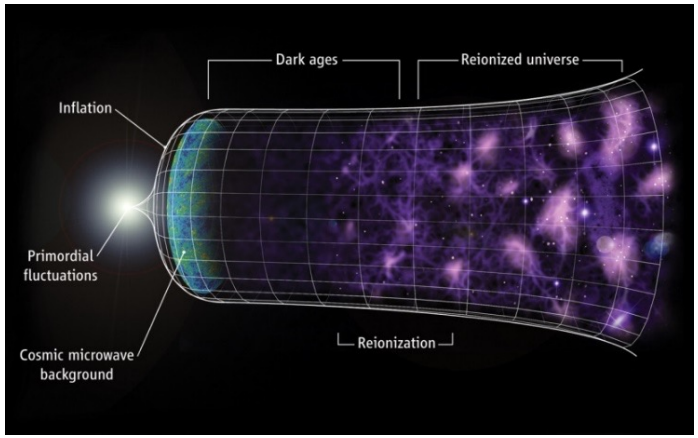
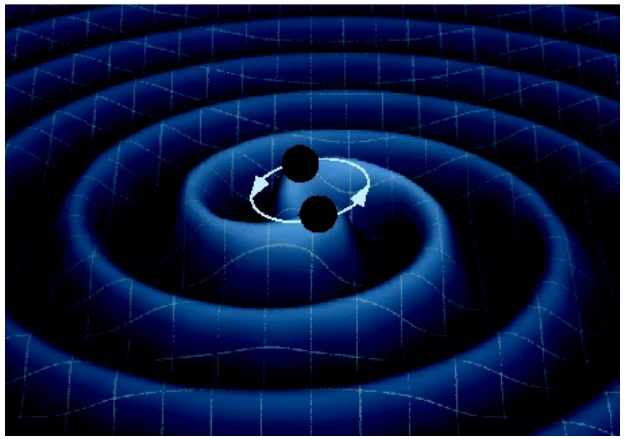
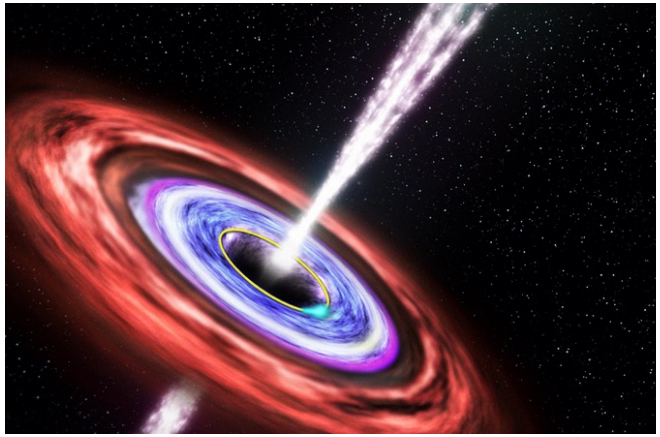
Physics of the Cosmos Program Analysis Group



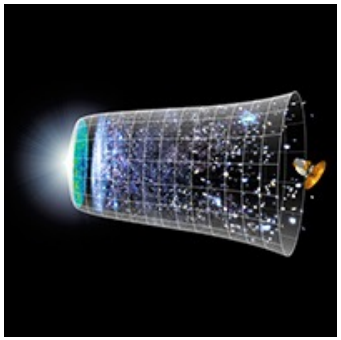
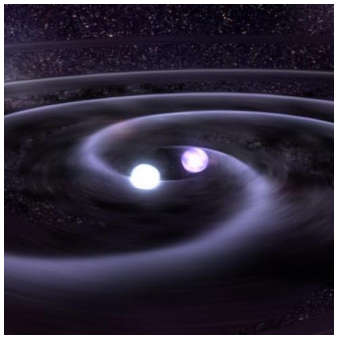
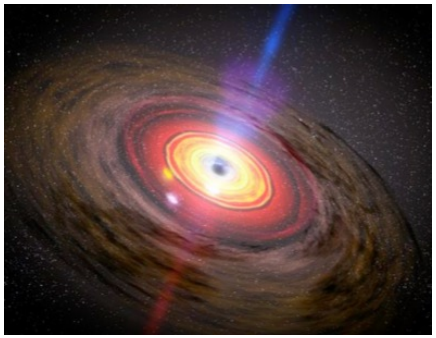


