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Perspectives for ultrahigh-energy particle observation based on the lunar orbital LORD space experiment

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The problem of searching for highest-energy cosmic rays and neutrinos in the Universe is reviewed. Possibilities for using the radio method for detecting particles of energies above the CZK cut-off are analyzed. The method is based on the registration of coherent Cherenkov radio emission produced by cascades of most energetic particles in radio-transparent lunar regolith. The Luna-26 space mission to be launched in the nearest future involves the Lunar Orbital Radio Detector (LORD). The potentialities of the LORD space instrument to detect radio signals from showers initiated by ultrahigh-energy particles interacting with lunar regolith are examined. The comprehensive Monte Carlo calculations were carried out within the energy range of 10^{20} to 10^{25} eV with the account for physical properties of the Moon such as its density, lunar-regolith radiation length, radio-wave absorption length, refraction index, reflection from the lower regolith boundary, and orbit altitude of a lunar satellite. The design of the LORD space instrument and its scientific potentialities for registration of low-intense cosmic-ray particle fluxes of energies above the GZK cut-off up to 10^{25} eV are discussed, as well. The designed LORD module (including the antenna, amplification, and data-acquisition systems) now is under construction. The LORD space experiment will make it possible to obtain important information on the highest-energy particles in the Universe, to verify modern models for the origin and the propagation of ultrahigh-energy particles. It is expected that the LORD space experiment will surpass in its apertures and detection capability the majority of well-known current and proposed experiments that deal with the detection of both ultrahigh-energy cosmic rays and neutrinos. The future prospects in the study of ultrahigh-energy particles by orbital radio detectors are also considered, namely, a multi-satellite lunar systems and space missions to largest ice planets of the solar system.

Collaboration

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