

Relativistic solar proton parameters derived by the GLE modeling technique (Apatity team)

Taking as a base our results on GLEs modeling (Vashenyuk et al., 2009) we can offer parameters of relativistic solar protons at different GLEs that can be used in calculations of a radiation dose effect caused by solar cosmic rays. The presented solar proton flux data were obtained from real neutron monitor data set adjusted to existing conditions of the NMDB project:

Limited number of NM stations, limited accuracy of asymptotic direction calculations, etc.

On the late quasi-isotropic phase of the event, when the main radiation effect is created, the solar proton spectrum can be described by the simple power law in the relativistic rigidity domain:

The anisotropy axis direction is defined by parameters Φ (longitude) and Θ (latitude) in the GSE coordinates. The pitch angle distribution can be described by the Gaussian-like function

$F(\theta(R)) \sim \exp(-\theta^2/C)$. The parameter $C=2\sigma^2$ determines a gaussian width at a level of 0.7 from the maximum.

Accordingly, the parameters of a flux of relativistic solar protons outside magnetosphere can be determined by parameters of rigidity spectrum J_0 , γ , anisotropy (symmetry) axis direction Φ and Θ , and a pitch angle distribution by a parameter C defined above.

References

Vashenyuk E.V., Balabin Yu.V., Gvozdevsky B.B. Relativistic solar cosmic ray dynamics in large ground level events // Proc. 21-st ECRS. – Kosice, Slovakia, 9-12 September, 2008. – Inst. of Experimental Phys., Slovak Academy of Sci. 2009. – P. 264-268

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	Time, UT	J_0 , [m ² ·s·st·GV] ⁻¹	γ	C , $C=2\sigma^2$,	σ , °	Θ , ° GSE	Φ , ° GSE
GLE 59 14.07.2000	11.10	2.0 10 ⁶	7.3	22.3	190	33	5
GLE 60 15.04.2001	14.10	6.7 10 ⁴	1.7	1.89	55	-23	-15
	15:30	2.5 10 ⁶	6.7	8.1	115	-21	-26
GLE 69 20.01.2005	08:00	4.3 10 ⁶	6.9	18.9	175	0	-7
GLE 70 13.12.2006	03.05	1.7 10 ⁵	4.4	0.46	27	2	-43
	04:00	4.3 10 ⁶	6.9	18.4	173	3	-48