February 29, 2024

Gamma-ray Science Priorities

working towards the 2040s

Meeting #1 of the Future Innovations in Gamma rays Science Analysis Group

Agenda

1:00 - 1:15 PM	Welcome & Introduction to FIG SAG
1:15 - 1:30 PM	General Group Discussion
1:30 - 1:55 PM	Breakout Session 1
1:55 - 2:20 PM	Group Discussion
2:20 - 2:45 PM	Breakout Session 2
2:45 - 3:00 PM	Concluding remarks

Please note that the general meeting is recorded. Breakout sessions are not recorded.

Welcome & Introduction to FIG SAG

… to explore gamma-ray science priorities, necessary capabilities, new technologies, and theory/modeling needs drawing on the 2020 Decadal to inspire work toward 2040.

Welcome & Introduction to FIG SAG

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

FIG 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.

Scheduled Meetings

February 29 (now) Gamma-ray Science Priorities

March 21	Theory/Modeling/Analysis/Fundamental Physics Needs
April 25	Technology Investment
May 30	Gamma-ray Mission Capabilities
June 24 – 28	FIG SAG Workshop at Michigan Tech (registration opening soon)
TBD	Synergies with Other Programs and Agencies
TBD	Broadening the Gamma-ray Science to the Whole Astrophysics community

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General Group Discussion

THINK BIG

What scientific questions do you hope to see answered within the next 20 years?

Follow up: how can gamma-ray observations support answering these questions?

THINK WIDE

Reflect on the diverse and interconnected domains of high-energy astrophysics. How can future gamma-ray research across different areas drive our understanding of the universe, challenge existing paradigms, and open new frontiers in both observational techniques and theoretical models?

NASA framework

- How Does the Universe Work?
- How Did We Get Here?
- Are We Alone?

How can gamma-ray observations fit into this framework?

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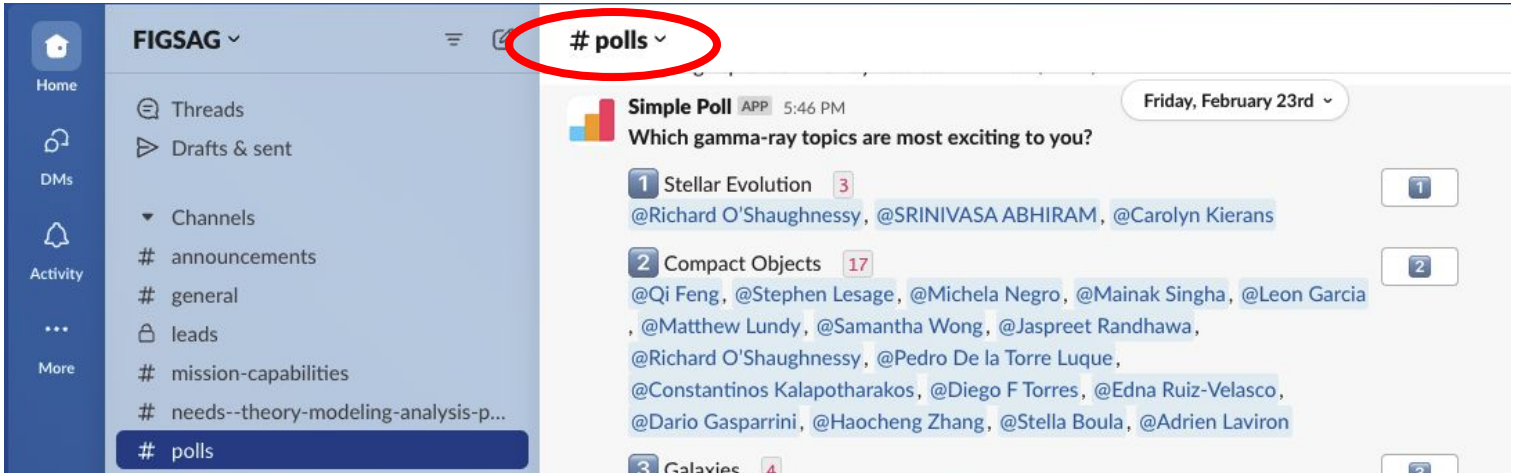
Discussion Guidelines

- Be mindful of time and interruptions.
- Be mindful of your positionality.
- Be a respectful listener.
- Commit to learning, not debating.
- Recognize that intent ≠ impact.

