

IAU Commission D1: Gravitational-Wave Astrophysics
Annual Report for 2021-2022
Submitted by Peter Shawhan, President of IAU Commission D1

IAU Commission D1 was created in 2015 with the goals of integrating gravitational-wave (GW) observations into mainstream astronomy, expanding the knowledge and science impact of GW astrophysics to the IAU community, and fostering communication among diverse communities of observers and theorists. Commission D1 currently has 216 members.

The year 2021-2022 saw further maturing of astrophysics investigations using the compact binary merger events that have been detected by the LIGO and Virgo detectors. Following the release of updated catalogs in 2021, over 90 high-confidence and probable events have now been reported, both by the LIGO-Virgo-KAGRA collaborations and by other scientists who are using the LIGO-Virgo data released through the Gravitational-Wave Open Science Center (<https://www.gw-openscience.org/>). Searches for many other types of GW signals also were published.

IAU Symposium 363, *Neutron Star Astrophysics at the Crossroads: Magnetars and the Multimessenger Revolution*, took place as an online meeting in November-December 2021 and included many discussions of GW astrophysics with neutron stars.

Searching for GW signals at much lower frequencies, analysis of data from the International Pulsar Timing Array (IPTA) – assembled from the NANOGrav, Parkes, and European pulsar timing arrays – was reported to find evidence for common timing shifts in the pulsars studied, consistent with what was previously reported by the NANOGrav team. However, it has not yet been determined whether this represents a true GW signal, in part because the timing shifts have not established the angular dependence that would be expected for an astrophysical signal.

Development continues on LISA and other space missions for GW detection. Also, proposed “third generation” ground-based detectors made important progress: the Einstein Telescope project was approved for inclusion in the European Strategy Forum on Research Infrastructures (ESFRI) roadmap, while the Cosmic Explorer project completed a comprehensive “CE Horizon Study” and was endorsed in the U.S. National Academies’ Decadal Survey on Astronomy and Astrophysics.

IAU Commission D1 is associated with the Gravitational Wave International Committee (GWIC), with the President of the Commission serving as a member of GWIC. In this role, Peter Shawhan presented the status of the Commission in the September 2021 GWIC meeting and discussed goals for international participation and community-building.

Finally, topics and speakers were suggested to incorporate GW astrophysics into the program of the IAU General Assembly in Busan, coming up in August 2022.