Terms of Reference
NASA Gravitational Wave - Electromagnetic Counterpart Task Force

March 2019

Introduction

Gravitational Wave (GW) Astrophysics has recently come of age with the detection, and further characterization, of sources of Gravitational Waves (GW) from the ground and the search for their electromagnetic counterparts. The double neutron-star merger detected by LIGO in August 2017, GW170817, captured the attention of scientists worldwide, who invested thousands of observing hours both at ground- and space-based observatories, to follow up in a search for the Electromagnetic (EM) emission hours to weeks after the merger. Because of its access from space to shorter wavelengths, both in survey and pointed instruments, NASA is an essential player in this field. In the case of GW170817, observations with X-ray and Gamma-ray observatories were obtained both simultaneously with the GW detection using wide-field monitors, and from hours to months after the event in dedicated pointings. Additionally, NASA contributes vital communications infrastructure through TDRSS and the Global Coordinates Network (GCN) for the timely downlinks and dissemination to the broad astronomical community of data and alerts from interesting transient phenomena.

While GW170817 demonstrated how observations using multiple messengers (EM and GW) can generate profound physical insights, future GW events will require more organized and possibly updated networks of EM observers and facilities. Maximizing the scientific output of these observations will involve combining, analyzing, and interpreting inhomogeneous data sets across the EM spectrum. Critical physical insights are provided by the merger time itself and the seconds immediately after; given the short notification time of the LIGO events, this requires an established protocol for the EM follow-up from space and ground.

In order to focus the activities of the Task Force, we concentrate on EM observations of GW events detected with LIGO and the future LIGO A+, while recognizing that Multi-Messenger Astronomy (MMA) encompasses a broader range of phenomena.

Tasks of the Task Force

The NASA Gravitational Wave Electromagnetic Countepart (GW-EM) Task Force will assess the role of NASA in GW-EM astrophysics, in particular in the EM prompt and follow-up observations of LIGO sources, with present and planned capabilities, and will provide findings to NASA regarding how to optimize its GW-EM strategy.

The NASA GW-EM Task Force is tasked with the following specific activities:

1. For the currently operating NASA missions, assess:
    a. Their current contributions, or potential for contributions, to GW-EM Astrophysics

b. Obstacles and barriers that need to be addressed for their optimal use including Mission operations, observations, data access, analysis, and interpretation of the data.
c. Existing gaps in either/both present and planned facilities and operations

2. For present and future operations, identify:
   a. A protocol to optimize the use of NASA's capabilities in EM followups of LIGO and LIGO A+ sources
   b. How this protocol might change over time as more GW events are found and extensive campaigns on individual mergers are replaced by studies of merger populations

3. Identify top-level needed capabilities for the distant (>10 yrs) future, in light of anticipated GW-EM science drivers and present and future NASA missions. Identify specific actions to explore the feasibility of such capabilities (e.g., forming study teams).

4. Identify near- and long-term practices NASA should adopt to optimize GW-EM return from its missions (e.g., R&A, archives format, etc.).

5. Address ways to improve or increase interagency collaboration between NASA and NSF.

The Task Force will leverage off the work of the Multi-Messenger Astrophysics (MMA) Science Analysis Group (SAG). The SAG includes volunteer members of the community who may be individually consulted for their specific expertise. Information about the MMA SAG activities can be found at https://pcos.gsfc.nasa.gov/sags/mmasag.php.

Membership

The GW-EM Countepart Task Force is an *ad hoc,* non-consensus group assembled and tasked by NASA HQ to perform the tasks above. It consists of Center civil servants and consultants drawn from the Centers and community as appropriate, including but not limited to selected members of the MMA SAG.

Civil Servants will co-Chair the GW-EM Counterpart Task Force. Ex-officio observers from the National Science Foundation will attend the Task Force activities, at NSF discretion.

At the end of the Study the Task Force will be disbanded.

Terms of Study and Deliverables

The duration of the study will be ~6-8 months, beginning in April 2019. The Task Force will meet remotely, i.e., via telecon and Webex, as no NASA funds are available to support travel. The Task Force may leverage off attendance to scientific conferences (e.g., AAS) to hold face-to-face meetings.

The main deliverable of the GW-EM Counterpart Task Force is a written report (powerpoint slides acceptable as well) and an oral presentation, to be delivered to HQ at the end of the study period. The report will be made public.

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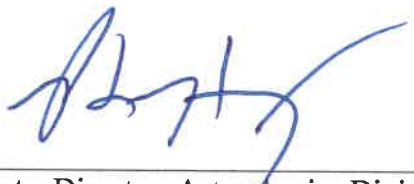

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Date