Adapted from BANG! Seminars at University of Maryland College Park, Department of Astronomy.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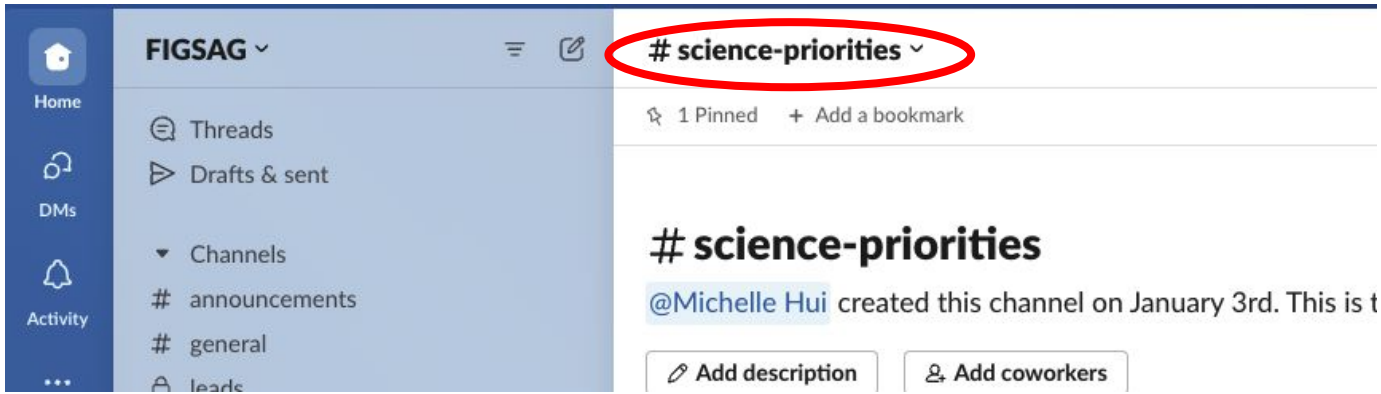
Friday, February 23rd
Which gamma-ray topics are most exciting to you?
1 Stellar Evolution 3
@Richard O'Shaughnessy, @SRINIVASA ABHIRAM, @Carolyn Kierans
2 Compact Objects 17
@Qi Feng, @Stephen Lesage, @Michela Negro, @Mainak Singha, @Leon Garcia, @Matthew Lundy, @Samantha Wong, @Jaspreet Randhawa, @Richard O'Shaughnessy, @Pedro De la Torre Luque, @Constantinos Kalapotharakos, @Diego F Torres, @Edna Ruiz-Velasco, @Dario Gasparrini, @Haocheng Zhang, @Stella Boula, @Adrien Laviron
3 Galaxies 4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Breakout session 1: Science Questions

1: Nature of Dark Matter/Dark Energy (Milena, GoogleDoc)

2: Formation and Merging of Supermassive Black Holes (Paolo, GoogleDoc)

3: Origins of Heavy Elements in our Galaxy (Zorawar, Chris (notes), Google Doc)

4: Sources of Cosmic Ray Accelerations (Michelle, Google Doc)

5: Existence of Life in our Galaxy (Marcos/Chris, Google Doc)

6: Questions not Included Above (Tiffany, Google Doc)

Breakout session 1: Science Questions

THINK **BIG**

THINK **W I D E**

NASA framework

Breakout session 1: Science Questions

Focus on science and methods/data, *not* technology, feasibility, or cost.

Assume *Swift* and *Fermi* are not operating in the 2040s.

Know that there are as many decades in energy from 100 keV to PeV as there are in the entire spectrum from radio to X-rays.

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Breakout session 1

1. What science questions will we be asking and focusing in the 2030s and 2040s? How can gamma-ray measurements contribute?
2. Look ahead to ground capabilities in astro and physics (e.g. 3rd generation GW detectors), ESA missions (e.g. LISA, Athena), large ground-based optical and radio surveys and telescopes, possible Moon infrastructure. What can gamma-rays bring to the table?

   Example: gamma-ray pulsar timing array for GWs
   Example: Nuclear lines — spatial distribution and (Doppler) velocities
   Example: Sampling sources across a range of cosmological redshifts

(in the next breakout session…)

3. What kind of gamma-ray data is needed to answer big questions?
4. Think broadly. For example, the Sun is detected in gamma-rays. What would detecting other nearby stars tell us?
5. What would characterizing nearby galaxies as we have done with the Milky Way help answer?

Nature of Dark Matter/Dark Energy	Formation and Merging of Supermassive Black Holes	Origins of Heavy Elements in our Galaxy	Sources of Cosmic Ray Accelerations	Existence of Life in our Galaxy	Questions not Included Above

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Report back: group discussion

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Breakout session 2

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Breakout session 2

1. What science questions will we be asking and focusing in the 2030s and 2040s? How can gamma-ray measurements contribute?
2. Look ahead to ground capabilities in astro and physics (e.g. 3rd generation GW detectors), ESA missions (e.g. LISA, Athena), large ground-based optical and radio surveys and telescopes, possible Moon infrastructure. What can gamma-rays bring to the table?

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General Info

Website	https://pcos.gsfc.nasa.gov/sags/figsag.php
Slack Workspace	https://join.slack.com/t/figsag/shared_invite/zt-282mbwfeb-vfP~x~jz9OYYZkOhoS0rOg
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Google Drive	https://drive.google.com/drive/folders/1ucUW9TTghyb7P_u2_QY-aqkwB3Nf41TV?usp=sharing