

# Three roads to UV Astrophysics at NASA

Peter Kurczynski\*  
Chief Scientist, Cosmic Origins Program  
NASA Goddard Space Flight Center

\*views expressed here are my own and do not necessarily reflect the views of NASA or the federal government

# Three Astrophysics Programs

- **Physics of the Cosmos**  
How does the universe work?
- **Cosmic Origins**  
How did we get here?
- **Exoplanet Exploration**  
Are we alone?



# UV Science for the 2030's - 2040's

a primer for Habitable Worlds Observatory

- exoplanets: ozone band is a proxy for atmospheric oxygen
- exoplanet host stars: UV drives exoplanet atmospheres
  
- evolution of galaxies: UV probes accretion and recycling of gas
- ionizing background: local analogues of early galaxies
  
- shape of the quasar ionizing continuum
- shock breakout in supernovae

# What are Program Analysis Groups (PAGs)?

(Meet the COPAG Executive Committee)

[cor.gsfc.nasa.gov](http://cor.gsfc.nasa.gov)

Cosmic Origins Program Analysis Group, COPAG: members of the scientific community who share an interest in Cosmic Origins

- **Executive Committee**  
leadership, coordination, communication
- **Science/Technology Interest Groups**  
affinity group organized around a specific field of interest
- **Science Analysis Groups**  
time-limited, focused group to study a specific issue.



Rana



Varsha



*Feb' 24 - Jan '27*

Shouleh (Chair)



Sabrina (Vice Chair)



Steve



Enrique



Hsiao-wen



Rachael



Sanch



# Community groups

Representative sample. See Complete list in supplemental slides

Physics of the Cosmos [pcos.gsfc.nasa.gov](https://pcos.gsfc.nasa.gov)

- X-ray Science Interest Group
- Time domain and Multi-Messenger Science Interest Group

Exoplanet Exploration [exoplanets.nasa.gov/exep](https://exoplanets.nasa.gov/exep)

- NEW! Technosignature Study Analysis Group: SAG-25
- Exo-Explorers (Program Office)

Cosmic Origins [cor.gsfc.nasa.gov](https://cor.gsfc.nasa.gov)

- Ultraviolet Science and Technology
- Diffuse Gas in Cosmic Ecosystems



# UV Working Group Science & Technology White Paper

UV driving science and status of technology crucial to Habitable Worlds Observatory

Co-chairs: Sarah Tuttle (UW, Seattle), Mark Matsumura (GSFC)

- 33 members, 11 universities, JPL, GSFC, industry represented
- Already in use by HWO working group/US persons
- White paper undergoing review for public release



# Precursor science gaps

## #16 Tracing Intermediate Temperature Gas with High-Ionization Emission Lines

OVI 1032, 1038 Angstrom doublet traces energy exchange and mixing between hot ( $>10^6\text{K}$ ) and warm ( $10^4\text{K}$ ) gas