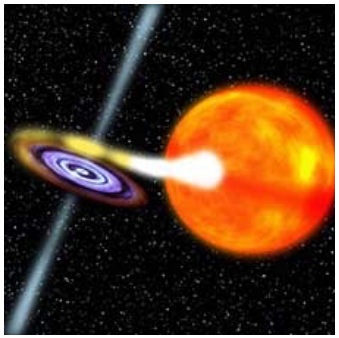


Justin Finke
Naval Research Laboratory
Chair Physics of the Cosmos Program Analysis Group, PhysPAG
justin.finke@nrl.navy.mil

APAC Meeting, 28 June 2023

Physics of the Cosmos Science Objectives



- Dark Energy
- Big Band and the Evolution of the Universe
- Dark Matter and Cosmic Structure
- General Relativity and the Nature of Spacetime
- Massive Black Holes and the Evolution of Galaxies
- Matter and Energy in the Most Extreme Environments

PhysPAG Executive Committee

Name	Institution	Expertise	Term	
			Start	End
Grant Tremblay (Chair Emeritus)	Smithsonian Astrophysical Observatory	XR SIG	Dec 2019	Dec 2023
Justin Finke (Chair)	Naval Research Laboratory	GR SIG	Dec 2020	Dec 2023
Vera Gluscevic	Univ. of Southern California	CoS SIG	Dec 2020	Dec 2023
Andrew Romero-Wolf	JPL	CR SIG	Dec 2020	Dec 2023
David Pooley	Trinity University	XR SIG	Dec 2021	Dec 2024
Athina Meli (Vice Chair)	North Carolina A&T	CR SIG	Dec 2021	Dec 2024
Eric Burns	Louisiana State University	GR SIG	Dec 2021	Dec 2024
Kristin Madsen	NASA/GSFC	XR SIG	Dec 2021	Dec 2024
Chiara Mingarelli	Univ. of Connecticut	GW SIG	Feb 2023	Dec 2025
Chien-Ting Chen	USRA/MSFC	XR SIG	Feb 2023	Dec 2025
Alessandra Corsi	Texas Tech	GW SIG	Feb 2023	Dec 2025
Roger O'Brient	JPL	IP SIG	Feb 2023	Dec 2025
Rebekah Hounsell	UMBC/GSFC	CoS SIG	Feb 2023	Dec 2025
Manel Errando	Washington U. St. Louis	GR SIG	Feb 2023	Dec 2025

PhysCOS staff

- **PhysCOS Chief Scientists: Francesca Civano, Brian Humensky**
- **PhysCOS Support Scientist: Bernard Kelly**
- **Project Support Specialist: Stephanie Clark**
- **Headquarters: Valerie Connaughton, Sanaz Vahidinia**

Science Interest Groups (SIGs)

