Town Hall
Cosmic Origins Program Analysis Group (COPAG) July 10, 2024

Dr. Shouleh Nikzad, JPL, Caltech
Chair, COPAG Executive Committee

Dr. Swara Ravindranath
NASA COR Deputy Chief Scientist

Prof Sabrina Stierwalt, Occidental College
Vice Chair, COPAG Executive Committee

Dr. Patricia Knezek, Program Scientist COR

Prof Sanchayeeta Borthakur, ASU

Dr. Ron Gamble, NASA GSFC
Dr. John O'Meara, Keck

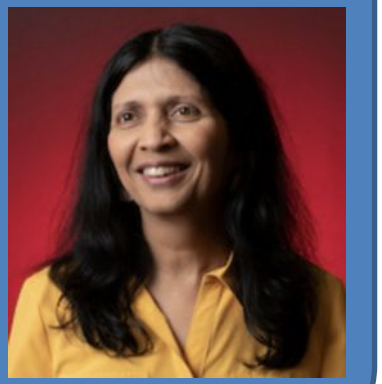
Members of COPAG EC and COPAG-SIG and STIG Leads

COPAG EXECUTIVE COMMITTEE

Member	Term	Institution
Shouleh Nikzad (Chair)	April 2022–October 2024	Jet Propulsion Laboratory
Stephan McCandliss	November 2018–October 2024	Johns Hopkins University
Hsiao-Wen Chen	April 2022–October 2024	University of Chicago
Enrique Lopez Rodriguez	April 2022–October 2024	Stanford University
Sabrina Stierwalt, Vice Chair	November 2020–October 2025	Occidental College
Rachael Beaton	January 2023–October 2025	Space Telescope Science Institute
Sanchayeeta Borthakur	January 2023–October 2025	Arizona State University
Rana Ezzeddine	February 2024–January 2027	University of Florida
Varsha Kulkarni	February 2024–January 2027	University of South Carolina

Rana

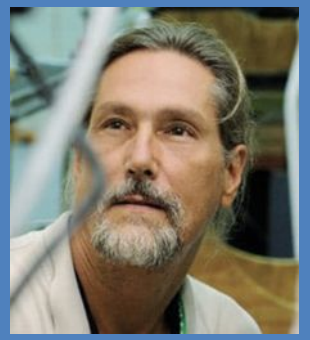
Varsha



Feb' 24 - Jan '27

Shouleh, Chair

Stephan



Hsiao-Wen

Enrique

Apr' 22 - Oct '24

Sabrina, Vice Chair

Rachael

Sanch

Nov '20 - Oct '25

Jan' 23 - Oct '25

COSMIC ORIGINS EXECUTIVE COMMITTEE: Review of charge and organization

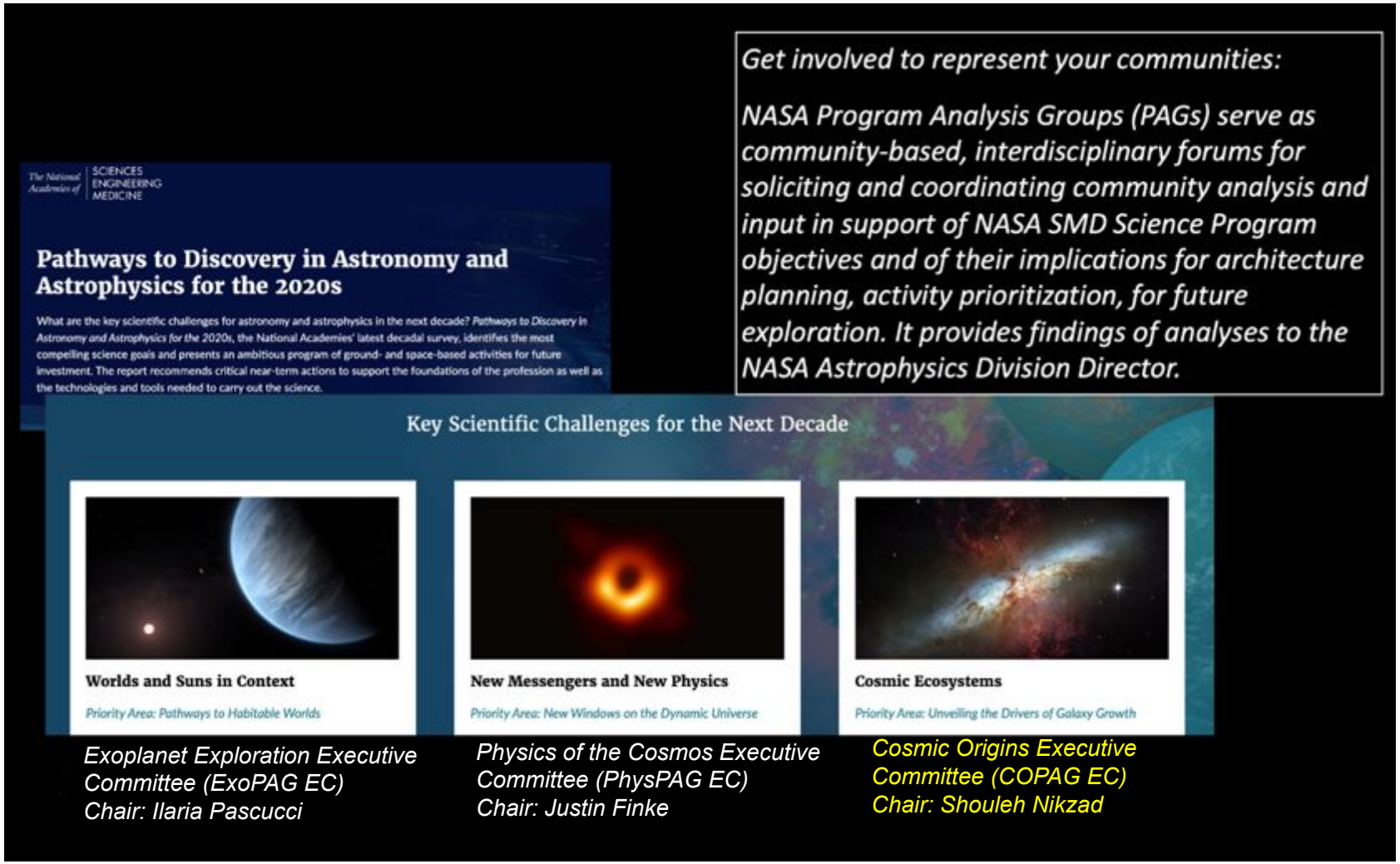
Cosmic Origins Program Analysis Group (COPAG)

COPAG EC lead analysis and coordinate PAG activities; members should span breadth of COR science, technology

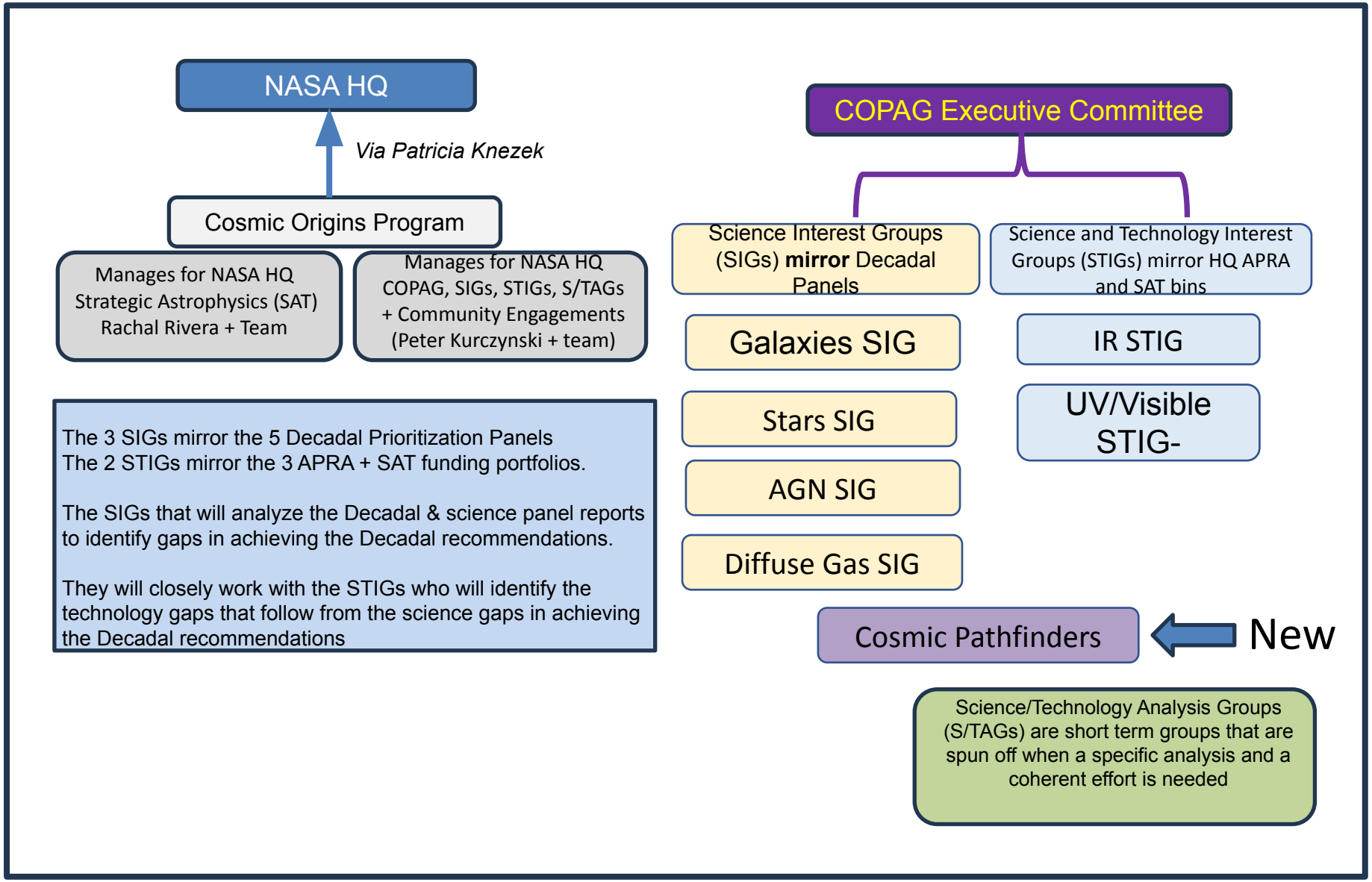



COR Chief Scientist: Peter Kurczynski
COR Deputy CS: Swara Ravindranath

Program Scientist: Patricia Knezek
Program Support Manager: Stephanie Clark



Cosmic Origins Program Ecosystem



UV Working Group: White Paper

Co-Chairs: Sarah Tuttle (UW, Seattle) & Mark Matsamura (GSFC)

