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Physics and effects of relativistic SEPs/GLEs

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Systematic study of relativistic solar energetic particles provides key information about various processes, such as production and acceleration of energetic particles at the Sun and the interplanetary medium, interactions of energetic particles with magnetic fields in the heliosphere i.e. probing the electromagnetic and plasma conditions of the heliosphere, assessment of their terrestrial and space weather effects.
Following solar eruptive processes, such as solar flares and/or coronal mass ejections solar ions are accelerated to a high-energy range. In the majority of cases, the maximum energy of the accelerated solar ions is several tens of MeV/nucleon, but in some cases, it exceeds 100 MeV/nucleon or even reaches GeV/nucleon range. In this case, the energy is high enough, so that solar ions generate an atmospheric cascade in the Earth's atmosphere, whose secondary particles reach the ground, eventually registered by ground-based detectors, specifically neutron monitors. This particular class of events is known as ground-level enhancements (GLEs). Here we report recent achievements related to the physics of relativistic SEPs/GLEs, their observations, and the related terrestrial and space weather effects.

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