

# Gamma-ray Astrophysics Science Goals SAG: Roadmap to a roadmap

(Name may need some work?)

GRSIG virtual meeting

16 June 2023

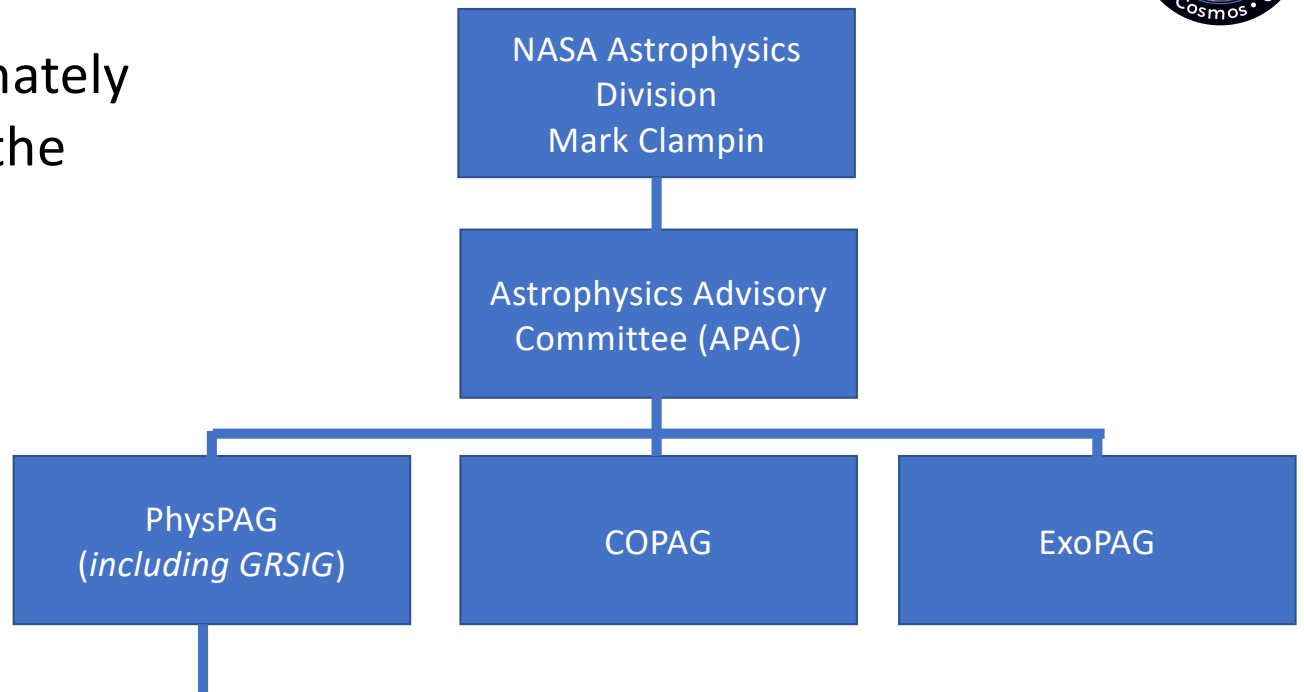


# Physics of the Cosmos Program Analysis Group (PhysPAG)

Provide APAC and ultimately NASA with input from the scientific community.

Membership: *you!*

Represented by  
***Executive Committee***



**Science Interest Groups (SIGs)** – permanent discipline-specific groups  
**Science Analysis Groups (SAGs)** – created to analyze specific question.  
Last about a year and deliver a report.