Goal: Create a foundational document to capture UV driving science, current status of UV technology crucial to HWO development, and specifiy areas needed to focus development to reach notional requirements. Capture key technical advancements in one location to encourage broad engagement in pathfinding missions

- Working Group initiated in late spring/early summer 2023
  - 33 members (including co-chairs, as well as Swara & Peter)
  - 11 universities represented, as well as JPL & GSFC, and Industry participants
  - Broad career stages (grads, postdocs, and researcher levels)
  - Weekly telecons
  - Draft white paper under review for circulation
- Meeting Participation
  - Participated in Mini UV-Exo Workshop at Caltech Keck Think Tank, May 2023
  - July Science w/HWO Meeting at STSci – multiple presentations & Tech Day Participation
  - Presentation at CGM meeting in September
- Upcoming
  - White paper is out for final round of comments by co authors
  - White paper will be shared throughout NASA leadership
  - White paper will post to arXiv/Astro-ph
  - Multiple presentations at AAS including supporting Mind the Gap/UVSTIG splinter session to share broadly with the community – across technology/science interests and engaging early career researchers.

COPAG Strategic Plan

Our Strategic Framework

Our Mission

We connect the astrophysics community with NASA through inclusive engagement and analyses of science, technology, and workforce interests in the pursuit of discovery of our cosmic origins.

Our Goals

1. COPAG establishes the science and technology scope of Cosmic Origins
2. COPAG is critical to achieving NASA astrophysics strategic goals
3. COPAG works effectively through close cooperation with the Cosmic Origins Program Office and HQ
4. COPAG fosters a more diverse and inclusive community
5. COPAG empowers and engages a diverse astrophysics community
6. COPAG and the Cosmic Origins Program Office ensure transparent and timely communication with the astrophysics community

Our Vision

We have empowered and engaged a diverse community to discover our cosmic origins and realize NASA's vision to explore the secrets of the universe for the benefit of all.

Our Core Values

Visionary | Inclusivity | Integrity | Excellence

Community Engagement Activities

AAS Splinters

- Splinter sessions for SIGs and STIGs
- Joint PAG Splinter (new format)—Proposed a new format to/with other PAG Chairs to potentially to have more community engagement
- Booths
- Hyperwall talks by Rachael Beaton and Sabrina Stierwalt
- Astronomy on Tap by Rachael Beaton and Ron Gamble

Community Townhall

- Town Halls to be planned virtually at a few months cadence

Astrophysics Advisory Committee (APAC)

- Public meetings, PAGs updates,

Workshops

- Developing a series of Cross PAG Workshops toward working with astrophysics community toward HWO
- UV Science and Instrumentation: May 7-9, 2024

UV Science and Instrumentation Workshop

- UV Science and Instrumentation Workshop was conceived as part of conversations across PAGs and following the AAS Winter 2023 and Mini Workshop (UVCOR-Exo) at Caltech Keck Center, May 2023, and the work of the UV Working Group led by Sarah Tuttle.
- Workshop was announced at the AAS and was met with great interest by the community.
- SOC has been formed and has met three times. One or two more members might be joining the SOC.
- Format is shaping up to be a true workshop format to allow for interactions and discussions amongst the participants.
- A report or series of papers are expected to be submitted to JATIS, potentially as a special issue which would include the UVWG output as well.

UV Science and Instrumentation Workshop

On the Way to the NASA Habitable Worlds Observatory and Beyond

Identify technology gaps

The workshop will generate and publish a peer-reviewed final report

Science Organizing Committee:

Shouleh Nikzad, Convener, Jet Propulsion Laboratory
Anahita Alavi, California Institute of Technology/IPAC
Rachael Beaton, Space Telescope Science Institute
Brad Cenko, NASA Goddard Space Flight Center
Kevin France, University of Colorado-Boulder
Erika Hamden, University of Arizona
Lynne Hillenbrand, California Institute of Technology
Bethan James, Space Telescope Science Institute
Evgenya Shkolnik, Arizona State University
Allison Youngblood, NASA Goddard Space Flight Center

Local Organizing Committee:

David Ardila - JPL
Chas Beichman - NExScI
Bertrand Mennesson - JPL
Leonidas Moustakas - JPL

Click HERE or scan the QR Code to register for the workshop

Deadline to register is Sunday, March 31, 2024

Website URL: https://science.jpl.nasa.gov/workshops/uv

SCAN ME

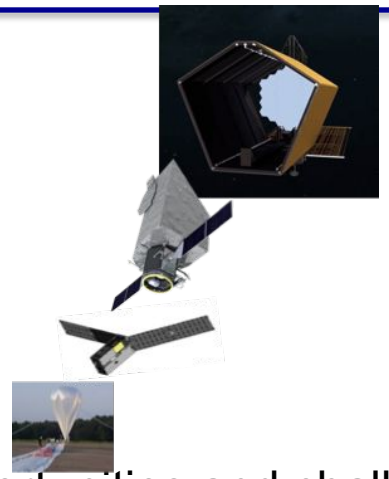
This workshop is in part supported by the Cosmic Origins Program Office.

Image credit: NASA/Swift/Stefan Immler (GSFC) and Erin Grand (UMD)

JPL Director Welcome Address

Panel: Humans in the Loop

CALL FOR PAPERS--JATIS
SPECIAL ISSUE : Ultraviolet Science & Instrumentation: On the Way to Habitable Worlds Observatory and Beyond



Target Publication Date
February 1, 2024

Submission Date Deadline
October 1, 2024

Scope

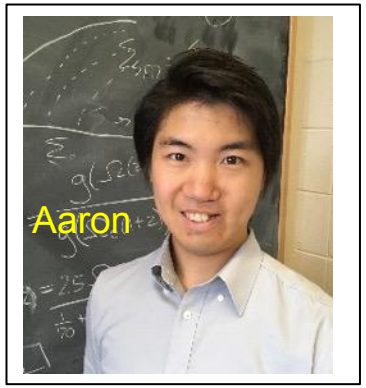
This special section of JATIS focuses on addressing the opportunities and challenges involved in doing science through ultraviolet observation, the gaps and capabilities of ultraviolet instrumentation and technologies, and the mission concepts necessary for achieving science objectives, in a variety of platforms, from CubeSats to the next astrophysics flagship: the Habitable Worlds Observatory.

Areas of interest for this special section include:

- Enabling technologies (detectors, reflective coatings, gratings, filters, μ-shutters, etc.)
- Modeling, simulations, and data analysis techniques and results
- UV Instrumentation, including reviews* (see note below)
- UV Science Cases for HWO and other classes of missions** (see note below)
- Mission concepts: all classes and in all stages of development and deployment

SIG and STIG leadership

Galaxies SIG



AGN SIG

Stars SIG

Cosmic Ecosystem SIG

- New leadership in Galaxies SIG and IRSTIG
- Leadership councils formed in all SIGs & STIGs
- COR CS and DCS met with all SIGs & STIGs leads to discuss the plans for the year—this is in part a result of COPAG's Strategic Plan

New !

IR STIG

UV/Visible STIG

UV/Visible Science Technology Interest Group: (McCandliss, Tumlinson, et al.)

https://cor.gsfc.nasa.gov/stigs/uvstig.php

UVSTIG

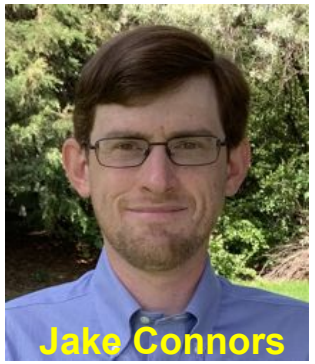
- **Winter** AAS Splinters:
  - Mind the Gap & Ultraviolet/Visual Science Interest Group Joint Splinter Session AAS 243 09 January 2024
    - Morning and Afternoon Sessions (~100 inperson + virtuial)
    - 19 Presentations – https://cor.gsfc.nasa.gov/copag/meetings/AAS_Jan2024/AAS2024-Agenda-MineTheGap-AM.php

- **UVSTIG QUEST* Virtual Seminar Planning Activities Winter/Spring 2024:**
  - Suggested topics: **UV Coronagraph**; **FarUV Mirror and Filter Variants**; **Multiobject and Integral Field Spectroscopy**; **Contamination Control**; **Photocounting Detectors – Photoemissive, Photoconductive, Photothermal**; **Diffraction Gratings**
  - **April – Kevin France will speak on his for STAMP-1 (Smallsat Technology Acceleration Maturation Platform-1)**

    - ***Quorum for Ultraviolet/visible Exploration of Science and Technology**
    - QUEST* seminars are archived at https://www.youtube.com/playlist?list=PL_dmnk6FeUeASWgZwzBIUR--Ut8axxSut

