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The progress of High-Energy Physics in Atmosphere achieved with the implementation of particle physics and nuclear spectroscopy methods

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At Aragats research station we are consistently applying methods of particle physics and nuclear spectroscopy for revealing details of the operation of electron accelerators emerging just above our heads in the thunderclouds. The newly emerging field of high-energy physics in the atmosphere needs successive application of experimentation paired with the simulation of physical processes with CORSIKA and GEANT4 packages well established in the high-energy physics community. In addition to the minute-long fluxes of high-energy electrons and gamma rays from relativistic runaway electron avalanches (RREA), we discover also the origin of hour-long isotropic fluxes of low-energy gamma rays from the 222Rn progeny. During 12 years of 24/7 monitoring of cosmic ray fluxes, we observe more than half-of-thousand thunderstorm ground enhancements (TGEs). Each od cosmic-ray species brings its own special evidence on the structure and strength of the atmospheric electric field. The depletion of muon flux (muon stopping effect) observed simultaneously with the world's largest-ever enhancement of electron and gamma rays at Mt. Lomnicky Stit allows us to estimate the maximum value of the atmospheric electric field. Using a high-precision spectrometer for the measurement of the energy spectra of the natural gamma radiation we discovered a new effect of circulation of radon progeny during thunderstorms. The comparison of electron and gamma ray energy spectra allows us to localize the emerging electrical structures in the atmosphere which makes it possible to accelerate seed electrons up to ≈100 MeV. Measuring simultaneously neutron and gamma ray fluxes by a neutron monitor and SEVAN hybrid particle detector we prove the photonuclear origin of the atmospheric neutrons.

Keywords

Electron accelerator in the atmosphere, energy spectra of electrons, and gamma rays of the atmospheric origin, Atmospheric electricity, TGE, RREA, LPCR

Collaboration

other Collaboration

Subcategory

Experimental Results

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