

Probing Star Formation and the High Mass Stellar IMF with UVIT

S Amrutha^{1,2} (amrutha.s@iiap.res.in), Mousumi Das²

¹Pondicherry University, R.V. Nagar, Kalapet, 605014, Puducherry, India

²Indian Institute of Astrophysics, Koramangala II Block, Bangalore 560034, India

Abstract

UV is a significant indicator of star formation and can trace star formation activity over the past 300 Myr. Hence, we present an overview of our research on star formation and the high-mass stellar initial mass function (IMF) using observations from the Ultraviolet Imaging Telescope (UVIT). With a high spatial resolution of approximately 1.2", UVIT allows for detailed analysis of star-forming complexes (SFCs) in nearby galaxies. Our research focuses on characterizing and comparing star formation across different types of star-forming dwarf galaxies (SFDGs), specifically examining 16 SFDGs and the gas-rich ultra-faint dwarf galaxy Leo T. Our key finding includes distinct star formation rate density limits for SFCs of each SFDG type, with dwarf irregulars exhibiting the lowest values. The study also establishes the star-forming main sequence on the SFC scale for all SFDG classes, revealing type-specific slopes α .

On the other hand, Leo T lacks massive OB stars. We found that emission line Be stars, Helium burning stars, horizontal branch stars, and some young main sequence stars are associated with UV emission, as determined by comparisons with the HST catalog. Additionally, we investigated the upper end of the stellar IMF in massive galaxy NGC 628 using UV and H α observations, where we showed that the ratio of massive to less massive B stars yields a consistent IMF value. Furthermore, we determined that the IMF is top-light.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

UV Dawn of Kilonovae: Enabling Science with upcoming UV missions

Smaranika Banerjee¹ (smaranika.banerjee@astro.su.se), Mansi Kasliwal² (mansi@astro.caltech.edu)

¹The Oskar Klein Centre, Department of Astronomy, Stockholm University, AlbaNova, SE-10691
Stockholm, Sweden,

²Cahill Center for Astrophysics, California Institute of Technology, MC 249-17, 1200 E California
Boulevard, Pasadena, CA, 91125, USA

Abstract

Binary neutron star (BNS) mergers provide an excellent cosmic laboratory for understanding the origin of heavy ($Z > 26$) elements, which has been a long-standing mystery in astronomy. In the neutron-rich material ejected from the BNS merger, heavy elements are synthesized via rapid neutron capture (r -process). The radioactive decay of such elements produces emission in the ultraviolet-optical-infrared (UVOIR) range, called a kilonova. Such a kilonova has already been detected as a follow-up observation of gravitational waves from a BNS merger (GW170817), ushering in the era of multi-messenger astronomy.

The observational properties of the kilonova (light curve and spectra) depend on the microphysics, i.e., the detailed atomic data of the heavy elements. Lack of such atomic data hinders the progress towards studying such transients to progress towards the origin of heavy elements. In our recent work, we have calculated such atomic data to calculate kilonova light curves starting from the early photospheric phase ($t \sim$ hour). Using the new atomic data, I have studied how the brightness of the kilonova emission varies with time, with a focus on the early UV phase (Banerjee et al. 2020, 2022, 2024, 2025b).

It is important to study such early kilonova, specially in the early UV phase since such early UV signal provides important insights about the abundance pattern of the outermost layer of the ejected material (ejecta), where most emissions escape from at this phase. My work provides important preparation for the existing and upcoming UV satellites, such as UVEX (Kulkarni et al., 2021), ULTRASAT (Sagiv et al., 2014) as the early UV emission of kilonova is the ideal target for these satellites.

In my talk, I will share the detection prospects of kilonova with the upcoming satellites and the unique physical information we understand from those observations, specially focusing on UVEX (Banerjee, Kasliwal+ et al. in prep.).

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Sulfur chemistry of a heavily UV irradiated PPD

Leire Beitia-Antero^{1,2} (lbeitia@ucm.es), Pablo Rivière-Marichalar³, Asunción Fuente⁴

¹*Departamento de Estadística e Investigación Operativa, Facultad de Ciencias Matemáticas, Universidad Complutense de Madrid, Spain,* ²*Joint Center for Ultraviolet Astronomy, Universidad Complutense de Madrid, Avda Puerta de Hierro s/n, 28040, Madrid, Spain,* ³*Observatorio Astronómico Nacional (OAN, IGN), Alfonso XII, 3, 28014, Madrid, Spain* ⁴*Centro de Astrobiología (CAB), CSIC-INTA, Ctra. de Ajalvir Km. 4, Torrejón de Ardoz, 28850, Madrid, Spain*

Abstract

The chemical evolution of protoplanetary disks is very complex and understanding it is crucial to trace the path of prebiotic molecules until planetary formation. In this contribution, we present our results on the analysis of the sulfur chemistry of the UV irradiated protoplanetary disk 170-337, under the influence of the radiation field of the Orion cluster. We detect a very strong signal of molecular CS and H₂S and discuss the effects of the radiation field on the apparent sulfur overabundance, also detected in the optical.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Characterizing precipitating electrons in Ganymede's auroral regions through Juno/UVS observations and coupled electron transport and radiative transfer models

B. Benmahi^{1,2} (bilal.benmahi@lam.fr), V. Hue¹, F. Leblanc³, B. Benne^{4,5}, B. Hubert², X. Jia⁷, R. Gladstone⁸, A. Vorbuger⁶, B. Bonfond², B. Collet¹, C. Louis⁹, M. Barthelemy^{10,11}, A. Moirano², M. Blanc¹², J. Waite¹³, G. Gronoff^{14,15}, D. Grodent², L. Lamy¹, R. Giles⁸, T. Greathouse⁸ and P. Molyneux⁸

1 Aix-Marseille University, CNRS, CNES, Institut Origines, LAM, Marseille, France ; **2** Laboratory for Planetary and Atmospheric Physics, STAR Institute, University of Liège, Liège, Belgium ; **3** LATMOS/CNRS, Sorbonne Université, UVSQ, Paris, France ; **4** The University of Edinburgh, School of GeoSciences, Edinburgh, UK ; **5** Centre for Exoplanet Science, University of Edinburgh, Edinburgh – UK ; **6** University of Bern, Faculty of Science | Physics Institute, Space Research & Planetary Sciences (WP), CH-3012 Bern, Switzerland. ; **7** Department of Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI 48109-2143, USA ; **8** Space Science and Engineering Division, Southwest Research Institute, San Antonio, TX, USA ; **9** LESIA, Observatoire de Paris, Université PSL, CNRS, Meudon, France ; **10** Univ. Grenoble Alpes, CNRS, IPAG, 38000 Grenoble, France ; **11** Univ. Grenoble Alpes, CSUG, 38000 Grenoble, France ; **12** IRAP, CNRS-Université Paul Sabatier, Toulouse Cedex 4, France ; **13** Department of Physics and Astronomy, The University of Alabama, Tuscaloosa, Alabama 35487 ; **14** NASA Langley Research Center, Hampton, Va, USA ; **15** Science Systems and Applications Inc., Hampton, Va, USA

Abstract

Auroral emissions offer crucial insights into the coupling between planetary magnetic fields, atmospheres, and surrounding plasma. While Jupiter's aurorae are well studied, those of Ganymede, the only moon in the solar system with an intrinsic magnetic field, remain less understood. Observations by the Hubble Space Telescope (HST) and Juno/UVS have revealed UV auroral ovals on Ganymede, shaped by its interaction with Jupiter's magnetosphere and associated with atomic oxygen emissions at 130 and 135 nm. While these emissions, originating from electron impact excitation of oxygenated species such as H₂O, O, and O₂, are clearly detected, the energy distribution of the precipitating electrons responsible remain poorly constrained.

Building on our previous work on Jupiter's aurorae (Benmahi et al. 2024a,b), we applied a similar methodology to Ganymede, focusing on emissions in the 125–136 nm range. Using our electron transport model TransPlanet coupled with a custom non-LTE radiative transfer model, we reproduced the OI 130 and 135 nm emissions observed by Juno/UVS during the PJ34 flyby, across sunlit auroral regions.

By analyzing the total brightness and intensity line ratio (I_{135}/I_{130}), and accounting for solar UV reflection by the surface, we constrained the energy flux and mean energy of the precipitating electrons. The theoretical line ratio varies with species: ~0.2 for H₂O, ~2.2 for O₂, and ~0.02 for O. The observed median ratio of 2.22 in these auroral regions suggests a dominant contribution from O₂, consistent with sublimation-driven H₂O depletion in the analyzed regions, located far from the subsolar point.

To infer the electron energy distributions, we tested both broadband kappa and monoenergetic inputs. Kappa distributions failed to reproduce the observed brightness and ratio simultaneously. In contrast, monoenergetic distributions provided better agreement, with characteristic energies from ~20 eV in quiescent areas up to ~200 eV in the brightest spots, and corresponding energy fluxes of 0.5–5.0 mW/m². These results indicate relatively low-energy electron precipitation, yet with energy fluxes comparable to those observed at Jupiter. The absence of high-energy electrons is consistent with Ganymede's tenuous atmosphere, where excitation cross sections for the OI 3S and 5S states decrease sharply with energy, limiting emission production at 130 and 135 nm.

In conclusion, the monoenergetic distribution for precipitated electrons generally offers the best fits, but discrepancies remain for some regions and none of the distributions, kappa or monoenergetic, allow us to fit the observations. These likely reflect uncertainties in the atmospheric composition, especially the H₂O profile, or alternative, more complex electron distribution functions. Refinements in atmospheric models and in-situ constraints from future missions will be essential to fully characterize Ganymede's auroral processes.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Ultraviolet Signatures of Stellar Wind Interaction with Early Hydrogen Atmospheres on Earth-like Planets

Ada Canet^{1,2} (adacanet@ucm.es) & Ana Inés Gómez de Castro^{1,2}

¹Joint Center for Ultraviolet Astronomy (JCUVA), Universidad Complutense de Madrid, E-28040, Madrid, Spain, ²Facultad de Ciencias Matemáticas, S.D. Física de la Tierra y Astrofísica, Universidad Complutense de Madrid, E-28040 Madrid, Spain

Abstract

At the early stages of their evolution, Earth-mass planetary cores are able to accrete a substantial amount of hydrogen directly from the protoplanetary disk, forming a primordial atmosphere around the planet. The stability and retention of gaseous envelopes are critical to the long-term habitability of Earth-like planets. In particular, stellar rotation during the early evolutionary stages plays a decisive role in determining the fate of these primordial atmospheres around Earth-mass exoplanets. Planets orbiting fast-rotating stars may undergo complete photoevaporation within the first few hundred Myr driven by the enhanced stellar XUV [X-rays and extreme ultraviolet (EUV)] radiation, while planets orbiting slow-rotating stars are expected to experience difficulty in losing their primordial envelopes. While XUV radiation from the host star is the main actor driving atmospheric losses, magnetized stellar winds can further contribute to the depletion of the atmosphere and redistribute its density around the planet, giving rise to high-temperature plasma accumulation, potentially observable in ultraviolet wavelengths. In this work, we present 3D magnetohydrodynamical (MHD) simulations to study the interaction between photoevaporating atmospheres of unmagnetized Earth-mass planets and stellar winds over the age range of 50 to 500 Myr. We analyse the coupled evolution of stellar wind properties, modulated by stellar activity, and planetary atmospheres, considering both fast- and slow-rotating host stars.

Our results predict substantial changes in the evolution of primordial atmospheres when influenced by fast-rotating stars, with a significant reduction in extent at early ages. In contrast, atmospheres embedded in the stellar winds from slow-rotating stars remain largely unaltered. The interaction of the hot, magnetized stellar winds with the ionized upper atmospheres of these planets allows us to evaluate the formation and evolution of different MHD structures, such as double bow shocks and induced magnetospheres. We find that the formed high-density, high-temperature bow shocks, formed by the mixing of the incoming stellar wind and the planetary atmosphere, can act as new sources of ultraviolet emission, especially for planets orbiting fast-rotating stars. We present precise predictions of the ultraviolet flux and evaluate its detectability with upcoming large UV facilities, comparing the expected signatures for Earth-like planets and sub-Neptunes with extended, inflated atmospheres.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Study of the atmospheric effects of energetic particle precipitations on giant planets with HWO

Chaufray J-Y¹ (chaufray@latmos.ipsl.fr), Dunn, W.², Fletcher, L.N.³, Fossati, L.⁴, Galand, M.⁵, Gkouvelis, L.⁶, Jackman, C.M.⁷, Lamy, L.^{8,9}, Roth, L.¹⁰

¹LATMOS/IPSL, CNRS, Guyancourt, France, ²MSSL, UCL, Dorking, UK, ³SPA, University of Leicester, Leicester, UK, ⁴IWF, OeAW, Graz, Austria, ⁵Imperial College, London, UK, ⁶LMU, University Observatory, Munich, Germany, ⁷Astronomy and Astrophysics Section, Dublin Institute for Advanced Studies (DIAS), Dunsink Observatory, Dublin, Ireland, ⁸LAM, Marseille, France, ⁹LIRA, Meudon, France, ¹⁰SPP, KTH, Stockholm, Sweden

Abstract

UV auroral emissions from giant planets are produced by extra-atmospheric energetic particles interacting with an atmosphere. They have been observed on Jupiter, Saturn and Uranus and should be present on Neptune. Even if the mechanisms are similar, each planet is unique due to its specific source of magnetospheric plasma and the structure and dynamics of its magnetosphere.

The aurorae of Jupiter and Saturn are characterised by a combination of main oval emission, polar emission, diffuse equatorward emission, and discrete structures generated from satellites (e.g. footprints and tails from Galilean moons at Jupiter and Enceladus at Saturn), while UV aurorae on Uranus are less well known and still undetected on Neptune. These aurorae, observed from soft X-ray to radio on Jupiter and Saturn, are produced by the precipitation of energetic magnetospheric particles (electrons and ions). These precipitations are a major source of energy into the atmosphere of the giant planets, responsible for heating the upper atmosphere at all latitudes. They also mirror the magnetospheric processes and provide a means of probing the action of both internal and external drivers, from variable plasma loading and associated plasma injections to solar wind-magnetosphere coupling. The changes influenced by these drivers can be monitored both temporally (through brightenings/dimmings of specific regions) and spatially (e.g. through “auroral family” structures at Jupiter in UV and X-ray). However, how these precipitations modify atmospheric heating, dynamics and chemical balance at local and global atmospheric scale is still poorly known and critical to understanding the global atmosphere-magnetosphere system of giant planets and exoplanets. In this presentation we will present how future observations by instruments, aboard the Habitable World Observatory (HWO) will provide new information to better understand the origin and the atmospheric effects of these precipitations. A major interest is for the distant magnetospheres of Uranus and Neptune, never explored by an orbital spacecraft whose UV auroral emissions remains at (Uranus) or below (Neptune) the HST sensitivity. Pollux is one such UV instrument concept, which will enable unprecedented high spectral resolution at fine spatial scale not previously seen and polarimetric observations of the planetary aurorae.