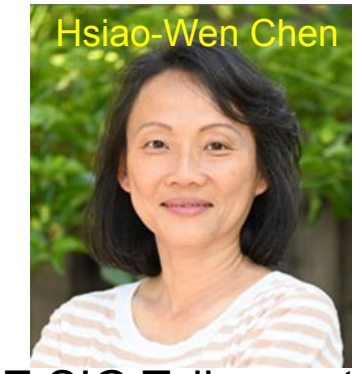
Infrared Science Technology Interest Group

IRSTIG



- **Webinar series**
  - Continuing cadence ~1 talk/month
  - ~ 20 /30 people in attendance each time
  - Half of the speakers were early-career scientists
- **Splinter Session at Winter AAS**
  - Very well attended winter AAS session discussing how a FIR probe could support GO science
- **Big Item: Hosting an IR Workshop May 5th-7th 2025 in Washington DC**
  - In the wake of the APEX decision, we would like to reconvene the IR community (following onto our Mar 2022 workshop) to discuss its future given the opportunities presented to it
  - Being held at the Johns Hopkins Bloomberg Center on Pennsylvania Ave. just blocks from the Capitol
  - We are currently working on seeking external funding to support the workshop, student travel support, catering etc
  - No registration fees will be charged

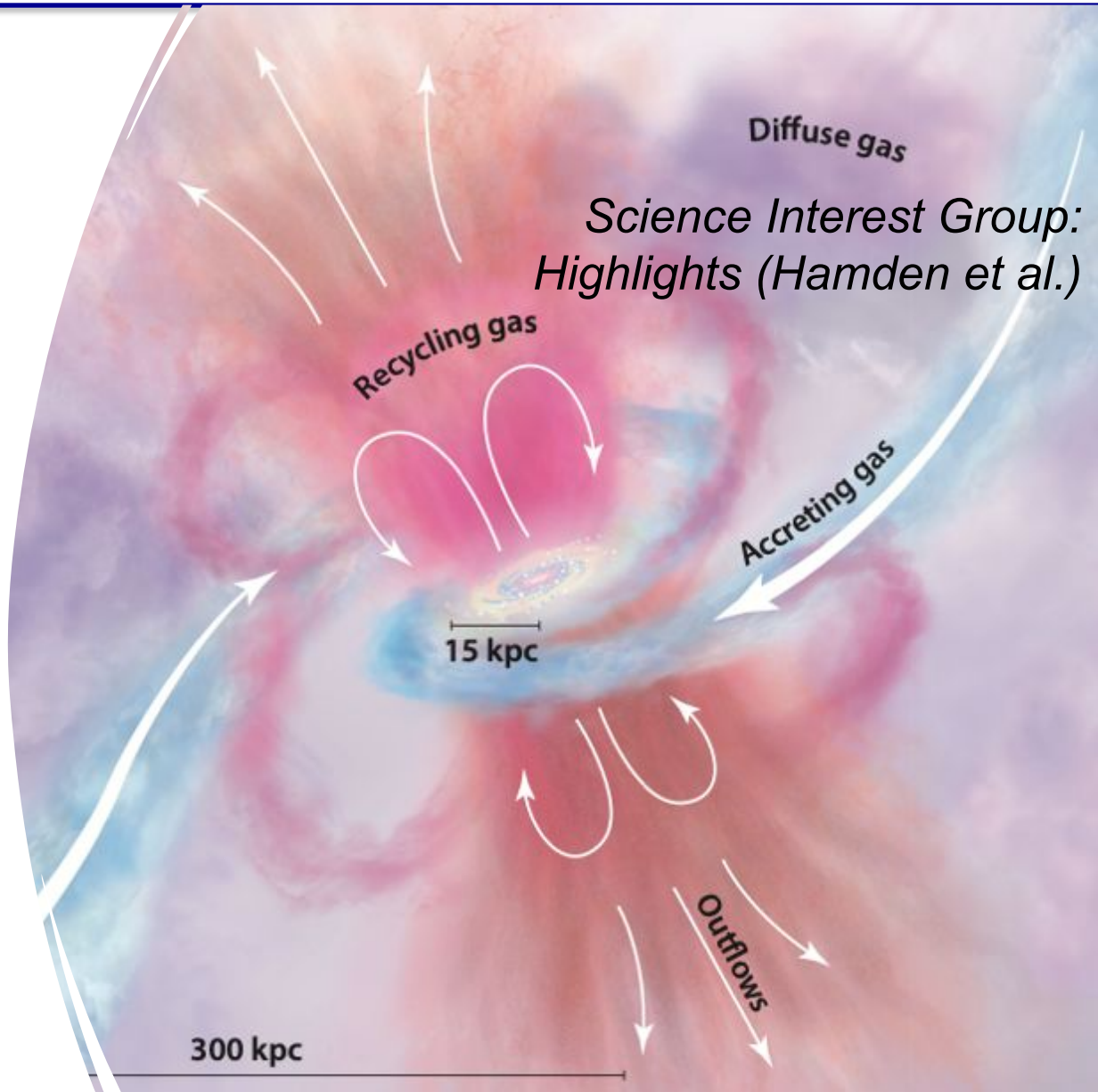
Diffuse Gas in Cosmic Ecosystem Science Interest Group



- DGCE SIG Talks continue each month and are well attended. In addition, the recordings are regularly viewed.
- Talks scheduled through August 2024, with between 30-50 viewers per session
- Talks are recorded on zoom and posted to YouTube
- Organized joint SIG splinter session at AAS which was well received and generated a great deal of discussion

Contacts:
Erika Hamden hamden@arizona.edu and
Hsiao-Wen Chen hchen@astro.uchicago.edu

Image: Tumlinson, Peeples, Werk, 2017, ARAA 55:389



Stars SIG

Stars Science Interest Group: Highlights (Beaton et al.)

https://cor.gsfc.nasa.gov/sigs/starssig.php

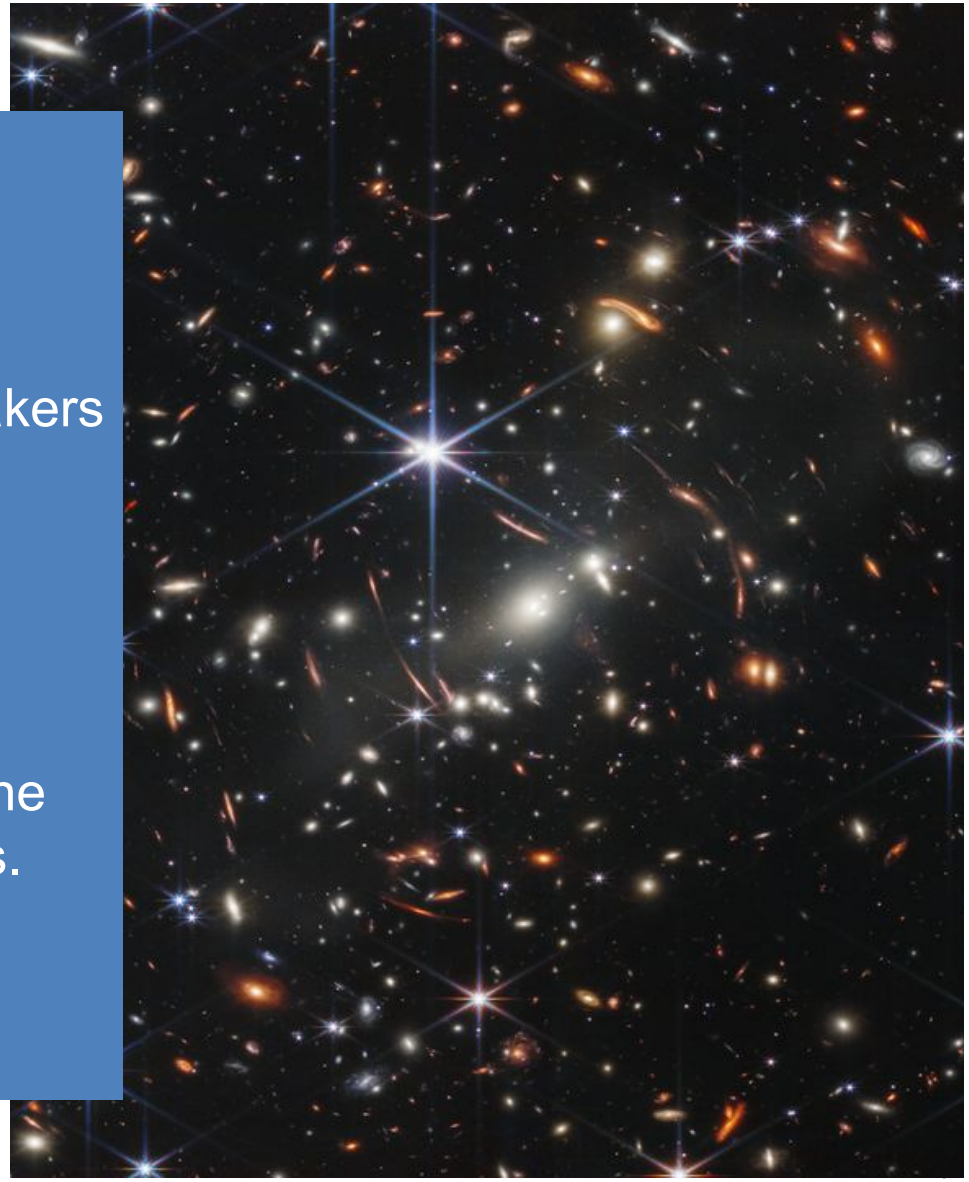
Co-Chairs:

Rachael Beaton (STScI)

Yuan-Sen Ting (ANU)

Aided in planning the UV Cosmic Origins Science Splinter at AAS243

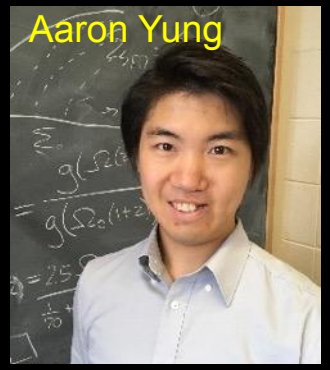
- Plan to write a short report on the science themes that were explored and engage speakers to get their highest priority science.
  -
- From this, the idea of a SAG on an "**Age Ladder**" that connects age measurements across space and time.
  - Currently coordinating how to organize the SAG around the other high priority topics.
- Plan to reboot speaker series around these topics as part of the SAG preparation work.



