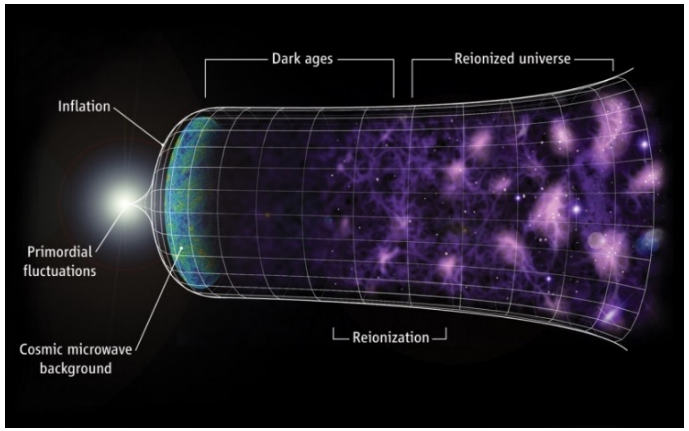
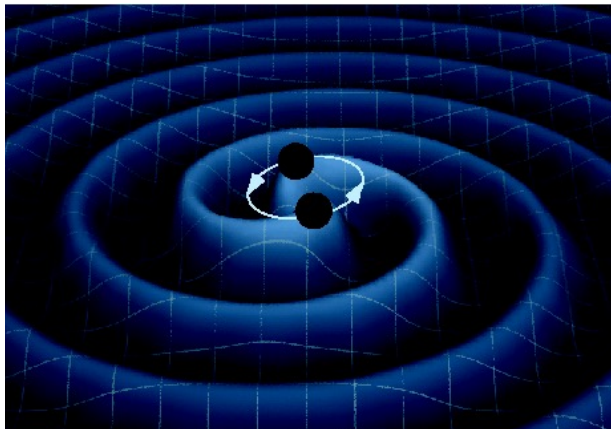
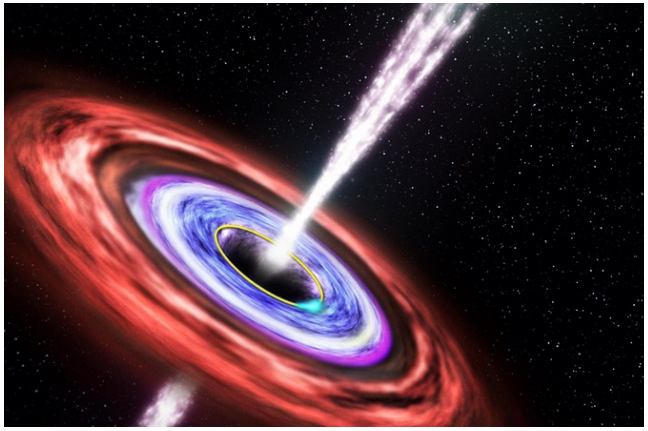
Physics of the Cosmos Program Analysis Group



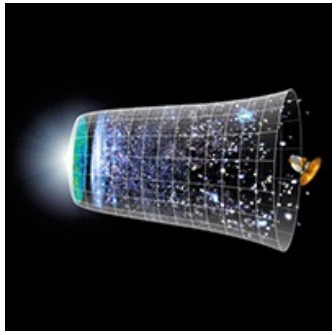
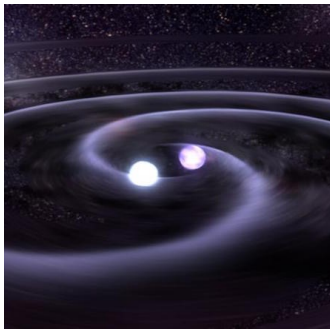
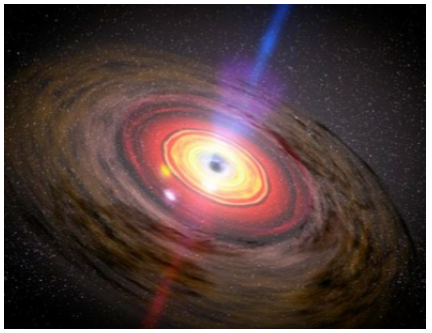


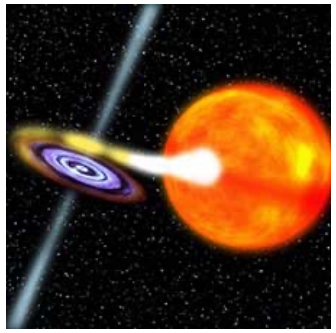


Justin Finke
Naval Research Laboratory
Chair Physics of the Cosmos Program Analysis Group, PhysPAG
justin.finke@nrl.navy.mil