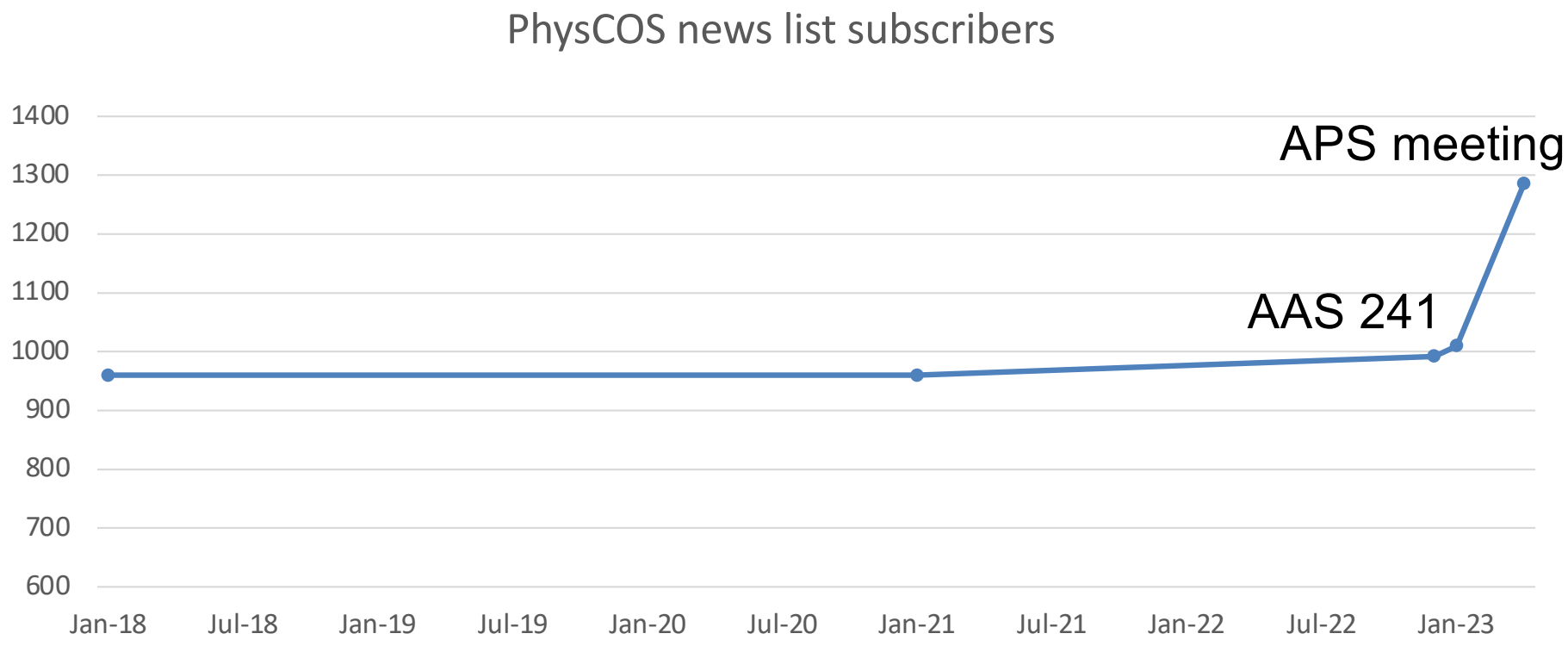
- Inflation Probe Science Interest Group (IP SIG)
- Cosmic Structure Science Interest Group (CoS SIG)
- Cosmic Ray Science Interest Group (CR SIG)
- Gamma-ray Science Interest Group (GR SIG)
- Gravitational Wave Science Interest Group (GW SIG)
- X-ray Science Interest Group (XR SIG)
- Time domain and Multi-Messenger Science Interest Group (TDAMM SIG)

PhysPAG Activities

- Continue bi-weekly EC meetings
- Booth and special sessions at HEAD meeting
- Booth and special session at APS meeting
- PhysPAG EC Planning Retreat – May 17-18
- Regular virtual meetings by GR SIG, GW SIG, CR SIG, CoS SIG
- Work continues for AWESOM SAG, NGO SAG, TCOM SAG
- GTNSAG – complete report, deliver to NASA and APAC

- *See bonus slides at the end of slide deck for details!*

PhysCOS mailing lists subscribers



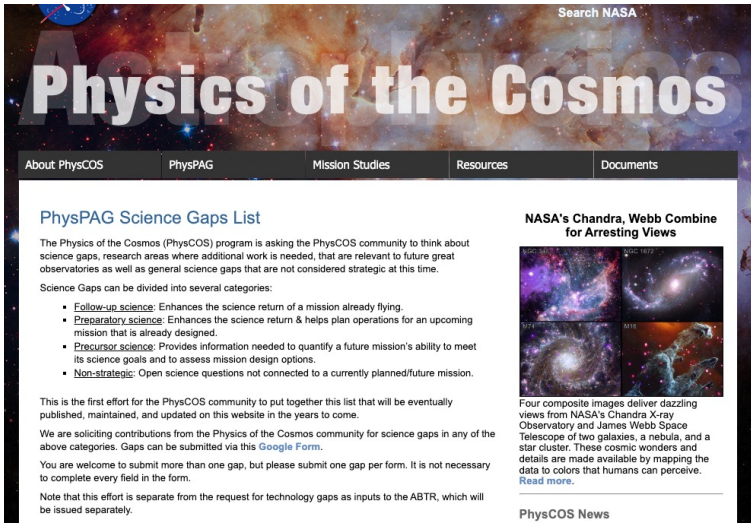
Time Domain and Multi-Messenger SIG

- Chaired by Eric Burns, three others TBD
- Previously recommended by APAC and approved by NASA
- Cross-PAG with COPAG and EXOPAG
- Two chairs from PhysPAG, one from COPAG, one from EXOPAG
- Terms of Reference delivered by time of APAC meeting
- Session at HEAD meeting

