

NEW RECONSTRUCTION OF EVENT-INTEGRATED SPECTRA (SPECTRAL FLUENCES) FOR MAJOR SOLAR ENERGETIC PARTICLE EVENTS. S. A. Koldobskiy^{1,2}, O. Raukunen², R. Vainio³, G. A. Kovaltsov⁴, I. Usoskin¹. ¹University of Oulu, 90570 Oulu, Finland (sergey.koldobskiy@oulu.fi), ²National Research Nuclear University MEPhI, 115409 Moscow, Russia, ³University of Turku, 20500 Turku, Finland, ⁴Ioffe Physical-Technical Institute, 194021 St. Petersburg, Russia.

The network of ground-based neutron monitors (NMs) is the most important detector aimed to study the long-term solar activity for the last 70 years. NMs register the nucleonic component of atmospheric cascades generated during the interaction of cosmic rays with the atmospheric nuclei. In addition to the registration of galactic cosmic-rays (GCR) variations induced by the changes in heliospheric magnetic field, NMs are also able to register the high-energy solar energetic particles (SEP) accelerated during solar flares and/or coronal mass ejections. Today we know about 73 high-energy events registered by the ground-based detectors, the latest occurred on October 28, 2021.

Here we report the new reconstruction of the event-integrated spectra of SEP detected by NM network and satellite experiments (mainly GOES data) during ground-level enhancement (GLE) events [1]. The reconstruction of SEP particle fluences is based on the “bow-tie” method employing the latest advances in NM data analysis (time-dependent GCR background and the use of the NM yield function directly verified with the AMS-02 cosmic-ray experiment data) and a detailed study of different uncertainties. For the pre-GOES period, we used all available SEP datasets. As a result of this work, we obtained integral fluences of SEPs in the energy range from 30 MeV to a few GeV for 58 moderate and strong GLE events since 1956. The results were fitted with the modified Band-function (a double power-law function with two exponential cutoffs) which is continuous together with its derivative. An easy-to-use presentation of SEP fluences in the form of an analytical expression forms a solid basis for new studies in different fields, such as the influence of SEPs on the atmosphere and a statistical study of extreme solar activity.

References:

- [1] Koldobskiy S. et al. (2021) *A&A*, 647, A132.