera is a NASA Pioneers Mission designed to measure faint OVI emission around nearby galaxies with unprecedented sensitivity. The SmallSat payload consists of two identical co-aligned spectrographs, both operating in the Far Ultraviolet (FUV) between 1030 − 1040 A. Missions operating at FUV wavelengths are particularly sensitive to contamination, as short wavelengths are easily blocked, scattered and absorbed by contaminants deposited on payload optical surfaces. A strict contamination control plan is critical to avoiding a severe loss in FUV throughput. Aspera contamination control efforts have been developed to fit within the scope of a sub-Class D mission, a challenge that has become increasingly relevant as advances in FUV optics/detectors drive an uptick in smaller platform, contamination sensitive UV payloads. Contamination monitoring is used to audit the cleanroom environment, avoid outgassing contaminants under vacuum, and assess contaminant levels on payload optics. We will present our ongoing contamination monitoring efforts and discuss protocols implemented for minimizing contamination-related performance degradation
11:30 AM	0:10	0:05		The Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID): Instrument and Technology	Nicholas Nell (LASP)	Contributed	The Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID) is a rocket-borne arcsecond-level ultraviolet (UV) imaging instrument covering four bands between 92 -- 193 nm. FLUID will observe nearby galaxies to find and characterize the most massive stars that are the primary drivers of the chemical and dynamical evolution of galaxies, and the co-evolution of the surrounding galactic environment. The FLUID short wave channel is designed to suppress efficiency at Lyman-α (121.6 nm), while enhancing the reflectivity of shorter wavelengths. Utilizing this technology, FLUID will take the first ever images of local galaxies isolated in the Lyman ultraviolet (90 -- 120 nm). As a pathfinder instrument, FLUID will employ and increase the TRL of band-selecting UV coatings, and solar-blind UV detector technologies including microchannel plate and solid state detectors; technologies prioritized in the 2022 NASA Astrophysical Biennial Technology Report. These technologies enable high throughput and high sensitivity observations in the four co-aligned UV imaging bands that make up the FLUID instrument. We present the design of FLUID, status on the technology development, and results from initial assembly and calibration of the FLUID instrument.
11:45 AM	0:10	0:05		The Polstar FUV Spectropolarimetry Explorer Mission	Paul Scowen (GSFC)	Contributed	Polstar combines, for the first time, the complementary benefits of spectroscopy and polarimetry to provide insight into the impact and effect of rapid rotation, mass and angular momentum loss, and stellar environment on the evolution of massive stars. Furthermore, it leverages an innovative combination of effective area and time coverage, to reach the diversity of targets necessary to transform our understanding of how massive stars evolve. Detailed knowledge of these bright, yet distant objects, is crucial because massive stars underpin the Baryonic life cycle in galaxies and thereby dictate the return of energy and processed material to the ISM for subsequent generations of stars and planets. Polstar will map stellar wind and magnetospheric structures by uniting time domain, polarimetry and spectroscopy capability in the near- and far-UV (NUV and FUV) which is densely populated with high-opacity resonance lines encoding a rich array of diagnostic information. The instrument combines advances in high reflectivity UV coatings and delta-doped detectors with high quantum efficiencies to provide dedicated FUV spectropolarimetry for the first time in 25 years. The instrument covers 122-320nm at resolution R~15k. The instrumental polarization stability is built to provide signal-to-noise ratios (SNR) for UV polarimetry precision of 1x10-3 per exposure per resolution element (resel). Precision can be further improved with spectral binning and/or stacking multiple exposures. Polstar spectral resolution is >10x better than WUPPE, with 10x better effective area, while reaching shorter wavelength than WUPPE to access strong lines of species like NIV and SiIV. The 3-year mission of Polstar is 100x longer than WUPPE with orders of magnitude gains in stellar observations.
12:00 PM	0:10	0:05		Nox: A Mission Concept for All-Sky Far-Ultraviolet Background Mapping	Haeun Chung (UofA)	Contributed	Nox is a CubeSat/SmallSat mission concept designed to map the Lyman-UV (LUV) and Far-UV (FUV) background distribution across the entire sky. Despite growing interest in LUV/FUV observations in orbit, the spectral and spatial distribution of the LUV/FUV background remains critically understudied. A lack of knowledge about background radiation makes planning future missions to detect faint diffuse emissions challenging. The Nox mission concept has been developed to bridge this gap by characterizing the background radiation in the LUV/FUV wavelengths. Utilizing state-of-the-art UV coating, grating, and detector technologies, Nox aims to deliver unprecedented foundational data in the LUV/FUV landscape. This will be achieved through spectroscopic all-sky observations in the 90-140 nm wavelength range, using a wide-field, low spectral resolution spectrograph. In this presentation, we describe the mission concept of Nox and its implications for future UV missions.
