FINE STRUCTURE OF THE GROUND LEVEL ENHANCEMENTS AS POSSIBLE IDENTIFIER OF THE SOLAR ENERGETIC PARTICLES TYPE

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Galactic cosmic rays incident on the atmosphere create fluxes of secondary particles reaching the earth. The intensities of these fluxes, as measured at different geographical positions by various particle detectors, are characterized mostly by geophysical conditions of the site, particular phase of solar activity, and by the local time of day. Transient solar events also influence the count rates of particle monitors. In this report we will examine short term enhancements of count rates detected by the Aragats Space-Environmental Center (ASEC) Neutron Monitors (NM) and correlated with the fluxes of high energy ions accelerated by Solar Flares and by shock waves driven by Coronal Mass Ejections.

The arrival times of the "first" ions at 1AU can be estimated by the technique described in (Lockwood et. al., 1990). In that paper it was proposed to use the registered arrival times of the first ions done by the space-born ion spectrometers to deduce the energy, therefore, the arrival time dependence.

Extrapolating the obtained dependence to the relativistic particles we readily obtain the arrival time of the ions that are energetic enough to enter the atmosphere at the Aragats geographical location and produce secondary fluxes reaching the Aragats altitudes. We assume that first ions of all energies are accelerated in the spatial region limited by a few sun radii and that interplanetary propagation of ions of highest energies is essentially scatter-free. Correctness of these assumptions can be validated by calculating the goodness of fit (or correlation coefficient) of the obtained linear regression function of the arrival times with the inverse of the particle velocity in units of **c**.

Analysis of the several events detecting during 23 cycle gave indications that Ground Level Enhancements (GLE) detected by the ASEC monitors are correlated with solar activity and that it is possible to isolate peaks in NM counts associated with definite types of ion. An interesting consequence of this GLE "mass spectroscopy" is that iron ions are much more efficient to produce GLE comparing with protons.

The correlation coefficients of all linear regression lines are rather large, more than 0.9, indicating that the assumptions concerning the location of the first ions injection in the vicinity of the sun and scatter free arrival at 1 AU are valid for the analyzed events.

Reference

Lockwood J.A., Debrunner H., Fluckiger E.O., 1990, JGR, 95,4187

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