

Hard spectra of extreme Ground Level Enhancements

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Ground Level Enhancement (GLE) is a significant increase of the count rate registered on ground-based neutron monitors (NMs). So far, 72 GLEs have been recorded by the worldwide neutron monitor network since the 1950s. The energy spectrum of solar energetic particles (SEP) for these events varied quite a lot between the events, as measured directly and indirectly. Here we studied a statistical relation between the event-integrated intensity of a GLE (expressed in percent-hours) and the 'hardness' of the solar particle energy spectra, quantified as the ratio of the the integral omnidirectional event-integrated fluences of particles with energy above 30 MeV (F_{30}) and above 200 MeV (F_{200}). We specifically analyzed the event-integrated energy spectrum for the GLE 71 (17-May-2012), the only directly measured by PAMELA over the entire span. We found no clear relation between the intensity and the spectral hardness for weak and moderate GLE events, but all extreme GLE events were characterized by a very hard spectrum. This implies that a hard spectrum can be securely assumed for all extreme GLE events, e.g., those studied using cosmogenic isotope data in the past.

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