Physics of the Cosmos
Program Analysis Group

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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

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Expertise</th>
<th>Term</th>
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<tbody>
<tr>
<td>Grant Tremblay</td>
<td>Smithsonian Astrophysical Observatory</td>
<td>XR SIG</td>
<td>Dec 2019 - Dec 2023</td>
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<tr>
<td>Justin Finke</td>
<td>Naval Research Laboratory</td>
<td>GR SIG</td>
<td>Dec 2020 - Dec 2023</td>
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<td>Vera Gluscevic</td>
<td>Univ. of Southern California</td>
<td>CoS SIG</td>
<td>Dec 2020 - Dec 2023</td>
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<td>Andrew Romero-Wolf</td>
<td>JPL</td>
<td>CR SIG</td>
<td>Dec 2020 - Dec 2023</td>
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<tr>
<td>David Pooley</td>
<td>Trinity University</td>
<td>XR SIG</td>
<td>Dec 2021 - Dec 2024</td>
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<td>Athina Meli (Vice Chair)</td>
<td>North Carolina A&amp;T</td>
<td>CR SIG</td>
<td>Dec 2021 - Dec 2024</td>
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<tr>
<td>Eric Burns</td>
<td>Louisiana State University</td>
<td>GR SIG</td>
<td>Dec 2021 - Dec 2024</td>
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<td>Kristin Madsen</td>
<td>NASA/GSFC</td>
<td>XR SIG</td>
<td>Dec 2021 - Dec 2024</td>
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<td>Chiara Mingarelli</td>
<td>Univ. of Connecticut</td>
<td>GW SIG</td>
<td>Feb 2023 - Dec 2025</td>
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<td>Chien-Ting Chen</td>
<td>USRA/MSFC</td>
<td>XR SIG</td>
<td>Feb 2023 - Dec 2025</td>
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<td>Alessandra Corsi</td>
<td>Texas Tech</td>
<td>GW SIG</td>
<td>Feb 2023 - Dec 2025</td>
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<td>Roger O'Brient</td>
<td>JPL</td>
<td>IP SIG</td>
<td>Feb 2023 - Dec 2025</td>
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<td>Rebekah Honsell</td>
<td>UMBC/GSFC</td>
<td>CoS SIG</td>
<td>Feb 2023 - Dec 2025</td>
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<td>Manel Errando</td>
<td>Washington U. St. Louis</td>
<td>GR SIG</td>
<td>Feb 2023 - Dec 2025</td>
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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
# NASA PhysCOS Program Analysis Group (PhysPAG) session:
**Sunday 7 January 2024**
*9a–3p Central*  


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<tr>
<th>Time</th>
<th>Group</th>
<th>Session Details</th>
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| 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 |
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:
  - 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
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 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.