Galaxies SIG

Galaxies Science Interest Group: Highlights (A. Yung, et al.)

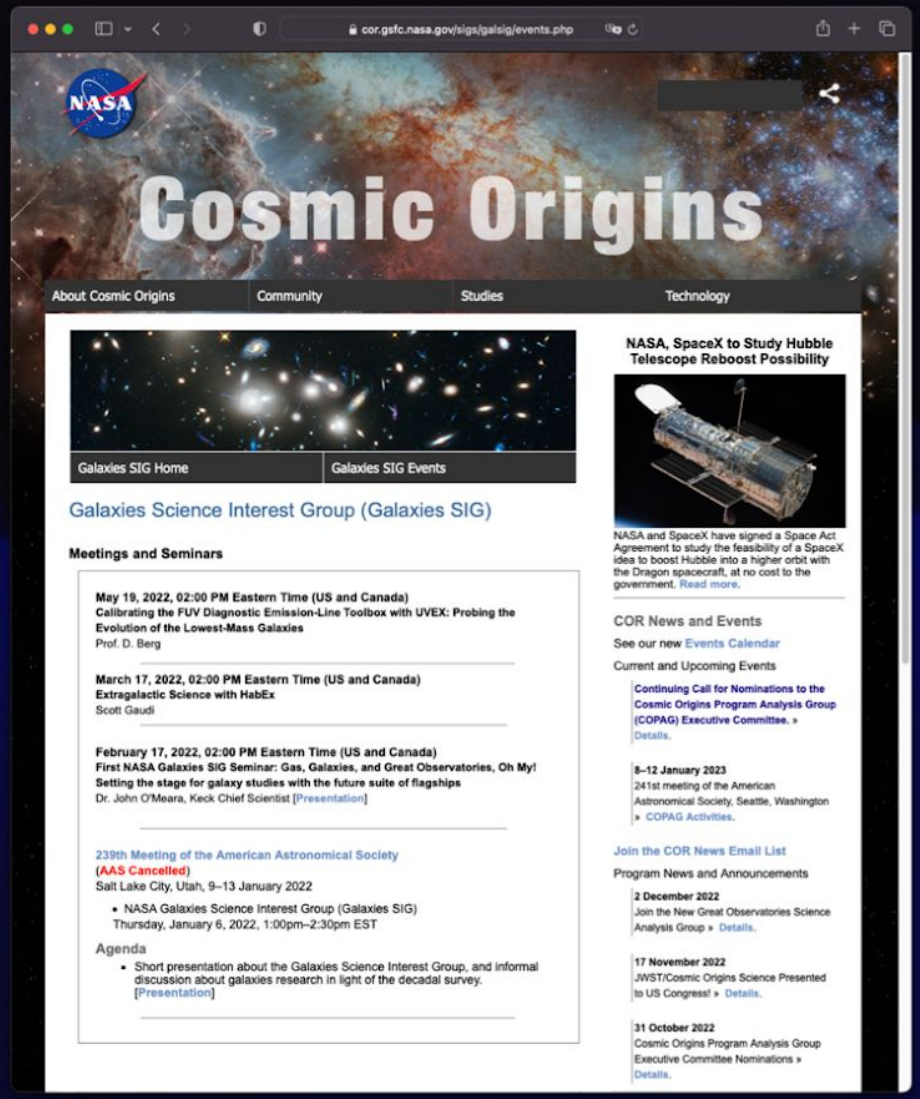

Benne Holweda


Aaron Yung

Also participated in planning joint splinter along with Stars and DGCE for Winter AAS 2024

Galaxies Science Interest Group

- The SIG was represented at the COPAG strategy retreat in Pasadena, May 2023, and discussed key science questions from the decadal survey, as well as appendix N on State of the Profession, and identified decadal survey science questions most relevant to Habitable Worlds Observatory.
- We are a relatively new group that was formed just over a year ago, and we are planning to ramp up group activities in the Fall semester, including a seminar series and discussions on identifying science gaps in the Astro2020 Decadal Report.
- Chair: Benne Holwerda
  Deputy Chair: L. Y. Aaron Yung



TDAMM Cross PAG SIG

New Cross PAG Science Interest Group: Highlights (Cenko et al.)

- Cross PAG SIG—Co Chairs: Brad Cenko (COPAG), Rebekah Hounsell (PhysPAG), Eric Burns (PhysPAG, Ian Crossfield (ExoPAG)
- First in person meeting at the Winter AAS meeting
- First virtual meeting (Mar. 1)
  - Opening talk by Fiona Harrison on the Decadal and TDAMM
  - Broad discussion between Fiona and members
    - Identified the key need for NASA to build the Decadal-recommended standing committee to provide TDAMM priority recommendations this decade
    - Emphasis on the Decadal priorities, with TDAMM as the top sustaining activity (noting the separate recommendation pipe for GOMAP and (what is now) HWO)
- Talks are recorded on zoom and posted to YouTube
- Working through next steps and plans for future meetings.


Brad Cenko

Cosmic Pathfinders Program

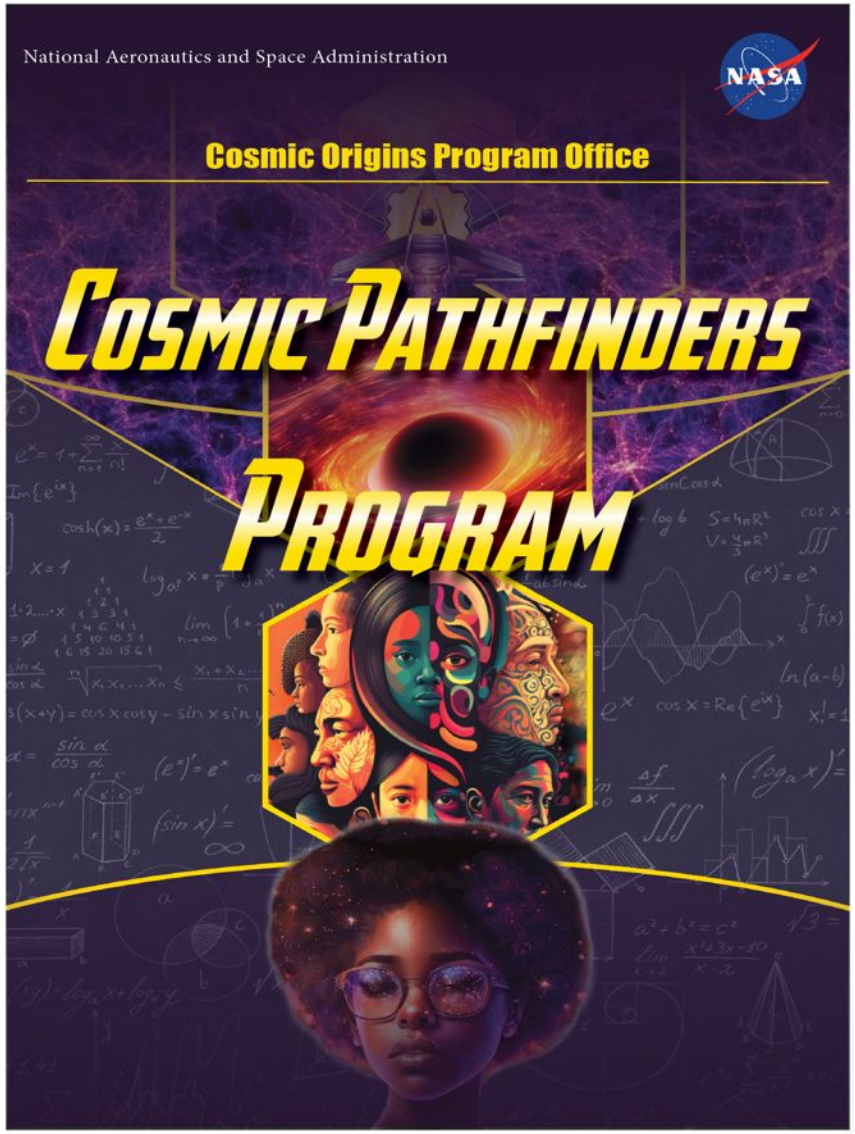
Directed by Ronald Gamble, NASA/GSFC/UMCP

Current student membership across the Cosmic Pathfinders footprint has eclipsed ~500 students & Early-Careers

Current student leadership:

- Amethyst Barnes (NASA GSFC/CRESST-II Post-Bac, Roman/STScI)
- Jordan Forman (NASA GSFC/CRESST-II Post-Bac, FERMI)
- Gokul Srinivasaragavan (Doctoral Candidate, UMCP Department of Astronomy)
- Isiah Holt (NASA Pathways Intern & Doctoral Candidate, UMCP Department of Astronomy)

- Cosmic Chatter
  - Career Roadmap Discussion — Career pathways for Missions
  - Science Communication Panel — Communication
  - (~12) Student Presentations [March - June] — Engagement
- Hack-a-thons
  - JWST, XRISM, COSI…Roman (?), HWO (?), LISA (?) , along with the potential to extend to many others.
- Professional Societies/ Conference Participation & Sessions
  - AAS, APS, NSBP, SACNAS, NSBE, SPIE, Great Minds in STEM