3:00pm-3:20pm	Introduction	Eric Burns	[PDF]
3:20pm-3:40pm	Presentation	Valerie Connaughton	[PDF]
3:40pm-4:30pm	Community Discussion		

PhysCOS Science Gaps

- **Involve the PhysCOS community to formulate strategic (precursor, preparatory, follow-up) gaps relevant to NGOs and probes (and TDAMM). Also non-strategic gaps**
- **Process: collect inputs, PhysPAG EC revise the list, publish on PhysCOS website:**
  - https://pcos.gsfc.nasa.gov/physpag/science-gaps/science-gaps.php .
  - Update gaps annually or bi-annually.
- **My concerns**



Gamma-ray Transient Network SAG

- **Meetings from January to June this year. Co-chairs Eric Burns, Michael Coughlin. 50+ SAG members. 50+ pages.**
  - First post-Decadal TDAMM SAG Report delivered to NASA HQ
- **Content:**
  - Multidisciplinary TDAMM science enabled by observations of magnetars, compact mergers, collapsars across electromagnetic, gravitational wave, and neutrino spectra
    - Implications for gamma-ray bursts, supernovae, fast radio bursts, multimessenger sources, etc
  - Focused section on how instrumental capabilities flow to specific scientific outcomes
  - Actionable items for improving TDAMM return from current/forthcoming/future NASA missions
    - E.g. “Immediately enacting the additional data downlinks requested by Swift during Senior Review would provide strong scientific return for low operational cost, with potential groundbreaking discovery given LIGO is now observing.”
  - Holistic exploration on enhancements to the InterPlanetary Network (IPN) operations to maximize TDAMM science return with existing facilities
    - E.g. treating all gamma-ray burst monitors as a single effective telescope (within existing international agreements) would vastly improve sensitivity without launching new hardware

Gamma-ray roadmap SAG

- **Presented to GR SIG June 16th**

- **Overall questions to answer:**
  What gamma-ray science would we like to accomplish?
  Is this gamma-ray science being met with currently existing or funded missions?
  What capabilities would we need to accomplish this gamma-ray science?
  - New observational facilities
  - Theoretical work
  - Laboratory astrophysics
- **How can gamma-ray astrophysics support Astro2020 recommendations? What important science did Astro2020 miss?**
- **Divide into science topics, each with a chair. 5-8 chairs.**

SAG timeline

- end of June 2023: open nominations for chairs
- August 2023: Pick chairs (5-8?). Wide variety of scientific/technical expertise, geographic locations, career stage, gender balance, etc.
- August-September 2023: chairs work on Terms of Reference
- Late Sept./Early Oct.: ToR reviewed by Valerie and Mark Clampin
- October 19-20, 2023: present SAG ToR to APAC for approval
- late November 2023: approval by APAC (presumably)
- January 2024: kickoff in-person (hybrid) meeting (maybe at AAS?)
- January 2024-February 2025: Monthly meetings of full SAG. Entire community welcome to join! Regular independent meeting for each science topic. Writing of report.
- March 2025: Deliver report to NASA and APAC
- 2025: SMEX due. Finish before then?

Summary

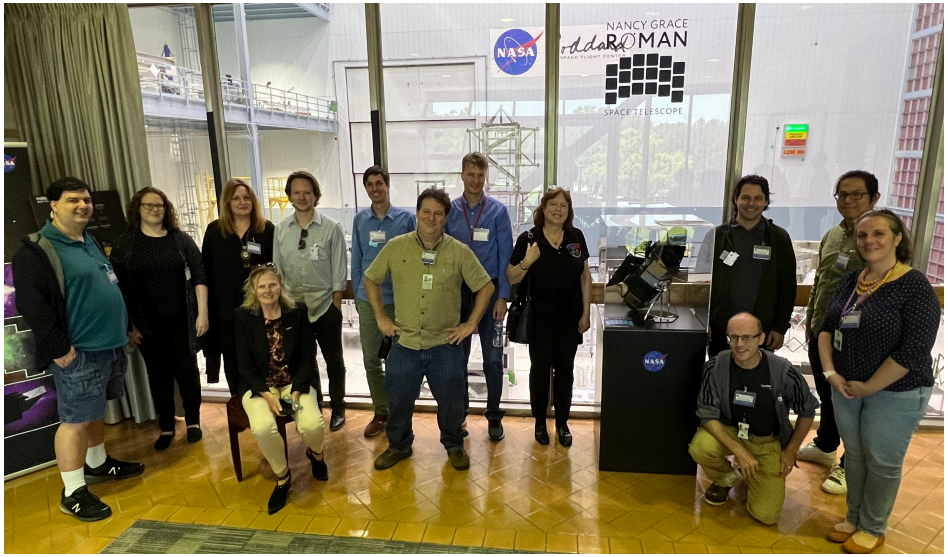
- **Numerous PhysPAG activities continue**
  - 3 current active SAGs, more in the pipeline
  - Numerous in-person and virtual meetings for PhysPAG and 7 SIGs
- **New TDAMM-SIG Terms of Reference delivered – any input from APAC?**
- **Science Gaps work begun – any suggestions from APAC?**
- **GTN SAG finished and delivered report – any comments from APAC?**
- **Request for Gamma-ray roadmap SAG at October APAC meeting – any input from APAC ahead of formal request?**