APAC Meeting, 19 October 2023

Physics of the Cosmos Science Objectives



- Dark Energy
- Big Bang 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**

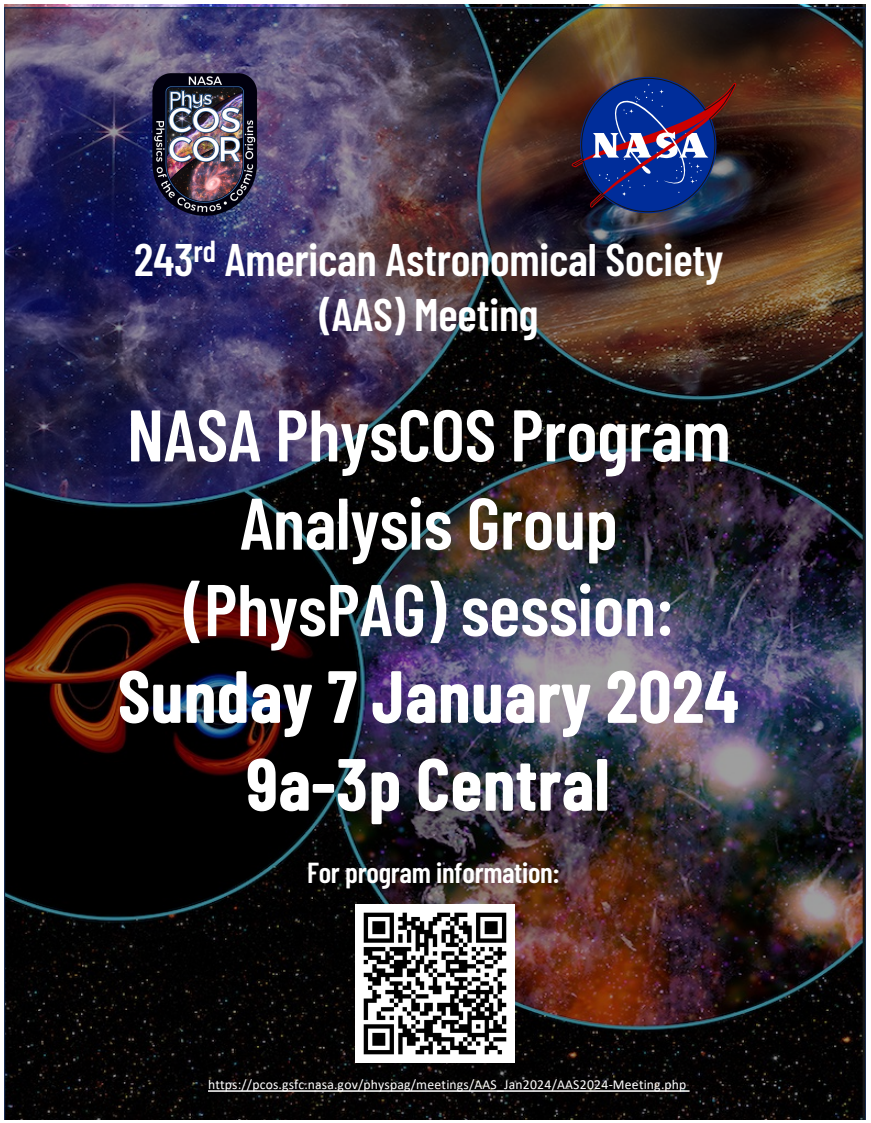
Science Interest Groups (SIGs)

- 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)

Science Analysis Groups (SAGs)

- **Gamma-ray Transient Network (GTN) SAG – *see talk by Eric Burns tomorrow***
- **New Great Observatories (NGO) SAG (cross-PAG)**
- **Astrophysics with Equity, Surmounting Obstacles to Membership: AWESOM SAG (cross-PAG)**
- **Time-domain and Multi-Messenger Communications (TDAMMCOM) SAG**
- **Future Innovations in Gamma-ray Science (FIGS) SAG – *proposed here***