We need a framework for interpreting observations on kiloparsec scales

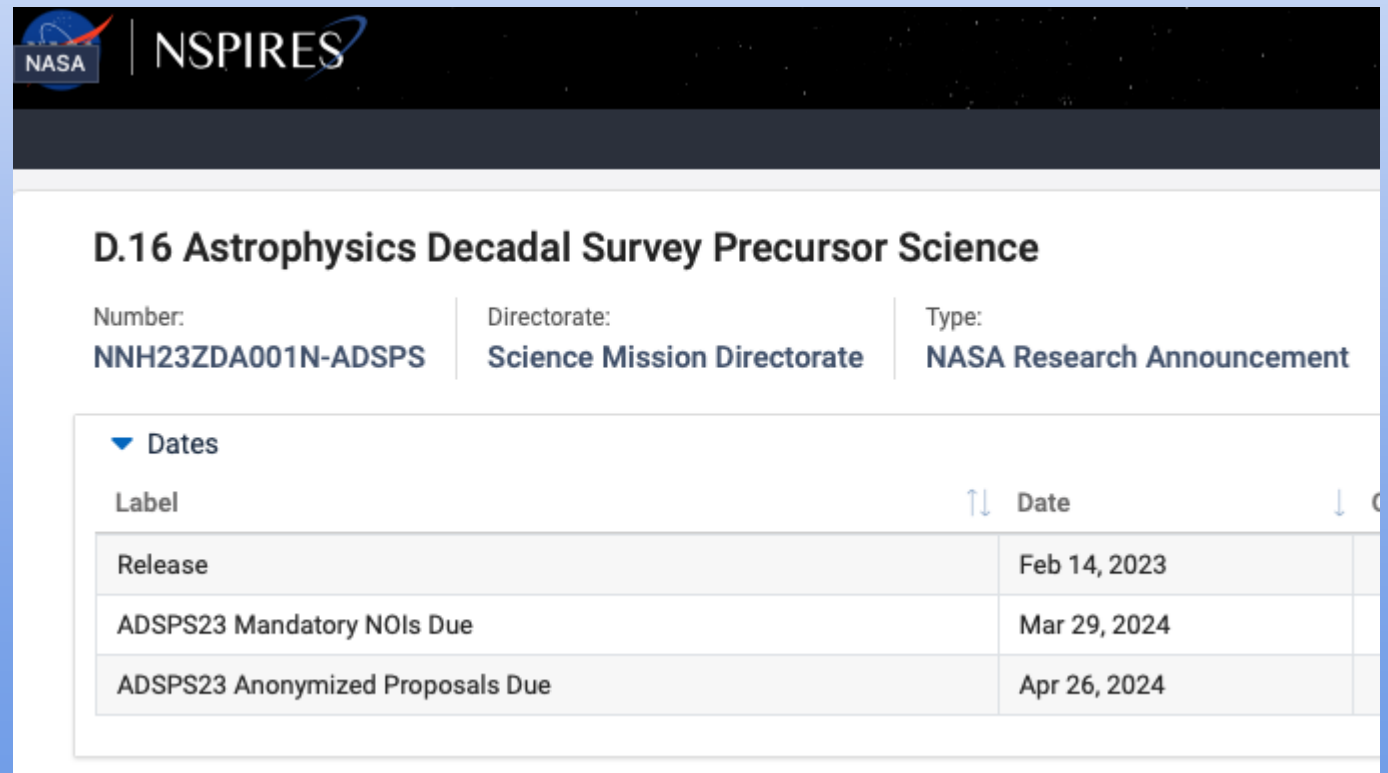
### Relevance to Mission architecture

spectral resolution, modes

### Capability needed

simulations that calculate line emission

down to 1000 Angstrom to include OVI



The screenshot displays the NSPIRES website interface. At the top, there is a header with the NASA logo and the NSPIRES logo. Below the header, the main content area features the title "D.16 Astrophysics Decadal Survey Precursor Science". Underneath the title, there are three columns of information: "Number: NNH23ZDA001N-ADSPS", "Directorate: Science Mission Directorate", and "Type: NASA Research Announcement". Below this information, there is a section titled "Dates" which contains a table with three rows of dates and labels.

Label	Date
Release	Feb 14, 2023
ADSPS23 Mandatory NOIs Due	Mar 29, 2024
ADSPS23 Anonymized Proposals Due	Apr 26, 2024

