

【Grant-in-Aid for Specially Promoted Research】
Science and Engineering (Mathematics/Physics)



Title of Project : Extreme Phenomena in the Universe Explored by Highest Energy Cosmic Rays

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Research Area : Particle / Nuclear / Cosmic ray / Astro physics

Keyword : Cosmic ray (experiment)

【Purpose and Background of the Research】

The AGASA experiment in Akeno, Japan observed 11 events of Ultra-high Energy Cosmic Rays (UHECRs) exceeding an energy of 10^{20} electron Volt (eV) in its 13 years of operation until 2003. The expected number of events was 3-4 in the same period due to the limitation imposed by the collision of UHECRs with the cosmic microwave background.

The AGASA was the world largest air shower array composed of ~110 surface particle detectors (SDs) covering the area of 100km². The AGASA's finding was, however, not confirmed by the subsequent observation by the HiRes experiment, which employed the fluorescence detector (FD) in Utah, USA. The FD records the track of air shower in the atmosphere using a large aperture telescope and a fast and sensitive imaging camera.

【Research Methods】

The Telescope Array (TA) experiment was built in Utah, USA as a hybrid detector of SD and FD. The SD (see Picture on the right) is composed of two layers of plastic scintillators each with 1.2cm thick and 3m² large. A total of 507 SDs were deployed on a grid of 1.2km spacing. The array of SDs covers the ground area of 680km². Each SD is operated by the solar panel and a battery. The location and precise timing of SD have been obtained by using the GPS. The control and data acquisition are performed using a wireless LAN.

A battery of 12-14 FDs is deployed in 3 locations (see Picture) surrounding the SD array. They observe the sky over the SD array in the moonless, clear night looking for a faint ultra-violet track in the sky caused by the air shower.

【Expected Research Achievements and Scientific Significance】

The major part of the TA was built by the budget from Japan (Kakenhi grant) and the USA (NSF). The construction was completed in March, 2008 and the observation began. The TA



is now being operated by the international collaboration of Japanese, American, Korean and Russian scientists expecting to unveil the enigmatic origin of UHECRs in near future.

【Publications Relevant to the Project】

1. M.Nagano, M.Teshima, M.Takeda (AGASA collaboration), "Extension of the Cosmic-Ray Energy Spectrum beyond the Predicted Greisen-Zatsepin-Kuz'min Cutoff", Phys. Rev. Lett. **81**(1998) 1164- 1166.
2. M.Fukushima, F.Kakimoto, S.Ogio, H.Sagawa (Telescope Array collaboration), "Measurement of Ultra-high Energy Cosmic Rays by Telescope Array (TA)", JPSJ **78** (2009) Suppl.A 108-113

【Term of Project】 FY2009 - 2013

【Budget Allocation】 499,300 Thousand Yen

【Homepage Address and Other Contact Information】

<http://taws100.icrr.u-tokyo.ac.jp/>