Presentation Preference:

X No preference

Student Participation:

Progress Report on the CASTOR Mission

Patrick Côté¹ (patrick.cote@nrc-cnrc.gc.ca), Tyrone E. Woods² (Tyrone.Woods@umanitoba.ca), on behalf of the CASTOR team

¹ National Research Council of Canada, Herzberg Astronomy & Astrophysics Research Centre, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada, ² Department of Physics and Astronomy, Allen Building, 30A Sifton Road, University of Manitoba, Winnipeg, MB R3T 2N2, Canada

Abstract

CASTOR is a wide-field, nearly diffraction-limited space telescope that is under development by the National Research Council of Canada (NRC) and Canadian Space Agency (CSA). The 1 m CASTOR telescope will produce panoramic imaging of the UV/optical (150-550 nm) sky, using a three mirror anastigmat design to deliver HST-like image quality over a wide field of view (0.25 sq. deg.) in three filters simultaneously. This presentation will review the mission design, including spacecraft and payload layout, telescope opto-mechanical design, focal plane arrays and spectroscopic instrument packages, thermal control, altitude and data handling, launch plan, orbit maintenance, communications, electronics, and ground support. I will describe CASTOR's unique capabilities within the astronomical landscape in the coming decade, and present highlights from the Phase 0 study and subsequent programs to define the science mission, including a suite of candidate Legacy Surveys. Finally, I will outline the mission development plan and summarize ongoing work designed to increase technology readiness levels associated with several key mission elements.

Bios: **Patrick Côté** is a Principal Research Officer at the National Research Council and science lead for the CASTOR mission. **Tyrone Woods** is a Professor in the Department of Physics and Astronomy at the University of Manitoba, and science co-lead for the CASTOR mission.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation: X

The CASTOR team includes dozens of students and some of their contributions to the scientific and technological development of the mission will be highlighted in this presentation.

Leveraging Planetary UV Spectrograph Development to Maximize Science Return on Future UV Astrophysics Missions

Michael W. Davis¹ (Michael.davis@swri.org)

¹Southwest Research Institute, San Antonio, TX, USA

Abstract

Nearly every space science mission is data-limited in some way, either by available data storage, downlink budget, or both. Planetary missions tend to be the most data limited missions of all due to their limited allowed mass and power preventing large on-board data storage. The large distances of planetary missions also limit their data downlinked to the ground. Developments over the last 25 years of planetary UV spectrograph production have helped to overcome some of these limitations so that science return is maximized. Southwest Research Institute (SwRI) has built six UV spectrographs for planetary missions, and in the process has incorporated several features in the design of their electronics to maximize science return. The first UV spectrograph was Alice for ESA's Rosetta mission, launched in 2004. This mission required minimal power and mass (4W, 4 kg for the entire instrument), so a baseline electronics package was developed and flown to meet these specs until the end of the Rosetta mission in 2016. The second, Alice for New Horizons, slightly increased power and mass to account for the redundancy needed for a flyby mission whose primary science took place at >30 AU from Earth. It launched in 2006 and still operates in the Kuiper Belt on its way out of the Solar System. The third, LAMP for the Lunar Reconnaissance Orbiter, was essentially a rebuild of New Horizons Alice. LAMP launched in 2009 and has been operating 24/7 in lunar orbit since shortly after launch. The fourth, UVS for the Juno mission, features automation to back off high voltage at high count rates and enhanced shielding to survive Jupiter's radiation belts. The electronics power increased to 7 W for greater detector resolution, increasing time sensitivity from 4 ms to 1 ms, and more advanced commanding. Juno launched in 2011 and has been in operation since 2016. The fifth, UVS for ESA's JUICE mission, features a programmable histogram mode so that image histograms can be compressed on-board to reduce data volume without reducing science return. JUICE launched in 2023 and UVS has been fully commissioned and undergoes regular calibration checks en route to Jupiter orbit in 2030. The sixth, UVS for the Europa Clipper mission, features all the JUICE enhancements as well as a borosilicate glass microchannel plate detector for reduced sensitivity to gamma ray background and enhanced gain stability. Future planned improvements include digitized delay line readout electronics for enhanced resolution, additive manufactured microchannel plates, and increased on-board data storage. All these enhancements can be used for planetary, heliophysics, and astrophysical ultraviolet instrumentation to enhance science return with limited resources.

Presentation Preference:

X Oral Presentation

Update on the UV MCP detector development at IAAT

S. Diebold¹ (diebold@astro.uni-tuebingen.de), J. Barnstedt¹, L. Conti¹, H.R. Elsener²,
C. Kalkuhl¹, D. Schaadt³, D. Rau³, T. Schanz¹, B. Stelzer¹, K. Werner¹

¹Institut für Astronomie und Astrophysik (IAAT), Eberhard Karls Universität Tübingen, Germany

²Empa, Swiss Federal Laboratories for Materials Science and Technology, Switzerland

³Institut für Energieforschung und Physikalische Technologien, Technische Universität Clausthal, Germany

Abstract

Microchannel plates (MCPs) were the driving detector technology for ultraviolet (UV) astronomy over many years, and still today MCP-based detectors are the baseline for several planned UV instruments. The development of advanced MCP detectors is ongoing and pursues the major goals of maximizing sensitivity, resolution, and lifetime, while at the same time decreasing weight, volume, and power consumption.

Development efforts for an MCP-based detector system for UV astronomy are running at the University of Tübingen. It is single-photon counting and visible-blind by design, which relaxes pointing stability and straylight protection requirements. The key concepts comprise the application of state-of-the-art ALD-coated borosilicate MCPs, a co-planar cross-strip anode, and FPGA-based readout electronics. For the near-UV and the far-UV down to about 116 nm, a sealed-tube version of the detector with an MgO window has already been successfully demonstrated. Alternatively, in order to extend the sensitivity to the complete far-UV range down to 90 nm and to cover the extreme-UV, an open-face version with a shutter mechanism is currently under development. In both versions, the sensitive range is tuneable via applying different photocathodes – in semi-transparent mode for the sealed-tube and in opaque mode for the open-face version.

This presentation gives an update on the development progress and highlights our latest results in implementing a non-iterative centroiding algorithm directly in the readout FPGA. Furthermore, the mission prospects for our detector system are presented.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Prometheus: An F3 Proposal to Characterise Populations of Stars

Billy Edwards¹ (b.edwards@sron.nl), Camilla Danielski², & the Prometheus Consortium

¹SRON, Space Research Organisation Netherlands, The Netherlands

²INAF, Osservatorio Astrofisico di Arcetri, Florence, Italy

Abstract

Our understanding of our place in the Universe is about to drastically change. In the next decade, the PLATO will discover temperate rocky planets around Sun-like stars while JWST and Ariel will assemble a rich dataset of exoplanetary atmospheres, enabling detailed studies of atmospheric composition and prompting efforts to decode planetary formation and evolution. In the 2040s, the Habitable Worlds Observatory (HWO), the Extremely Large Telescope (ELT), and the Large Interferometer For Exoplanets (LIFE) will begin surveying the nearest FGKM stars for planets, with the ultimate aim of detecting and characterising potentially habitable Earth-like worlds. Our ability to assess the habitability of these worlds will critically depend on our capacity to constrain the magnetic activity, chemistry and ultraviolet (UV) radiation of their host stars.

To fully characterise the radiative environment that shapes exoplanet atmospheres, simultaneous observations of the stellar chromosphere and photosphere are essential. This requires high-resolution spectroscopy spanning both the UV and visible (VIS) bands. Currently, the Hubble Space Telescope remains the only operational high-resolution UV facility, but it is heavily oversubscribed and lacks the capability for simultaneous UV/VIS observations. Moreover, no planned or proposed missions are set to address this critical observational gap. Without a new facility to provide robust constraints on the irradiation environments of exoplanets, our ability to interpret the atmospheric properties—and thus the potential habitability—of these worlds will remain agonisingly out of reach. In response to this pressing need, the Prometheus Consortium has developed a mission concept for submission to the ESA F3 call, specifically devised to deliver the required observational capabilities and to enable the comprehensive studies of stellar radiation environments that are fundamental to understanding exoplanet habitability.

As the era of discovering potentially habitable rocky exoplanets dawns, Prometheus will use a high-resolution UV-VIS echelle spectrograph (215–905 nm, $R \sim 25,000$) to map magnetic activity signatures across spectral types, resolving long-standing degeneracies related to stellar metallicity and mass, as well as enhancing our understanding of planetary atmospheric evolution and habitability. By observing stars at different evolutionary stages, Prometheus will deliver a rich dataset — including magnetic activity proxies, flaring rates, activity cycles and elemental abundances. It will also derive stellar ages using chemical clocks, extending age estimates to stellar types inaccessible to photometric methods. With all measurements coming from a single instrument, Prometheus will deliver a self-consistent set of stellar properties, placing stellar magnetic activity in its full evolutionary context, revealing the past, present, and future irradiation environments of planetary systems.

I will present an overview of the Prometheus mission, discussing its design, the key observables, and the stellar surveys that it would facilitate.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

CUTE is so much more than just exoplanets: Science highlights from years 3 and 4 of NASA's first UV astronomy smallsat

Arika Egan¹ (arika.egan@jhuapl.edu), Dolon Bhattacharyya², Kevin France²

¹Johns Hopkins Applied Physics Laboratory, ²Laboratory for Atmospheric and Space Physics

Abstract

Originally designed to look for signs of escaping hot Jupiter atmospheres through entrapped ions via its NUV (2479 – 3306 Å) bandpass, the Colorado Ultraviolet Transit Experiment (CUTE) has been executing science observations for more than five times its original mission lifetime. Most recently, CUTE has monitored the NUV output and variability of Alpha Centauri, covering approximately 5 months in two campaigns in 2024 and 2025. We will present an analysis of the Alpha Centauri observations that supports precursor NUV variability science for the Habitable Worlds Observatory. We also present four NUV transits of KELT-20b, combining them with HST-COS transit spectra at FUV wavelengths (1400 – 1750 Å) to create the first FUV-through-optical transmission spectrum an ultrahot Jupiter. We will also present first results on our 3-month campaign to monitor Mars as it moved towards aphelion in 2024 and 2025. Pursuant to the collaborative and technological themes of this workshop, we will highlight the successes and lessons learned from the CUTE mission, emphasizing the scientific and educational utility of small UV observations, what value CUTE clones can bring to the community, and how the CUTE CubeSat design and mission framework can enable many institutions to successfully develop small space missions for astronomical applications.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Development of High-Reflectivity Ultraviolet Mirrors

Umi Enokidani¹, Go Murakami¹, Atsushi Yamazaki¹, Ayaka Tadokoro^{1,2},
Shingo Kameda³, Masato Kagitani⁴, Fuminori Tsuchiya⁴

¹Institute of Space and Astronautical Science (ISAS), JAXA

²Tokyo University of Science

³RIKKYO UNIVERSITY

⁴TOHOKU UNIVERSITY

Abstract

We are developing high-reflectivity mirrors to improve the detection efficiency of the focal plane instruments aboard LOPYUTA, a Japanese UV telescope that was selected as one of candidates of JAXA's M-class mission. Conventionally, ultraviolet mirrors are fabricated by vacuum-depositing aluminum (Al), which has high reflectivity in the UV range, onto polished glass substrates. However, Al oxidizes upon exposure to atmospheric oxygen, leading to a rapid decline in reflectivity. To prevent this oxidation, magnesium fluoride (MgF₂) coatings are applied over the Al layer. For one of LOPYUTA's primary science targets, the atomic oxygen emission line at 130.4 nm, the typical reflectivity of Al + MgF₂ mirrors remains around 85%. If the instrument had four mirrors, the detection efficiency would be halved at the current reflectivity. Therefore, improving the reflectivity of each mirror is essential to maintain high detection efficiency. In this study, we explore various deposition parameters—such as film thicknesses of Al and MgF₂, substrate temperature during deposition, and vacuum pressure—to fabricate mirrors and identify the optimal conditions for maximizing reflectivity. Our improved deposition process has achieved a reflectivity of 87.6% under current best parameters.

In addition, we are starting the development of an advanced coating process. A recent study (Quijada et al., 2024) showed that adding a small amount of xenon fluoride between the Al and MgF₂ deposition steps causes the Al to react with fluorine before it oxidizes, helping to keep its high reflectivity. Mirrors fabricated with this process have demonstrated reflectivity exceeding 90%. We aim to determine the best parameters for this process and achieve reflectivity approaching the theoretical maximum of 95%.

These developments are expected to contribute not only to LOPYUTA but also to future missions, including the Habitable Worlds Observatory (HWO). This presentation will also present recent progress in the development of this coating process.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Integral Field Spectroscopy for the Next Generation – from SmallSats to HWO

Fleming, Brian¹ (Brian.Fleming@lasp.colorado.edu), Vorobiev, D¹, France, K¹, Indahl, B¹, Ochoa, A¹, Haughton, A¹, Kruczek, N¹, Witt, E²

¹Laboratory for Atmospheric and Space Physics, University of Colorado, ²Johns Hopkins University

Abstract

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, 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, UV fiber optics, micro-mirror devices, and efficient aberration-correcting gratings, this technology-limited paradigm has changed. This talk presents several new instruments in development at the University of Colorado, LASP that test designs for long-slit, multi-object, and integral-field spectroscopy. These prototypes, sounding rockets, and SmallSats are laying the groundwork for future large-scale orbital survey missions, as well as the upcoming Habitable Worlds Observatory (HWO). This talk provides an overview of enabling technologies, current and in-development missions, and concepts for both near- and medium-term mission designs for the first ever efficient, medium resolution surveys of local galaxies and nebular regions in the far- and near-UV.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Developing the UV Instrument Capability for the Habitable Worlds Observatory: Instrument Design, Flight Testing, and Workforce Maturation

Kevin France¹ (kevin.france@colorado.edu), Brian Fleming¹, Nicholas Kruczek¹, Briana Indahl¹, Nicholas Nell¹, Dmitry Vorobiev¹, Patrick Behr¹, Maitland Bowen¹, Emily Farr¹, Alex Haughton¹, Fabien Grise², Randall McEntaffer², Stephan McCandliss³, Emily Witt³, John Hennessy⁴, Michael Hoenk⁴, Paul Scowen⁵, Oswald Siegmund⁶

¹University of Colorado, ²Penn State University, ³Johns Hopkins University, ⁴NASA/JPL, ⁵NASA/GSFC, ⁶UC Berkeley / Sensor Sciences

Abstract

Following the 2020 US Astronomy and Astrophysics Decadal Survey's recommendation of the Habitable Worlds Observatory (HWO) as NASA's next astrophysics flagship observatory, the international astronomical community has turned its attention to the science drivers for and the technical development of the HWO mission concept. It is widely recognized that most of the galactic ecosystem, exoplanet, and stellar science goals of HWO require high-throughput imaging and spectroscopy at ultraviolet (UV) wavelengths. The final UV instrument design for HWO will be developed to meet the science requirements developed by the HWO science working groups and will evolve from the previous LUVUOIR/Habex concepts. Nevertheless, numerous common instrument "goals" emerge from these studies (potential optical wavelength extensions in parentheses):

1. multi-object imaging spectroscopy across the 100 – 400nm (700 nm) bandpass over 2 – 10 arcminute fields,
2. integral field spectroscopy across the 100 – 320 nm (1,100 nm) bandpass over 1 – 10 arcsecond fields,
3. medium-band imaging across the 100 – 200nm (1,700 nm) bandpass over 2 – 6 square arcminute fields, and
4. multiple spectral resolution modes to support a broad range of science goals, including very low ($R \sim 100$), low ($R \sim 3,000$), medium ($R \sim 40,000$), and high ($R \geq 100,000$) resolution capabilities.