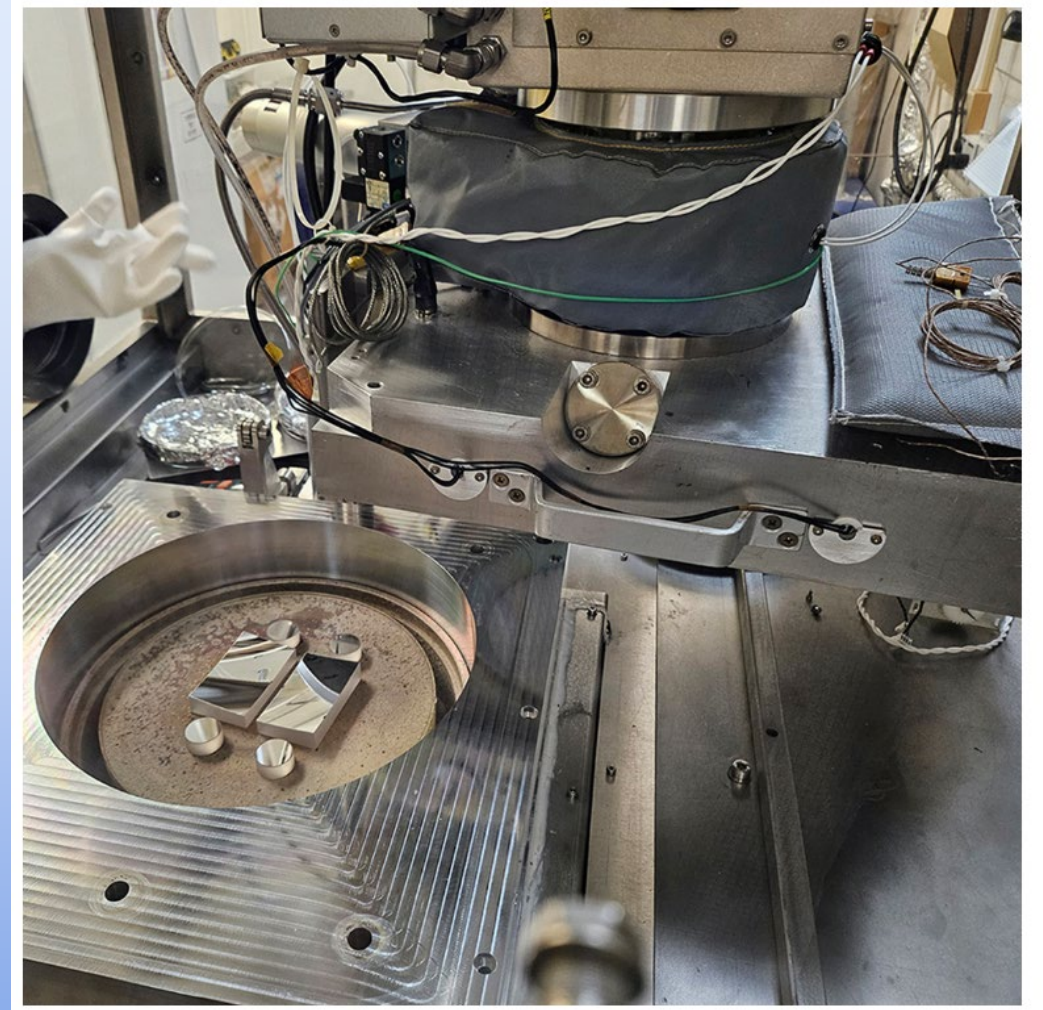
# Technology Development

*“success of NASA’s astrophysics missions depends upon early and robust investments in astrophysics technologies” - ABTR 2022*



learn more!

- Check out the Astrophysics Technology Development database [www.astrostrategictech.us](http://www.astrostrategictech.us)
- Your input needed for technology gaps! Submission deadline June 3



Flight-optic coating inside JPL ALD chamber for the Aspera Pioneers mission using a mirror coating that combines GSFC’s eLiF process with thin ALD MgF2 encapsulation. Image credit John Hennessy



# Cosmic Pathfinders

<https://cor.gsfc.nasa.gov/copag/program/cosmic-pathfinders>

Ron Gamble | [ronald.s.gamble@nasa.gov](mailto:ronald.s.gamble@nasa.gov)