12:15 PM		1:30		**Lunch**			
1:45 PM	0:10	0:05	Chas Beichman (Caltech)	Life-environmentology, Astronomy, and PlanetarY Ultraviolet Telescope Assembly (LAPYUTA) mission	Go Murakami (JAXA)	Contributed	The Life-environmentology, Astronomy, and PlanetarY Ultraviolet Telescope Assembly (LAPYUTA) mission aims to carry out spectroscopy with a large effective area (>300 cm2) and a high spatial resolution (0.1 arc-sec) and imaging in far ultraviolet spectral range (110-190 nm) from a space telescope. The main part of the science payload is a Cassegrain-type telescope with a 60 cm-diameter primary mirror. As a current design, three main UV instruments are installed on the focal plane of the telescope: a mid-dispersion spectrograph, a high-dispersion spectrograph, and a slit imager. The mid-dispersion spectrograph contains a movable slit with different slit width, a holographic toroidal grating with 2110 lines/mm, and an MCP detector coupled with CMOS imaging sensors. Spectral resolution of 0.02 nm and field-of-view of 100 arc-sec will be achieved. The high-dispersion spectrograph consists of a slit, a toroidal mirror, an echelle gating, a cross disperser, and a detector. Highest spectral resolution of 3 pm will be achieved at the target wavelength (130.5 nm). The UV slit imager consists of imaging optics, several bandpass filters with a rotation wheel, and a same type of UV detector as the one installed in the spectrometer. In order to achieve a high spatial resolution of 0.1 arc-sec, we will install a target monitoring camera at 0th order position inside the spectrometer and slit imager for both attitude control and image accumulation process. We also plan to install a fine guidance sensor to monitor guidance stars. In addition, new technologies such as funnel-type MCPs, CMOS-coupled readout system, highly reflective UV coating, and blazed holographic grating will be applied to satisfy requirements of LAPYUTA. These technologies will be also demonstrated by LAPYUTA and expanded to future missions such as Habitable World Observatory. Here we present the LAPYUTA concept design, the overview of the spacecraft and instruments, and the status of technical developments.
2:00 PM	0:10	0:05		HWO Exoplanet Observations in the UV using a Starshade	Stuart Shaklan (JPL)	Invited	A starshade is a large flower-shaped screen that is aligned between a telescope and target star. It blocks the light of the target star so that the telescope can characterize the reflected light of an adjacent exoplanet. The starshade has high throughput, deep contrast, large bandwidth, small working angle, and works with on- or off-axis telescopes. Starshades equally effective in the UV, Visible, and NIR. For HWO, we have designed a 35 m diameter starshade with an inner working angle of 65 mas at the petal tips, and a bandwidth spanning 250-500 nm. We will discuss the general characteristics of starshades and the state-of-the-art in starshade technology including demonstrations of broad-band 10^-10 contrast and half-scale petal and disk structures. We will also show models of UV imaging and measurement of the Hartley UV band in Earth-like exoplanets.
2:15 PM	0:10	0:05		High-cadence observations of galactic nuclei by the future two-band UV-photometry mission QUVIK	Michal Zajacek (Masaryk U.)	Contributed	The accepted concept of the two-band UV telescope Quick Ultra-Violet Kilonova surveyor (QUVIK), which will be the first Czech space telescope, will focus on detecting early UV afterglows of kilonovae (Werner et al., 2024). In addition, it will study the UV emission of stars and stellar systems (Krtička et al., 2024) as well as the intense and variable emission of active galactic nuclei (AGN) or galactic nuclei activated by the tidal disruption event (Zajaček et al., 2024). In this contribution, I will describe the role of a small (30-cm diameter) UV telescope for studying bright, nearby AGN. With its NUV (260-360nm) and FUV (140-190 nm) bands, the telescope will perform high cadence (~0.1-1 day) two-band photometric monitoring of nearby AGN (z<0.5), which will allow us to probe accretion disk sizes/temperature profiles via the photometric reverberation mapping. Thanks to its versatility, the QUVIK will be able to perform a moderately fast repointing (<20 min) to target candidates for tidal disruption events (TDEs). Early detection of the UV emission following the TDE optical flare, in combination with the subsequent two-band monitoring, will enable us to infer the time delay (or its lack of) between the optical, UV, and the X-ray emission. In combination with theoretical models, it will be possible to shed more light on the origin of the UV/optical emission of TDEs. Furthermore, the two-band monitoring of nuclear transients will be beneficial to distinguish between TDEs (nearly constant blue colour) and supernovae (progressive reddening).
