【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Mathematics/Physics)

Title of Project : Extended Telescope Array Experiment - Nearby Extreme Universe Elucidated by Highest-energy Cosmic Rays

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Research Project Number : 15H05693 Researcher Number : 80178590
Research Area : Particle/Nuclear/Cosmic ray/Astro physics
Keyword : Cosmic ray (experiment)

【Purpose and Background of the Research】

Due to cosmic magnetic fields, arrivals of cosmic rays from the universe are largely isotropic. The Telescope Array (TA) is the largest cosmic-ray observatory in the northern hemisphere, and has recently found an evidence for an excess spot (hot spot) in the arrival directions of cosmic rays among 72 events with energies greater than 5.7×10^{19} electron volts (E_{cutoff}) near the direction of the Great Bear using five years of data since 2008. Our experiment TA also confirmed a suppression of the flux of cosmic rays beyond E_{cutoff}, which supports a scenario that sources of highest-energy cosmic rays exist within 200 million light years from the Earth. These are the first results from which we expect to observe sources of highest-energy cosmic rays by expected rectilinearity in the universe.

【Research Methods】

When ultra-high-energy cosmic rays enter the atmosphere, an enormous number of secondary particles are generated. They arrive at the ground over an area of 10 kilometers in diameter. TA is

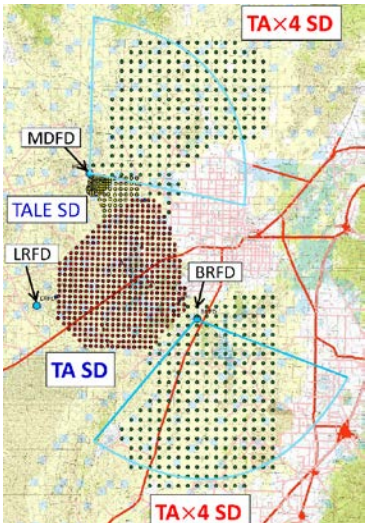

Figure 1 TAx4

located in Utah, USA, and uses an array of 507 surface detectors (SDs) deployed over an area of 700 square kilometers to detect the secondary particles. Each SD has 3 square meters of plastic scintillator and they are placed on a square grid of 1.2 kilometer spacing. Our new research TAx4 adds 500 SDs with 2.08 kilometer spacing to the east of the present TA array to quadruple the TA aperture to approximately 3,000 square kilometers in total. TAx4 detects highest-energy cosmic rays with high statistics and measures their energy spectrum, arrival directions and mass composition in the northern sky.

【Expected Research Achievements and Scientific Significance】

We accumulate the equivalent to 19 years of the current TA data in the research period including data already taken, and expect to observe approximately 300 cosmic rays above E_{cutoff}. We will confirm the hot spot and explore its origin along with the search for other excess spots. We will search for correlations with nearby galaxies and active galactic nuclei. And we will search for point sources of highest-energy cosmic rays.

【Publications Relevant to the Project】

・"The cosmic-ray energy spectrum observed with the surface detector of the Telescope Array experiment", T. Abu-Zayyad et al., Astrophys. J., 768:L1 (5pp), 2013.
・"Indications of intermediate-scale anisotropy of cosmic rays with energy greater than 57 EeV in the northern sky measured with the surface detector of the Telescope Array experiment", R.U. Abbasi et al., Astrophys. J., 790:L21 (5pp), 2014.

【Term of Project】 FY2015-2019

【Budget Allocation】 447,100 Thousand Yen

【Homepage Address and Other Contact Information】

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