AAS Meeting January 2024

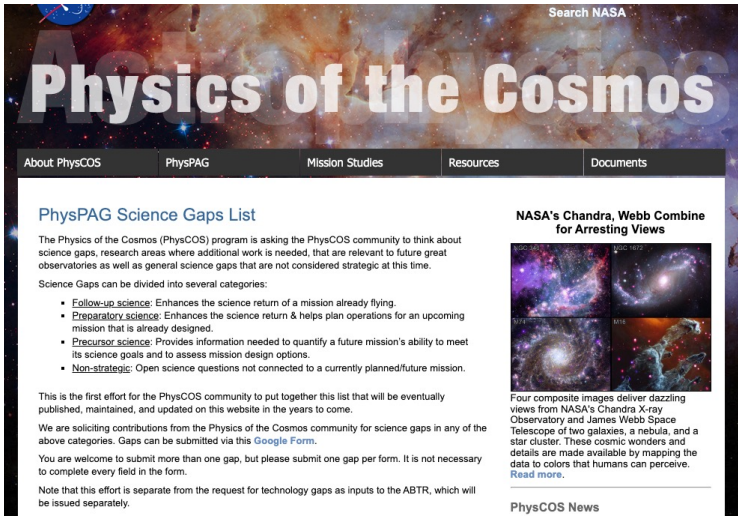


35 min	CoS SIG	- Co-chairs talk (science gaps and how the PO and PAG can support Roman in next few year) - Talk on PhysCOS Science with Roman
30 min	IP SIG	- Chair talk – introduction - Potential science for a SAG
18 min	GTN SAG	Co-chairs report summary & action items
18 min	TDComm SAG	Co-chairs report summary & action items
45 min	XR SIG	- What next after the probes/MIDEX? - Precursor Science Gaps - XRISM talk (B Williams)
40 min	GW SIG	- Co-chairs talk - Connection between GW and other SIGs - PTA results and what's next
15 min	GRSIG	- New SAG introduction
60 min	TDAMM SIG	- Co-chairs talk - Presenting long term goals

FIGS SAG and GW SIG within AAS meeting proper

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 every year or every other year



X-ray SIG

- **Co-chairs: Grant Tremblay, David Pooley, Kristin Madsen, and Chien-Ting Chen**

- **Astrophysics Probe Explorer Announcement of Opportunity released on July 31st.**
- **Proposals due November 16th**

Responses to the APEX AO are limited to one of those two mission themes recommended by the Decadal Survey. These areas are

- A far-infrared imaging or spectroscopy mission, and
- An X-ray probe.

Time Domain and Multi-Messenger SIG

- Cross-PAG SIG with COPAG and ExoPAG
- Co-chairs: Eric Burns (PhysPAG), Rebekah Hounsell (PhysPAG), Brad Cenko (COPAG), Ian Crossfield (ExoPAG)
- Chairs have begun meeting, working out how Cross-PAG will work
- Kickoff session planned at January 2024 AAS Meeting

Gamma-ray SIG

- **Co-chairs: Eric Burns, Manel Errando, and Justin Finke**
- **Online meeting September 22**

  - Drivers of Future Gamma-ray Astrophysics Science Analysis Group (DFGA SAG) co-chair selection
  - Update from the DFGA SAG taskforce chairs
  - Physics of Cosmos Science Gaps List
  - Science talk: Searches for indirect dark matter detection in the gamma-ray band (Joshua Foster, MIT)

- **New FIGS SAG**

Astrophysics With Equity, Surmounting Obstacles to Membership (AWESOM) SAG

- **Co-chairs: Ryan Hickox, Vallia Antoniou, and Christian Soto**
- **Work continuing with virtual meetings September 8, 22, October 6, 20. Complete report expected Spring/Summer 2024**

Working Group Concept

- Overview of existing/ongoing NASA initiatives
- Research projects/funding opportunities at MSIs, CCs, etc.
- Student training programs (w/ bridge programs)
- DEI practices in NASA astrophysics (e.g., selection and recruitment)
- Overview of the landscape of astrophysics at MSIs, CCs, PUIs, etc.

https://pcos.gsfc.nasa.gov/sags/awesom.php

For notes see dartgo.org/awesom_meeting_notes

Sign up form

dartgo.org/awesom

TDAMM Communications SAG

- **Co-chairs: Jamie Kennea and Judy Racusin**
- **Aimed at providing requirements for the future NASA/Commercial communications system to meet the unique needs of TDAMM science and missions**
- **Study began: June 2023; Final Report: ~April 2024**
- **Membership**
  - Open invitation to community
  - Specifically recruited from current and in-development missions, as well as SCaN and DSN
  - ~30 members regularly participating
- **Meetings**
  - Monthly discussion of TOR questions
  - Recordings of past meetings available: https://pcos.gsfc.nasa.gov/sags/tdammcomm-sag.php

Future Innovations in Gamma-ray Science (FIGS) SAG

Astrophysical gamma rays span ten orders of magnitude in energy and capture key physics from a broad range of astrophysical phenomena. This SAG will explore gamma-ray science priorities, necessary capabilities, new technologies, and theory/modeling needs drawing on the 2020 Decadal to inspire work toward 2040.

