Form 8

Research Result Report
ICRR Inter-University Research Program 2024

Research Subject: Ultra-high-energy cosmic-ray origin studies with the Telescope Array and TAx4 surface detector
Principal Investigator: Grigory I. Rubtsov, Deputy director, Institute for Nuclear Research of the Russian Academy of Sciences
Participating Researchers: Oleg E. Kalashev (INR RAS), Ivan V. Kharuk (INR RAS), Maxim S. Pshirkov (INR RAS), Sergey V. Troitsky (INR RAS), Maria A. Kudenko (INR RAS), Konstantin A. Dolgikh (INR RAS), Mikhail Yu. Kuznetsov (INR RAS), Igor I. Tkachev (INR RAS), Shoichi Ogio (ICRR, University of Tokyo), Takashi Sako (ICRR, University of Tokyo), Hiroyuki Sagawa (ICRR, University of Tokyo)
Summary of Research Result： We use a new method to estimate the injected mass composition of ultrahigh cosmic rays (UHECRs) at energies higher than 10 EeV. The method is based on comparison of the energy-dependent distribution of cosmic ray arrival directions as measured by the Telescope Array (TA) experiment with that calculated in a given putative model of UHECR under the assumption that sources trace the large-scale structure (LSS) of the Universe. We report an estimation of the injected mass composition of ultrahigh energy cosmic rays (UHECRs) at energies higher than 10 EeV. The composition is inferred from an energy-dependent sky distribution of UHECR events observed by the Telescope Array surface detector by comparing it to the Large Scale Structure of the local Universe. In the case of negligible extragalactic magnetic fields (EGMFs), the results are consistent with a relatively heavy injected composition at that becomes lighter up to , while the composition at is very heavy. The latter is true even in the presence of highest experimentally allowed extragalactic magnetic fields, while the composition at lower energies can be light if a strong EGMF is present. The effect of the uncertainty in the galactic magnetic field on these results is subdominant. We report new results on the search for ultra-high energy photons using the

Form 8

Telescope Array Surface Detector (TA SD) array. The method is based on a neural network classifier trained on the photon-induced and proton-induced Monte-Carlo event sets. The classifier is trained on waveform signals at each SD station supplemented with event-level composition-sensitive parameters. The latter parameters such as the curvature of the shower front, area-over-peak, asymmetry of the signal at the upper and lower detector layers lead to an increase of the classification accuracy. We report the updated limits on the ultra-high energy photons based on 14 years of TA SD data.

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