# Preliminary thoughts

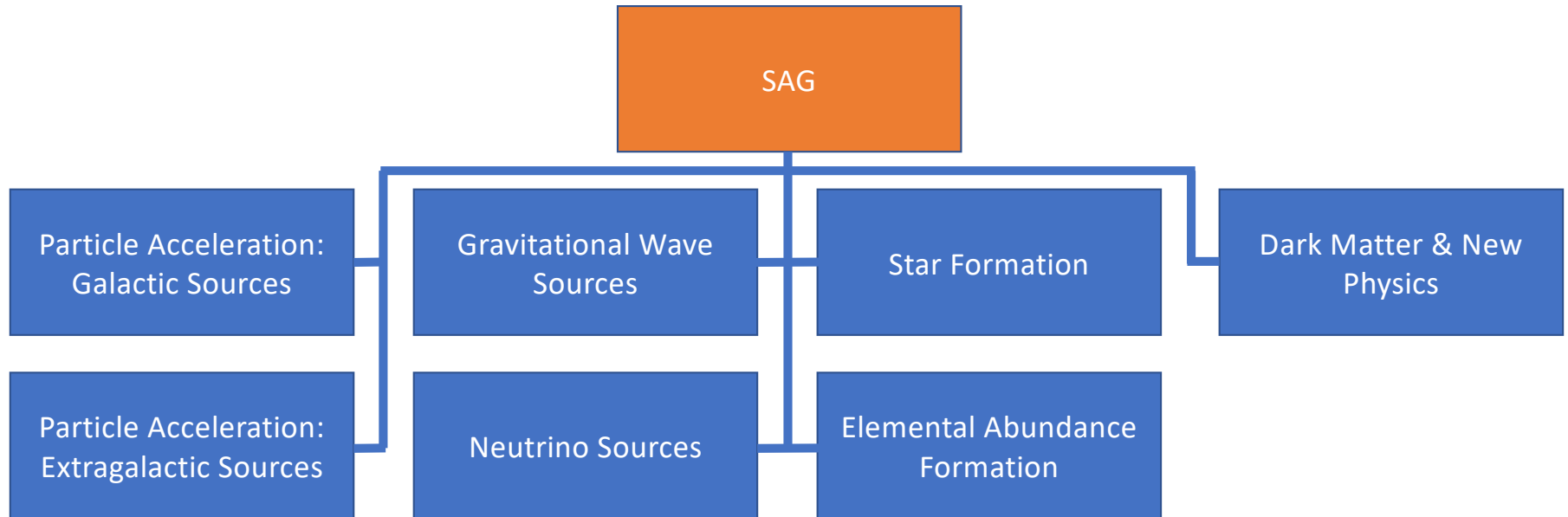
- Report must deliver something that is useful or interesting to NASA APD
- Doesn't mean it can't serve other purposes (e.g., advertising gamma-ray science to broader scientific community)
- Overall questions to answer:
  - What gamma-ray science would we like to accomplish?
  - Is this gamma-ray science being met with currently existing or funded/planned missions?
  - What new 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?

# Partial Science Traceability Matrix

Science Objective	Observation/ Performance	Result	Benchmark Scenario	Performance requirement or Science Gap

# Science Topics

- Open to community input!



# Timeline

- end of June 2023: open nominations for chairs
- August 2023: Pick chairs (5-8?). Wide variety of scientific/technical/messenger expertise, geographic locations, *career stage*, gender balance, etc. (Need to be at US institutions?)
- 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**
- 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.
- 2024: Workshops for early career scientists to discuss roadmap?
- March 2025: Deliver report to NASA and APAC
- 2025: SMEX due. Finish before then?

Extras

# Particle Acceleration: Galactic Sources

- Origin of Galactic cosmic rays
- PA in supernova remnants
- PA in pulsars
- PA in PWN
- PA in novae
- PA in protostellar jets
- PA in microquasars
- PA in colliding wind binaries
- PA in Fermi bubbles?
- Polarization?



# Particle Acceleration: Extragalactic Sources

- Origin of UHECRs
- PA in gamma-ray bursts
- PA in AGN jets
- PA in AGN without jets – PA in coronae/RIAFs
- PA in Tidal Disruption Events
- Polarization?

# Gravitational Wave Sources

- Gamma-rays from GW sources
  - Merging neutron stars
- Gamma-rays as pulsar timing array to detect GWs

# Neutrino sources

- TeV neutrinos
  - AGN
  - GRBs
  - star formation
  - Galactic sources
- MeV neutrinos
  - supernovae

# Star Formation

- gamma-rays from star forming regions
- absorption of gamma-rays by EBL

# Elemental Abundance Formation

- Origin of r-process elements
- Type Ia supernovae
  - $^{56}\text{Ni}$  production?
  - Origin? single or double degenerate mergers?
- Core-collapse SNe
  - How do they explode?
- distribution of elements in the Galaxy
- Origin of positrons in the Galaxy
- kilonovae
- novae?

# Dark Matter and New Physics

- WIMP Dark matter
- WISPs and Axion-like particles
- Dark energy (?)
- Lorentz invariance violation
- Vacuum birefringence
- Primordial black holes