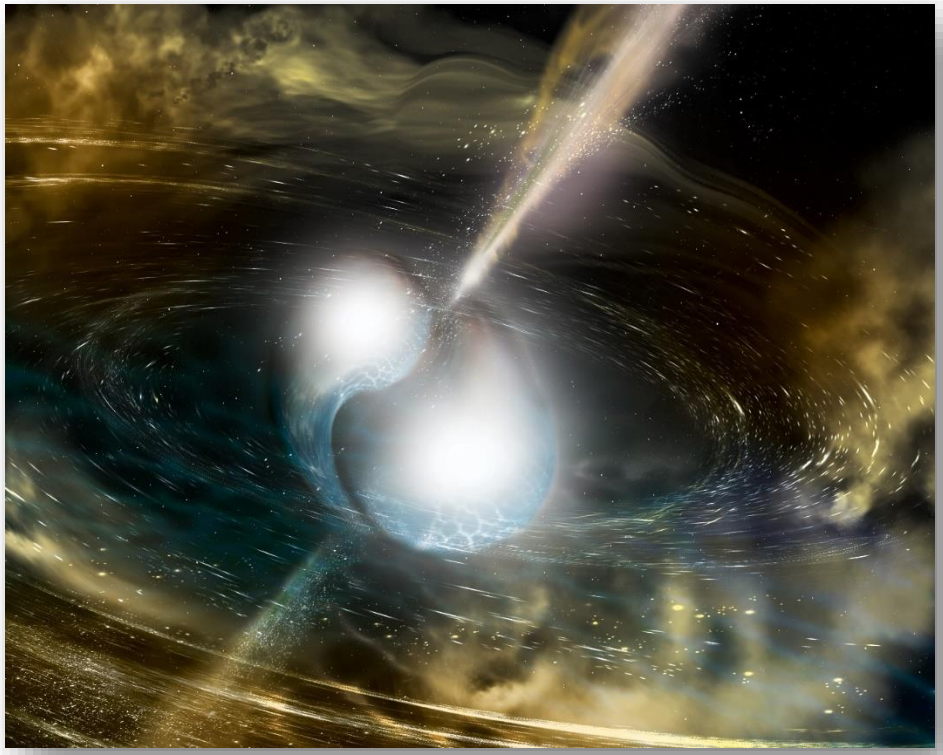
NASA Multimessenger Astrophysics Science Analysis Group (MMA SAG)



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Chair, NASA MMA SAG

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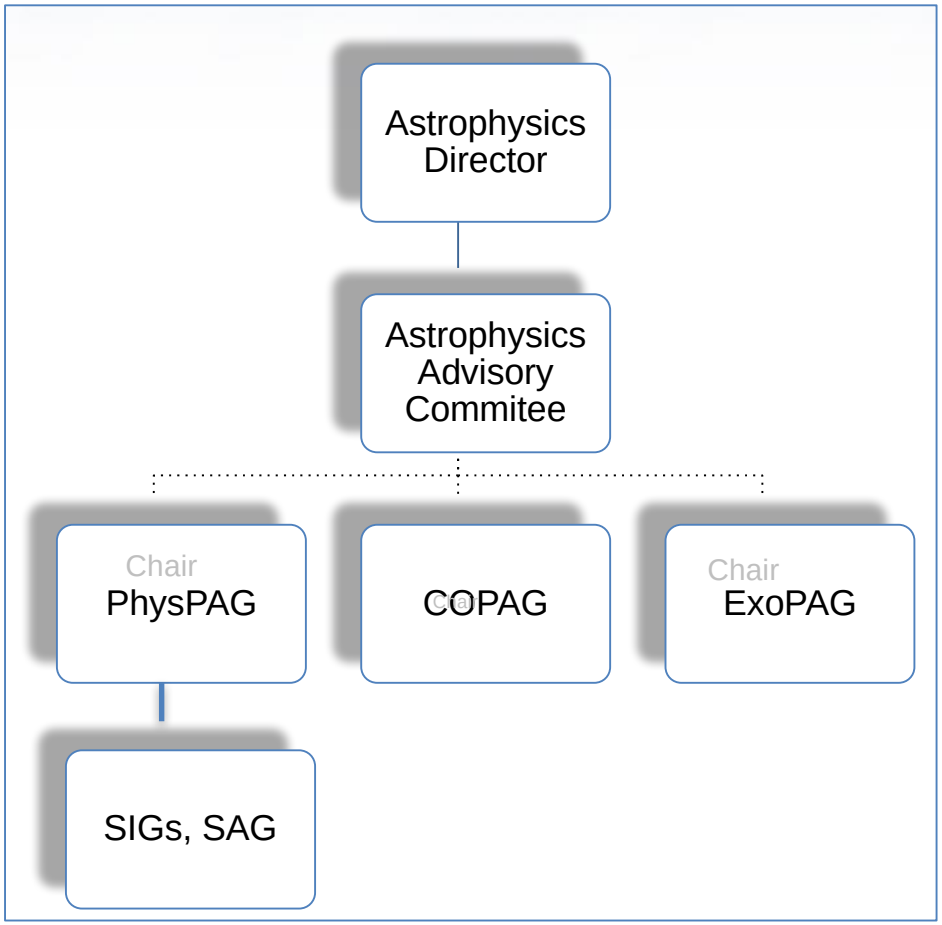
What is a Science Analysis Group (SAG)

