November 2021

IAF SPACE ASTRONOMY TECHNICAL COMMITTEE (SATC)

1. Introduction/Summary

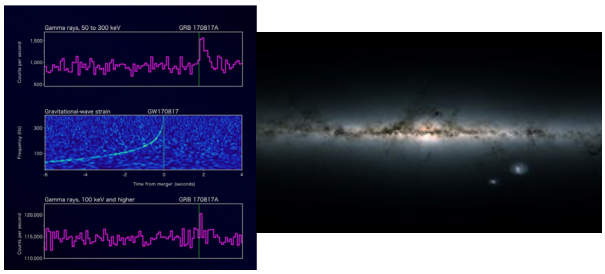
Ground and Space Astronomy synergy has recently permitted a phase of remarkable discovery and growth. Public recognition is the several Nobel physics prizes gained in (observational) cosmology, exoplanets, gravitational waves, X-ray astronomy, and astrophysical neutrinos. Although the field of astrophysics is vast, the the IAF Space Astronomy Technical Committee (SATC) concentrates its work in the area of space astronomy and in particular, serve as a forum for the exchange of information and interaction between the scientific community, space industry, and space agencies involved in the preparation and the future development of new astronomy missions. Therefore, the SATC action covers the very early phases of mission conception before missions are proposed to the Agencies for assessment. As such, the SATC role comes up-front and is largely complementary to the current work that the Agencies achieve. Its principal intended role is to enable or improve the emergence of new science mission concept.

2. Highlights

Astronomy is currently in a phase of remarkable discovery and growth. A public recognition of this impact are the Nobel physics prizes in 2021, Giorgio Parisi, *"for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales"*; Roger Penrose, Reinhard Genzel and Andrea Ghez "*for the discovery of a supermassive compact object at the centre of our galaxy"* in 2020; Jim Peebles - cosmology, Michel Mayor and Didier Queloz – exoplanets in 2019; Rainer Weiss, Kip Thorne and Barry Barish in 2017– gravitational waves; Saul Perlmutter, Brian Schmidt and Adam Reiss in 20211 – observational cosmology; John Mather and George Smootin 2006 – observational cosmology, Riccardo Giacconi – X-ray astronomy, and Ray Davis Jr and Masatoshi Koshiba – astrophysical neutrinos in 2002. The impressive range of progress is manifest. Just few examples among others:

- **Gravitational waves and Astrophysical counterpart search of BH-BH Mergers**
- **NS-NS Mergers: first Gravitational Wave counterpart detection**

On August 17, 2017, after a long quest, Fermi and INTEGRAL detected a short γ-ray burst (GRB 170817A) linked to GW70817 caused by the merger of two neutron stars. The time lag (1.7 s) between the GW event and the prompt γ-ray observation after 120My travel time, imposed constraints on the difference between the speeds of light and gravity, placed new bounds on the violation of Lorentz invariance, and presented a new test of the equivalence principle. The observations also constrained the size and bulk Lorentz factor of the γ-ray emitting region. To date, this observation remains the only firm detection of the so-called Kilonova generated by the NS-NS merging process with spill-over of nuclear dense matter.



Joint, multi-messenger, detection of GW170817 and GRB 170817A (left) and Gaia's view of the sky. Credit: Abbott et al. 2017, ApJ 848, L13 and ESA/Gaia/DPAC, CC BY-SA 3.0 IGO.

- **Protoplanetary disks and exoplanets**
- **Fast Radio Bursts**
- **GRB detected at TeV**
- **Origins of a Cosmic Neutrino**
- **Gaia**
- **Asteroseismology**

3. Future Outlook

The increasing size and complexity of large space-based observatory missions place a growing emphasis on international collaboration. The increasing range of joint missions involving space agencies in Europe (ESA), United States (NASA), Japan (JAXA), the Russian Federation (RKA) and China (CNSA), India (ISRO), and more recently, the United Arab Emirates (UAESA), and others. The Astronomy and Astrophysics Decadal Survey (US: Astro2020) and the ESA Cosmic Vision (EU) outline a comprehensive research strategy and vision for a transformative science at the frontiers of astronomy and astrophysics in the next decades. Similar plans, though at a lower level, are on-going under other major national space agencies mentioned before. In particular, large scale flagship missions like the Athena X-ray Observatory, LISA GW explorer, the Jupiter icy moons Explorer (juice) (ESA), NASA technological studies for LUVOIR, Nancy Roman Space Telescope (NASA), and medium size missions like Euclid, PLATO, and TESS, and Starburst are already operative, approved, or in the realization phase. This impressive fleet of space observatories will be complemented during this decade by large-scale ground based facilities like TMT, ELT (ESO), SKA, CTA, and others, spanning from radio to optical/IR to high energy gamma rays. The new observational window opened by the GW interferometers and Neutrino detectors are under upgrade and optimized to be inter-operative with other ground-based infrastructure and space-based missions.

4. Committee activities

The main SATC activity for the current year have been focused on:

1. Long-term analysis of the technical, scientific and programmatic areas of space astronomy. Serve as a *forum for exchange of information and interaction between the scientific community, space industry and agencies* involved in the preparation and future development of new astronomy missions. Particular emphasis is on technological breakthroughs for future space applications (e.g. space cryogenics systems, cubesat constellations, space-ground synergy).
2. Of particular importance are the recent developments and actions to preserve the “Dark Sky” against the optical and radio interference between 1.000-10.000 small-sat for TLC and ground and space astronomical observatories. The strong interaction with STM-TC26 Committee has been finalized during the Dubai IAC 2021 meeting with cross participation of members of TC23 and TC26 meetings. As such, the SATC role will be complementary to the current work carried out by the Agencies, industries, Academia and space and ground-based stakeholders;
3. Organization of the A7 symposium at IAC 2021 and IAC 2022, for the discussion and publication of ideas and relevant results and issues to the impact and needs of future astronomical missions.
4. Provide a point of contact for national and international bodies.

The Action plan foresee: IAC 2021 sessions with active participation (done), IAU Las Palma UNOOSA, ISSI Forum 2021 (done), participation to “Ground and Space Astronomy: Challenges and Synergies“, November 2021, to COSPAR 2022 (Athens) and 2023 Space science with small satellites (Singapore), IAU Busan 2022 etc.