We will discuss related instrument designs and strategies under development at CU-LASP/CUSP, as well as technology needs supporting the UV imaging and spectroscopy goals for HWO. This talk will present recent advances in these areas with an emphasis on demonstrations as part of suborbital / small satellite missions and discuss a development path for both the hardware and the people that will be required to enable HWO's science objectives.

Presentation Preference:

X Oral Presentation

Student Participation: X

LUV: A laboratory for ultraviolet experimentation

María Frutos¹ (maria.frutos@ucm.es) and Ana Inés Gómez de Castro

¹AEGORA Research Group, Fac. CC. Matemáticas, Universidad Complutense de Madrid.
Plaza de Ciencias, 3. 28040, Madrid, Spain.

Abstract

The performance of experiments in the Vacuum Ultraviolet (VUV) range (120-200 nm) always represents a great challenge due to the exhaustive control of the measurement conditions that working at such short wavelengths demands and the need of highly specialized instrumentation and components that are not always commercially available.

In this contribution, we present the Laboratory of Vacuum Ultraviolet (LUV) which is fully equipped to carry out a broad variety of experiments under vacuum ultraviolet irradiation.

The laboratory is provided with an ISO 7 softwalls cleanroom, which contains an ISO 5 glass box, where the table and some equipment are placed which assures the control of the particles-contamination within the experimentation area.

The laboratory counts with the so-called optical emulator consisting in a vacuum chamber where the evaluation of the performance of optical elements can be carried out. The vacuum chamber can operate under high vacuum through the concomitant performance of a turbopump baked by a scroll pump, ensuring an oil-free environment. The VUV source of the experimental set-up is a deuterium lamp with a spectral distribution ranging from 115 to 400 nm. Once the light beam completes the specifically designed optical path, it will reach a photon-counting detector.

This optical emulator can be straightforward converted into an instrument that allows the study of the reflectance spectral response of a collection of meteorites of different nature.

In addition, the LUV is equipped to carry out irradiation experiments to evaluate the effects that the VUV irradiation triggers on the surface of carbon-based materials.

The LUV is also provided with an Atomic Force Microscope which can measure the topography of samples with nanometric resolution, as well as other samples' properties (such as magnetic, electrical or mechanical). In this way, the study of the surface of, for example, the optical elements tested in the LUV can give valuable information about the presence of irregularities or defects due to their manufacturing process (or to their degradation by the VUV irradiation) which can help to the improvement of their performance.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Near Ultraviolet Transient Explorer (NUTEx): A CubeSat-Based NUV Imaging Payload for Transient Sky Surveys

Shubham Ghatul^{1,2} (shubham.jankiram@iiap.res.in), Rekshesh Mohan¹, Jayant Murthy¹, Margarita Safonova¹, Shubhangi Jain^{1,2}, Praveen Kumar^{2,3}, Mahesh Babu S.¹

¹ Indian Institute of Astrophysics, Bangalore, India

² Department of Applied Optics and Photonics, University of Calcutta, India

³ Indian Institute of Science, Bangalore, India

Abstract

We present the development of the Near Ultraviolet Transient Explorer (NUTEx), a CubeSat-based compact ultraviolet imaging payload designed to conduct wide-field near-ultraviolet (NUV) transient sky surveys in the 200–300 nm band. NUTEx is part of a growing class of small satellite missions that aim to address specific scientific objectives through low-cost, modular, and rapidly deployable instrumentation. The imager features a 146 mm diameter aperture and employs a Ritchey–Chrétien optical system coupled with a photon-counting microchannel plate (MCP) detector equipped with a solar-blind photocathode paired with an in-house-developed readout unit. NUTEx provides a field of view of 4°, spatial resolution of 13 arcseconds, and a peak effective area of 15 cm^2 at 260 nm.

The primary science goals of NUTEx include the study of transient astrophysical phenomena that includes monitoring of rapidly varying NUV sources such as flaring stars, M-dwarfs and supernovae. These phenomena, particularly in the UV, remain underexplored due to limitations in previous missions which often avoided bright regions of the sky, such as the Galactic plane, due to detector sensitivity limits. NUTEx, with its relatively lower sensitivity and wide field of view, is ideally suited to explore these regions and provide valuable insights into UV time-domain astrophysics. In addition to its scientific capabilities, NUTEx emphasizes in-house design of key subsystems, such as the mechanical structure and the development of on-board electronics using commercially available off-the-shelf (COTS) components that meet standard spaceflight qualification requirements.

Currently in its integration phase, NUTEx is on track for a Q4 2025 launch. With its targeted science case, compact form factor, dedicated UV sensitivity, and low-cost development, NUTEx demonstrates how scientifically impactful missions can be realized within the constraints of small satellite platforms. The mission is expected to contribute meaningfully to ultraviolet time-domain astronomy and support coordinated observations with ground and space-based observatories.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

The Ultraviolet Researcher to Investigate the Emergence of Life - URIEL

Gómez de Castro¹, Ana I. and the URIEL consortium

¹Space Astronomy Research Group (AEGORA), Fac. CC Matemáticas, Universidad Complutense de Madrid, Plaza de Ciencias 3, 28040 Madrid, Spain

Abstract

URIEL is an M-class size space telescope designed to open the UV spectropolarimetry window to astrophysics at large.

URIEL will be a versatile facility enabling a broad range of scientific programs providing the astronomical community, as a whole, of an invaluable tool inspired in the pioneering, and extremely successful, International Ultraviolet Explorer (IUE). Some of the key programs of the mission are

- Search for signatures of AAs in the spectropolarimetric signal of comets in the Solar System.
- Surface characterization of Solar System bodies through high-sensitivity UV spectroscopy and spectropolarimetry.
- Constrain the evolutionary paths of young planetary systems (YPS).
- UV high-resolution spectropolarimetric portal to a vast supply of never-before studied data from nearby bright stars

The optical design of URIEL profits from successful design of the IUE and updates and upgrades it to comply the scientific requirements of the broad community. With its current design, a flat polarization rate of 2% will be detectable for about 80% of the sources observed with IUE with the same IUE exposure times.

In this talk, the URIEL scientific objectives, payload, and consortium behind the proposal will be described.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

Student Participation:

Fabrication of next-generation UV gratings for current NASA missions, with applicability to the Habitable Worlds Observatory

Fabien Grisé¹ (fug39@psu.edu), Randall McEntaffer¹

Brian Fleming², Kevin France², Nicholas Kruczek², Briana Indahl²

Stephan McCandliss³, Mackenzie Carlson³

¹Penn State University, ²University of Colorado/Boulder, ³John Hopkins University

Abstract

The Habitable Worlds Observatory (HWO), NASA's next strategic flagship mission, aims to revolutionize our understanding of habitable planets beyond our solar system while enabling transformative astrophysics discoveries. Building on the legacy of the Hubble Space Telescope and previous ultraviolet (UV) missions, HWO requires unprecedented UV spectroscopic performance to achieve its scientific objectives.

Leveraging cutting-edge nanofabrication techniques, we present advanced grating fabrication methods critical to meeting these demands. Some of these methods are currently being applied to manufacture Variable Line-Space (VLS) gratings with an ultra-low blaze ($< \sim 1$ deg) angle. These innovations are broadly applicable to a wide range of UV missions, including sounding rockets, CubeSats, and Explorer-class missions. We discuss fabrication methodologies and results, as well as their implications for next-generation spectrographs including the challenges that remain—such as extending these techniques to curved substrates.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

High velocity dispersion and accuracy to characterize the diffuse cloud seen from within: deformation, shock and turbulence?

Cecile Gry¹ (cecile.gry@lam.fr)

¹Aix Marseille Univ., CNRS, CNES, LAM, Marseille, France

Abstract

The UV absorption spectrum of any nearby star bears the imprint of the diffuse local interstellar cloud (LIC) in which the Sun is embedded —the only cloud to be observed from within.

This particular position of the cloud surrounding the Sun, combined with the high wavelength resolution of the HST UV spectrometers, in particular STIS, have allowed to study small kinematic disturbances, as well as other variabilities inside the cloud.

From the velocity measurements in all directions, Gry & Jenkins (2014, A&A 567, A58) evidenced coherent deviations from the bulk motion, interpreted as a compression in the direction of motion and an expansion in perpendicular directions, indicating a differential deceleration of the cloud inside the Local Bubble.

Column densities of atomic lines (Mg II & Fe II) evidence a metal abundance gradient from the front to the rear of the cloud.

Many sight-lines even the shortest ones exhibit secondary velocity component(s):

- In half of the sight-lines covering half of the sky a component is present with a consistent blue-shift of 7 km/s relative to the LIC, that we interpret as evidence for a shock moving toward the cloud interior, possibly due to an enhancement of the external thermal pressure on one side of the LIC.
- Other extra nearby secondary components could be kinematic disturbances inside the LIC, probably due to turbulence in the cloud, and can be compared with turbulence model of the diffuse medium.

Specifying these characteristics would not be possible without a velocity dispersion of at least 3 km/s and a velocity accuracy better than 1 km/s, recommended requirements for any future UV spectroscopic instrument to address interstellar or circumstellar gas studies.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Looking to future UV spectroscopy from the perspective of developing the Space Telescope Imaging Spectrograph

Theodore R Gull¹

¹Code 660, Goddard Space Flight Center (tedgull@gmail.com)

Abstract

The capability of the 1st Gen spectrographs for Hubble (the UV Goddard High Resolution Spectrograph & the UV/visible Faint Object Spectrograph), were limited by their linear 1K detectors. The 2nd Gen spectrograph needed to take advantage of the near-diffraction imagery of Hubble and expand spectral coverage. Key innovations of the Space Telescope Imaging Spectrograph (STIS) were:

- 2D detectors – development of flight-rated multi-anode multi-array (MAMA) 2K by 2K UV detectors and 1K by 1K CCD
- Several spectral resolving powers: R=100, 1000, 40,000 and 109,000 plus selected filters
- Multiple optimized apertures and filters

The STIS provided a plethora of options allowing studies from solar system objects outward to distant galaxies ranging from 1150 to 10000 Å. Such required multiple reflections within the instrument which limited magnitude especially in the UV. Hence the Cosmic Origins Spectrograph (COS) was added as a 3rd Gen instrument extending UV coverage from about a dozen AGNs and QSOs to hundreds of fainter objects. The MAMAs (1150 to 1700Å and 1600 to 3200Å) proved to be stable UV workhorses with stable sensitivity three decades later. With photon counting capability or integrated count options and low background levels, the MAMAs perform magnificently but are limited from high photon fluxes. The single CCD (1700 to 10,000 Å), had several electron-readout noise coupled with thermal noise and radiation-induced background noise. Cost cutting limitations led to descopeing to a single unit and no echelle mode longward of 3200 Å. The back-thinned CCDs proved problematic longward of 7000 Å.

The plethora of options designed in STIS allowed unplanned applications: trailing stars along the slit to build S/N; imaging exoplanets close to host stars, obtaining the Crab Pulsar spectrum with phase, mapping the ejecta of Eta Carinae in selected emission lines from high- to low-ionizations state

Science goals of the Habitable World Observatory must drive the design well beyond that of the STIS:

- greatly increased dynamic range: develop flight-ready solid-state detectors (essential!)
- Multi-aperture coverage of complex structures (galaxies, globular clusters, nebular clumps, etc.)
- Carefully selected resolving powers
- Extension into the UV shortward of Lyman alpha (Perhaps a special single bounce channel).

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Unravelling the mechanisms of Lyman continuum emission through spectral mapping of the nearest Green Pea Analog

Alex Haughton¹ (alex.haughton@colorado.edu), Brian Fleming¹, Sally Oey², Emily Witt³, Celeste Elizalde Flores¹, James Green¹, Kevin France¹, Oswald Siegmund⁴, Adrian Martin⁴, Takashi Sukegawa⁵

¹University of Colorado, Boulder, ²University of Michigan, ³Johns Hopkins University, ⁴Sensor Sciences LLC, ⁵Canon, Inc.

Abstract

Green Pea (GP) galaxies are thought to be analogous to galaxies at the Epoch of Reionization; conditions within these galaxies permit Lyman continuum (LyC) photons to escape the galaxy and ionize neutral hydrogen. While bulk properties of GPs have been collected through point source spectroscopy, and extended Lyman alpha halos have been identified, their compact size combined with their distance at redshifts of $z \sim 0.3$ mean that they are not spatially resolved even with the largest telescopes.

NGC 2366, a low mass and low metallicity galaxy, is close enough at 3.4 Mpc that the structure and interior of the galaxy can be studied. A bright starburst knot within NGC 2366 known as Markarian 71 (Mrk 71) shares many traits with GPs and is hypothesized to be a source of LyC emission. While many observations have focused on Mrk 71, the surrounding region including the companion galaxy NGC 2363 has not been studied in the ultraviolet (UV) outside of a GALEX image and one FUSE pointing.

Using integral field spectroscopy in both the far UV and visible spectrum we study data cubes of NGC 2366 and NGC 2363 to better understand the conditions and mechanics that can lead to features such as Mrk 71. The visible data comes from observations taken with the George and Cynthia Mitchell Spectrograph at McDonald Observatory, and the far UV data will be obtained on an upcoming sounding rocket flight of the INtegral Field Ultraviolet Spectrographic Experiment, or INFUSE.

INFUSE leverages a number of advances in UV technology while providing technology development for future UV telescopes such as the Habitable Worlds Observatory. Some of these include the largest cross strip microchannel plate detector ever flown in space, an adaptable integral field spectrograph design enabled by a UV quality image slicer, and advanced mirror coatings such as Xenon-enhanced lithium fluoride.

