

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

Science and Engineering (Mathematical and Physical Sciences)



Title of Project : Physical Cosmology with POLARBEAR-2: a New Instrument for the Cosmic Microwave Background Polarization Measurements

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Research Project Number : 26220709 Researcher Number : 20263197

Research Area : Particle Cosmology

Keyword : Cosmic Microwave Background, CMB, Cosmic Inflation, Radio Telescope

【Purpose and Background of the Research】

How did the universe begin? What are the fundamental laws of physics that governed the beginning of the universe? These questions are one of grand challenges in science. Usually, it is said that the universe began as a “fireball” that exploded, which is often called the Big Bang. The cutting-edge research in cosmology, however, is pursuing the universe before the hot Big Bang, where the most promising hypothesis is called the cosmic inflation. The most important prediction of the cosmic inflation is primordial gravitational waves. Measurements of the cosmic microwave background (CMB) polarization are currently the only possible method with sufficient sensitivity for the discovery.

In March 2014, the BICEP2 collaboration announced a discovery of the primordial gravitational waves. There is a possibility, however, that the results are contaminated by microwave emission from cosmic dusts. In our project, we develop a new receiver system called POLARBEAR-2, which is 6 times as sensitive as the POLARBEAR receiver system that has been already deployed. The measurements with POLARBEAR-2 will allow us to firmly establish primordial gravitational waves if the signal is sufficiently large. We will also measure the effect of gravitational lensing, which will be used to constrain the sum of neutrino masses with the better precision than any of present results.

【Research Methods】

A new telescope with a diameter of 3.5m, which is a copy of the one we currently use for the POLARBEAR project (Fig.1 left), will be deployed in Atacama, Chile. The POLARBEAR-2 receiver system (Fig.1 right) will be mounted on the new telescope. The outstanding features of the POLARBEAR-2 system include a large focal plane of 7,588 transition-edge sensors (TESes) with dichroic readout for simultaneous measurements of 95 GHz and 150 GHz. We plan to deploy the system in FY2015. The final results will be shown in FY2018.



Figure 1 The radio telescope we currently use for the POLARBEAR project (left), and the POLARBEAR-2 receiver system in preparation (right).

【Expected Research Achievements and Scientific Significance】

The discovery of the primordial gravitational waves would be one of the biggest scientific discoveries of all time. Even no detection will be a significant result because it allows us to constrain inflationary models. Measurements of the sum of the neutrino masses with a better precision will also be an important contribution to particle physics.

【Publications Relevant to the Project】

• “Evidence for Gravitational Lensing of the Cosmic Microwave Background Polarization from Cross-correlation with the Cosmic Infrared Background”, POLARBEAR Collaboration (76 authors including Y. Chinone, M. Hasegawa, K. Hattori, M. Hazumi, Y. Hori, Y. Inoue, T. Matsumura, H. Nishino, S. Takakura, T. Tomaru), Phys. Rev. Lett. 112, 131302 (2014).

【Term of Project】 FY2014-2018

【Budget Allocation】 158,300 Thousand Yen

【Homepage Address and Other Contact Information】

<http://cmb.kek.jp/>