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Deriving the properties of relativistic SEPs by using neutron monitor data

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Ground Level Enhancements (GLEs), observed in cosmic ray intensity records of ground-based particle detectors, are related to the most energetic class of solar energetic particle (SEP) events, being them associated with both solar flares and coronal mass ejections (CMEs) and requiring acceleration processes that produce particles with energies $\geq\sim$500 MeV/part. upon entry in the Earth's atmosphere.

The Neutron Monitor Based Anisotropic GLE Pure Power Law (NMBANGLE PPOLA) model (*Plainaki et al. 2010*), is an effective modeling tool that treats the neutron monitor network as an integrated omnidirectional spectrometer able to measure the characteristics of the relativistic primary solar proton flux, at some point of the near-Earth magnetosphere. In this context, modeling of the neutron monitor response to an anisotropic SCR flux, registered during a GLE event, and solving the inverse problem, can provide the actual characteristics of the relativistic SEPs that are responsible for the event.

In this work, we apply the NMBANGLE PPOLA model to the recent GLE of 2012 May 17 (also known as GLE71). Our results are summarized as follows: (i) the SEP spectrum related to GLE71 was rather soft during the whole duration of the event, manifesting some weak acceleration episodes only during the initial phase (at $\sim$ 01:55-02:00 UT) and at $\sim$02:30-02:35 UT and $\sim$02:55-03:00 UT; (ii) the spectral index of the modeled SEP spectrum supports the CME-shock driven particle acceleration scenario, in agreement with past results based on the analysis of satellite measurements; (iii) during the very initial phase of GLE71, the solar proton source at the top of the atmosphere was located above the northern hemisphere, implying that the asymptotic directions of viewing of the northern hemisphere NMs were more favourably located for registering the event than the southern ones; (iv) the spatial distribution of the solar proton fluxes at the top of the atmosphere, during the main phase manifested a large variation along longitude and latitude; (v) at the rigidity of 1 GV the maximum primary solar proton flux resulted to be of the order of $\sim 10^4$part. m^{-2} s^{-1} sr^{-1} GV^{-1}.

Plainaki, C., Mavromichalaki, H., Belov, A., Eroshenko, E., Andriopoulou, M., Yanke, V., (2010). A New version of the Neutron Monitor Based Anisotropic GLE model: Application to GLE60, Solar Physics, Volume 264, Issue 1, pp.239-254, doi:10.1007/s11207-010-9576-6