This talk will include discussion of the results from the visible band observations as well as the evolution of the UV technologies used on INFUSE.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

An Astrometric Measure Camera for Small Space Telescopes

Sally Heap (Sara.Heap@Gmail.com) and Tony Hull (TonyHull@UNM))

Telescope jitter is a limiting problem for most space telescopes, which cannot afford Hubble-level pointing stabilization. For these telescopes, we introduce the Astrometric Measurement Camera (AMC), designed to measure and correct for jitter. The AMC is based on two critical components: the GAIA database of stellar positions, and an affordable CMOS camera described by Norbert Werner at a previous NUVA Workshop. The design assumes an IUE-like layout in which the spectrograph (or camera) lies at the center of a guide-star field 15' in diameter. Tests using >2000 Hubble/COS sightlines to targets show that a 0.5-m telescope can achieve fully jitter-corrected spectroscopy or imagery over the full sky.

The Ultraviolet Satellite Auroral Footprints at Jupiter: An Overview

V. Hue (Vincent.hue@lam.fr)¹, T. K. Greathouse², G. R. Gladstone², A. Moirano^{4,5}, S. Satoh^{6,1}, B. Benmahi^{1,4}, B. Bonfond⁴, J. Rabia⁷, R. S. Giles², J. A. Kammer², A. Mura⁵, M. H. Versteeg², D. C. Grodent⁴, S. J. Bolton²

1 : Aix-Marseille Université, CNRS, CNES, Institut Origines, LAM, Marseille, France

2 : Southwest Research Institute, San Antonio, TX, USA

3 : LESIA, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Université de Paris, Meudon, France

4 : STAR Institute, LPAP, Université de Liège, Liège, Belgium

5 : Institute for Space Astrophysics and Planetology, National Institute for Astrophysics, Rome, Italy,

6: Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University

7: Institut de Recherche en Astrophysique et Planétologie, CNRS-UPS-CNES, Toulouse, France,

Abstract

Jupiter's vast magnetosphere is populated by plasma primarily sourced from Io's atmosphere, which in turn is sustained by sublimation of surface SO₂ produced by the intense volcanic activity. This plasma forms a dense sheet in near-corotation with the planet's magnetic field, confined to the centrifugal equator. As the Galilean moons orbit within this environment, they act as obstacles to the plasma flow, generating Alfvén waves. The interaction of Alfvén waves, including their propagation and reflection between Jupiter's northern and southern ionospheres, produces distinct auroral footprints observed from radio frequencies to X-ray, including the far-ultraviolet. Looking at the UV wavelength range, the brightness and structure of these UV auroral spots are strongly influenced by each moon's location within the plasma sheet. While the Hubble Space Telescope has provided important insights into these moon-magnetosphere interactions, NASA's Juno mission is now delivering unprecedented in-situ and remote-sensing observations—often simultaneously. In this talk, I will highlight key discoveries made by Juno, discuss open questions, and explore how upcoming missions such as JUICE and Europa Clipper may build on Juno's legacy.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

The FUV Imaging Satellite (FISAT)

Shubhangi Jain¹ (shubhangi.jain@iiap.res.in), Judhajeet Basu¹ (judhajeet.basu@iiap.res.in), Praveen kumar¹ (praveenkuma4@iisc.ac.in), Shubham Jankiram Ghatul¹ (shubham.jankiram@iiap.res.in), Mahesh Babu S¹ (maheshsada97@gmail.com), Rekhesh Mohan¹ (reks@iiap.res.in), Margarita Safonova¹ (margarita.safonova62@gmail.com), Jayant Murthy¹ (jmurthy@yahoo.com), Bharat Chandra¹ (bharat.chandra@iiap.res.in)

¹Indian Institute of Astrophysics

Abstract

Despite the importance of far-ultraviolet (FUV) observations, there are relatively few FUV imaging missions planned in the near future. Large and sensitive UV telescopes are often oversubscribed and they are too sensitive to cover brighter regions of the sky. We are developing a small Far-Ultraviolet Imaging telescope to cover some of the science cases that are not possible with larger sensitive telescopes. This instrument (FUV Imaging Satellite (FISAT)) is a compact Far UV telescope designed for daily transient monitoring. It features an 80 mm Ritchey–Chrétien (RC) design, operating in the 130–180 nm range with a 3° field of view and can detect objects as faint as 19 AB (1200 s, SNR = 5). It's a compact design which is compact enough to be flown on a CubeSat. The 6-12 month survey will focus on capturing novae outbursts and other transient events. Novae, explosive events in cataclysmic binaries caused by thermonuclear runaway reactions on white dwarfs, provide valuable insights into accretion processes, particle acceleration, binary evolution, and galactic chemical evolution. The Andromeda Galaxy (M31), with its high nova rate, is an ideal target for nova studies. Monitoring M31 daily in the far-ultraviolet (FUV) will produce unprecedented light curves, providing key data on nova speed class, peak brightness, and UV flashes. Current UV surveys are limited in depth and cadence, but FISAT's capabilities, alongside optical observations, will enable the detection of new novae and continuous monitoring of known novae. Daily exposures can detect FUV sources up to 19 magnitudes, increasing the chances of observing short-lived UV flashes, which are rarely captured. FUV surveys can also refine estimates of nova rates and populations, and offer insights into supernova type Ia progenitors. Beyond novae, FISAT may detect other transients like core-collapse supernovae, thermonuclear supernovae, and fast blue optical transients (FBOTs). Additionally, the survey will include a Galactic plane survey, broadening its observational scope beyond M31.

The small size of the payload combined with a simple design makes the development cycle faster compared to larger missions, and brings down the cost of manufacturing and launch significantly. This telescope will be hosted by InterCosmos, a private space startup, on one of their upcoming missions towards the end of 2026.

Presentation Preference:

Oral Presentation

Student Participation:

Yes

Lyman UV Exploration: Present and Far

Li Ji¹ (ji@pmo.ac.cn), Mingsheng Cai¹, Zheng Lou¹, Shu Niu¹, Wei Liu¹, Yuan Qian¹, Shuping Yan¹, Shuinai Zhang¹, Jiangtao Li¹, Sen Wang², Keqiang Qiu³, Jinlong Zhang⁴, Zhanshan Wan⁴, Chen Xu⁵, Fu Li⁶, Klaus Werner⁷, Sebastian Diebold, Norbert Kappelmann, Beate Stelzer

¹ Purple Mountain Observatory, CAS, China, ² National Astronomical Observatory, CAS, China, ³ University of Technology and Science of China, Hefei, China, ⁴ Tongji University, Shanghai, China, ⁵ Nanjing Institute of Astronomical Optics & Technology, CAS, China, ⁶ Xi'an Institute of Optics & Precision Mechanics, CAS, China, ⁷ Institute for Astronomy and Astrophysics, Universität Tübingen, Tübingen, Germany

Lyman UV mapping has historically been limited by the relevant technologies including optical coating, gratings, as well as the advanced detectors. After a decade of explorations in China, we have achieved great improvements in those technological fields. We present here the lab assembling and calibrations of the prototype of the scientific payload of CAFE ((Census of Warm-Hot Intergalactic Medium, Accretion, and Feedback Explorer)) mission, which aims to mapping the Lyman UV emissions (ionized oxygen (OVI) resonance lines at 103.2 and 103.8 nm, and Lyman series) for the diffuse sources mainly for the circum-galactic mediums of the nearby galaxies. We also report the current status of our proposed mission: Lyric (Lyman UV Radiation from Interstellar medium and Circum-galactic medium), as an independent external payload operating on the Chinese Space Station.

Conceptual design of Integral Field Spectrograph and High Resolution Spectrograph for Habitable Worlds Observatory

Shingo Kameda^{1,2}, Go Murakami², Atsushi Yamazaki²

¹Rikkyo University

²Institute of Space and Astronautical Science (ISAS), JAXA

Abstract

Earth-like planets have been detected in the habitable zone of low-mass stars. However, transit spectroscopy requires extremely high precision to observe the thin layer of lower atmosphere of a small terrestrial planet, and at present no atmospheres of terrestrial exoplanets have been detected. On the other hand, strong XUV radiation of low-mass stars may cause the far-extended upper atmospheres. We investigate the possibility of detecting the upper atmospheres of terrestrial exoplanets by transit spectroscopy with future ultraviolet space telescopes, LAPYUTA and Habitable Worlds Observatory (HWO). There are several atomic and ionic emission lines (H, C, N, and O) in the far UV spectral range which will be helpful for understanding the surface environment of the exoplanet especially in case the lower atmosphere cannot be detected. In addition, icy moons in the solar system have water plumes. H and O atoms are generated by dissociation and could be detected by far UV imaging spectroscopy.

We performed a conceptual design study on a high-resolution spectrograph (HRS) and an integral field spectrograph (IFS) for far UV as potential contribution to HWO by JAXA. We are developing a large-format high-efficiency funnel microchannel plate (MCP) for photon counting. In this presentation, we introduce our study especially on exoplanets and solar system bodies, conceptual design of IFS and HRS for HWO, and the current status of UV technology development.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Probing the energy of Jovian auroral electrons with HST/STIS through the color and brightness ratio method

Lamy L.^{1,2} (Laurent.lamy@lam.fr), Pit C.¹, Bonfond, B.³, Tao⁴, C., Prangé R.², Benmahi B.¹

¹LAM, AMU/Pythéas, CNES, CNRS, Marseille. ²LIRA, Observatoire de Paris, PSL, CNRS, Paris. ³LPAP, Univ. Liège, Liège. ⁴NICT, Japan.

Abstract

The Far-UV auroral observations of the giant planets, such as those obtained the Hubble Space Telescope, can be used to probe the energy of primary auroral electrons precipitating to the atmosphere through two methods known as (i), the color ratio, calculated between H2 bands absorbed and not absorbed by hydrocarbons, and (ii) the brightness ratio, calculated from the ratio between the H γ line and the H2 bands. While the former, sensitive to highly energetic electrons yielding deep enough emissions to undergo absorption (typically > 10 keV) has been intensively used at Jupiter, the latter, more sensitive to weakly energetic electrons precipitating at higher altitudes, has only been tested in the proof-of-concept work of (Tao et al., 2017). Here, we analyze HST/STIS long-slit slewing observations of the Jovian auroral regions, such as those previously analyzed by (Gérard et al., 2014) to reconstruct spectro-images and derived maps of both the color ratio and the brightness ratio, from which we aim at producing complementary maps of electron energies.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Pollux instrument for HWO

Le Mignant D.¹ (david.lemignant@lam.fr), Fossati L.², Muslimov E.³, Neiner C.⁴, Bouret J.-C.¹, A.I. Gomez de Castro A.I.⁵, Marin F.⁶, Dohlen K.¹, Reess J.-M.⁴

¹Aix Marseille Univ. CNRS CNES LAM, ²Space research Institute Graz Austria, ³Univ. of Oxford UK, ⁴Paris Observatory, ⁵Univ. Complutense de Madrid, ⁶Univ. de Strasbourg

Abstract

Pollux is a high-resolution spectropolarimeter working from 100 nm to 1.6 microns proposed for HWO by a European consortium. Pollux will allow us to study stellar and (exo)planetary systems, as well as cosmic ecosystems. For example, Pollux will provide new insights on exoplanet formation and evolution, characterisation of the atmospheres and magnetospheres of stars and planets, and star-planet interactions. It will also allow us to resolve narrow UV emission and absorption lines, enabling us to follow the baryon cycle over cosmic time - from galaxies forming stars out of interstellar gas and grains, and planets forming in circumstellar disks, to the various forms of feedback into the interstellar and intergalactic medium - and from active galactic nuclei. The most innovative characteristic of Pollux is its unique spectropolarimetric capability in the UV, which will open a new parameter space. Its very high spectral resolution (~60000 to ~120000) and stability over a very large wavelength range will also be a major asset. We will summarise the main scientific drivers of Pollux and present its current conceptual design, technological challenges, and the Pollux consortium organisation.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

FUV bandpass technology: current state and future prospects

P. López-Reyes¹(paloma.lopez@csic.es), C. Honrado-Benítez¹, N. Gutiérrez-Luna¹, F. Valls-Vicent^{1,2}, A. García-Cañas¹, A. Iglesias-Moreno¹, J. I. Larruquert¹

¹Instituto de Óptica Daza de Valdés (IO), CSIC, 28006-Madrid, Spain ²Centro de Microanálisis de Materiales (CMAM), UAM, 28049-Madrid, Spain

The performance of future space observatories, such as HWO/NASA, is critically dependent on the efficiency of optical coatings optimized for the far UV (FUV: $\lambda < 200$ nm). This efficiency decreases at shorter wavelengths due to the increasing absorption of fluorides. This turns especially critical in the Lyman ultraviolet range (LUV: 91.2-115 nm), where lithium fluoride (LiF) is practically the only transparent material.

The GOLD-IO/CSIC group specializes in multilayer (ML) technology, with a particular focus on band-pass filters operating by reflectance or transmittance for both the FUV and LUV ranges.

Bandpass mirrors tuned at wavelengths longer than 120 nm are based on periodic fluoride MLs, with a high reflectance and good stability under humid environments. By selecting different fluorides or introducing variations in the periodic design, the shape and/or bandwidth of the filter can be adapted in a wide range that goes from ~ 4 nm to ~ 20 nm FWHM. This design cannot be used in the LUV, since LiF is practically the only available fluoride. Rather, they are prepared by evaporation and sputtering combining Al/LiF/SiC/LiF, with the additional requirement of suppressing the intense and ubiquitous H Lyman- α (121.6 nm). We will present different ways to improve the performance and/or stability of these coatings, especially critical due to the hygroscopic nature of LiF.

Filters operating by transmittance are based on ML combinations of Al/MgF₂ or Al/AlF₃, and they have excellent out-of-band rejection yet with modest peak performance. Additionally, we will present a new method based on material modification by ion irradiation, as a promising alternative to get new FUV transmittance bands.

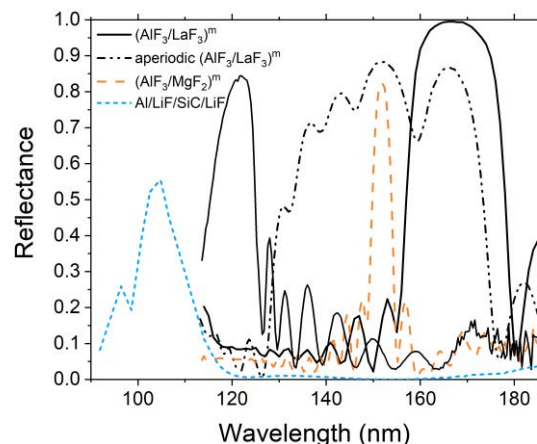


Figure 1 different FUV and LUV bandpass mirrors

LAM UV heritage and future developments

Fabrice Madec (fabrice.madec@lam.fr)¹, David LE MIGNANT¹, Kjetil Dohlen¹, Anne Costille¹, Zalpha Challita¹, Kacem EL HADI¹, Johan Floriot¹, MARCOS Michel¹, Salat Clément

¹Aix Marseille Univ, CNRS, CNES, LAM, Marseille, France

Abstract

Marseille was pioneer in UV instruments for astronomical research since the early space ages. A review of the historical contributions is presented starting from the instrument launch by the French rocket Véronique ancestor of the current Ariane rocket in the 70s to the stratospheric balloon Fireball including contributions to large space missions from NASA, CNES and ESA like FUSE and GALEX.