2:30 PM	0:30	0:45	David Ardila (JPL)	**Session 7: DIY for Space Missions**			
2:30 PM	0:10	0:05		STM Development	Sabrina Feldman (JPL)	Invited	
2:45 PM	0:10	0:05		Proposal Development	Paul Propster (JPL)	Invited	
3:00 PM	0:10	0:05		Learning opportunities	Erika Hamden (UofA) / Tiffany Kataria (JPL)	Invited	
3:15 PM		0:30		**Panel 5: DIY Space Missions**	Sabrina Feldman (JPL), Paul Propster (JPL), Erika Hamden (UofA), Tiffany Kataria (JPL)		
3:45 PM		0:25		**Coffee**			
4:10 PM	0:15	0:50	Shouleh Nikzad (JPL)	**Session 8: Looking Towards the Future**			
4:10 PM	0:15	0:05		Space-Based astronomy in the 2030/2040s	Rob Petre (GSFC)	Invited	This talk surveys the capabilities of major astronomy facilities that are planned or expected to be operation over the next two decades, focusing on space-based observatories. The suite of observatories available today offers unprecedented sensitivity across the electromagnetic spectrum. As these facilities age, significant gaps in spectral coverage could emerge. While 2040 seems a long time from now, the process of developing a major space-based or a ground-based observatory can take decades. If the planned facilities become available in a timely way and provide their promised performance, they will be worth the wait.
4:30 PM		0:30		**Panel 6: Open Mike: What did we miss?**	All participants		
5:00 PM		0:15		**Report, conclusions, and assignment**	Shouleh Nikzad (JPL)		
5:15 PM				Adjourn			

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Posters

Speaker	Title	Abstract
Paul Scowen	Next Generation Microshutter Arrays for the FUV – optimizing design for the needs of HWO	The strong support for Far Ultraviolet (FUV) multi-object spectroscopy (MOS) from both the Large Ultraviolet Optical Infrared Surveyor (LUVOIR) and Habitable Exoplanets Observatory (HabEx) mission studies has led to the identification of a MOS capability as a Tier-1 Technology Gap in the Astrophysics Biennial Technology Report (2022). MOS is a foundational element in the definition of the transformational astrophysics portfolio for Habitable Worlds Observatory (HWO), and enables spectroscopy of many faint targets within a common field to trace, for example, energy transport in and out of galaxies as well as sampling individual star forming regions across galaxies. The leading candidate for the provision of this capability is the microshutter array (MSA), which can address hundreds of sight lines simultaneously for spectral analysis when placed at the entrance aperture of a spectrograph, without introducing stray and scattered light, which is particularly critical in the ultraviolet (UV) range.
Ossy Siegmund	UV photon counting MCP detectors – Advances and prospects for HWO	Detectors with Microchannel Plates (MCPs) provide unique capabilities in astronomy applications where single photon detection is needed for sensors capable of large formats with very low dark count rate, large dynamic range, high spatial and timing resolution. Development of this type of sensor has substantially improved in performance levels over those used in earlier missions like Galex and HST-COS. Examples include achieving many orders of magnitude enhancement of counting rate capabilities, significantly greater lifetimes and stability, improved quantum efficiency, spatial and temporal resolution, and large / curved formats. Implementation of these devices vary widely, from low power, long lifetime, radiation hard, planetary missions to large area, high spatial resolution, ultralow background sensors in low earth orbit. The adaptable nature of the MCP sensor configurations is a key element that has enabled these many successfully flown instruments over long durations. New enhancements for these sensors include atomic layer deposited MCPs with longer lifetime, high stability, ultralow background (<2 events/pixel/fortnight), low cosmic ray/particle cross sections and improved UV quantum efficiency. Photon counting imaging readout technologies of several types have been employed, with some as large as 20 cm x 20 cm^2. Readouts can be pixelated ROICs (Readout Specific Integrated Circuits), achieving high spatial resolution (5 µm FWHMs) of photons at very high counting rates (GHz levels per detector) at low gains of 10^5, as well as allowing detection of multiple simultaneous photons. Recent Timepix4 chips which are 4-side buttable with all the contacts to the die provided Through Silicon Vias (TSV can support large active areas (e.g. 10x10 cm^2). Cross strip and cross delay line readouts with formats up to 20 cm with modest spatial resolution (20µm) can operate at multi MHz rates, and can be implemented with low power / ASIC electronics. These sensor properties are achieved without cooling, or out of bandpass filtering. Such large area, high counting rate, low dark count detectors are being developed further for high precision astronomical sensors for a number of selected and prospective future NASA missions, and may be enabling technology for HWO instruments.
Fabien Grise	Electron-beam lithography-driven development of diffraction gratings for UV missions	Spectroscopy is a core component of most UV missions, from sounding rockets to flagships. Design requirements associated with diffraction-grating based spectrometers are driven by a variety of science cases. This in turn leads to a large range of possible grating prescriptions that, in any case, call for performance qualities such as maximized diffraction efficiency and minimized scatter, as well as aberration-correcting groove layouts. To meet imposed requirements, grating patterns benefit from a high level of customization in a parameter space that spans a wide range of groove density, substrate curvature, and groove-facet shape. Their ideal design leads to strong constraints on the fabrication techniques involved, and in some cases, precludes certain methods. We have been developing various processes to fabricate UV gratings relying on electron-beam lithography patterning on both flat and curved substrates. This includes employing multiple methods for facet shaping, with an emphasis on achieving a wide range of blaze angles. We will summarize our efforts to date and will expand on their applicability to future missions including HWO while outlining the technological challenges and possible solutions.