Bonus slides

PhysPAG EC Strategic Planning Retreat

- In-person meeting at NASA/GSFC on May 17-18, 2023
- 10 EC members in person + 1 remote: great team building experience
- Presentations about Program Office activities, SIG statuses and future plans, GOMAP
- Extensive discussion of Science Gaps and science with HWO
- Visit to Roman viewing deck and W. Zhang X-ray mirror lab

Thanks to PhysCOS chief scientists Francesca Civano and Brian Humensky for organizing it!



PhysCOS at HEAD meeting

- **XR SIG session, attendees: 46 in person**
- **TDAMM SIG session, attendees: 32 in person, 1 online**
- **PhysPAG session, attendees: 70 in person, 4 online**

2:00pm	PhysPAG Activities	Justin Finke, NRL	[PDF]
2:15pm	PhysCOS	Francesca Civano, GSFC	[PDF]
2:30pm	TDAMM Overview	Eric Burns, LSU	[PDF]
2:55pm	LISA	Sean McWilliams, West Virginia	[PDF]
3:20pm	Discussion		

PhysCOS at April APS Meeting

- Special session with 7 talks (~50 attendees)
- Staffed booth in high-traffic location.
- Much interest in TDAMM topics and synergy between GW and high-energy community

Time Domain and Multi-Messenger SIG

- Chaired by Eric Burns,
- Cross-PAG with COPAG and ExoPAG
- Two chairs from PhysPAG, one from COPAG, one from ExoPAG
- Terms of Reference delivered by time of APAC meeting
- Session at HEAD meeting

3:00pm-3:20pm	Introduction	Eric Burns	[PDF]
3:20pm-3:40pm	Presentation	Valerie Connaughton	[PDF]
3:40pm-4:30pm	Community Discussion		

Gravitational Wave SIG

- **Chaired by Alessandra Corsi & Chiara Mingarelli**
- **Helping with white paper for submission for Roman. Focusing on multi-messenger benefits of Roman and LISA**
- **Will contribute to GRSIG roadmap SAG**
- **Held telecon May 19**

Agenda

- Round of intro
- Summary of APS meeting and PhysPAG retreat (Francesca and Brian)
- Update on HEAD newsletter (Alessandra)
- Future meetings of relevance (Chiara)
- Responding to decadal survey and coordinating with TDAMM and GR-SIG (Alessandra and Chiara)
- Proposal for flash talks during quarterly meetings (10 minutes so we know what people work on) and schedule for the Fall (Alessandra)

X-ray Science Interest Group

- **Chaired by Grant Tremblay, David Pooley, Kristin Madsen, Chien-Ting**
- **Session at HEAD meeting**

3:00pm-3:20pm	Introduction & PhysCOS Informercial	Kristin Madsen & Francesca Civano	[PDF]
3:20pm-4:10pm	Athena Update & Discussion, NAST Information	Andy Ptak & Laura Brenneman	[PDF] [PDF]
4:10pm-4:30pm	XRISM Update & Discussion	Brian Williams	[PDF]

