Research Result Report
ICRR Inter-University Research Program 2022

Research Subject: Ultra-high-energy cosmic-ray origin studies with the Telescope Array and TAx4 surface detector

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Summary of Research Result :

The origin of the ulta-high energy cosmic rays remains a puzzle in the modern astroparticle physics. Two large-scale experiments – the Telescope Array and Pierre Auger Observatory have recorded the unprecedentedly large statistics of the extensive air shower events induced by the ultra-high energy cosmic rays. The Telescope Array (TA) Surface Detector (SD) is an array of 507 stations, each containing two layers plastic scintillator with an area of 3 m^2. The results of the 14 years of TA SD observations (2008-2022) are used for the analysis within the project.

We have performed an extensive search for spatial correlations of high-energy neutrinos with the ultra-high-energy cosmic rays. The neutrino data by IceCube and ANTARES are used together with the extensive air shower events with energies above 50 EeV registered by Telescope Array and Pierre Auger Observatory. No significant excess have been found. We have improved the constraints on the neutrino flux spatially correlated with ultra-high-energy cosmic rays.

We have developed a method for particle type identification of the TA SD events based on the deep learning. We have performed Monte-Carlo simulations of events induced by the primary gamma-rays for the conditions of 14 years of observations.

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