Manuel Quijada	Improving Coating Deposition Process for Realizing High-Reflectance and Stable Mirror Coatings for Observations in the Far Ultra-violet	Astronomical instrumentation for observation in the Far Ultra-Violet (FUV, 90-200 nm) could provide key insights in cosmic origin studies such as the stages of development of galaxies and planetary systems and to map the exchange of matter and energy in and out of galaxies during the star formation process. However, these studies have proven to be challenging due (in part) to the deficient performance of reflecting mirror coatings and the extremely faint light available from astronomical objects in the FUV spectral range. The focus of this presentation will be to discuss recent progress during the deposition of Al+LiF coatings. Our team at GSFC has developed a new reactive Physical Vapor Deposition (rPVD) process that consists of a fluorination process with XeF2 gas combined with our traditional PVD process. We have found that this new rPVD coating process offers a protected version of Al+LiF with a more environmentally stable and more transparent LiF layer, along with unprecedent reflectivity. This presentation will also discuss the paths for realizing the uniformity requirements of these broad-band Al-based coatings for application in the future flagship mission that NASA will be pursuing in the coming years such as the Habitable World Observatory (HWO).
Briana Indahl	The MANTIS 16U CubeSat Mission: Characterizing the High Energy Stellar Radiation Environment of Exoplanetary Systems with Simultaneous Extreme-UV through Visible Observations	The MANTIS (Monitoring Activity of Nearby sTars with uv Imaging and Spectroscopy) 16U CubeSat mission, led by the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado Boulder, will characterize the high-energy stellar radiation that drives atmospheric photochemistry and escape on extrasolar planets by conducting simultaneous observations of exoplanet host stars at extreme-ultraviolet (100–1200A; EUV), far-ultraviolet (1300–2200A; FUV), near-ultraviolet (2200–3500A; NUV), and visible (3500–10000A; VIS) wavelengths. The science payload’s two-telescope design enables simultaneous coverage over the entire UV passband and provide the first EUV astrophysics capability in over 20 years. MANTIS will mature several key EUV technologies for future astrophysics missions including a first of its kind Hetrick-Bowyer grazing incidence telescope, a grazing incidence EUV diffraction grating, and a microchannel plate detector with a QE optimized for higher-energy bands. The MANTIS design, detector systems, spacecraft bus and mission operations build off the heritage of the previous UV CubeSats, CUTE and SPRITE, developed by the MANTIS team. This presentation overviews the design of the MANTIS instrument, general mission concept, and EUV technology development.
Laura Vega	Exploring Flares in Simultaneous Multiwavelength Observations from Active M Dwarf Stars	M dwarfs are cool low-mass stars that are the most common stellar type (>70%) in our galaxy and are known to frequently host small planets. Most M dwarfs exhibit high levels of activity in the form of flares and coronal mass ejections due to magnetic reconnection processes. This energetic activity may subject potential planets, orbiting around them, to significantly more radiation than we receive from the Sun. It remains unclear just how much this radiation affects a planet’s atmosphere and potential habitability. I will present preliminary results on our multiwavelength analysis of highly active M dwarf stars located within our solar neighborhood. We used simultaneous optical, ultraviolet, X-ray, and radio observations from TESS, Swift, XMM-Newton, NICER, and the VLA. We compare the flare frequency distribution (FFDs) of events, observed by the different telescopes, to estimate the overall energy output, allowing us to investigate the relationship of stellar flares at different wavelengths.
Emily Farr	Development of narrowband coatings for future UV missions: Increasing throughput and environmental stability in the far- and Lyman-ultraviolet	In pursuit of maturing high priority UV optics technology for the Habitable Worlds Observatory, we present laboratory reflectivity results and ongoing environmental stability testing of band-selecting filters designed for the Lyman-ultraviolet bandpass (LUV; 90-120 nm) and the far-ultraviolet bandpass (FUV; 120-150 nm). These band-selecting coatings (narrowband filters) were developed in coordination with the Grupo de Optica de Laminas Delgadas (GOLD) at the Instituto de Optica-Consejo Superior de Investigaciones Cientificas for the Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID) sounding rocket payload. Environmental stability tests of Lyman alpha (Ly-ƒ¿; 121.6 nm) suppressing filters that peak near 105 nm (□gF110M□h) and 140 nm (□gF140M□h) were conducted in the optical testing facilities at CU Boulder.

