

## Research Result Report

### ICRR Inter-University Research Program 2023

Research Subject: Synergies at new frontiers at gamma-rays, neutrinos and gravitational waves.

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Summary of Research Result :

Discoveries of high-energy cosmic neutrinos and Gravitational Waves (GWs) from astrophysical objects have led to the new era of Multi-Messenger (MM) astrophysics. Observatories and experiments are now more than ever able to observe the sky in different energy ranges and with different messengers. Each class of messengers - photons, neutrinos, cosmic-rays and GWs- provides distinct and valuable information of the most violent phenomena in the Universe. Only with MM astronomy we will be able to fully unveil the mechanisms at operation in different galactic and extragalactic sources. The aim of this project, in its first edition, was to explore potential synergies between different MM windows of the highly-energetic Universe using the following large experiments: the Cherenkov telescopes MAGIC, the gamma-ray observatory CTA, with its first Large Size Telescope (LST1), the cosmic ray and gamma-ray detector CALET, the Gravitational Wave project KAGRA and the neutrino observatories Super-Kamiokande and Hyper-Kamiokande. The 2022 edition of the workshop gave the opportunity to have a first discussion about the characteristics of the different experiments involved in the project, as well as the work done by each experiment on the different MM sources.

The second edition of the workshop was held in Japan in March 2024 (+info: <https://indico.icrr.u-tokyo.ac.jp/event/951/>). This time, the workshop was focus on the available real-time alert systems which have been developed by the astrophysics community in order to assess its usefulness.

A total of 46 researchers participated in this event, all onsite and with the participation of 20 high-level invited speakers from different international institutions.

Important conclusions were obtained from the workshop regarding different aspects. Such as the capabilities of each experiment to detect radiation and/or particles from high energy sources, or GWs and the possible synergies among the experiments for the MM astrophysics and how to improve the alerts systems. The detailed results were presented at the Research Results Presentation Meeting of the ICRR Inter-University Research Program FY2023. In addition, the slides of the different talks are available on the indico website.

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