HWO Update
John O'Meara

The Habitable Worlds Observatory: Status, Plans and Opportunities

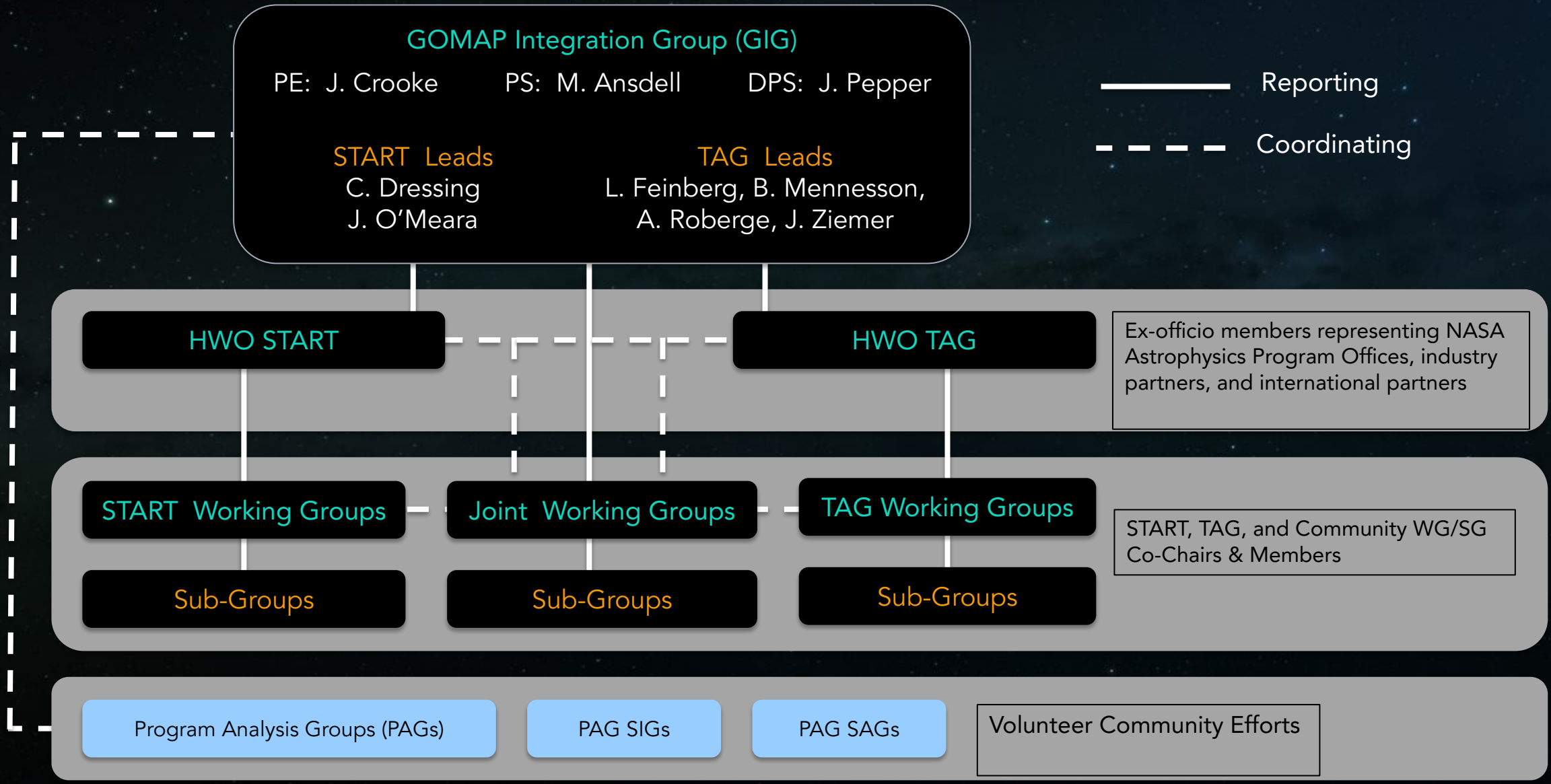
John O'Meara[E], John Ziemer[B], Megan Ansdell[C], Julie Crooke[C], Courtney Dressing[D], Bertrand Mennesson[B], Lee Feinberg[A], Joshua Pepper[C], Aki Roberge[A]

[A] Goddard Space Flight Center, Greenbelt, Maryland 20771; [B]JPL; [C] NASA HQ; [D] UCB; [E]Keck

COR Town Hall
July 10, 2024

HABITABLE WORLDS OBSERVATORY

Organization & Relationships



HWO Working Groups

Likely to evolve in future

START

- Galaxy Growth
  Ravindranath & Postman
- Living Worlds
  Arney & Parenteau
- Evolution of the Elements
  Lee & Scowen
- Solar System in Context
  Robinson & Shkolnik
- Ground-Based Astronomy in the 2030s/2040s
  Lopez-Morales & Miyazaki
- Space-Based Astronomy in the 2030s/2040s
  Petre & Kataria

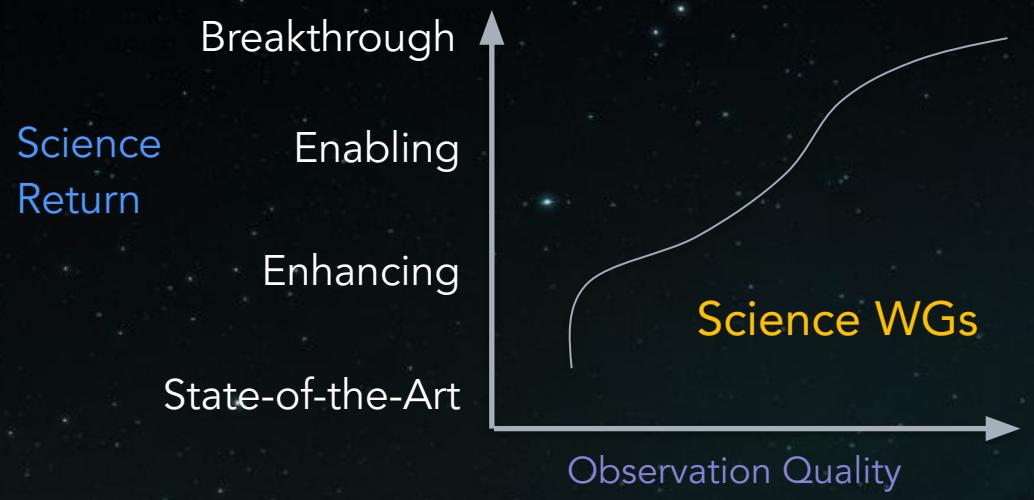
Joint & Community

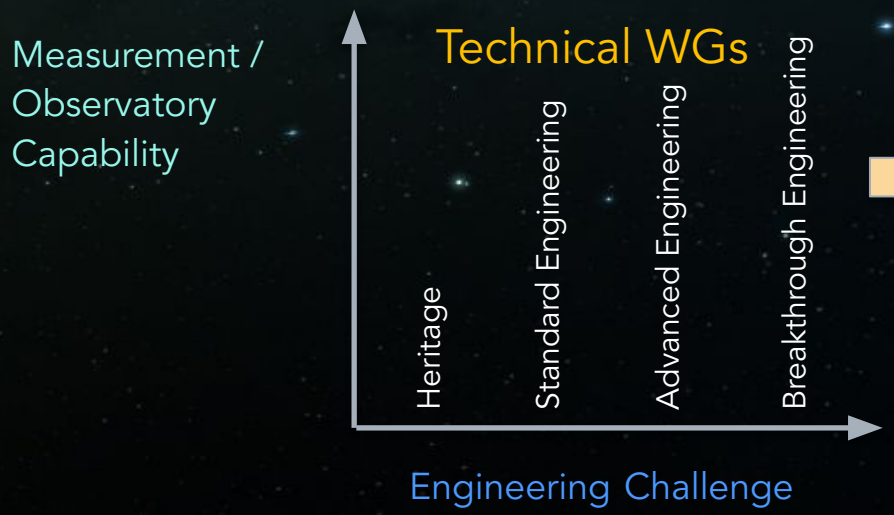
- DEIA & Mentorship
  Scannapieco & Beaton
- Science Case Simulation
  Batalha & Osten
- GOMAP Synergies for Future Missions
  Gaskin & Oschmann
- Science Data Simulation
  Greene & Tumlinson
- Communications
  Schirner & Straughn
- Science-Engineering Interface
  Morrissey & Sitarski
- Artificial Intelligence & Machine Learning
  Ansdell & Dean
- Past Studies Comparison
  Gaudi

TAG

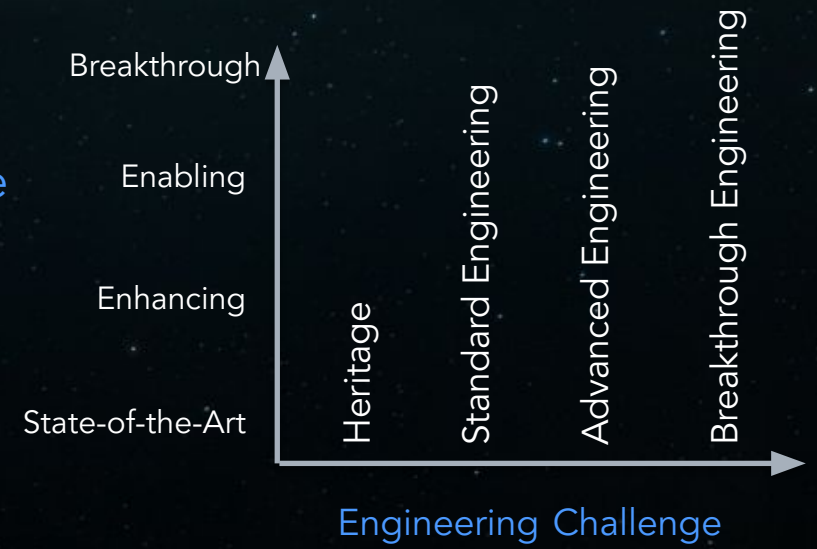
- Systems
  Menzel & Shaklan
- Integrated Modeling
  Levine & Liu
- Technology
  Bolcar & Zhao
- Servicing
  Van Campen & Grunsfeld