Nick Kruczem	The Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID): Instrument and Technology	The highest mass stars, born in short-lived bursts of star formation, dominate the stellar luminosity of early galaxies and are the strongest drivers of a galaxy's on-going kinematic and chemical evolution. Determining the spatial distribution and environmental impact of these massive stars are therefore key focus area for understanding galactic feedback and evolution. The Far- and Lyman-Ultraviolet Imaging Demonstrator (FLUID) is a proposed rocket-borne multi-band ultraviolet imager that will leverage its novel selection of channels to image local galaxies across the Lyman (LUV; 90 – 120 nm) and Far ultraviolet (FUV;) for the first time. We will discuss the scientific and technological motivations for the FLUID instrument, including how its four channel design offers an empirical means to simultaneously solve for the stellar population ages (temperatures) and dust extinction of individual clusters at spatial scales characteristic of star forming regions in local galaxies (~100 pc). Laboratory testing and assembly of FLUID is already underway, including successful demonstration of the multi-layer filter telescope coatings and arc-second level telescope performance. FLUID will raise the technology readiness level (TRL) of band-selecting UV coatings and solar-blind, UV detector technology needed for next-generation UV facilities such as the Habitable Worlds Observatory (HWO), while simultaneously addressing key "Cosmic Ecosystems" science questions from the Astro2020 Decadal Survey.
Alex Haughton	Integral-field spectroscopy in the far ultraviolet with INFUSE, a pathfinder instrument for Habitable Worlds Observatory	The Integral Field Ultraviolet Spectrographic Experiment (INFUSE) sounding rocket is the first far-ultraviolet integral field spectrograph. INFUSE leverages new enhanced lithium fluoride mirror coatings, a large format photon counting cross strip microchannel plate detector, and a custom image slicer made with novel micromachining techniques to produce over 1000 1D spectra simultaneously in a 2.4 by 2.6 arcminute field-of-view. INFUSE covers a bandpass of 100-180 nanometers and achieves a spatial resolution of 2-5 arcseconds and spectral resolution of 3-6 angstroms. The integral field spectrometer design on INFUSE can be scaled to either small or large scale orbital missions. INFUSE successfully demonstrated these technologies during its first launch from White Sands Missile Range on October 29th, 2023. The second launch of INFUSE is projected for spring 2025. Several enhancements are planned for this second flight, including improved baffling and spectrograph alignment. INFUSE-II will also prove new technologies, flight testing a xenon-enhanced lithium fluoride coated grating that is a candidate for Habitable Worlds Observatory. In addition, INFUSE-II will carry a ride along, SUMO, testing multi-object spectroscopy with digital micromirrors in space for the first time.
Aaron Tohuvavohu	NUV and FUV cameras for the Quick Ultra-Violet Kilonova Surveyor (QUVIK)	The Quick Ultraviolet Kilonova Surveyor (QUVIK) is an approved Czech national space mission, scheduled for launch in 2028. QUVIK will image the dynamic UV sky in two simultaneous bands (NUV+FUV), across 1 deg^2, behind a 35 cm telescope with rapid response capabilities. It is designed for discovery and characterization of hot and fast UV transients, including kilonovae and supernovae, and as a follow-up engine for ULTRASAT triggers. QUVIK has been fully approved for rapid development and launch, with a limited budget designed with a 'New Space' approach. I will describe the development of the LUVCamera system for the NUV + FUV focal plane of QUVIK. LUVCam features a large format, low-noise, large pixel, and high quantum efficiency, backside illuminated COTS CMOS sensor, packaged with custom built readout electronics and thermomechanical structure. LUVCam is ITAR-free, cheap to fabricate, and will fly to orbit on a technology demonstration CubeSat mission this summer as part of the development pathway for QUVIK.

Paloma Lopez Reyes	Narrowband mirrors based on fluorides tuned at vacuum ultraviolet wavelengths	Despite the interest of the astrophysics community to take space observations to the far ultraviolet (FUV, 100-200 nm), optics for this range are challenging due to material absorption and the limited knowledge of the optical constants. Future space observatories like the JWST successor "Habitable Worlds Observatory, HWO/NASA" require efficient coatings capable of providing high-throughput image bandpasses in the FUV, a technology that is currently included as a technology gap by NASA. Among the scarce transparent materials in this range, metal fluoride materials exhibit the shortest cutoffs. Conventionally, high-reflective narrowband coatings have consisted of periodic combinations of fluoride multilayers (MLs), with contrasting refractive index, such as MgF_2/LaF_3 or AlF_3/LaF_3 MLs. In this context, our group, GOLD-IO-CSIC, has been developing high-performance all-dielectric FUV coatings, with special emphasis on short wavelengths down to 120 nm. This region of the short FUV has been relatively unexplored, showing comparatively lower performance due to the increased absorption of fluorides towards shorter wavelengths. Here, we present combinations of MgF_2/LaF_3 and AlF_3/LaF_3, which can be tuned in any FUV wavelength >120 nm with a remarkable performance above 85% at H Ly-á (121.6 nm) for AlF_3/LaF_3 MLs, that improves the state-of-the-art at such short wavelengths. We also present a comparative study on the nanostructural morphologies of the two sets of MLs. Both the selection of the ML materials and the introduction of some aperiodicity on the ML designs allow to choose the bandwidth or the desired optical profile with remarkable freedom. Below ~120 nm there is no suitable combination of fluorides since all fluorides but LiF turn absorbing. We, then, present narrowband coatings based on Al, LiF, and SiC films, tuned at ~100 nm, with a strong rejection at the close H Ly-á line that could mask the observations.
