【Grant - in - Aid for Scientific Research on Innovative Areas(Research in a proposed research area)】

Science and Engineering

Title of Project : Gravitational wave physics and astronomy: Genesis

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Research Project Number : 17H06357   Researcher Number : 40281117

【Purpose of the Research Project】

The first direct detection of gravitational waves (GWs) was announced by LIGO in 2016. KAGRA, Japanese GW detector, is going to start operation in full configuration from 2019. We have advantages in GW data analysis, multi- messenger observations of the GW counterparts, and a long history of theoretical research. The purpose of this area is to extract the synergy effects and push forward the new trend of GW physics / astronomy.

【Content of the Research Project】

Currently, we are at the very beginning of GW observation. The impact of this completely new observational probe on the progress of physics and astronomy is high. The task of this innovative area is to conduct world-leading researches in exploiting the research fields that are rapidly expanding.

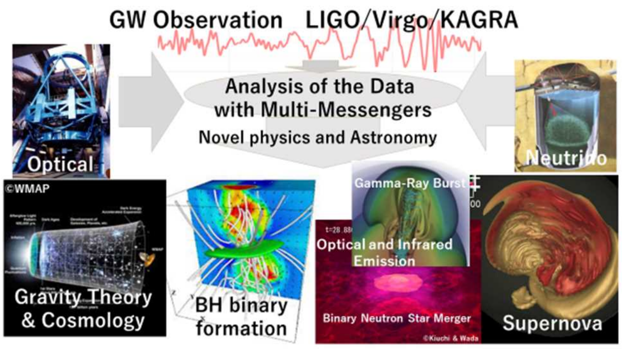

Fig.1 Image of the expanding research area

As past heritage, preparations for basic data analysis and organizations of follow-up observation teams have been already completed. Taking the advantage of this opportunity, we promote GW physics and astronomy from the following two aspects:

(1) Comprehensive analysis of GWs

Theoretical and data analysis researches closely cooperate to develop new GW data analysis methods beyond the standard framework and extract valuable information.

(2) New physics and astronomy spreading out of GW detection

By the close collaboration of observational and theoretical researches, we promote research fields that are directly driven by GW observations. We will organize and promote research projects focusing on the themes that expect drastic progress in near future.

【Expected Research Achievements and Scientific Significance】

(1) Comprehensive analysis of GWs

For the development of GW physics and astronomy, it is required to extract maximum information from weak GW signals, and the following results are expected: Actual detection of GWs by the KAGRA data analysis team members participating in this innovative area. Proposing and implementing advanced GW data analysis method for the test of gravity (A01). Obtaining restrictions on the equation of state and internal structure of high density matter from binaries including neutron stars (B01). Giving a quantitative theoretical prediction of the GW waveform from supernovae based on state-of-the-art simulations (C01).

(2) Expanding frontiers of GW physics/astronomy

Accelerating the new research trend stimulated by GWs, we expect to obtain the following results: Identification of GW sources and follow-up observation. Testing extended gravity theories and cosmological scenarios (A02). Providing a quantitative prediction on the evolution of massive black hole binaries to be compared with GW observations (A03). Clarifying the radiation mechanism of the counterparts of GW sources, and the formation history of black holes and neutron stars by X-ray and gamma-ray observations (B02). Identification and observation of the optical and infrared counterparts of GW sources. Identification of the production site of r-process elements in the universe (B03). Obtaining new restrictions on background neutrino quantity and average energy from distant supernova origin. Realizing theoretical calculation of more precise supernova explosion based on it (C02).

【Key Words】

Gravitational waves: Space-time ripples predicted by Einstein's general relativity.
Multi-messenger observation: Observing one astrophysical event by infrared, visible light, neutrino, GWs, etc. simultaneously to obtain detailed information.

【Term of Project】 FY2017-2021

【Budget Allocation】 1,079,000 Thousand Yen

【Homepage Address and Other Contact Information】

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