THE BIG PICTURE





Science Return Level



Science Analysis Flow

SEI = Science-Engineering Interface WG
SCS = Science Case Simulation WG
SDS = Science Data Simulation WG

1. Science Goals to Observations

What: Link physical parameters to desired observations

- Example: # of objects detected vs. imaging depth
- Stop before observatory characteristics are needed

Needs: Astrophysical input assumptions

Who: Science WGs; SEI

Deliverable: Science Case Development Document

2. Observations to Observatory

What: Link desired observations to observatory characteristics

- Example: imaging depth vs. telescope diameter / instrument sensitivity / exposure time
- Static observatory performance parameters (not varying over the observation)

Needs: Exposure time calculators; starting engineering input assumptions

Who: SCS; SDS; SEI (consult Science WGs)

Deliverable: Design Concept Mission

3. Static to Dynamic Observatory

What: Add realism by allowing observatory characteristics to vary

- Example: simulated dataset that can be analyzed to assess science returns
- Dynamic observatory performance parameters (e.g., PSF varying over the observation)

Needs: Engineering model outputs

Who: SDS; SEI; Science WGs

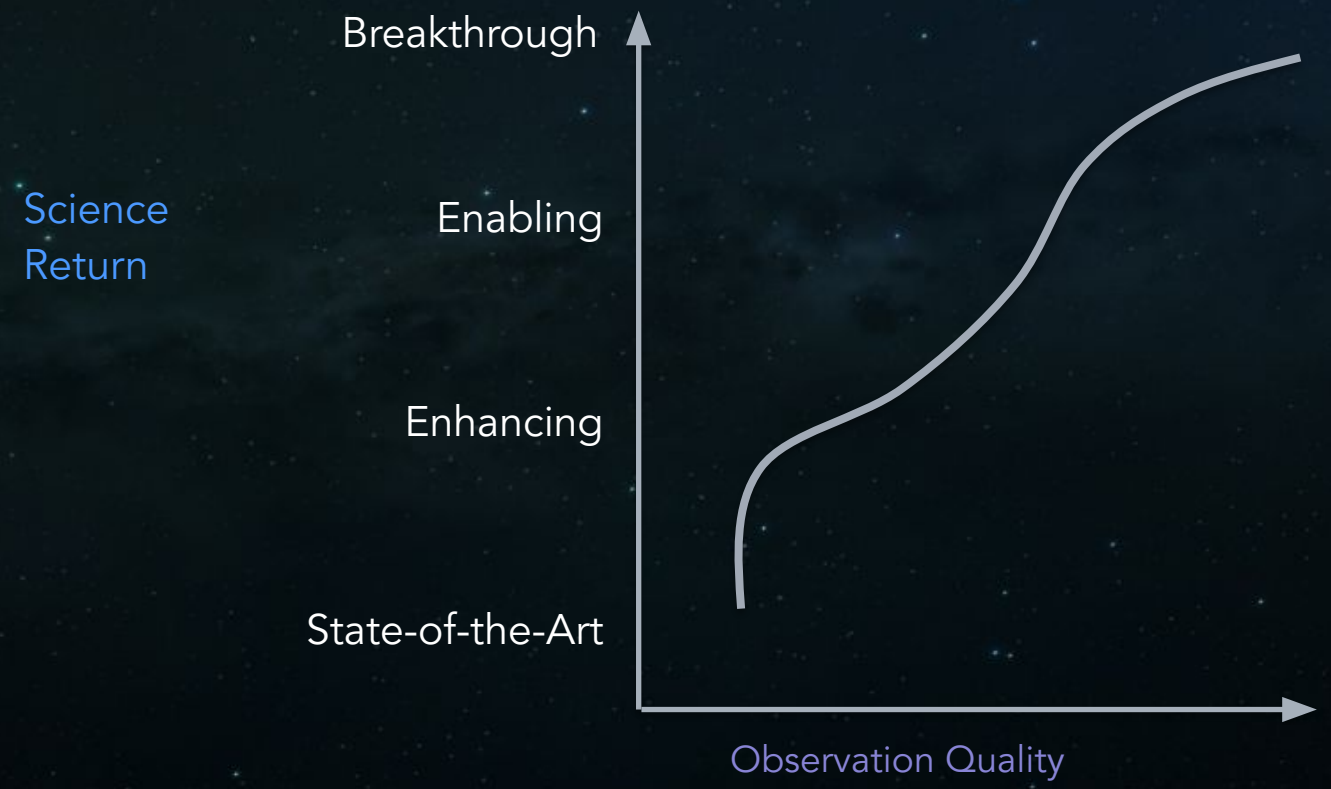
Deliverable: Design Reference Mission

CML 3 → CML 4

The Work forward

Science Working Groups

- **Living Worlds**
  - Biosignature Possibilities
  - Biosignature Interpretation
  - Target Stars & Systems
- **Evolution of the Elements**
  - Stars & Stellar Populations
  - Star Formation
  - Cosmic Explosions
- **Galaxy Growth**
  - ICGM & CGM
  - AGN
  - Ionizing Photons
  - Dark Sector
- **Solar Systems in Context**
  - Characterizing Exoplanets
  - Solar System Observations
  - Demographics and Architectures
  - Birth and Evolution



SCIENCE CASE DEVELOPMENT DOCUMENTS UNDERWAY

The Work forward

Joint Working Groups

- Science Case Simulation
  - Astrometry
  - Exoplanet Yields
  - UV Galaxy Formation
  - Exoplanet Characterization
- Science Data Simulation
  - High-Contrast
  - UV MOS
  - Wide Field Imaging
- Science-Engineering Interface
- AI/ML
- Past Studies

ETCs, Simulations, Interfaces in development

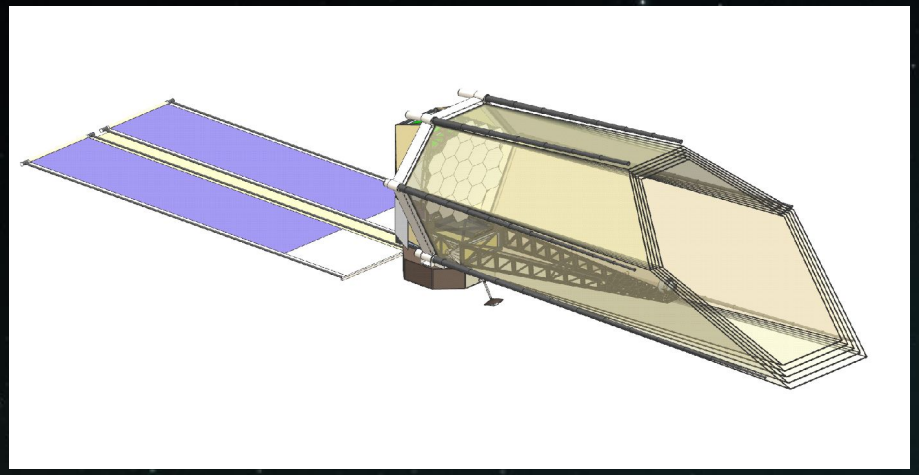
The Work forward

Community Working Groups

- Communications
- DEIA-Mentorship
- Future Ground-Based Facilities
- Future Space-Based Facilities
- GOMAP Synergies

Sign up for the mailing list on the NASA HWO website!

Notional Exploratory Analytic Cases



EAC1:

6m ID/7.2m OD off-axis

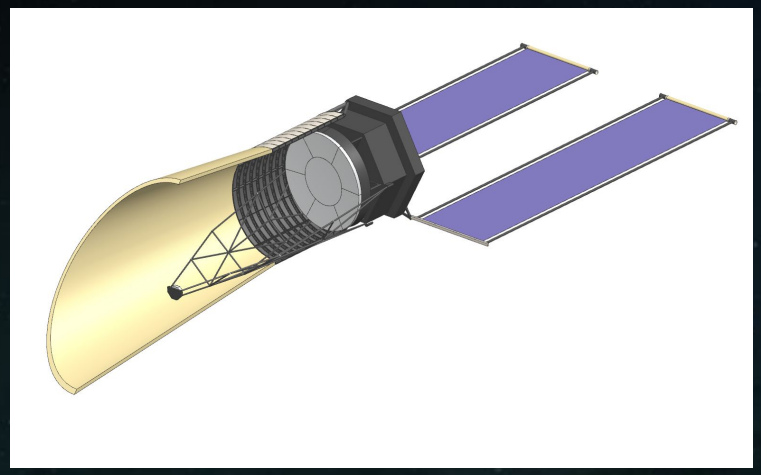
19 hex segments

PM faces horizontal in rocket

JWST like wing deployment

Fits in New Glenn, Starship Standard

Low Areal Density Mirrors



EAC2:

6m ID (round) off-axis

Non-deployed Primary mirror

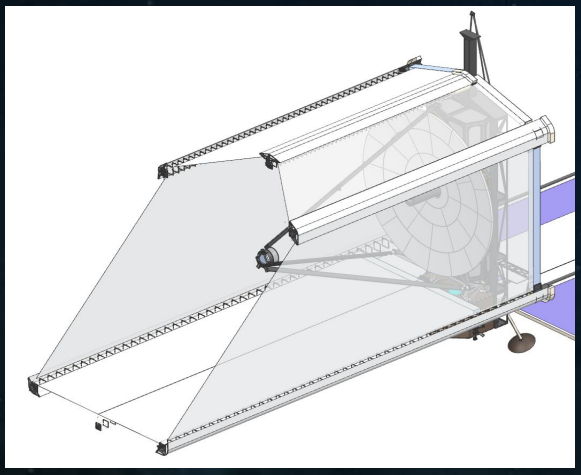
- Central 3 m, + 6 keystone

Primary mirror faces up in rocket

Lower barrel is fixed, upper barrel and SM deploy

Fits in Starship Standard

Higher Areal Density Mirrors



EAC3:

8m ID (round) on-axis

34 keystone segments

PM Faces horizontal in rocket

JWST like wing deployment

Fits in Starship Standard

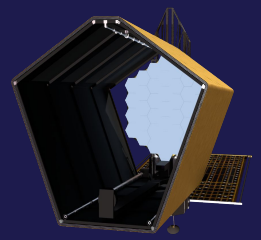
Low Areal Density

Large FOV guider/active wavefront sensing and control

HWO PRELIMINARY SPECS & CANDIDATE INSTRUMENTS

Telescope

Diameter	6+ meters
Bandpasst	100 nm (TBR)-2500nm
Diffr. Lim. Wavelength, Line of Sight	.5um, .4mas LOS

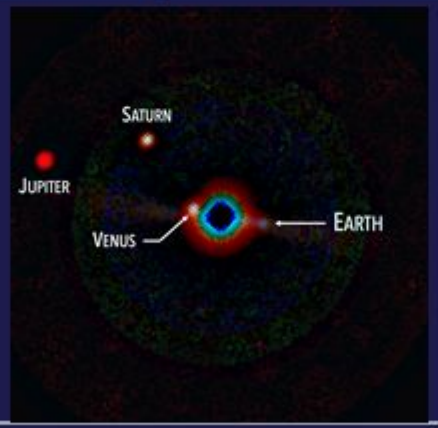


Fourth Instrument To be defined

Coronagraph*

High-contrast imaging and imaging spectroscopy

Bandpass	~350–1800 nm
Contrast	$\lesssim 1 \times 10^{-10}$
R ($\lambda/\Delta\lambda$)	Vis: ~140 NIR: ~70, 200



High-Resolution Imager

UV/Vis and NIR imaging

Bandpass	~200–2500 nm
Field-of-View	~3′ × 2′

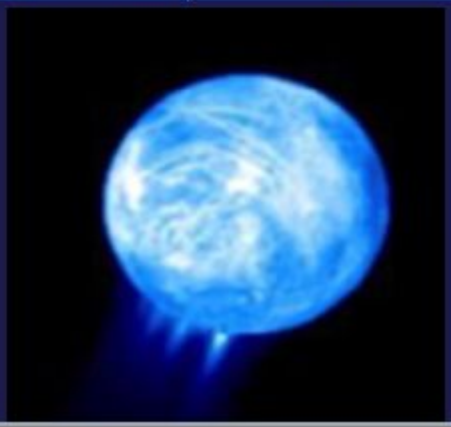
~67 science filters + grism

High-precision astrometry?

UV Multi-Object Spectrograph

UV/Vis multi-object spectroscopy and FUV imaging

Bandpass	~100–1000 nm
Field-of-View	~2′ × 2′
Apertures	~840 × 420
R ($\lambda/\Delta\lambda$)	500–50,000



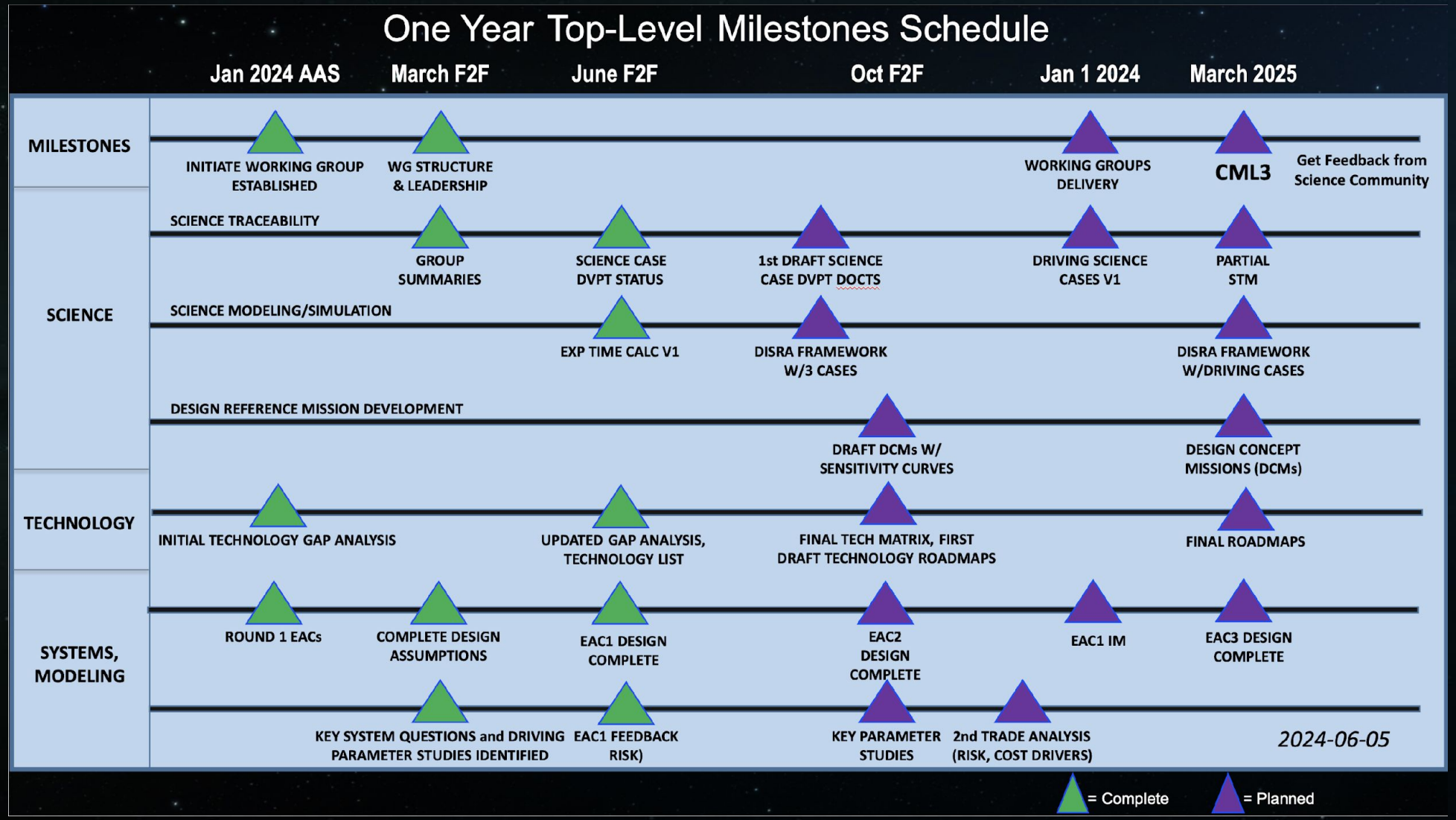
* High contrast NUV could be fourth instrument (XI)

Slide by Aki Roberge/GSFC

KEY TECHNOLOGIES FOR HWO (Draft)

