

## 【Grant-in-Aid for Scientific Research (S)】

### Science and Engineering (Mathematical and Physical Sciences)



#### Title of Project : Identification of Gravitational Wave Sources with X-ray Transient Monitor and Study of Black Hole Formation Mechanism

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Research Project Number : 16H06342 Researcher Number : 40345608

Research Area : Mathematical and Physical Science

Keyword : Astrophysics(Experiment), Gravitational Wave, X-ray, Satellite, Black Hole

#### 【Purpose and Background of the Research】

In this research, we will strongly contribute to construct and develop the gravitational wave (GW) astronomy.

The first detection of gravitational wave has been done by GW observatory LIGO in United States on Sep. 15, 2015. Since we obtained a new method “GW” to observe the universe, we expect to realize a brand new astronomy with simultaneous observations with both GW and electro-magnetic wave, especially for the moment of black hole formation and related phenomena in surrounding environments.

However, the localization accuracy by GW observation only is too poor to identify the origin of GW sources. Therefore, in this research, we will perform synchronous observations with GW detections using a wide field X-ray imaging detector and a gamma-ray trigger system aboard micro satellite planning to launch in FY2018. We will promptly send alert messages of X-ray and gamma-ray observation, and we strongly encourage follow-up observations by optical, infrared, radio (multi-wavelength) large observatories.

#### 【Research Methods】

The wide field observation with over 1/10 of entire sky can be realize only in X-ray and gamma-ray, so we enable to detect transient phenomena coincide with GW detections. In this research, we will develop flight model of X-ray and gamma-ray detectors (Figure1). We also install the alert system, and organize the follow-up observations (Figure 2).

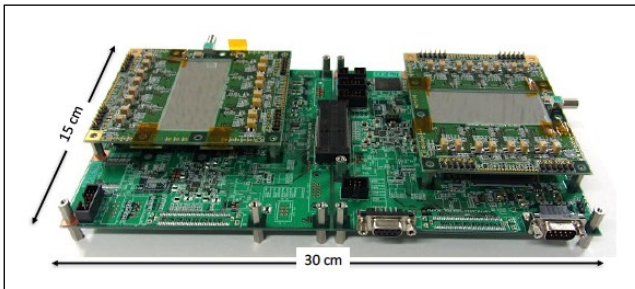


Figure 1. Proto-type model of wide field X-ray imaging detector. We develop the flight model in this research.

#### 【Expected Research Achievements and Scientific Significance】

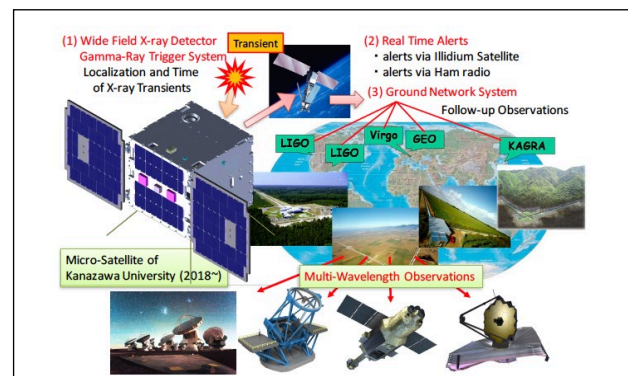


Figure 2. A complete picture of this research.

Several models of black hole formation are discussed, for example a direct collapse model and a massive magnetar model as an intermediate state of its formation. Using the time difference between GW and X-ray/gamma-ray detections, we will enable to discuss the process of black hole formation. Moreover, the main energy source of relativistic outflow (jet), i.e. a neutrino driven or a magnetic driven models, will be distinguished. We will realize advanced astrophysics with GW and electro-magnetic wave observations.

#### 【Publications Relevant to the Project】

”Establish of Gravitational Wave Astronomy with Gamma-Ray Burst and X-ray Transient Monitor”, D. Yonetoku, et al., UNISEC, 5, 2, pp.19-27 (2014)  
”X-raying extended emission and rapid decay of short gamma-ray bursts”, Y. Kagawa, D. Yonetoku et al., ApJ, 811, 8 (2015)

【Term of Project】 FY2016-2020

【Budget Allocation】 140,800 Thousand Yen

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