

Research Outline of Research Areas

The Creation of Multimessenger Astrophysics -- The unified picture of dynamical universe driven by births of black holes
<https://multimessenger.jp/en/>

Number of Research Area : 23A205 Term of Project : FY2023-2027
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1. Details of Research Area

The gravitational energy produced by the mighty gravity of black holes has been the primary energy source of the universe since the Big Bang and is the source of the diversity of the universe, driving the growth of black holes, the synthesis of elements that are the origin of matter, and the creation of ultra-high energy cosmic ray nuclei with enormous energy that has never been achieved by human-made accelerators. In this Research Area, we will promote multi-messenger observations that combine neutrino and gravitational wave measurements which have made overwhelming progress in recent years, with traditional electromagnetic wave observations, in order to obtain the unified picture of the final fate of gravitational energy, from the growth process of ultra-dense fireball plasma produced by the strong gravitational field to elemental synthesis and high-energy radiation.

This Research Area consists of three groups: Group A, which is a collection of the subgroups to dramatically advance observational research in multi-messenger astrophysics by strengthening the observational experiments and facilities currently in operation; Group B, which conducts future-oriented development research; and Group C, which promotes theoretical research. Each of these research groups is as follows. Cosmic neutrinos (IceCube - A01), gravitational waves (LIGO - A02), visible, near-infrared and radio waves (A03), X-rays (A04), gamma rays (CTA - A05), astroparticle detection technology (B01), multi-messenger observation satellite (B02), theoretical study of high energy neutrino astrophysics (C01), and theory of strong gravitational radiation from astronomical objects (C02).

Multi-messenger astrophysics is a newly born interdisciplinary field that requires the formation of a new community of researchers with expertise in different research backgrounds. The ultimate goal of this Research Area is to create an expert group of multi-messenger astrophysics with a diverse spectrum of astrophysics researchers and make world-leading discoveries to reveal the nature of extreme universe.

2. Call for Proposals and Expectations for Publicly Offered Research, etc.

Multi-messenger astrophysics, by its very nature, is related to a wide range of astronomical, space, and particle physics research fields. Although each of the Planned Research Groups has introduced a top-down approach for integrating various specialized research fields, there are many research topics and projects that cannot be covered by this top-down program. We expect bottom-up research proposals that broaden the base of interdisciplinary research in the open call for Publicly Offered Research proposals. We welcome observation research proposals that are not part of the top-down research agenda, such as observational research using balloons and other flying objects, survey observation specializing in a certain wavelength band, and cosmic particle observation using ground-based detectors, as well as proposals for detector development based on novel ideas. We also expect seed research proposals that will promote interdisciplinary research, such as developments on methods for integrating and analyzing data of different quality, and theoretical research proposals on cosmology, particle theory, gravity theory and so on, which will form the basis of the framework of multi-messenger astrophysics.

We would also like to remark that the Research Group Number E01 can accept truly pioneering proposals which requests annual budget up to 5 million yen, in order to promote relatively large-scale observation and development programs.

3. Research Group, Upper Limit of Annual Budget and Number of research projects scheduled to be selected

Research Group Number	Research Group	Upper Limit of Annual Budget (Million yen)	Number of research projects scheduled to be selected
E01	Observational study or R&D for multi-messenger astrophysics : Large-scale programs	5	2
E02	Observational study, numerical simulation, or R&D for multi-messenger astrophysics	3	8
E03	Theoretical research on multi-messenger astrophysics	1	8