Gamma-ray Science Interest Group

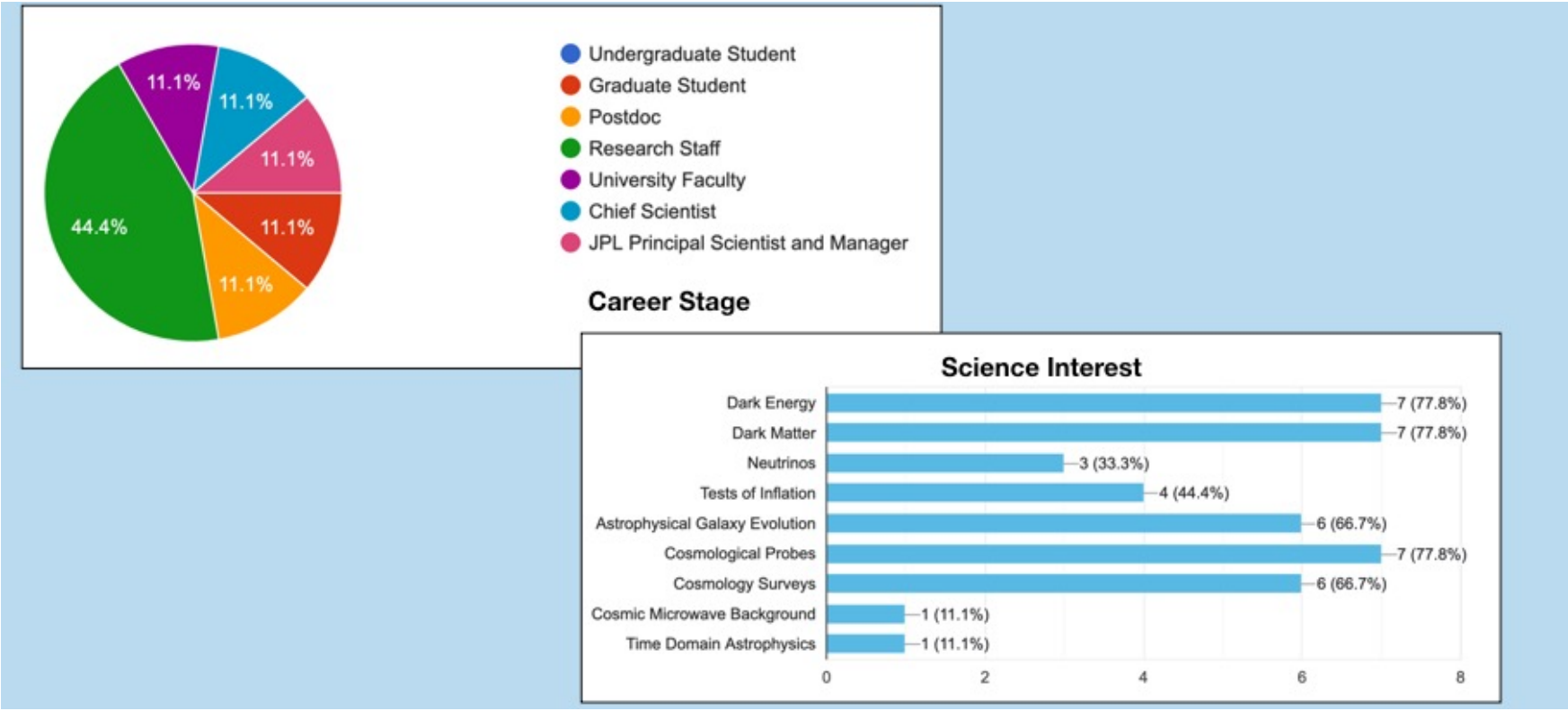
- **Chaired by Eric Burns, Manel Errando and Justin Finke**
- **Monthly virtual meetings**
  - May 12
    - Lessons learned from the Advanced Compton Telescope (Steve Boggs, UCSD)
    - Design and implementation of future gamma-ray missions: a co-design approach (Chris Fryer, LANL)
    - Science capabilities of future gamma-ray missions (Jeremy Perkins, GSFC)
    - Discussion: "Community efforts leading to future gamma-ray missions"
  - June 16
    - Roadmap to Complementarity: Key Investments in the High-Energy Space Infrastructure Environment for 2040 (Tiffany Lewis, GSFC)
    - Lessons learned from the 1997 Roadmap for Gamma-ray Astronomy (Peter Michelson, Stanford)
    - Discussion: How to design a road mapping taskforce? (Justin Finke, NRL)
- **Gamma-ray roadmap task force (SAG)**