Nicole Sanchez	The Scatter Matters: Circumgalactic Metal Content in the Context of the M-σ Relation	In this talk, I will discuss the effects of supermassive black hole (SMBH) feedback on the circumgalactic medium (CGM) using the cosmological hydrodynamic simulation, Romulus25 (Tremmel et al. 2017). Within our simulated galaxies, we trace the motion of metal-rich gas from its formation in the disk out into the CGM and beyond. We explore the mechanisms that drive metal flow during the evolution of ~L* galaxies and what properties constrain the amount of metals left within the disk and CGM. We find that the retention of metals in the central 0.1Rvir of these galaxies trends with the scatter of SMBH mass on the empirical M-σ relation, and we make predictions for future observations to constrain our results. Finally, our work links the accretion history of the SMBH and its efficiency at impacting the gas and metal enrichment of the CGM to its host galaxy's gravitational potential.
Patrick Behr	HST-COS Transit Spectroscopy of KELT-20b: First Detection of Excess Far-ultraviolet Absorption Around an ultra-hot Jupiter	Consisting of an ultra-hot Jupiter with Teff ~2300 K and a bright (V ~ 7.6) fast-rotating A2 star, the KELT-20 system provides an ideal laboratory to investigate upper atmospheric physics and chemistry using ultraviolet spectroscopy. The atmosphere of KELT-20 b has been studied extensively via transmission spectroscopy at optical wavelengths, showing strong hydrogen absorption as well as metals including Na, Ca, Fe, Mg, and Cr. The strong photospheric far-ultraviolet flux from the bright A-type host star may be balanced by a relatively modest extreme-ultraviolet radiation field as the stellar dynamo that generates choromospheric and coronal activity is thought to shut down at spectral types hotter than ~A4. Therefore, the atmospheric ionization and escape properties of this planet are expected to deviate from the observed behavior of hot Jupiters orbiting cooler, coronally active, main sequence stars. We present the first spectroscopic observations of KELT-20 b in the far-ultraviolet using the Hubble Space Telescope Cosmic Origins Spectrograph, allowing the measurement of never before detected low-ionization and neutral atoms in the upper atmosphere. We present preliminary results from this program, including continuum transit depth (~2%) twice as deep as observed at optical wavelengths and potential absorption of C I, N I, Al II, and Si II.
Randall McEntaffer	Nanofabrication techniques for UV gratings and diffractive optics – results and path forward	Recent success in fabricating X-ray reflection gratings with record-high diffraction efficiencies and spectral resolving power have been leveraged to begin a program of developing high performance UV diffractive optics. Gratings with high densities (10,000 lines/mm), echelles with smooth/high-angle facets, gratings with curved groove layouts, ultra-low blaze angles (<1 deg), and thermally activated blaze profiles have all been studied. Efforts to pattern custom layouts accurately on curved substrates are also ongoing. The results of these studies will be summarized along with a discussion of how they have paved the way for future improvements. We will detail our current efforts as well as what we define as the major challenges in developing the next generation of UV gratings.

Matt Kalscheur	H2 Fluorescence in T Tauri Star Disk Winds (by Matt Kalscheur and Kevin France)	We use far-UV spectra of 36 T Tauri stars, predominately from Hubble Space Telescope's ULLYSES program, to examine the kinematic properties of fluorescent H2 emission lines for evidence of disk winds and outflows. We co-add isolated lines within four fluorescent progressions ([v′,J′] = [1,4], [1,7], [0,2], and [3,16]) to improve signal-to-noise, and we fit each co-added line profile with either one or two Gaussian components. Of the high S/N line profiles (S/N ≥ 12 or 15 per resolution element at the peak of the profile), over half are best fit with both broad and narrow Gaussian components. We find a low-significance systematic blue-shift between the component (single, broad and narrow) centroid velocities and stellar radial velocities for profiles of the [1,4] and [1,7] progressions, but no systematic velocity offsets between the centroid velocities of the broad and narrow components. For the [0,2] progression, we find centroid velocities consistently blueshifted with respect to stellar radial velocities on the order of -5 to -10 km s-1 for the single and narrow components, and -15 km s-1 for the broad components. Overall, the blueshifts observed in our sample suggest that the molecular gas traces an outflow from a disk wind in some sources, and not solely disk gas in Keplerian rotation. We do not find strong correlations between centroid velocities, line FWHMs and outer disk inclinations. We compare our results to those of optical [O I] surveys of similar T Tauri stars.
