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

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Study of the Ultra High Energy Cosmic Ray Source Evolution by Detailed Measurement of Cosmic Rays in the Wide Energy Range

Shoichi Ogio
(Osaka City University, Graduate School of Science, Professor)

Research Project Number : 15H05741 Researcher Number : 20242258
Research Area : Particle/Nuclear/Cosmic ray/Astro physics
Keyword : Cosmic ray physics (experiment)

【Purpose and Background of the Research】

The Telescope Array (TA) experiment consists of the surface detector (SD) array of 680 km^2 and fluorescence detectors (FDs), and in 2012 we started the Telescope Array Low Energy extension (TALE) experiment observing lower energy cosmic rays. The effective threshold energy of the experiment is successfully turned down to lower than 10^{16} eV. We reported the cosmic ray energy spectrum in the wide energy range from $10^{15.9}$ eV above 10^{20} eV. It has complicated structures showing several kinks and dips rather than a simple power law as shown in Figure 1.

With TALE hybrid detector, we will measure not only the energy spectrum with a high statistics and with energy-independent detection efficiency, but also arrival direction information and the chemical composition with the hybrid technique.

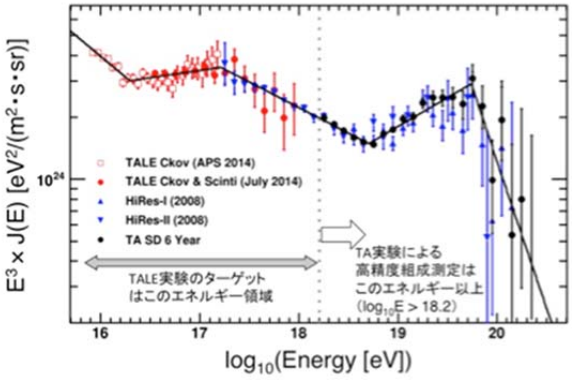

Figure 1 Energy spectrum of cosmic rays

【Research Methods】

We will construct the TALE hybrid detector with installing the air shower array of 67 km^2 with 103 SDs in the FOV area of the TALE-FDs as shown in Figure 2. This air shower array has 100 % detection efficiency for energies above 1.4 × 10^{17} eV, and hybrid observations with FDs provides a remarkable improvement in the Xmax (an observable depends on primary cosmic ray particle species) determination achieving the error of 20 g/cm^2 comparing with the monocular FD resolution of 40 g/cm^2.

【Expected Research Achievements and Scientific Significance】

The galactic and the extragalactic components coexist in the lower energy range than 10^{18} eV, and the extragalactic component spectrum has convolved information of source spectra, the distribution of extragalactic sources, integration of energy losses during propagations and the shielding by the galactic magnetic field. Moreover, the galactic spectrum has a convolution of the physics process limiting the accelerated energy at galactic sources and the confinement of cosmic rays in the Galaxy. We will collect observational data for resolving these convolved information.

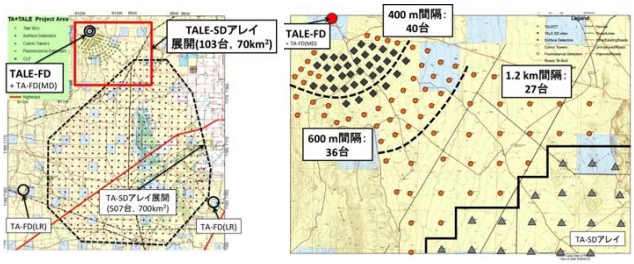

Figure2 (*Left*)A map of the TA experiment site. (*Right*)The close up of the TALE-SD array area.

【Publications Relevant to the Project】

"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., Ap. J., 790, L21, 2014

"The energy spectrum of ultra-high-energy cosmic rays measured by the Telescope Array FADC fluorescence detectors in monocular mode", T. Abu-Zayyad, et al., Astropart. Phys., 48, p.16, 2013

【Term of Project】 FY2015-2019

【Budget Allocation】 124,900 Thousand Yen

【Homepage Address and Other Contact Information】

http:// www.telescopearray.org
sogio@sci.osaka-cu.ac.jp