In the second part of this paper, we will detail the new technology development undertaken at LAM and the plans to contribute to future UV instruments leveraging on the LAM expertise in grating developments as well as instrument integration and testing.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

The vibrant life of UV photons emitted near supermassive black holes

Marin Frédéric (frederic.marin@astro.unistra.fr)

Université de Strasbourg, CNRS, Observatoire Astronomique de Strasbourg, UMR 7550, 67000 Strasbourg, France

Abstract

Accretion disks around supermassive black holes are optically thick, geometrically thin structures that dissipate energy via thermal emission. The cooler, outer parts of such disks are supposed to emit in the near-infrared, while the inner, hotter parts are powerful UV emitters. This results in a multi-temperature blackbody spectrum peaking in the UV-optical band, often coined the Big Blue Bump, that is a characteristic signature of active galactic nuclei (AGNs). However, the true geometry and location of this UV-emitting region is still debated, as there is more and more evidence for an emission region extending further away than the accretion disk. In addition, the disk atmosphere is expected to reprocess part of the disk UV photons into the X-rays, giving birth to the power-law emission observed in the high energy band. If correct, there should be a very strong coupling between the UV and X-ray temporal and polarimetric signatures in AGNs.

Using Monte Carlo simulations, I will show how complex is the life of UV photons emitted at the heart of supermassive black holes and how timing and polarimetric signatures can be used to determine the true location, shape and composition of the source of the Big Blue Bump. In turn, such simulations can be used to promote future UV and X-ray polarimetric missions, such as the UV spectropolarimeter POLLUX that could equip the Habitable Worlds Observatory or the Enhanced X-ray Polarimetry Explorer (EXPO), an ambitious ESA M8 mission for broadband X-ray polarimetry.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Reconstructing the star formation histories of massive early-type galaxies in local galaxy clusters, through the combination of their UV and H α emission

S. Martocchia (silvia.martocchia@lam.fr)¹, A. Boselli^{1,2}, C. Maraston³, D. Thomas³, M. Boquien⁴, Y. Roehlly¹, M. Fossati^{5,6}, L.-M. Seillé¹, P. Amram¹, S. Boissier¹, V. Buat¹, P. Côté⁷, J.-C. Cuillandre⁸, L. Ferrarese⁷, S. Gwyn⁷, J. Hutchings⁷, Junais^{9,10}, C. R. Morgan^{11,12}, J. Postma¹³, T. E. Woods¹⁴, J. Roediger⁷, A. Subramaniam¹⁵, M. Sun¹⁶, H.-X. Zhang¹⁷, M. Mondelin⁸, M. Bolzonella

1 Aix Marseille Université, CNRS, CNES, LAM, Marseille, France, 2. INAF - Osservatorio Astronomico di Cagliari, via della Scienza 5, 09047 Selargius, Italy, 3. Institute of Cosmology, University of Portsmouth, Burnaby Road, Portsmouth, PO1 3FX, UK, 4. Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange, 06000, Nice France, 5. Università di Milano-Bicocca, Piazza della scienza 3, 20100 Milano, Italy, 6. INAF - Osservatorio Astronomico di Brera, Via Brera 28, 20159 Milano, Italy, 7. National Research Council of Canada, Herzberg Astronomy and Astrophysics Research Centre, Victoria, BC V9E 2E7, Canada, 8. AIM, CEA, CNRS, Université Paris-Saclay, Université de Paris, 91191 Gif-sur-Yvette, France, 9. Instituto de Astrofísica de Canarias, Via Lactea S/N, E-38205 La Laguna, Spain, 10. Departamento de Astrofísica, Universidad de La Laguna, E-38206 La Laguna, Spain, 11. Waterloo Centre for Astrophysics, University of Waterloo, Waterloo, ON N2L 3G1, Canada, 12. Department of Physics and Astronomy, University of Waterloo, Waterloo, ON N2L 3G1, Canada, 13. Dept. of Physics and Astronomy, University of Calgary, Calgary, AB T2N 1N4, Canada, 14. Department of Physics and Astronomy, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada, 15. Indian Institute of Astrophysics, Bangalore, India, 16. Department of Physics & Astronomy, University of Alabama in Huntsville, 3001 Sparkman Drive, Huntsville, AL 35899, USA, 17. Department of Astronomy, University of Science and Technology of China, Hefei, Anhui 230026, People's Republic of China, 18. INAF-Osservatorio di Astrofisica e Scienza dello Spazio di Bologna, Via Piero Gobetti 93/3, 40129 Bologna, Italy

Abstract

Understanding the formation of massive early-type galaxies (ETGs) poses a significant challenge in galaxy mass assembly and is closely tied to the evolution of the Universe as outlined by the Λ Cold Dark Matter model. Within this context, we are reconstructing the star formation histories of the most massive ETGs in local galaxy clusters. We analysed their spatially resolved stellar population (SP) properties including their ultraviolet (UV) and H α emission. We used deep, narrow-band CFHT H α images to select ETGs that show no signs of ongoing star formation. We report here results for seven Virgo galaxies (as part of the Virgo Environmental Survey on Ionized Gas Emission, VESTIGE) and preliminary results for other seven galaxies in the Perseus clusters, all more massive than $10^{10} M_{\odot}$.

We combined CFHT/MegaCam images with Astrosat/UVIT, GALEX, and spectacular Euclid images of the Perseus cluster, to analyse the radial spectral energy distributions (SEDs) of ETGs from the far-UV (FUV) to the near-infrared. The UV emission in these galaxies is likely due to old, low-mass stars in post main sequence (MS) phases, the so-called phenomenon of the UV upturn. We fitted the radial SEDs through the code CIGALE, by implementing novel SP models that include an old, hot stellar component of post-MS stars with various temperatures and energetics. This way, we explored the main stellar parameters responsible for UV upturn stars regardless of their evolutionary path. Standard models are not able to reproduce the galaxies' central FUV emission (SMA/Reff<1), while the new models well characterise it through post-MS stars with temperatures $T \sim 25000$ K.

Our results show that these ETGs formed with star formation timescales < 1500 Myr, having assembled between ~ 40 - 90% of their stellar mass at $z \sim 5$. This aligns with new JWST observations of quiescent galaxies at high redshift, and therefore corroborates a consistent picture where massive quiescent galaxies formed and quenched with extreme starbursts and rapid mass assembly.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

Student Participation:

The ultra-violet star-forming galaxy luminosity function at redshifts $0.4 < z < 0.6$

Alice Eleanor Matthews¹ (alice.matthews.21@ucl.ac.uk), M. J. Page¹ (m.page@ucl.ac.uk), A. Breeveld¹ (a.breeveld@ucl.ac.uk), M. Sharma² (monu.sharma@uv.es)

¹Mullard Space Science Laboratory, University College London, Holmbury St Mary, Dorking, Surrey, RH5 6NT, UK

²University of Valencia, Av. de Blasco Ibáñez, 13, El Pla del Real, 46010 València, Valencia, Spain

Abstract

We present new measurements of the rest-frame far-ultraviolet (1500Å) luminosity function at redshift $0.4 < z < 0.6$ using combined deep imaging from the XMM-Newton Optical Monitor and Swift UVOT observations in the Chandra Deep Field South. Our total survey area from this combination was 585.7 arcmin^2 comprising of 417 galaxies. We use robust redshift measurements, of which 75% have spectroscopic redshifts. Through careful treatment of systematic effects including cosmic variance, dust extinction, and active galactic nucleus contamination, we derive Schechter function parameters $M^* = -18.67^{+0.09}_{-0.12}$, $\alpha = -1.25^{+0.04}_{-0.07}$ and $1 \varphi^* = 4.41^{+0.16}_{-0.21} \times 10^{-3} \text{ Mpc}^{-3}$. Our characteristic magnitude is notably fainter than previous studies at similar redshifts, potentially reflecting our deeper imaging and systematic removal of 75 X-ray selected AGN. The faint-end slope is consistent with local universe measurements, sitting within 1.4σ of the intermediate redshift consensus value of $\alpha = -1.55$. Our high spectroscopic completeness and comprehensive treatment of selection effects provide robust constraints on the UV luminosity function at intermediate redshifts, bridging the gap between local universe measurements and higher redshift regimes. The systematic differences between our results and previous studies highlight the importance of combining multiple UV facilities with high spectroscopic completeness, careful AGN removal, and comprehensive treatment of selection effects when measuring the UV luminosity function at intermediate redshifts.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Probing the Circumgalactic Medium of Local Group Satellite Galaxies: The Need for Future UV Spectrographs

Sapna Mishra¹ (smishra@stsci.edu), Andrew Fox (afox@stsci.edu)²

¹Space Telescope Science Institute

Satellite galaxies are not mere celestial companions—they play an active role in the ecosystem of galaxy evolution. Their interactions with massive hosts like the Milky Way (MW), through processes such as ram-pressure and tidal stripping, can significantly affect star formation and growth of both the satellites and their hosts. The circumgalactic medium (CGM) of the satellites, despite its pivotal role as both a gas reservoir and a shielding interface, remains poorly explored in the satellite systems. The Large Magellanic Cloud (LMC) is the only satellite with a well-characterized CGM to date. We recently mapped the LMC's CGM, using 28 AGN sightlines observed with HST/COS within 35 kpc. Our UV absorption-line ((O I, Fe II, Si II, Al II, S II, Ni II, and Si III)) measurements reveal a two-component structure: a compact inner halo extending to 17 kpc, and a more extended, stripped region aligned with the Magellanic Stream. These results are consistent with simulations predicting ram-pressure stripping by the MW's hot corona and provide a rare observational glimpse into the complex dynamics of a satellite CGM. However, key questions remain: How typical is the MW–LMC system in the broader context of galaxy interactions? Can all the LMC-like satellites retain their cold gas despite intense environmental effects? Answering these questions calls for direct observations of diffuse satellite CGMs such as M33—possible only with UV spectroscopy. In addition, with upcoming satellite galaxy surveys (e.g., ELVES, SAGA) identifying analogs to the MW-LMC system, UV capabilities will be crucial to expanding this research beyond the Local Group. This presentation will highlight the critical role of UV observations in the evolution of the satellite CGMs and discuss how our LMC results offer new insights into feedback, environment, and galaxy evolution in low-mass galaxies.

Presentation Preference:

- Oral Presentation: **Yes**
- Poster Presentation
- No preference

Student Participation: **No**

Development of CubeSat based UV Astronomy Payloads at Indian Institute of Astrophysics: Launch Opportunities and Challenges

Rekshesh Mohan¹ (reks@iiap.res.in)

¹Indian Institute of Astrophysics

Abstract

The space industry is experiencing a paradigm shift globally and within India. There is a widespread interest in CubeSats and nanosatellites, leading to a distinct design philosophy for payloads on these platforms. Quite often, the small payloads for astronomy are designed to address specific science cases that are not possible with larger, more sensitive missions. The development of these payloads demands innovation to address the technological challenges. The Small/Space Payloads group at Indian Institute of Astrophysics (IIA) has been building UV astronomy instruments suited for short-term (1-2 years) missions on CubeSat platforms. In this talk, I will summarize a few science cases and the UV astronomy payloads being developed to address them. The design of innovative subsystems for these missions will be discussed and launch opportunities for science payloads in India will also be covered.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation: [no]

Mapping the 2175 Å Feature with UVES: Probing Interstellar Dust from Space

Rekshesh Mohan¹ (reks@iiap.res.in), Joice Mathew², Andrew Battisti^{3,4}, Israel Vaughn², Ferry Yap^{4,5}, Pratham Gupta^{4,6}, Sven Buder⁴, Praveen Kumar^{1,7}, Shubhangi Jain¹, Jayant Murthy¹, Kevin France⁸

¹Indian Institute of Astrophysics, Koramangala 2nd Block, Bengaluru, India 560034, ² Advanced Instrumentation and Technology Centre, Research School of Astronomy and Astrophysics, Australian National University, Canberra, ACT 2611, Australia, ³International Centre for Radio Astronomy Research (ICRAR), University of Western Australia, M468, 35 Stirling Highway, Crawley, WA 6009, Australia, ⁴Research School of Astronomy and Astrophysics, Australian National University, Cotter Road, Weston Creek, ACT 2611, Australia, ⁵Bandung Institute of Technology, Jawa Barat, Indonesia, ⁶Indian Institute of Space Science and Technology, Thiruvananthapuram, India, ⁷Indian Institute of Science, Bengaluru, India, ⁸University of Colorado, Laboratory for Atmospheric and Space Physics, Boulder, Colorado, United States

Abstract

Dust extinction, particularly in the ultraviolet (UV), poses a major challenge for accurately characterising stars and galaxies. The 2175 Å bump, the most prominent feature in the UV extinction curve, varies significantly across sightlines and offers important clues about the composition and processing of interstellar dust grains. However, its origin remains uncertain due to the small number of UV extinction measurements available to date. To address this, the Australian National University, in collaboration with the Indian Institute of Astrophysics, is developing UVES (Ultraviolet Extinction Sky Survey), a small satellite mission equipped with a compact UV spectrograph and MCP-based detector. Covering the 1500 - 3000 Å range with $R \sim 200$ resolution, UVES will map thousands of sightlines - expanding current coverage by up to 10 times- to better characterise dust properties in the Milky Way and nearby galaxies. The mission will also integrate with infrared datasets (e.g., Spitzer GLIMPSE, SPHEREx) to explore possible links between the 2175 Å bump and PAH grains, contributing to a more complete understanding of interstellar dust.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Prospectives of study of extragalactic sources with future QUVIK mission

Filip Münz¹ (munz@physics.muni.cz), Norbert Werner¹, Jakub Řípa¹, Michal Zajaček¹

¹Dept. of Theor. Physics and Astrophysics, Faculty of Science, Masaryk University, Brno, Czech Republic

Abstract

Besides its primary aim on NS-NS mergers, the Quick Ultra-Violet Kilonova surveyor (QUVIK), future Czech smallsat mission, will provide data for study of many stellar systems as well as extragalactic objects, esp. those related to active galactic nuclei (AGN) or tidal distruption events happening in their vicinity. Observations in NUV and FUV bands, possibly complemented with ULTRASAT data in intermediate range, would shed light on different time lag predictions (and eventually filter other origins of transient events like SNe). For smaller supermassive black holes (SMBH) in galactic nuclei and for detailed reverberation mapping several hour cadence of sampling would be required. Observations of other phenomena like Quasi-periodic eruptions (QPE) in UV could significantly enhance the understanding based on X-ray data.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Life-environmentology, Astronomy, and Planetary Ultraviolet Telescope Assembly (LAPYUTA) mission: instrument overview and development updates

Go Murakami¹ (murakami.go@jaxa.jp), Fuminori Tsuchiya², Atsushi Yamazaki¹, Masato Kagitani², Umi Enokidani¹, Shingo Kameda³, Kazuo Yoshioka⁴, Masaki Kuwabara³, and Tomoki Kimura⁵