Sona Hosseini	Next Generation of Miniature High Spectral Resolution UV Spectrometry	High-resolution spectrometry is crucial for space exploration, allowing for detailed analysis of spectral signatures and phenomena like composition, temperature, isotopes, and physical processes. For example, hydroxyl (OH) serves as a surrogate for lunar water, and its spectral signatures, visible only in high spectral resolution measurements (Δλ < 1Å), can represent a significant portion of lunar water abundance. Traditional remote spectroscopic techniques often require a trade-off between instrument size and sensitivity, limiting their effectiveness. Spatial Heterodyne Spectrometry (SHS) addresses this challenge by offering high spectral resolution of extended sources such as Earth's upper atmosphere, planetary atmospheres, and exospheres within a targeted bandpass, all in a compact format with exceptional sensitivity. Unlike traditional methods, SHS operates similarly to Fourier Transform Spectrometers (FTS) but with a simpler optomechanical design akin to grating spectrometers. A key advantage of SHS lies in its compatibility with small aperture telescopes, making it exceptionally compact. This feature makes SHS suitable for various applications, including small mobile field instruments, robotic platforms, and space missions aboard SmallSats or the International Space Station (ISS). These platforms enable prolonged observations that are not feasible with large ground telescopes or significant space missions. Here, we report on our ongoing work on developing SHS sensors for planetary, astrophysics, and heliophysics research applications.
Kyle Cook		Ultraviolet is a known tracer of star formation and GALEX data have frequently been used to find the star formation rates of nearby galaxies. We instead use the narrow NUV Swift UVOT filters to infer recent star formation histories for comparison to the gas reservoir traced by HI data from the Looking At the Distant Universe with the MeerKAT Array (LADUMA) survey. We report seven SWIFT detected sources in L-band LADUMA data and one additional unique XMM/OM source. We note a similar NUV color for all HI detected sources. We compare the relative HI/stellar mass fraction and find two are highly depleted and three are notably gas-rich. Our working hypothesis is that the two gas poor galaxies are (slowly) quenching, while the three gas-rich galaxies are in a period of rejuvenation. The remaining three sources are the most UV-blue and consistent with on-going star formation. We discuss how our results are indicative of what to expect when UVEX and ongoing HI surveys are combined for synthesis science results.
April Jewell	Detector Coatings for Ultraviolet Imaging and Spectroscopy	Here we report on the latest developments in optical coatings methods for silicon-based UV detectors. The topics to be covered include UV-optimized antireflection coatings, solar-blind UV bandpass filters, as well as patterned coatings yielding detectors with spatially varying response spanning the UV and visible wavelength ranges. The latter innovation is achieved by combining well-established lithographic patterning techniques with optical coating techniques to produce butcher-block style AR coatings, similar to linear variable filters often used in infrared spectroscopy systems. With these patterned AR coatings, a detector's spatial response can be tailored according to the spectral dispersion of the optical system. Thus, high-throughput, wide-wavelength imaging and spectroscopy can be achieved on a single detector.

Daniel Wilson	E-Beam Fabricated Diffractive Optics for Space, Air, and Surface Instruments	For over three decades, JPL's Microdevices Laboratory has been fabricating diffractive optical components by grayscale electron-beam lithography on flat, convex, concave, and aspherical substrates, for wavelengths from ultraviolet to long-wave infrared. We will show examples of flight optics that we have delivered for space, air, and surface instruments including diffraction gratings for spectrometers, occulting masks for coronagraphs, and computer-generated holograms for hazard avoidance and particle/fluid flow characterization.
Carlos Vargas	Mapping the CGM with Aspera	For over half a century, observational astrophysics has been eager to successfully detect and map one of the most massive baryonic components of galaxies: warm-hot phase coronal gas extending into the circumgalactic medium (CGM). Despite its importance to galaxy evolution, this phase of gas is entirely unmapped in the nearby universe. The evolution of galaxies relies heavily on the properties of gaseous halos, indicating an urgent need to map and measure these understudied regions. In the last decade, high-efficiency reflective coatings for UV optics have experienced improvements in reflectivity per bounce and overall coating stability in the far ultraviolet (FUV). Detector technology sensitive to FUV wavelengths has seen steady development of Microchannel Plate (MCP) detector technology. In parallel with these advances in FUV technology, SmallSat missions with serious science objectives—which did not exist a decade ago—have emerged as a promising platform for high-impact science, an opportunity for more adventurous experiments and investigations. In this talk, I present Aspera (PI C. Vargas): a FUV SmallSat mission to detect and map warm-hot phase gas emission in nearby galaxies for the first time. The Aspera mission is designed to target the O VI emission line doublet from highly ionized oxygen, located at 103.2, 103.8 nm rest frame. Aspera combines a simple spectroscopic optical design using advances in highly-reflective FUV-coated optics with advanced UV MCP detectors to optimize throughput and sensitivity. Aspera will build multiple days of exposure time on each individual target to ensure spectroscopic detection of O VI emission and produce 2D morphological maps and direct measurements of physical conditions such as kinematics. The Aspera mission was selected for funding in the inaugural 2020 NASA Astrophysics Pioneers Program in January of 2021. The mission is currently in its integration & testing phase with a projected rideshare launch in 2025.