- **Promote Open Dialogue:** The program drives discussions on prominent challenges that students face in today's STEM professional landscape.
- **Nurture Professional Growth:** The program will access key topics pertaining to issues surrounding Imposter Syndrome, Career Navigation, Conference Participation, Cultural Inclusivity, and Accessibility.
- **Broaden Horizons:** The program creates exposure and opportunities for students to develop relationships with professionals from a range of space science disciplines in academia, government, and private industry.
- **Cosmic Chatter**
  - **Career Roadmap Discussion — Career pathways for Astrophysics Science & Technology**
  - **Science Communication Panel — Communication**
  - **(~12) Student Presentations [April - June] — Engagement**
- **Hack-a-thons**
  - **Collaboration with missions & technical skills exposure**
- **Professional Societies/ Conference Participation & Sessions**
  - **AAS, APS, NSBP, SACNAS, NSBE, SPIE, Great Minds in STEM**
- **University Chapters**

**Cosmic Pathfinders: Cosmic Chatter Series,"** aimed at providing a platform for students in the program to share their research. This series will happen bi-weekly, starting May 2nd, 2024, and concluding June 27th, 2024. Talks will be 20 mins each

Interested students can scan the QR code to sign up for talks!



# Habitable Worlds Observatory

- COR, PhysCOS, and ExEp are actively supporting the Habitable Worlds Observatory (HWO) Science and Technology Teams
- 4 Ex-officio members from the program offices are on the HWO START and TAG teams
- COPAG, PhysPAG, and ExoPAG are involved in the HWO working groups as co-chairs or group members
- Opportunities for community participation in HWO working groups, meetings, and seminars are announced through the program office newsletters.

# Sharing inspiration



## ASTRONOMY ALL-STARS KREWE on tap



# Summary: How you can get involved

- Join a Science/Technology Interest Group
- Submit a technology gap
- Join the Cosmic Pathfinders
- Invite a NASA Program Office scientist to give a seminar or colloquium at your institution next fall

# Supplementary slides



# Physics of the Cosmos

[pcos.gsfc.nasa.gov](http://pcos.gsfc.nasa.gov)

## Science Interest Groups

- Inflation Probe
- Cosmic Structure
- Cosmic Ray
- Gamma-ray
- Gravitational Wave
- X-ray
- Time domain and Multi-Messenger

## Science Analysis Groups

- New Great Observatories (cross-PAG)
- Astrophysics with Equity, Surmounting Obstacles to Membership: AWESOM (cross-PAG)
- Time-domain and Multi-Messenger Communications
- Future Innovations in Gamma-ray Science

# Exoplanet Exploration

[exoplanets.nasa.gov/exep](https://exoplanets.nasa.gov/exep)

## Science Interest Groups

Exoplanets Demographics

Exoplanets Solar System Synergies

## Study Analysis Groups

NEW! Technosignature Study Analysis Group: SAG-25

The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys Exploring the  
Complementary Science Value of Starshade Observations

## ExoExplorers Program

# Cosmic Origins

[cor.gsfc.nasa.gov](http://cor.gsfc.nasa.gov)

## Science Interest Groups

- Ultraviolet Science and Technology
- Infrared Science and Technology
- Stars
- Galaxies
- Active Galactic Nuclei
- Diffuse Gas in Cosmic Ecosystems

## Programs

- Cosmic Pathfinders
- UV Science and Technology Working Group



# abstract

Ultraviolet astrophysics at NASA falls within three thematic programs: Cosmic Origins, Physics of the Cosmos, and Exoplanet Exploration. These themes encompass both science and technology. UV technology development activities include coatings and detectors for future missions. Science themes seek to answer three fundamental questions: How did the universe come to be? How does the universe work? Are we alone? Science interest and analysis groups, and working groups are actively advancing ultraviolet astrophysics in each of these areas. Understanding the breadth of these activities and, how you can become involved with them, will lead to more effective engagement with NASA, and create opportunities to advance your science and career.