Cosmic Ray Science Interest Group

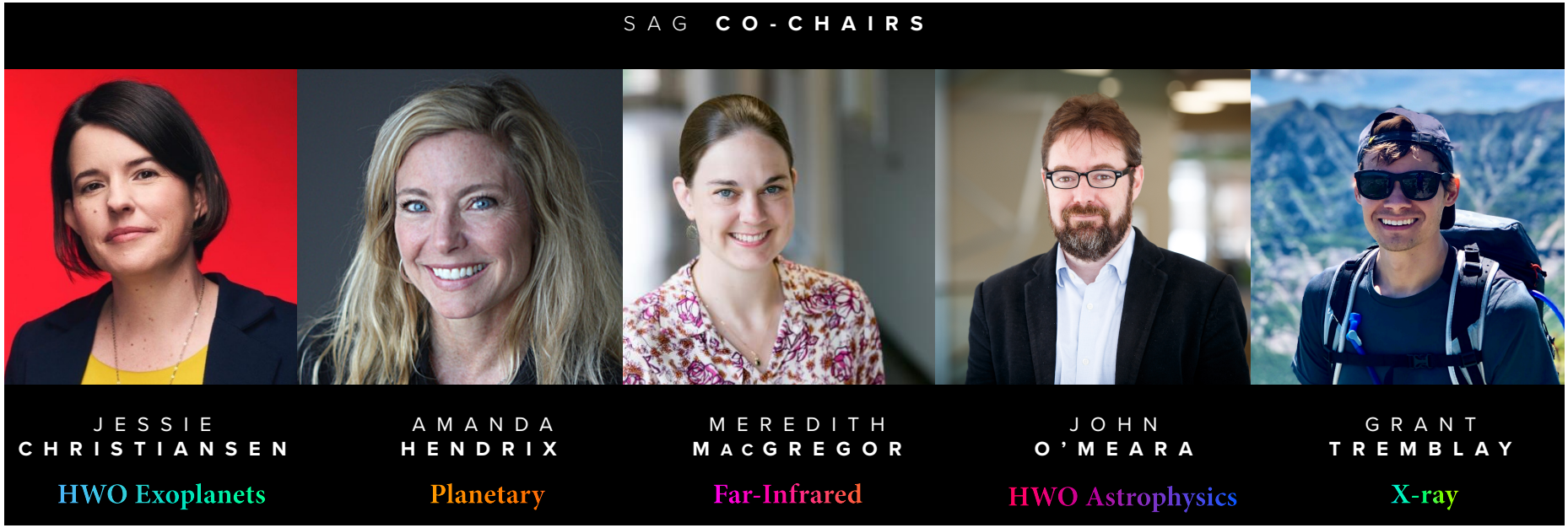
- **Chaired by Athina Meli and Andrew Romero-Wolf**
- **Will host virtual forum on June 30: "On the Origin of Heavy Elements"**
  - Brian Raouch, "TIGERISS Ultra Heavy Cosmic Ray Science Objectives"
  - Carolyn Kierans, "Imaging nuclear line emission from the Galaxy with COSI"
  - Brian Metzger, "Heave Element Nucleosynthesis from the Birth of Black Holes"
  - Brian Fields, "When Stars Attack!: Live Radioisotopes as Laboratory Signatures of Nearby Cosmic Explosions and their Nucleosynthesis"

Cosmic Structure Science Interest Group

- **Chaired by Vera Gluscevic and Rebekah Hounsell**
- **Will host monthly virtual meetings monthly. First one May 26**



New Great Observatories SAG



New Great Observatories SAG

- **A *cross-PAG* SAG charged with analyzing how the *three notional GOMAP mission entrants* (HWO, X-ray, FIR) can advance the Key Science Questions from both Astro2020 and the 2022 Planetary Decadal.**
- **In other words, "*what is the science case for the GOMAP*?" One can synthesize this from Astro2020, but it's not immediately apparent from the executive summary.**
- **Work is now underway by an inclusive and diverse membership of *more than 200* scientists and engineers from across the country and globe.**
- **We will closely work with the HWO START and HQ GOMAP leadership, and aim to deliver a report in about a year.**
- **Read the terms of reference and join the SAG at http://greatobservatories.org/sag**

TDAMM Communications SAG

- Led by Jamie Kennea and Judy Racusin
- NASA's Tracking and Data Relay System (TDRSS) will be replaced circa
- 2030 by a commercial service
- SAG will explore requirements of a future communication system based on TDAMM science drivers
- First meeting June 20th