¹Japan Aerospace Exploration Agency, ²Tohoku University, ³Rikkyo University, ⁴The University of Tokyo, ⁵Tokyo University of Science

Abstract

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 grating, 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 key technologies such as funnel-type MCPs and CMOS-coupled readout system and highly reflective UV coating (Al + MgF₂ or Al + XeLiF) will be applied to satisfy requirements of LAPYUTA. These key technologies can be applied to the future international flagship missions such as Habitable Worlds Observatory. Here we present the LAPYUTA concept design, the overview of the spacecraft and instruments, and the status of key technology developments.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

UV spectropolarimeter developments and application to space mission projects

C. Neiner¹ (coralie.neiner@obspm.fr), A. Girardot¹, E. Muslimov², J.-M. Reess¹ et al.

¹LIRA, Paris Observatory, France, ²Oxford University, UK

Abstract

Several space missions are proposed or planned for the coming two decades dedicated or including mid- to high-resolution spectropolarimetry on a wide UV band. This includes the European instrument Pollux for the NASA HWO flagship mission, the ESA M8 candidate Arago, the NASA SMEX candidate Polstar, and the French nanosatellite demonstrator CASSTOR. We are developing UV polarimeters for these missions thanks to a R&D program funded by CNES. For the mid- and near-UV, i.e. above 120 nm, birefringent material (MgF₂) can be used to produce polarimeters. This is the baseline for Arago, Polstar, CASSTOR, and the MUV and NUV channels of Pollux. Prototypes have been built and tested with excellent results, and further tests are ongoing to fully characterize them. For the FUV channel of Pollux however, it is not possible to use this technology and we have instead studied a design based on mirrors only. I will present the various missions and instruments, their technical challenges, as well as the R&D work performed on UV polarimeters and the proposed design solutions.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation: **X**

UMIS: Advancing Planetary UV Spectroscopy Through a Micromirror-Based Image-Slicing Architecture

Alan Ochoa¹ (alan.ochoa@lasp.colorado.edu), Brian Fleming¹, Dmitry Vorobiev¹, Briana Indahl¹, Amanda Hendrix², Rebecca Schindhelm³

¹Laboratories for Atmospheric and Space Physics, ²Planetary Science Institute, ³BAE Systems

Abstract

The Ultraviolet Micromirror Imaging Spectrograph (UMIS) represents a next-generation advancement in ultraviolet spectroscopy for planetary science, building on the proven heritage of instruments such as JUNO-UVS, Alice, and Cassini UVIS. These instruments have been central to many of the field's most significant discoveries, demonstrating the power of long-slit spectroscopy for space-based exploration. UMIS preserves key aspects of this legacy while introducing an innovative design that expands observational capabilities, particularly for investigating spatially extended, time-variable phenomena like planetary plumes and transient atmospheres. The heart of UMIS is a novel image-slicing architecture that incorporates a 400 element, independently addressable micromirror array (AMA), providing full flexibility in sampling a 3×3 -degree field of view (FOV). This two-dimensional tip/tilt mirror array directs incoming light into five identical holographic gratings, enabling the simultaneous acquisition of hundreds of spatially resolved spectra. The system's adaptable configuration supports multiple observation modes and delivers high-resolution spectroscopy in the far-ultraviolet across any region within the instrument's FOV. The current brassboard prototype, under development at the Laboratory for Atmospheric and Space Physics (LASP), will play a key role in advancing the technology readiness level (TRL) of this digital micromirror-based image-slicing architecture. UMIS is being developed through NASA's MatISSE program in collaboration with BAE Systems Inc. and under the leadership of the Planetary Science Institute. We will detail the finalized optomechanical design, provide updates on fabrication, integration, and testing (I&T), and highlight the instrument's unique capabilities. By combining broad spatial coverage with high spectral resolution, UMIS is poised to deliver transformative insights into the structure and evolution of planetary atmospheres and exospheres.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

Star formation exists in all early-type galaxies -- evidence from ubiquitous structure in UV images

Divya Pandey ^{1,2} (divyapandey1212@gmail.com), Sugata Kaviraj³, Kanak Saha⁴

¹Tartu Observatory, University of Tartu, Observatooriumi 1, 61602 Tõravere, Estonia, ²Aryabhata Research Institute of Observational Sciences, Manora Peak, Nainital 263 002, India, ³Centre for Astrophysics Research, University of Hertfordshire, College Lane, Hatfield AL10 9AB, UK, ⁴Inter-University Centre for Astronomy & Astrophysics, Postbag 4, Ganeshkhind, Pune 411 007, India

Abstract

Recent surveys have demonstrated the widespread presence of UV emission in early-type galaxies (ETGs), suggesting the existence of star formation in many of these systems. However, potential UV contributions from old and young stars, together with model uncertainties, makes it challenging to confirm the presence of young stars using integrated photometry alone. This is particularly true in ETGs that are fainter in the UV and have red UV-optical colours. An unambiguous way of disentangling the source of the UV is to look for structure in UV images. Optical images of ETGs, which are dominated by old stars, are smooth and devoid of structure. If the UV is also produced by these old stars, then the UV images will share this smoothness, while, if driven by young stars, they will exhibit significant structure. We compare the UV and optical morphologies of 32 ETGs (93 per cent of which are at $z < 0.03$) using quantitative parameters (concentration, asymmetry, clumpiness and the Sérsic index), calculated via deep UV and optical images with similar resolution. Regardless of stellar mass, UV-optical colour or the presence of interactions, the asymmetry and clumpiness of ETGs is significantly larger (often by several orders of magnitudes) in the UV than in the optical, while the UV Sérsic indices are typically lower than their optical counterparts. The ubiquitous presence of structure demonstrates that the UV flux across our entire ETG sample is dominated by young stars and indicates that star formation exists in all ETGs in the nearby Universe.

Presentation Preference:

Oral Presentation — Yes

Poster Presentation

No preference

Student Participation: — Yes (Postdoc)

UV study of blue stragglers stars in Galactic fields

Anju Panthi^{1,2} (p20190413@pilani.bits-pilani.ac.in, anju.panthi@iiap.res.in), Annapurni Subramaniam², Kaushar Vaidya¹, Vikrant Jadhav³, Sharmila Rani^{2,4}, Sivarani Thirupathi², and Sindhu Pandey⁴,

¹Department of Physics, Birla Institute of Technology and Science, Pilani, Rajasthan-333031, India, ²Indian Institute of Astrophysics, Sarjapur Road, Koramangala, Bangalore 560034, India, ³Helmholtz-Institut für Strahlen-und Kernphysik, Universität Bonn, Nussallee 14-16, D-53115 Bonn, Germany, ⁴Aryabhata Research Institute of Observational Sciences, Manora Peak, Nainital 236002, India

Abstract

Blue straggler stars are conventionally defined as stars that are brighter and bluer with respect to the main sequence turn-off. They are termed stragglers because they linger on the main sequence despite being massive and, hence, are lagging in their evolution. These stars are much brighter in the UV wavelengths as they are comparatively hot objects (7000K – 10000K). One of the main advantages of the UV-based studies of blue straggler stars is the fact that these wavelengths allow the search for their unresolved hot companions based on excess UV emission in their multi-wavelength spectral energy distributions. Such an analysis allows us to determine the fundamental properties, such as temperatures, radii, and luminosities, of blue straggler stars, and the unresolved hot companions, if any. Based on these properties, we can understand the nature of the hot companions and hence constrain the formation channels of blue straggler stars. We report the first-ever UV-based study of 27 blue metal-poor stars (the field blue straggler candidates), to confirm if they are genuine field blue straggler stars or accreted from dwarf satellite galaxies. Among these blue metal-poor stars, 12 out of 27 display UV excess and we fit them with double component spectral energy distributions.

We discover 6 extremely-low mass white dwarfs, 3 low-mass white dwarfs, 2 normal-mass white dwarfs, and 1 high-mass white dwarf as the hot companions of these 12 stars. We suggest that at least 12 out of 27 (~ 44%) blue metal-poor stars are indeed field blue straggler stars, formed via binary mass transfer or mass transfer/merger of inner binaries in the hierarchical triple systems.

Presentation Preference

Oral Presentation

A balloon borne UV slicer IFS for cosmic web emission detection

Vincent Picouet¹ (vpicouet@caltech.edu), on behalf of the SCWI collaboration^{1 2}

¹The California Institute of Technology: C. Martin, D. Miles , M. Matuszewski

² NASA Jet Propulsion Laboratory: L. Jones-Wilson, S. Nikzad, J. Pineda, P. Eryos, A. Johnson, G. Kyne, C. Lefler, I. McKinley, J. Perez, A. Sailliard

Abstract

The Stable Cosmic Web Imager (SCWI) is a balloon-borne, UV integral-field spectrograph currently under development by Caltech and JPL, targeting a first long-duration flight in ~2029. Designed to detect low-surface brightness emission from the circumgalactic and intergalactic medium (CGM/IGM) at redshifts $z < 1$, SCWI addresses the discovery area identified in Astro2020 for galaxy evolution: unveiling the gas flows that regulate galaxy formation and trace cosmic structure in the nearby universe.

SCWI combines a heritage image-slicer spectrograph with a sub-arcsecond stabilized telescope and a photon-counting UV detector operating at 200 nm. With a 2×2 arcmin field of view, $R \sim 2000$ spectral resolution, and a $\sim 4''$ FWHM spatial resolution, it will map Ly α , CIII, CIV, and OVI emission lines while operating in the 200 nm UV atmospheric window.

Balloon-borne projects impose strong constraints on mass, stability, autonomy, and funding, and therefore require a strong system-level thinking to mitigate risks and achieve scientific objectives within these limitations. This can be particularly challenging when combined with long-duration flights and the specific demands of photon-starved UV instrumentation.

This contribution will present the SCWI instrument concept, and UV specific challenges (integration and testing, vacuum and cryocooling, contamination control, baffling, and coatings) and key trades (performance/risks/cost/complexity). It will also present a generic instrument model and observation simulator I developed to help define system requirements, study the instrument trade-offs, and inform implementation and testing strategies.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Lithium-rich Stars: UV Clues to Hidden Binaries


Sharmila Rani¹ (sharmila.rani@inaf.it), Elena Pancino¹

¹ INAF — Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50125 Firenze, Italy

Abstract

Lithium-rich (Li-rich) stars are a rare class of evolved stars that exhibit an abnormally high abundance of lithium (Li) in their atmospheres. They are observed at all evolutionary phases, and their origin is still unclear. Among the various explanations proposed in the literature, there are two different ideas involving a binary origin for lithium enhancement, either mass transfer from an AGB star or a companion spinning up the visible star, thereby enhancing the lithium content on its surface. In this work, we attempt to shed light on the role of binarity in the enrichment of Li in Li-rich stars and compare their properties across different environments, including open clusters (OCs), globular clusters (GCs) and the field. We assembled a sample of stars with well-measured Li abundances in OCs, GCs, and the field. The main objective is to characterize these stars to search for possible hidden companions and thus test the binary interactions scenario for the formation of Li-rich stars. To accomplish this, we employed the archival UV photometric data from various facilities such as *GALEX*, *Swift*-UVOT, *AstroSat*/UVIT, and *IUE*, combined with optical and infrared data to perform SED modelling and search for the presence of hot companions, if any. Our study reveals that 25 out of 157 Li-rich stars show significant UV excess, indicating the presence of hot companions. However, none of the known Li-rich stars in GCs exhibit a significant UV excess. It can be due to the lack of UV data for some stars, or they might be chromospherically active. To better understand these exotic stars, we have further proposed MAUVE observations in the NUV regime as most currently lack UV data. These findings highlight the key role of binary interactions in the emergence of Li-rich stars across diverse stellar environments.

Presentation Preference:

- Oral Presentation 
- Poster Presentation
- No preference

Student Participation:

Ultraviolet satellites and CubeSats can be used to know more about the Earth

Virginia Raposo-Pulido¹ (viraposo@ucm.es), Ana Inés Gómez de Castro²

^{1,2}Space Astronomy Research Group - AEGORA, Facultad de Ciencias Matematicas,
Universidad Complutense de Madrid, Plaza de Ciencias, 3, 28040, Madrid, Spain

Abstract

Magnetometers are fundamental space instruments of the attitude control systems, enabling precise orientation and stabilization of satellites, specially for low Earth orbiting satellites. However, magnetometers can also be used to study the Earth's magnetic field, providing valuable data for space weather research. This preliminary study uses magnetometer data from CubeSats in the Satellite Networked Open Ground Station (SatNOGS) network to assess the availability and accuracy of the measurements required to properly characterize the Earth's magnetic field. The aim of this approach is to explore the potential of a distributed network of CubeSats, equipped with high-precision magnetometers, for real-time monitoring of geomagnetic field.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Habitable Worlds Observatory Project Status & Maturation Plans

Roberge A¹ (Aki.Roberge@nasa.gov)

¹NASA Goddard Space Flight Center

Abstract

Humans have long wondered if there were worlds around other stars – and life on those worlds. Over the last two decades, astronomers have found that the answer to the first question is a resounding YES. Those accomplishments have put us in a position to possibly answer the second question. The 2020 US Astrophysics Decadal Survey (Astro2020) laid out a path to the first telescope that can find out if habitable exoplanets are common or rare and search them for signs of global biospheres. At the same time, this UV / optical / near-IR space observatory would perform a wide range of transformative astrophysics studies from dark matter to galaxy evolution to star formation and be capable of a wide range of powerful Solar System remote sensing observations.

NASA has dubbed that space telescope the Habitable Worlds Observatory (HWO) and initiated the HWO Technology Maturation Project Office (TMPO) on Aug 1, 2025. This presentation will provide an overview of the current project status; our strategies to mature the mission concept; progress to date in developing science cases, engineering trade studies, and a technology development roadmap; and plans for upcoming activities & milestones. Success in this monumental and multi-faceted journey will require enthusiastic collaboration between a wide range of disciplines, interests, and stakeholders.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Contrasting neutron star heating mechanisms with Hubble Space Telescope ultraviolet observations

Luis Rodríguez¹ (Isrodrig@uc.cl), Andreas Reisenegger², Denis González-Caniulef³, Cristobal Petrovich⁴

¹Pontificia Universidad Católica de Chile, ²Universidad Metropolitana de Ciencias de la Educación,

³Institut de Recherche en Astrophysique et Planétologie, ⁴Indiana University

Abstract

Passively cooling neutron stars are expected to reach undetectably low surface temperatures $T \lesssim 10^4$ K within $< 10^7$ yr. However, likely thermal ultraviolet emission was detected from the Gyr-old millisecond pulsars PSR J0437–4715 and PSR J2124–3358 and the $\sim 10^7$ yr-old classical pulsars PSR B0950+08 and PSR J0108–1431, implying temperatures $T_s \sim 10^5$ K. This discrepancy could be explained by various heating mechanisms proposed in the literature. Therefore, we computed thermal evolution curves considering different heating mechanisms, contrasting them with the observations.