To get involved and stay informed, please enter your contact information here: https://forms.gle/VBijBgapMRwJm9dU6

Lead Chairs:
Chris Fryer & Michelle Hui

Co-chairs: Paolo Coppi, Milena Crnogorčević, Tiffany Lewis, Marcos Santander, and Zorawar Wadiasingh

FIGS SAG Terms of Reference

The Terms of Reference define the scope of the SAG as the science relevant to space-based gamma-ray astronomy. The space-based gamma-ray regime is bounded in energy at ~100 keV by the X-ray regime, and at ~100s GeV by the ground-based gamma-ray regime, where Cherenkov detectors are better suited. This leaves the MeV range, which will be partially addressed by COSI (a SmEx specializing in polarization and nuclear lines) and the GeV range, which is currently covered by *Fermi*-LAT.

So, the primary question for this SAG is: ***What science has not or cannot be done with existing or funded space-based gamma-ray instrumentation?***

The Terms of Reference additionally define the scope to include drawing connections with other wavelengths and messengers for which this gamma-ray science is also crucial.

FIGS SAG Terms of Reference

1. **Gamma-ray Science Priorities:** Identify opportunities uniquely afforded by gamma-ray observations.

2. **Gamma-ray Mission Capabilities:** Which science objectives are only done or best done by space-based gamma-ray missions, considering the current missions in extended operation and funded missions in development.

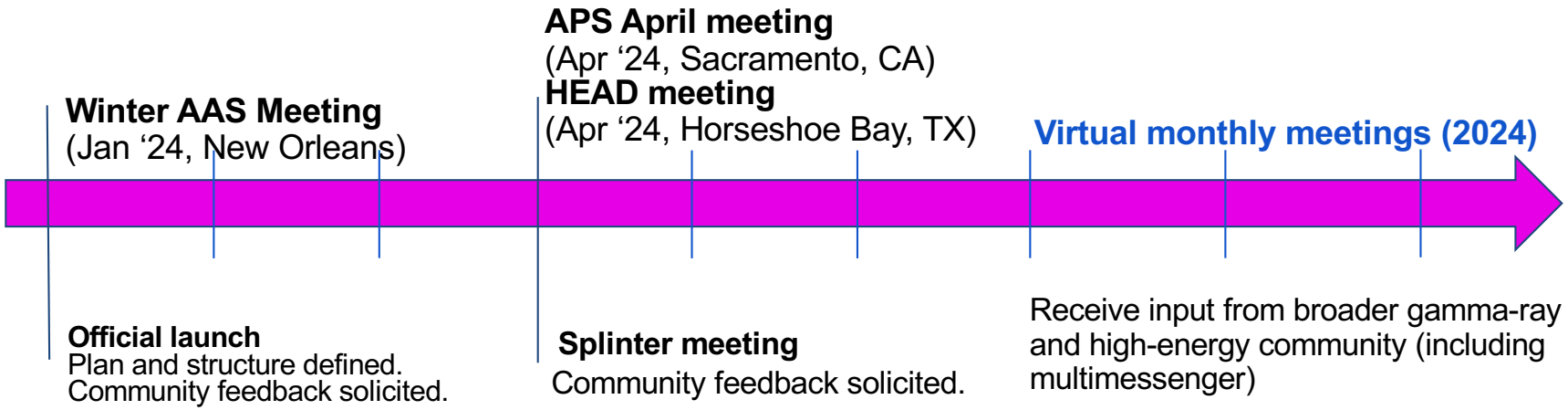
3. **Technology Investment:** What new technologies/methodologies exist and what is needed to achieve the science priorities.

4. **Theory and Analysis Needs:** What advances do we need to make in theory and analysis to achieve the science priorities.

5. **Synergies with Other Programs:** How do these goals tie to the broader astrophysics and physics community. What are the timelines to align with current priorities in multi-messenger astronomy.

FIGS SAG Timeline

FIGS SAG is already generating interest among the gamma-ray community, and that interest is being collected informally.



- **Community participation will be vital** for a well-informed report on the future of gamma-ray science and how innovations in technology and instrumentation at NASA can help make it possible.

Summary

- **Numerous PhysPAG activities continue**
  - 3 current active SAGs, 1 closed out, 1 proposed here
  - Numerous in-person and virtual meetings for PhysPAG and 7 SIGs and 3 SAGs
  - Science Gaps
- **Action item for APAC**
  - Recommendation for FIGS SAG

Bonus slides

FIGS SAG Timeline

- FIGS SAG is already generating interest among the gamma-ray community, and that interest is being collected informally.
- It plans to be formally launched at the Winter AAS Meeting in New Orleans, where the chairs will elaborate on plans and structure, as well as solicit community feedback, both in real time and on an ongoing basis.
- There are plans for a splinter session at the HEAD Meeting in 2024.
- There will also be virtual meetings to solicit input from a broader swath of the gamma-ray and high-energy communities, including our colleagues who specialize in other messengers.
- This broad community participation will lead to a well informed report on the future of gamma-ray science and how innovations in technology and instrumentation at NASA can help make it possible.