Technology System	Capability Needed	Candidate Technologies	Anticipated TRL5 Performance Need	Current State of the Art	Threshold	Baseline	Enhancing	Estimated Current TRL	POC / Subgroup
Coronagraph System	Starlight Suppression Components	CLC, HLC, VVC4, APLC, PAPLC, PIAA-CMC, etc.	Component fabrication tolerances demonstrated (e.g., polarization leakage, apodization shape error, film thickness uniformity, etc.)	Some candidates achieve individual metrics, however simultaneous achievement by any one candidate of all metrics has not been demonstrated.	X			3-4	Coronagraph
	Deformable Mirrors	Xinetic PMN, MEMs, etc.	96x96 stable, high-yield, low-creep actuators, robust electronics	CGI Xinetics PMN DMs are SOA with 48x48 actuators; actuator drift is an issue. MEMs DMs need better surface figure.	X			4	Coronagraph
	Sensing & Control	LOWFS, OOBWFS, HOWFS, etc.	(1) Quasi-static contrast: >1e-10 contrast over 20% bandpass over specified IWA-OWA, core throughput with segmented apertures; (2) Contrast stability: Stabilize speckles to ~1e-11 level over specified temporal and spatial bandwidth -- residual from	CGI LOWFS is SOA, controlling tip/tilt and focus. CGI HOWFS achieves ~1e-8 raw contrast.	X			3-5	Coronagraph
	VIS Imaging & Spectroscopy Detectors	EMCCD, Skipper CCD, TES, etc.	4k x 4k format, <0.1 e- read noise, <1e-4 e-/p/s dark current, >80% QE at detection wavelengths, radiation hard	EMCCD have 0 read noise, dark current of 7e-4 e/p/s, not rad hard and have poor QE at long wavelengths. Skipper CCDs count photons with low dark current, but readout times need improvement.	X			4	Detectors
	NIR Imaging & Spectroscopy Detectors	H4RG, LM-APD, TES, etc.	2k x 2k format, <0.1 e- read noise, <1e-3 e-/p/s dark current, >90% QE over 1-2 um band, ≥70 K operating temp.	Roman H4RG have single-digit read noise, 1e-3 e/p/s dark current and large format. LM-APDs have ~0.5 e- read noise; spurious counts dominated by ROIC glow at 0.01 e-/frame	?	?		3	Detectors
	High-contrast Spectroscopy	IFS, Fiber-fed, Energy-resolving Detectors	Need R~70 for VIS, ~140 for NIR with high-throughput. Resolve questions around contrast gain and speckle chromaticity.	PISCES demonstrator for IFS; Some lab demonstrations of fiber-fed devices.	X			3-4	Coronagraph
	Noiseless, Single-photon Detectors for UV/VIS/NIR	TES, MKID, SNSPD	1k x 1k array format with >90% QE at specified wavelength, stable performance in radiation environment. If energy resolving, need to achieve R ~70/140 for VIS/NIR Note: These techs would supplant need for VIS/NIR Detectors as well as High-contrast Spectroscopy	MKID and TES have demonstrated energy resolving at 0.1 K and 0.05 K respectively. MKID QE~70% at 0.4 um, ~40% at 1.0 um; TES QE ~97% over band.			X	2-3	Detectors
Ultra-stable Telescope System	Ultra-stable Mirrors	ULE, Zerodur	Stiff, thermally stable mirror segment of desired areal density, 500 nm diffraction-limited surface figure, 1 mm edge roll-off	MMSD program made 5 ULE 1.4m mirror segments, one full PMSA assembly, one finished to 8 nm RMS surface, one mounted and Flight qualified, three segments built on three-week centers to demonstrate fab process.	X			4-5	TOAST
	Ultra-stable Structures	Composite	<1e-9/K CTE uncertainty, low CME & creep. Key goal to screen, characterize, and verify piece-parts and sub-assemblies.	JWST, Roman both using composite metering structures with characterized CTE/CME; need ~order of magnitude better uncertainty in material property characterization	X			4-5	TOAST
	Thermal Control System	Various	Need sub-mK control over 0.5-1 Hz rate; Low electronics noise; Need thermal system components (heaters, sensors, cables, straps, etc.) to have low impact on system stability.	Sub-mk control demonstrated on small scale in ultra-stable systems lab with non-Flight-like electronics.	X			3	TOAST
	Segment Rigid-body Actuation	Mechanical, Piezo, Hybrid	Low-creep, large stroke actuators with picometer resolution	JWST mechanical actuators achieve stroke and coarse-phasing requirements. PZTs demonstrate near capability for fine stage, but require integration with mechanical systems and electronics development.	X			4	TOAST
	Sensing & Control	Edge Sensors, Laser Metrology, Phase Retrieval, etc.	Segment rigid-body sensing and global alignment sensing to picometer level at high bandwidths	Capacitive, Inductive, and Optical edge sensors in development with varying degrees of sensitivity. Image-based techniques demonstrated on JWST, sub-nm stability measurement achieved with long data set.	X			3-4	Sensing & Control
	Far-UV Mirror Coatings	eLIF+Al, etc.	>60-80% reflectivity 100-120 nm, robust to environments, no impact to coronagraphy	>50%-80% reflectivity below 120 nm. Major gaps are in environmental stability, and scale & uniformity needs for HWO, including measurements of impact on coronagraphy.	?	?		3-5	UV & UV Detectors
	Low Disturbance Systems	Active & Passive Isolation, Microthrusters, low-disturbance cryo-coolers	~40 dB isolation / suppression of disturbances > 1 Hz	Disturbance free payload hardware is ~TRL4, and microthrusters have been used on missions with different requirements than HWO. Low/No-disturbance cryo-coolers require characterization and evaluation for impact to coronagraph performance.	X			4	Cross-cutting
	Mirror Baffle Assembly	Deployable Membrane	Robust to micrometeoroids, low complexity deployment, low thermal impact on OTE	JWST sunshield represents state-of-the-art deployable membrane	X			3	Cross-cutting
High-Sensitivity UV/VIS Instrumentation	Large-format, low-noise NUV/VIS Detectors	CMOS, CCD, MCP	>8K x 8K pixels, <2.5 e- read noise, <0.002 e-/p/s dark current, >50% QE between 300-400 nm	Commercial CCD and scientific CMOS sensors exist, but would require improvements in noise. Low-noise detectors like EMCCD or Skipper CCDs require improvements in QE between 200-400 nm to be viable.		X		4	Detectors
	Enhanced Far-UV Detectors	MCPs	>40% QE 100-200 nm; 100 mm array size with 40 um resels, 1e-5 OOB rejection >300 nm	FUV-optimized MCPs with peak QE of 50% between 100-180 nm exist		X		4-5	UV & UV Detectors
	Multi-object Selection	Next-gen MSAs, DMDs, reflective IFS	<100 mas spatial resolution, >500 simultaneous objects	MSA & DMD are TLR5+ for most missions, but require scaling and tile-ability for HWO; IFS requires additional study for scattered light and resolution		X		3-5	UV & UV Detectors

THE WORK AHEAD



Project Office Considerations

Since September 2023, early HWO efforts have been guided initially by the START and TAG committees set up by NASA headquarters

- Science, Technology, Architecture Review Team (START)
  - Primarily Science Oriented with ex-officio reps from industry
- Technical Assessment Group (TAG)
  - Government team led engineering and science analysis
  - Study architecture options and supporting engineering analyses
  - Develop Technology Roadmaps and Plans
  - This talk will focus on the TAG efforts

NASA has announced a HWO Technology Maturation Project Office at Goddard which is just starting up and will build upon the efforts in this talk

- As part of the transition to a Project Office, the TAG members will fold under the project office activities
- START phases out but working groups continue at least through end of the Fiscal Year

NASA Astrophysics Division Update

Cosmic Origins (COR) Town Hall | July 10, 2024

Patricia Knezek
COR Program Scientist

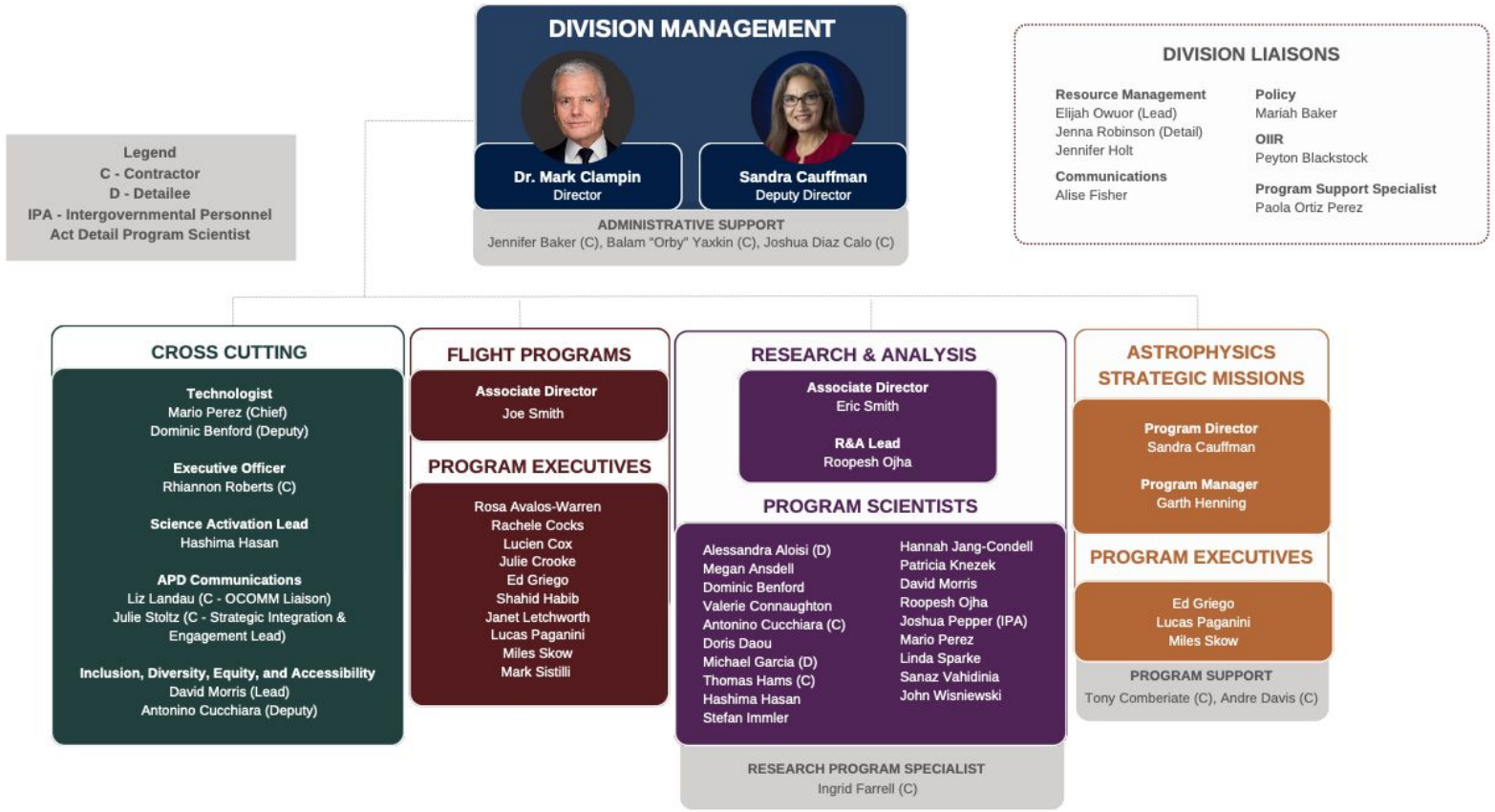
NASA Astrophysics Division Update (1/2)

- 2023 Astrophysics Probe Explorer review is still on track to announce selection(s) in Q4 of CY2024.
- Habitable Worlds Observatory Project Office setup at GSFC is underway.
  - START will disband when the Project Office is official.
  - HWO Working Groups will not experience any changes to their work through the end of CY2024.
- The Hubble and Chandra operations paradigm review has concluded. Results will be debriefed at the July 23-24 APAC meeting. Please attend that to hear more! (The meeting information was sent to the COR listserv Monday.)
- Curious what was said at the NASA AAS Town Hall? The report on the most recent Senior Review? Check https://science.nasa.gov/astrophysics/resources/documents

NASA Astrophysics Division Update (2/2)

- SAT Results: 12 selected out of 40 compliant proposals, for a 30% selection rate.
- APRA: 36 selected of 163 proposals, for a 20% selection rate.
- For ROSES 2024 SAT & APRA, mandatory Notices of Intent (NOIs) are due 12/13/2024, and proposals are due 01/20/2025.

NASA Astrophysics Division



More details can be found at https://science.nasa.gov/astrophysics/astrophysics-organization-and-staff/

Community Participation & Discussion

Backup Slides