We found that the set of observations can be explained by rotochemical heating with cooper-paired nucleons, involving a strong proton energy gap of $\Delta_p = 1.5$ MeV, a weak neutron energy gap of $\Delta_n \approx 0.1$ MeV, and varying internal magnetic fields. The temperatures of millisecond pulsars are only compatible with weak internal magnetic fields. In contrast, those of classical pulsars can be explained either with strong or weak fields.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

MUSTI: A Massive Stars Far-Ultraviolet Spectroscopic Mission

Royer P.¹ (pierre.royer@kuleuven.be), Sana H.¹ (hugues.sana@kuleuven.be) and the MUSTI consortium

¹Institute of Astronomy, KU Leuven, Celestijnenlaan 200D, 3001 Leuven, Belgium

Abstract

We present MUSTI, a miniFast mission concept enabling highly cost-effective far-ultraviolet (FUV) high-resolution spectroscopy dedicated to time-domain stellar physics. MUSTI combines a 40-cm telescope, a tailor-made high-resolution echelle spectrograph and a secondary high-precision pointing system with a compact commercially available platform. MUSTI aims to obtain breakthrough observational constraints on massive stars' interior physics, stellar winds and binary products. These novel constraints will enable the precise calibration of the evolution of massive single and binary stars towards their final fate, with far reaching implications for cosmic models, the interpretation of the first stars and the first galaxies observed by the James Webb Space Telescope and inference-based analyses of Gravitational Waves detections.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Radial shift of the Io plasma torus seen with lead angle of the satellite auroral footprints at Jupiter

Shinnosuke Satoh^{1,2} (shinnosuke.satoh@pparc.gp.tohoku.ac.jp), Vincent Hue², Fuminori Tsuchiya¹, Shotaro Sakai³, Yasumasa Kasaba¹, Masato Kagitani¹, Hajime Kita⁴, Rikuto Yasuda^{1,5}

¹ Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University

² Aix-Marseille Université, CNRS, CNES, Institut Origines, LAM,

³ Faculty of Environment and Information Studies, Keio University,

⁴ Tohoku Institute of Technology,

⁵ LIRA, Observatoire de Paris, Université PSL

Abstract

The Galilean moons act as an obstacle to the corotating plasma in the Jovian magnetosphere. Through the electrodynamic interaction at the moons, Alfvén waves are launched and propagate along the magnetic field. Auroral electrons are accelerated toward/away from Jupiter's atmosphere by the Alfvén waves and ultimately induce multiple satellite auroral footprints and a diffuse auroral tail in Jupiter's atmosphere.

The Alfvén velocity depends on the local magnetic field magnitude and the local plasma mass density. The position of satellite auroral footprints is determined by the Alfvén wave propagation time. The angular separation between the satellite body and the auroral footprint is called the lead angle. The footprint lead angle has been used to investigate variations of plasma density and temperature in the Io plasma torus (Moirano et al., 2023) and the plasma disk at Europa's orbit (Satoh et al., 2024).

In this talk, we present our extended study of Io's footprint lead angle observed by Juno-UVS to investigate the morphology of the Io plasma torus (IPT). The IPT is shifted toward the dawn side due to the dawn-to-dusk electric field, but the exact pointing of this shift has not yet fully understood. We provide a new perspective of this dawn-dusk asymmetry of the IPT from the observations of Io's footprint lead angle.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation: X

Towards the HWO Astrophysics Instrument Complement – Science Drivers and Capabilities

Paul A. Scowen¹ (paul.a.scowen@nasa.gov), Breann Sitarski¹ (breann.n.sitarski@nasa.gov),
Jessie Dotson² (jessie.dotson@nasa.gov)

¹NASA Goddard Space Flight Center, ²NASA Ames Research Center

Abstract

The Habitable Worlds Observatory (HWO) was listed as the top science priority in the US National Academies of Science Decadal Survey of 2020, and is currently identified as NASA's next Flagship mission, after the Roman Space Telescope. The mission is ambitious - providing coronagraphy with contrast at the part in 10^{10} level to allow direct observations of reflected starlight of exoplanets around nearby stars, to perform a search for Earth-like analogs and to look for biosignatures in the resulting spectra. In addition to this capability, building on the point design work of the LUVOIR and HabEx studies that went into the Decadal Survey, the Observatory carries a complement of transformational astrophysics instrumentation that will leverage the large aperture and spectral coverage into the far ultraviolet.

Over the past 2 years many members of the international science community have crafted science case development documents (SCDDs) to capture the groundbreaking science that HWO will be able to enable. The breadth of science addressed has been guided by the priorities of the 2020 Decadal Survey and seeks to leverage the extended reach and angular resolution of the new Observatory. In this talk I will review some of those drivers as well as the instrumental capabilities they seek to require with a pinch of reality throw in. We ultimately seek to balance the conception of visionary science against the practical implementation of a new Observatory that needs to deliver unprecedented stability and performance in the UVOIR.

There is ample opportunity for international participation in the HWO mission especially from a contributed instrumentation perspective, and already we have received inquiries from a number of space agencies and national science councils. We look forward to engaging with our colleagues to discuss possible instrument capabilities and what each country and agency might be interested in pursuing.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Detector developments for UV space missions

Jesper Skottfelt¹ (jesper.skottfelt@open.ac.uk), Chiaki Crews¹, Ben Dwyer¹, Angaraj Duara¹, David J. Hall¹, Martin J. Prest¹, Joan Requena¹, Konstantin D. Stefanov¹

¹Centre for Electronic Imaging, School of Physical Sciences, Open University, Walton Hall, Milton Keynes, United Kingdom

Abstract

The success of many future space telescope missions depends on high-performance sensors capable of detecting in the UV band. The Centre for Electronic Imaging (CEI) at The Open University, UK, is actively engaged in the development and testing of advanced UV detector technologies to meet the demanding requirements of upcoming missions, such as the Canadian-led CASTOR mission and NASA's Habitable Worlds Observatory. This includes testing and de-risking UV enhancement techniques, characterising and optimising next-generation CMOS image sensors, and developing new photon-counting technologies.

Because UV photons are predominantly absorbed within the first few nanometres of silicon, achieving high quantum efficiency (QE) in the UV band requires specialised surface treatment technologies to improve the collection of photoelectrons generated. CEI has conducted a comprehensive assessment of UV enhancement approaches, such as the delta-doping technique developed by NASA/JPL, benchmarking performance across electro-optical parameters and manufacturability. This includes QE measurements spanning the visible band and extending to wavelengths below 100 nm.

Through our close collaboration with Teledyne e2v, CEI is testing and optimising the latest CIS300 series CMOS image sensors using a dedicated electro-optical and space qualification test platform. The results from this will be presented to demonstrate the detectors' potential for use in future UV-capable space instruments.

The development of a new CMOS test chip, fabricated in spring 2025, is also highlighted. The device incorporates several innovative pixel designs, including a photon-counting variant, offering a pathway to enhanced sensitivity and dynamic range in future detector generations.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Characterization and optimization of Skipper CCDs for UV astronomy

Kélian Sommer¹ (sommerk@arizona.edu), Brock A. Parker¹, Stephen Kaye¹, and Erika Hamden¹

¹University of Arizona, Steward Observatory, 933 N. Cherry Ave., Tucson, AZ 85721, USA,

Abstract

Observations of faint astronomical objects in the low-signal, low-background photon-counting regime with conventional CCDs are fundamentally limited by the detector intrinsic readout noise. This limitation poses a significant challenge for next-generation experiments—including direct imaging and spectroscopy of terrestrial exoplanets in the habitable zones of nearby stars [1], multi-object spectroscopy of faint stars and galaxies [2], medium-to-high resolution spectroscopy at blue wavelengths where sky-background levels are low, and high-cadence searches for short-duration transients [3,4]. Reducing readout noise to 0.1–0.5 e⁻ rms/pixel across the UV to near-infrared wavelengths is critical to enable significant improvements in sensitivity and measurement precision for these applications [5,6].

Skipper CCDs offer a promising solution by combining the well-established advantages of conventional astronomical CCDs - stability, linearity, dynamic range, quantum efficiency, and radiation response - with the unique capability of performing multiple non-destructive pixel reads [7]. This technique enables sub-electron readout noise over configurable subregions of the detector [8]. While Skipper CCDs have originally been employed in particle physics experiments (e.g., the DAMIC direct dark matter search [9]), recent advancements demonstrate their successful deployment in astronomical instrumentation (e.g., use as a focal plane prototype for the Southern Astrophysical Research Integral Field Spectrograph [10]).

In this presentation, I will provide an overview of the design and implementation of our dedicated Skipper CCD characterization test bench, and share preliminary results from our visible/near-infrared wavelength experiments. I will also discuss plans to extend these studies to delta-doped [11], UV-optimized Skipper CCDs, opening new frontiers for UV astronomy.

[1] National Research Council, [New Worlds, New Horizons in Astronomy and Astrophysics], National Academies Press (2010).

[2] DESI Collaboration, Aghamousa, A., Aguilar, J., Ahlen, S., et al., "The DESI Experiment Part I: Science, Targeting, and Survey Design," arXiv e-prints, arXiv:1611.00036 (2016).

[3] Richmond, M. W. et al., "An optical search for transients lasting a few seconds," PASJ 72, 3 (Feb. 2020)

[4] Tingay, S., "High-cadence optical transient searches using drift scan imaging I: Proof of concept with a pre-prototype system," PASA 37, e015 (Apr. 2020).

[5] Crill, B. P. and Siegler, N., "Space technology for directly imaging and characterizing exo-Earths," in [Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series], Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series 10398, 103980H (2017).

[6] Crill, B. and Siegler, N., "Exoplanet Exploration Program Technology Plan Appendix," (2019)

[7] Drlica-Wagner, A., "Characterization of skipper CCDs for cosmological applications", in X-Ray, Optical, and Infrared Detectors for Astronomy IX, 2020, vol. 11454, Art. no. 114541A. doi:10.1117/12.2562403.

[8] Tiffenberg, J., Sofo-Haro, M., Drlica-Wagner, A., Essig, R., Guardincerri, Y., Holland, S., Volansky, T., and Yu, T.-T., "Single-electron and single-photon sensitivity with a silicon Skipper CCD," Phys. Rev. Lett. 119(13), 131802 (2017).

[9] A. Aguilar-Arevalo et al., "Search for low-mass WIMPs in a 0.6 kg day exposure of the DAMIC experiment at SNOLAB," Phys. Rev., vol. D94, no. 8, p. 082006, 2016.

[10] E. M. Villalpando, A. Drlica-Wagner, A. A. P. Malagón, A. Bakshi, M. Bonati, J. Campa, B. Cancino, C. R. Chavez, J. Estrada, G. Fernandez Moroni, "Characterization and Optimization of Skipper CCDs for the SOAR Integral Field Spectrograph", PASP, Volume 136, Number 4, DOI 10.1088/1538-3873/ad2865

[11] Nikzad, Shouleh, et al. "Delta-doped CCDs: high QE with long-term stability at UV and visible wavelengths." Instrumentation in Astronomy VIII. Vol. 2198. SPIE, 1994.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

Student Participation:

Wide-band Atmospheric Laboratory for Transiting Exoplanet Research

A. G. Sreejith¹ (sreejith.aickara@oeaw.ac.at), L. Fossati¹, L. Carone¹, P. Cubillos¹, Ch Helling^{1,17}, G. Giono¹, R. Wallner¹, I. Argyriou², T. Belenguer³, S. Boro Saikia⁴, E. Bolmont⁵, F. Borsa⁶, V. Bourrier⁵, A. Brandeker⁷, C. Broeg^{8,15}, J. M. Carrasco⁹, L. Carone¹, P. Cubillos¹, L. Decin², A. Deline⁵, O. Demangeon¹⁰, B.-O. Demory^{8,15}, D. Ehrenreich⁵, B. Edwards¹¹, I. Esteva⁹, C. F. Jentink⁵, B. Fleming¹³, K. France¹³, L. M. González Fernández³, M. Güdel⁴, M. Ivchenko¹², F. Kerschbaum⁴, K. Kislyakova⁴, C. Kitzinger¹⁴, D. Kubyskhina¹, M. Lendl⁵, C. Mordasini⁸, J. C. Morales⁹, M. Munari¹⁶, R. Ottensamer⁴, D. Piazza⁸, I. Ribas⁹, L. Roth¹², N. Santos¹⁰, G. Scandariato¹⁶, S. Sousa¹⁰, V. Van Grootel¹⁴

¹Space Research Institute, Austrian Academy of Sciences, Graz, Austria, ²KU Leuven, Belgium, ³National Institute of Aerospace Technology (INATA), Spain, ⁴University of Vienna, Austria, ⁵University of Geneva, Switzerland, ⁶INAF, Brera, Italy, ⁷Stockholm University, Sweden, ⁸Center for Space and Habitability, University of Bern, Switzerland, ⁹Institute of Space Studies of Catalonia, Spain, ¹⁰University of Porto, Portugal, ¹¹Netherlands Institute for Space Research (SRON), The Netherlands, ¹²Royal Institute of Technology (KTH), Sweden, ¹³University of Colorado, USA, ¹⁴University of Liege, Belgium, Space Research and Planetary Sciences, ¹⁵Space Research and Planetary Sciences, Physics Institute, University of Bern, Switzerland, ¹⁶INAF, Catania, Italy, ¹⁷Institute for Theoretical Physics and Computational Physics, Graz University of Technology, Austria

Abstract

The discovery of exoplanets opened a new field in astrophysics. Following the success of detection facilities, we have started to pursue a coherent atmospheric characterisation of the most easily accessible exoplanets: Warm (800 K) to hot (>2000 K) gas giants that orbit their stars on short-period orbits (< 10 days). These planets exhibit atmospheric conditions unlike anything known in the Solar System. The intense and energetic radiation they receive from their host star, especially variable in the ultraviolet (UV), triggers extreme and dynamic atmospheric phenomena that can be robustly captured with sustained, repeated, and wide-band observations. The Wide-band Atmospheric Laboratory for Transiting Exoplanet Research (WALTzER) mission submitted to the recent ESA mini-F call precisely aims at providing simultaneous medium-resolution near-UV (NUV; 250-330 nm) and visible spectroscopy (416-820 nm) as well as broad-band near-infrared (NIR; >820 nm) photometry to probe the atmospheres of close-in gas giants. By providing fast-track access to the NUV band, only reachable from space, WALTzER also enables collecting data that are key to understanding stellar activity, habitability conditions, solar system objects, and a breadth of astrophysical phenomena beyond the HST era.