- **PhysPAG EC initiates SIGs and SAGs with APAC approval**
- **Science Analysis Groups conduct specific analyses**
  - Start and end dates
  - Report delivered at the end to the APAC
- **Science Interest Groups (SIGs) are long-lasting forums for community interaction**



Motivation

- **NASA observatories in 2020 decade and beyond will have an important role to play in future MMA observations, including:**
  - those that continue to operate in 2020s (Hubble, Chandra, Swift, Fermi)
  - those currently planned (JWST, WFIRST, Athena, LISA, and Explorers)
  - those that will be considered by the 2020 astrophysics decadal committee
- **Many scientific communities within PCOS have participated in the Astro2020 decadal survey**
- **MMA SAG was formed to help organize the community to analyze potential scientific benefits of MMA observations made possible by NASA observatories in 2020's and beyond**
  - NASA observatories working in conjunction with each other or with other ground and/or space-based instruments

What was the MMA SAG?

- **Community-driven; community-owned; open to all**
- **MMA SAG consists of astrophysicists from multiple disciplines within the PhysPAG and COPAG**
- **While inspired by GW BNS observation, MMA SAG is not necessarily GW-specific**
- **Chair, John W. Conklin, University of Florida**
  PhysPAG Co-chair, John Tomsick, UC Berkeley
  COPAG Co-chair, Suvi Gezari, University of Maryland

MMA SAG Source Teams

- **Organized around astrophysical sources (not λ or spectrum)**
  - Goal: form teams with people interested in the same sources but observing via different messengers
  - Asked for volunteers to lead/co-lead the source teams.

1. **AGN, SMBH binaries, EMRIs**
   - Sarah Burke-Spolaor & Bindu Rani, co-leads
2. **NS+NS, NS+BH, WD-WD binaries, GRBs**
   - Eric Burns, Colleen Wilson-Hodge, co-leads
3. **Stellar mass BH-BH binaries**
   - Peter Shawhan, Saavik Ford*, co-leads
4. **FRBs, SNe Ia, SN remnants**
   - Geoff Clayton, lead

Summary of MMA SAG Activities

- **Solicited membership from broad astrophysics community**
- **~Monthly telecons of full SAG, source teams met more frequently**
- **10 community science white papers organized by MMA SAG, including one overarching paper, submitted to Astro2020**
- **Organized sessions and gave presentations at conferences to facilitate community interaction, including:**
  - January 2018 AAS meeting, National Harbor – Formulate SAG charter
  - March 2019 AAS HEAD meeting, Monterey
  - April 2019 Astrophysics Landscape meeting, Patomac
  - January 2020 AAS meeting, Honolulu – Present SAG findings
  - April 2020 APS meeting, Virtual – Present SAG Final Report

MMA SAG Final Report

- **Final Report presented to the APAC and accepted as input to NASA in early March 2020:**
  - Summary of MMA SAG charter and goals
  - Summary of MMA possibilities
  - 12 sections summarizing specific opportunities
  - Discussion of communications across MMA observatories
  - Conclusions and summary of key findings

- **Summary of key findings provided in the next four charts**

- **The MMA SAG Final Report can be found here: https://pcos.gsfc.nasa.gov/sags/mmasag.php**

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Summary of Key Findings of MMA SAG (1/4)

1. **Wide EM & GW wavelength coverage and neutrino detectors are needed; Few measurements in particular are currently lacking or will go offline soon:**
   a. Observatories with fast response and focus on time-domain; Neil Gehrels Swift Observatory is good example, but it is old (2004), and a replacement needed
   b. Fermi provides vital MMA measurements, esp. GRB monitor; Launched in 2008, the end-of-life is far on the horizon
   c. X-Ray, UV and low-frequency gravitational waves can only be observed from space and are important

Summary of Key Findings of MMA SAG (2/4)

2. **MMA requires NASA and NSF to collaborate, since both ground- and space-based measurements are needed; Proposing for time on both ground & space observatories can be a challenge**
   - Mismatching time frames of relevant NASA and NSF solicitations can be roadblock for simultaneous space and ground observations
   - More joint time proposal opportunities would be beneficial; Many proposals to one agency that includes observations from the other are considered 2nd or 3rd tier because they require multiple instruments
   - The separation of NSF and NASA solicitations for observing time can lead to a bifurcation of the astrophysics community, hindering interactions between certain sub-communities
   - It is important that disparate catalogs, database systems (e.g. GCN) can work together to facilitate analyses requiring multiple observations
   - Some MMA science can be performed using archived data; They do not require observing time, but personnel & computing time; More support for these resources without observing time are desirable

Summary of Key Findings of MMA SAG (3/4)

3. **Many MMA science cases in space require not only sufficient sensitivities in particular wavelengths, but also operational capabilities, e.g. rapid commanding to enable rapid re-pointing, and enhanced data taking modes**
   - Such capabilities require both communications and commanding infrastructure, as well as flexible scheduling of ground segments
   - Enhancements to autonomous and real-time capabilities of TDRSS is needed
   - Development of flexible and autonomous observation scheduling software for mission ground segments is important

Summary of Key Findings of MMA SAG (4/4)

4. **MMA now reaching fidelity where astrophysicists increasingly need to leverage progress in computer science and wide range of physics**
   - Capabilities needed include fluid dynamics and turbulence, plasma physics, atomic physics, numerical general relativity, nuclear and particle physics
   - To maximize the science learned from multi-messenger astronomy, it is important for these different disciplines to work together, sharing expertise