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

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Probing into the Intra-Halo Light and the Epoch of Cosmic Re-Ionization by Rocket Experiments to Measure the Cosmic Infrared Background

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Research Project Number : 15H05744 Researcher Number : 10321572
Research Area : Math and Physics
Keyword : Astrophysics (Experimental), Optical/near-IR astronomy

【Purpose and Background of the Research】

Aim of this research is to reveal underlying physics of structure formation in the dark matter universe, by measuring the extragalactic background light arising from the epoch of re-ionization and intra-halo light (IHL) of external galaxies.

As the results of recent researches, the universe was ionized at its beginning, it was neutralized at the epoch of recombination 400 thousand years after Big Bang, and it was re-ionized by mysterious sources – perhaps, first stars and black holes as the remnants of the first stars, born in about 5 billion years after Big Bang.

We have conducted measurements of the cosmic near-infrared background (wavelength : 1-5 μm) as red-shifted ultraviolet radiation filling the entire universe at the epoch of re-ionization. As the results of such experiments, we found an extra light in the cosmic background beyond an expected brightness by accounting all of known galaxies in the universe. The extra light may arise from the first stars, but total amount of the extra light brightness seems too high to have the early universe origin. Thus, we thought the extra light is coming from the local universe, and a possible hypothesis to explain the extra light is the existence of huge amount of stars in the dark matter haloes of external galaxies.

To give definite conclusion on the origin of the extra background light, more precise measurement is necessary, and this research is the one.

【Research Methods】

We figure out real cause of our finding, the extra light in the near-infrared background, by a new rocket experiment CIBER-2 (Cosmic Infrared Background ExpeRiment). The new experiment should have 10 times higher sensitivity than old experiment CIBER, especially to justify the hypothesis of first stars and IHL.

The two theories can be discriminated by their spectrum; first stars should indicate Lyman-break feature, and IHL should have smooth spectrum. CIBER-2 probes such spectral difference of the spatial fluctuations of the near-infrared background (see Figure 1).

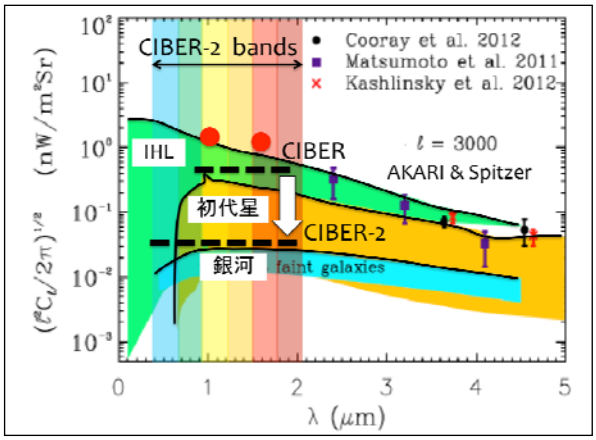

Figure 1 spectrum

【Expected Research Achievements and Scientific Significance】

Revealing the origin of the near-infrared background, first direct detection of the epoch of re-ionization, providing information on the missing baryons problem by measuring IHL, and studying intergalactic absorption of ultra-high energy gamma-rays by infrared-photons.

【Publications Relevant to the Project】

"On the origin of near-Infrared extragalactic background light anisotropy", M. Zemcov, *et al.*, Science, 346, 732-735 (2014).

【Term of Project】 FY2015-2019

【Budget Allocation】 100,000 Thousand Yen

【Homepage Address and Other Contact Information】

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