Presentation Preference

- Oral Presentation
- Poster Presentation
- No preference

Unveiling the Properties of Massive single and binary Stars in the Northeast Outskirts of the SMC: A UVIT-Driven Exploration

Annapurni Subramaniam¹ (purni@iiap.res.in), Sipra Hota¹, Vikrant V. Jadhav²

¹Indian Institute of Astrophysics, Bangalore-560034, India

²Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, D-53115 Bonn, Germany

Abstract

Massive stars are key agents of feedback in galaxies, shaping their evolution through ionizing radiation, winds, and supernovae. Their study in low-metallicity environments like the Small Magellanic Cloud (SMC) is crucial for understanding the conditions of early-universe star formation, where such environments were more common. Massive stars in binaries are also equally important as their evolution is moderated by binary interaction resulting in the formation of exotic systems leading to subdwarfs, type-Ia supernovae etc. In this study, we investigate the physical properties of single and binary stars (photometric mass $\geq 2 M_{\odot}$) located in the SMC Shell—a young stellar structure in the north-eastern outskirts of the SMC. In this study, we utilize multi-wavelength photometric data comprising far-UV and near-UV bands from the Ultra Violet Imaging Telescope (UVIT/AstroSat), optical measurements from Gaia DR3 and the Survey of the MAgellanic Stellar History (SMASH), and near-infrared data from the VISTA Magellanic Clouds survey (VMC). These datasets were cross-matched to compile a sample of 1,352 sources with complete photometric coverage across 18 distinct filters. We employed the Virtual Observatory SED Analyzer (VOSA) to perform spectral energy distribution (SED) fitting, adopting both single- and double-component model configurations to derive fundamental stellar parameters, including effective temperature (T_{eff}), luminosity (L), and stellar radius (R). Of the full sample, $\sim 1,200$ stars yielded reliable fits the single SEDs, while ~ 100 produced statistically acceptable fits using binary model configurations. The majority of single stars are found to be B- and early A-type main-sequence and A- and F-type giant stars, with effective temperatures ranging approximately from 6,000 K to 30,000 K, with radii from 2 to 25 R_{\odot} . The binary systems exhibit diverse configurations, including main sequence–main sequence, giant–giant, and main sequence–giant pairs, with some indicating the presence of hot subdwarf companions with main-sequence stars.

This work demonstrates the effectiveness of UV diagnostics in detecting and characterizing massive stars and binaries in resolved, low-metallicity galaxies. Our study provides a foundation for future detailed spectroscopic follow-up and contributes to the broader effort of understanding stellar populations in the early-type galaxies using ultraviolet facilities.

Presentation Preference:

Oral Presentation

The Iapetus' case: NUV as tracer of two populations of dark material

Tinaut-Ruano, Fernando¹ (ftinautruano@gmail.com), Rizados, J. L.²; de Leon, J.³, Tatsumi, E.³, Pinilla-Alonso, N.⁴, Vilas, F.⁵, Hendrix, A.⁵

¹ Observatoire de la Côte d'Azur, Nice, France; ² Instituto de Astrofísica de Andalucía, Granada, España;

³ Instituto de Astrofísica de Canarias, Santa Cruz de Tenerife, España; ⁴ Universidad de Oviedo, España;

⁵ Planetary Science Institute, Tucson, AZ 85719, USA

Abstract

Iapetus, one of Saturn's largest and oldest regular moons, exhibits the most extreme albedo dichotomy in the Solar System. Its leading hemisphere is coated in dark material with an albedo as low as 2–6%, while the trailing side remains bright at 50–60%. This dramatic contrast has puzzled scientists for decades. Proposed explanations include both endogenic geological processes and exogenic deposition—particularly from Phoebe, Saturn's outer irregular moon. However, spectral analyses have revealed inconsistencies between Phoebe and the dark material on Iapetus, leaving its true origin unresolved.

In this study, we use high spatial resolution Near-Ultraviolet (NUV) imaging from the Cassini-Huygens spacecraft to offer new insights into the nature and origin of Iapetus' dark material. The NUV data, acquired through the Imaging Science Subsystem (ISS), uniquely reveal spectral slope variations across the transition zone between the moon's bright and dark hemispheres. These NUV slope distributions allowed us to identify three distinct surface populations: bright ice, dark lithospheric material, and an exogenous dark component. The ability of NUV data to distinguish between these populations demonstrates its critical role as a diagnostic tool for surface composition and space weathering effects.

Furthermore, by correlating NUV spectral slopes with infrared (IR) data from the Visible and Infrared Mapping Spectrometer (VIMS), we found that the exogenous material exhibits a strong link between UV and 3 μm IR absorptions—a trend previously observed in primitive asteroids. This cross-wavelength correlation underscores the power of UV observations in characterizing and differentiating space-borne materials.

One of the most compelling NUV findings is the systematic deepening of UV absorption within crater interiors, likely due to fresher, less-weathered material. This result provides observational evidence that space weathering reduces UV absorption depth over time, affirming theoretical models and highlighting the NUV's sensitivity to regolith maturity.

In conclusion, NUV observations are not just complementary but essential in deconstructing the complex surface history of icy satellites. This study demonstrates how NUV imaging provides unparalleled sensitivity to compositional variations and weathering processes, reinforcing its value for planetary science and future mission planning.

Presentation Preference:

Oral Presentation

Dynamic UV sky simulation with transient M dwarf Flares

Akshank Tyagi¹ (akshanktyagi@iisc.ac.in), Rekshesh Mohan²(reks@iiap.res.in), Jayant Murthy²

¹Indian Institute of Science, ²Indian Institute of Astrophysics

Abstract

UV Sky Simulation for Satellite missions (UVS3) is our general-purpose Astronomical sky simulation to support UV space mission planning. It incorporates synthesised Stellar SEDs, Zodiacal light, and Galactic diffuse ISRF in UV bands for satellite-bound instruments in Low-earth orbits. UVS3 allows customisable instrument parameters, from narrow fields of view suited for spectroscopy to wide-field configurations for time-domain or survey missions.

In this work, we extend UVS3 to incorporate transient astrophysical phenomena by modelling stochastic flaring events from Galactic M dwarfs. The study of M-dwarf flares, which often peak in UV, provides key insight into stellar magnetism and the radiation environments around potentially habitable exoplanets. Using empirical flare frequency distributions (FFDs) and magnetic activity statistics, we simulate the time-dependent ultraviolet emission from these stars across a range of flare energies and occurrence rates, and analyse their observational photometric signatures. This enables an assessment of the detectability and contribution of M dwarf flares to transient UV event rates, critical for future UV missions targeting time-domain astrophysics. We present the implementation details, simulation outputs, and implications for instrument sensitivity and survey cadence design.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Unveiling the ionising spectral shape of galaxies

Anne Verhamme¹ (anne.verhamme@unige.ch)

¹Astronomy Department of the University of Geneva,

Abstract

Cosmic Reionization is a major phase transition in the history of the Universe, when the first sources of light transformed the opaque neutral intergalactic Hydrogen gas into an ionised and transparent cosmic plasma. There are several observational pieces of evidence of Reionization. In particular, most recent statistics of the Lyman- α ($\text{Ly}\alpha$, $\lambda 1216\text{\AA}$) transmission along the line of sight of distant quasars indicate that Reionization is over at redshifts below $z \sim 5.3$ (Bosman et al. 2022). A number of important questions remain unanswered:

- What are the astrophysical sources of the ionising radiation ?
- How did they form fast and numerous enough ?
- What is their ionising spectral distribution ?

We developed complementary strategies to put observational constraints on these questions: (0) proposing indirect tests of leakage; (1) searching for low-redshift analogues of the sources of Reionization, because the intergalactic medium is transparent at low-redshift, and we can cross-match Lyman-continuum detections with other characteristics to test for indirect diagnostics of the escape of ionising photons; (2) searching for intermediate-to-high redshift leakers, to explore the ionising spectral shape over a larger wavelength coverage, and quantify the contribution of nebular emission to the ionising photons budget; (3) on longer timescales, determine the occurrence rate and statistics of leakers by designing instruments and surveys for blind (BlueMUSE) whole sky (UVEX) observational campaigns. (4) Finally, we are exploring the possibility of building an EUV spectrograph on a balloon, as the only way to put direct constraints on the ionising spectral shape of individual stars, and ionised nebulae.

Presentation Preference:

Oral Presentation

Poster Presentation

No preference

Student Participation:

QUVIK — Quick Ultra-Violet Kilonova surveyor

Norbert Werner¹ (werner@physics.muni.cz), Jakub Řípa¹, Filip Münz¹, Lydia Štofánová¹,

Michal Zajaček¹, Jiří Krtička

¹Department of Theoretical Physics and Astrophysics, Faculty of Science, Masaryk University,

Kotlářská 2, Brno, 611 37, Czech Republic

Abstract

I will present the status and the science case of the Quick Ultra-Violet Kilonova surveyor—QUVIK mission. QUVIK is an ultra-violet (UV) space telescope on a small satellite with a mass of approximately 200 kg, with a moderately fast re-pointing capability and a real-time alert communication system, approved for a Czech national space mission. The satellite, which is expected to launch in five years, will provide key follow-up capabilities to increase the discovery potential of gravitational wave observatories and future wide-field multi-wavelength surveys. The primary objective of the mission is the measurement of the UV brightness evolution of kilonovae, resulting from mergers of neutron stars, to distinguish between different explosion scenarios. The mission, which is designed to be complementary to the Ultraviolet Transient Astronomy Satellite—ULTRASAT, will also provide unique follow-up capabilities for other transients both in the near- and far-UV bands. These will include UV counterparts of gamma-ray bursts (GRBs), supernovae, and novae, but also transients in active galactic nuclei (AGN), such as the tidal disruption of stars by supermassive black holes at the centres of galaxies. Our objectives also include the characterisation of UV emissions from stars and stellar systems, including stars hosting exoplanets. In particular, the envisioned simultaneous two-band UV photometry will be key to making progress in many fields of astrophysics.

Presentation Preference:

Oral Presentation

Mauve: a three-year UV-Vis survey dedicated to monitor stellar activity and variability

Fatemeh Zahra Majidi¹ (fatemeh@bssl.space), Arianna Saba¹, Lawrence Bradley¹, Giovanna Tinetti¹, Ian Stotesbury¹, Giorgio Savini¹, Fabio Favata¹, Marcell Tessenyi¹, and Benjamin John Wilcock¹

¹Blue Skies Space

Abstract

Mauve is a satellite equipped with a 13-cm telescope and a UV-Visible spectrometer (with an operative wavelength range of 200-700 nm) conceived to measure the stellar magnetic activity and variability. The science program will be delivered via a multi-year collaborative survey program, with thousands of hours each year available for long baseline observations of hundreds of stars, unlocking a significant time domain astronomy opportunity. Mauve's mission lifetime is 3 years with the ambition of 5 years, and will cover a broad field of regard (-46.4 to 31.8 degrees in ICRS) during this period. Booked to launch on October 2025, Mauve's science team will form prior to the launch date, defining the observation strategy and targets.

The scientific themes selected for the first survey so far are:

Monitoring multiple stellar systems, classical Be stars, young planet hosts, candidate targets for the Habitable World Observatory (HWO), stellar flares on solar analogs and cool dwarfs, coronal dimming associated with CMEs, and Herbig Ae/Be stars.

Mauve is designed to foster innovative pilot studies and nurture emerging scientific ideas, with a dedicated focus on time-domain astronomy. Beyond its core scientific objectives, the data collected by Mauve can serve as a valuable resource for both supporting and enhancing current and future astronomical facilities, acting as a pathfinder and enabling coordinated or follow-up observations.

In this presentation, we will provide the ultraviolet astronomy community with a comprehensive update on Mauve's progress from multiple perspectives, including: the completion of satellite construction, advances in scientific research and the implementation of major survey themes, and formation of the science team.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation:

Development of an Ultraviolet Multi-Object Spectroscopic (UVMOS) Capability for Space Astronomy

Frederic Zamkotsian¹ (frederic.zamkotsian@lam.fr), John Pazder² (John.Pazder@nrc-cnrc.gc.ca), Dmitry Vorobiev³ (Dmitry.Vorobiev@lasp.colorado.edu), Matt Taylor⁴ (matthew.taylor2@ucalgary.ca), Tyrone Woods⁵ (tyrone.woods@umanitoba.ca), Deborah Lokhorst² (Deborah.Lokhorst@nrc-cnrc.gc.ca)

¹ Aix Marseille Univ, CNRS, CNES, LAM, Marseille, France, ² National Research Council of Canada, Herzberg Astronomy & Astrophysics Research Centre, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada, ³ Laboratory for Atmospheric and Space Physics, Boulder, Colorado, United States, ⁴ University of Calgary, Department of Physics and Astronomy, Calgary, Alberta, Canada, ⁵ University of Manitoba, Department of Physics and Astronomy, Winnipeg, Manitoba, Canada

Abstract

The National Research Council of Canada is funding and leading a three-year technology development program to enable an Ultraviolet Multi-Object Spectroscopic (UVMOS) capability for space astronomy. A UVMOS capability, with a design based on the BATMAN spectrometer, was recommended during the recent CASTOR Phase 0 study. Three enabling technologies are in need of development: UV performance of convex gratings; UV performance of Digital Mirror Devices (DMDs); and characterization of UV detectors. The program is now underway, led by NRC-HAA (Victoria, BC) with contributions by: the Laboratoire d'Astrophysique de Marseille (LAM, Marseille, France) on the development of the convex UV grating; Laboratory for Atmospheric and Space Physics (LASP, University of Colorado) on the development of UV modifications to the TI DMD devices; JPL/Teledyne-e2v/CSA on the delta-doped detectors; and the Vacuum Ultra-Violet Laboratory (VUVLab, University of Calgary) for the vacuum UV testing. The program will develop and test prototypes for each of these components, followed by the assembly of a UVMOS spectrometer test bench that will itself be tested at the VUVLab. This program aims to raise the technology readiness level (TRL) of the UVMOS instrument to TRL6 by characterizing the use and performance of the integrated system within a vacuum environment and at UV wavelengths. This UVMOS development, motivated by the CASTOR mission, will raise the TRL of any HWO UVMOS instrument design that features digital micro-mirror devices (DMDs) as the object selector. This presentation will give an overview of the development program and the current status.

Bios: **Frederic Zamkotsian** is a senior researcher at the Laboratoire d'Astrophysique and PI of the BATMAN instrument. **John Pazder** is a Research Council Officer at the National Research Council of Canada, and lead for the UVMOS development program. **Dmitry Vorobiev** is a research scientist in the Laboratory for Atmospheric and Space Physics at the University of Colorado. **Matthew Taylor** is a Professor in the Department of Physics and Astronomy at the University of Calgary and director of the UV Vacuum Laboratory. **Tyrone Woods** is a Professor in the Department of Physics and Astronomy at the University of Manitoba, and science co-lead for the CASTOR mission. **Deborah Lokhorst** is a Research Officer at the National Research Council of Canada.

Presentation Preference:

- Oral Presentation
- Poster Presentation
- No preference

Student Participation: X

A number of students are participating this UVMOS project, and their contributions will be highlighted during their presentation.