# Research Report
# ICRR Inter-University Research Program 2019

Research Subject:

Anisotropy of Ultra High Energy Cosmic Rays

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Summary of Research Result :

Telescope Array times 4(TAx4) was proposed to broaden detection area for study of Ultra High Energy Cosmic Rays (UHECRs). In 2018, 30 Surface Detectors (SDs), scintillation detector for TAx4, were built in Sungkyunkwan Univ. in Korea, and transported to Utah. Telescope Array collaborators successfully deployed 257 Surface Detectors for Telescope Array times 4 from Jan. to Mar. of 2019.

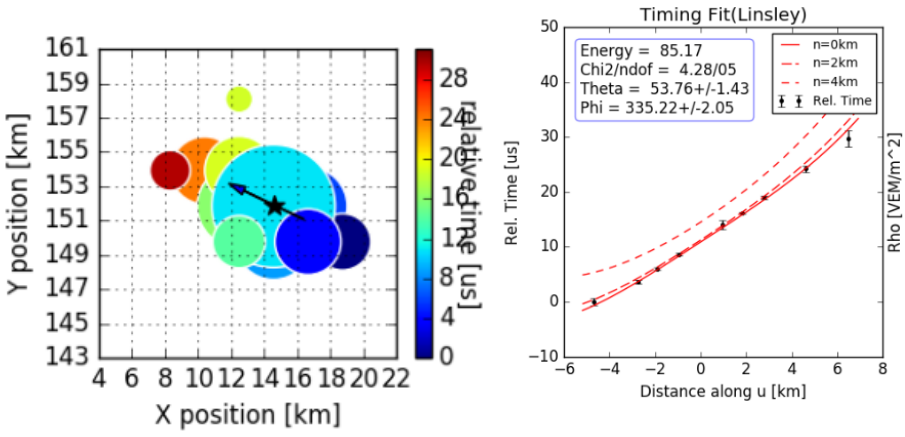


**Fig. 1. Detected signal from SD array (left) and timing fit result(right)**

Since Apr. of 2019, Tax4 SDs have operated to detect the extensive air showers enhanced by UHECRs. From the timing and charge of detected signal from each SD, one can reconstruct the arrival direction of primary cosmic rays. Example of detected signals and reconstruction result are shown on Fig. 1. Arrival direction resolution is

tested with Monte Carlo simulation, and resolution is about 2 degree. From particle density from lateral distribution of particles from Extensive Air Shower, energy can be estimated. An example of lateral distribution fit result is shown on Fig. 2.

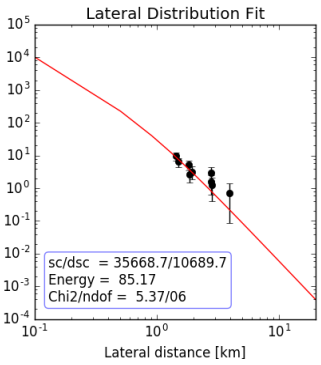


**Fig. 2. Lateral Distribution Fit result.**

Reconstructed arrival direction and energy distribution from 6-month detection period (from Oct. 2019 to Mar. 2020) is shown on Fig. 3. Only the number of triggered SDs is greater than 4 are included in Fig. 3.

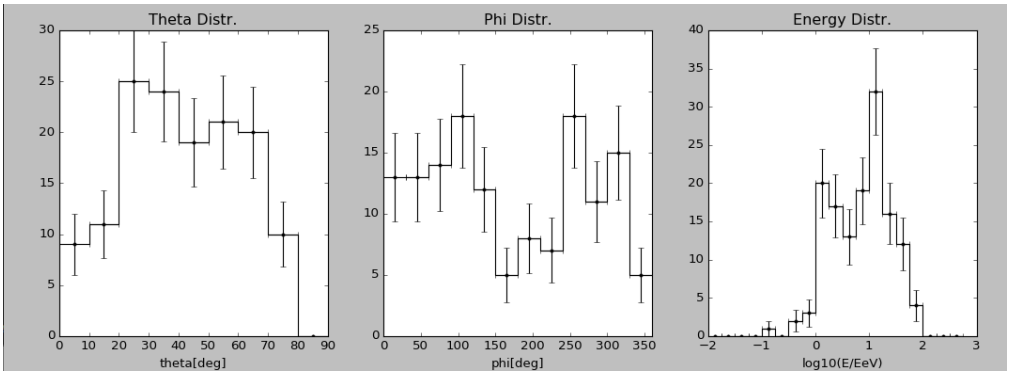


**Fig. 3. Theta (left), phi (middle) and energy (right) distribution detected in 6-month.**

The target of this research is to find out anisotropy of UHECRs, especially with energy greater than 57 EeV. To find out the anisotropy, eliminating mis-reconstructed low energy events from detected UHECR events is mandatory to figure out anisotropy of UHECRs. Setting appropriate cutting out criteria, so called quality cut, is being tested with Monte-Carlo simulation. This quality cut is expected to improve arrival direction and energy resolutions of reconstruction program, and we expect that anisotropy of UHECRs will be shown gradually with accumulating data.