

PhysPAG MMA SAG Charter

Charter for the Physics of the Cosmos Program Analysis Group (PhysPAG) Study Analysis Group (SAG) on Multimessenger Astrophysics (MMA)

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The power of multimessenger astrophysics was recently demonstrated through the observation of the first astrophysical event in both the gravitational wave and electromagnetic spectra. On August 17, 2017 a binary neutron star (BNS) merger was detected in gravitational waves by LIGO and Virgo, and 1.7 seconds later, in gamma-rays by the *Fermi* space observatory. These two events triggered a flurry of follow-up observations by the international astronomical community. Through MMA observations of this single event, astronomers have made a number of profound conclusions, including that (a) BNS mergers occur in nature, (b) short gamma-ray bursts are associated with at least a fraction of BNS mergers, (c) kilonovae are connected to BNS mergers, (d) gravitational waves indeed travel at the speed of light as Einstein predicted, and more.

Multimessenger astrophysics will remain an important tool for astronomers in the future as we combine electromagnetic radiation, gravitational wave radiation, and particle astrophysics observations of cosmic events. NASA's space observatories in the 2020 decade and beyond will have an important role to play, including those that will continue to operate in the 2020s, such as *Hubble*, *Chandra*, *Swift*, *Fermi*, those currently planned, including JWST, WFIRST, Athena, LISA, and Explorers, and those that will be considered by the 2020 astrophysics decadal committee. Many of the scientific communities within Physics of the Cosmos are now preparing for the upcoming 2020 decadal survey. To support this effort, the MMA SAG will analyze the potential scientific benefits of multimessenger observations made possible by NASA observatories in the 2020 decade and beyond, working in conjunction with each other or with other ground and space-based instruments. The MMA SAG will consist of astrophysicists from multiple disciplines within the PhysPAG (and CoPAG) that may contribute to multimessenger astrophysics.

The goals of the MMA SAG are as follows:

- Identify science goals that could be achieved by combining different astrophysical messengers measured by current and future ground- and space-based observatories.
- Identify measurements that can be made by existing, currently approved, and future planned ground- and space-based observatories that could contribute to multimessenger astronomy in the 2020's and early 2030's.
- Determine how these enhanced or new science goals align with NASA Astrophysics Division's scientific priorities.
- Identify the key qualitative technical drivers that are needed to achieve these science goals (e.g. wavelength, sensitivity, sky localization, latency, ...) and determine desirable performance levels for each.

The SAG will document its findings in one or more publically available white papers delivered to APAC in mid-2019.