Jack Ford	Characterizing Tungsten Filaments for Lyα attenuation: Hydrogen Cell Absorption Technology	Geocoronal Lyα has been a significant challenge for astronomical observations from low-Earth orbit (LEO) and suborbital platforms. The geocorona forms when water vapor in the atmosphere is photo-dissociated into OH and H by solar ultraviolet (UV) radiation, then the atomic hydrogen migrates to the exosphere where it resonantly scatters solar Lyα photons. This overwhelming signal has been a hinderance for FUV (120-150 nm) and LUV (90-120 nm) missions in LEO, and despite being a well-known issue since the early days of sounding rocket explorations, no effective narrow band Lyα rejection filter exists to mitigate this problem. Here, we present the Hydrogen Cell (H-cell), a windowed tube filled with molecular hydrogen (H2) that is collisionally dissociated into its neutral atomic components (H I) using a hot tungsten filament. The H I is then free to absorb incoming Lyα photons. The dissociation of the H2 and, thus the efficiency of Lyα rejection, is strongly dependent on the surface temperature of the filament. We present the results of testing a variety of filaments with varying diameter, length, and H2 pressures in order to maximize the filament temperature while minimizing power consumption. We then investigate and show our preliminary results for Lyα attenuation of the H-cell as a function of filament temperature. The use of this technology would greatly benefit potential HWO observations in the FUV and LUV band passes.
Nathan Bush	Silicon Detectors for Ultraviolet Imaging and Spectroscopy in Space	JPL is developing, maturing, and delivering large format, high performance silicon detector arrays with different architectures in CCDs, CMOS image sensors, and single photon counting silicon detectors for ultraviolet imaging and spectroscopy in space. Nanoscale surface engineering technologies developed at JPL enable the stability and sensitivity required for NASA science over a wide spectral range, spanning soft X-rays through the UV, visible, and near infrared. The unique capabilities of 2D-doped detectors will be particularly important in the advancement of silicon detectors to address technology gaps for NASA's Great Observatories, while also contributing to missions in all platforms including suborbital missions such as FIREBall or Faint Intergalactic Redshifted Emission Balloon and SHIMCO or Spatial Heterodyne Interferometric Molecular Cloud Observer, cubesats such as SPARCS or Star Planet Activity Research CubeSat, Explorers such as MIDEX-UVEX or Ultraviolet Explorer, and several SMEX and smallsat concepts. We are partnering with industry and universities to further develop silicon detector capabilities for applications and missions that require large format, mosaicable detectors with high UV efficiency, low noise, high dynamic range, and solar blind response. JPL's technologies apply to a wide variety of silicon detector designs and architectures, including CMOS image sensors, CCDs, avalanche photodiode arrays, single photon avalanche diode (SPAD) arrays, Quanta Image Sensors (QIS), and skipper detectors.

Mackenzie Carlson	Tackling the Second Parameter Problem with the Off-Axis FORTIS Sounding Rocket	The Far-UV Off Rowland-circle Telescope for Imaging and Spectroscopy (FORTIS) is a forefront sounding rocket experiment designed in a “two bounce” Gregorian fashion with a diffractive secondary to conduct multi-object spectroscopy. Its new off-axis design, motivated by the recurrence of geocoronal Lyman-α scattering off the optical train assembly, will enable us to field the first statistically significant exploration of the curious UV diversity of the hot horizontal branch (HHB) in the otherwise similar globular clusters M10, M13, and M3. HHB morphology is largely driven by metallicity, but these three clusters have nearly identical [Fe/H] abundance and age, and despite their similarities they exhibit significant differences in the thermal distribution of stars along the HHB (Sandage and Wallerstein 1960; Faulkner 1966). This issue is commonly referred to as the "second parameter problem" as researchers hunt for the additional parameter driving this diversity (Dalessandro et al. 2013). Additionally, the demonstration of critical technologies such as mirror coatings, diffraction gratings, detectors and programmable slit arrays in a spectroscopic system such as FORTIS will help enable the promise of HWO by raising their technical readiness.