Geophysical Research Abstracts, Vol. 7, 10303, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10303

Cosmic ray using for monitoring and forecasting of great radiation hazards for the Earth's ecosystem

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We show that the monitoring and exact forecast of great radiation hazards for the Earth's ecosystem (especially dangerous for satellites in magnetosphere and aircrafts on regular airlines on altitude about 10 km and higher) caused by solar flare events can be made by using high-energy particles (few GeV/nucleon and higher) which transportation from the Sun is characterized by much bigger diffusion coefficient than for small and middle energy particles. Therefore high energy particles came from the Sun much more early (8-20 minutes after acceleration and escaping into solar wind) than main part of smaller energy particles caused dangerous situation for electronics (more than 30-60 minutes later). We describe here principles and experience of automatically working of program "FEP-Search". The positive result which shows the exact beginning of FEP event on the Emilio Segre' Observatory (2025 m above sea level, R_c = 10.8 GV), is determined now automatically by simultaneously increasing on 2.5 St. Dev. in two sections of neutron supermonitor. The next 1-min data the program "FEP-Search" uses for checking that the observed increase reflects the beginning of real great FEP or not. If yes, automatically starts to work on line the programs "FEP-Research". We determine also the probabilities of false and missed alerts.

The first of programs "FEP-Research" is the program "FEP-Research/Spectrum". We consider two variants: 1) quiet period (no change in cut-off rigidity), 2) disturbed period (characterized with possible changing of cut-off rigidity). We describe the method of determining of the spectrum of FEP in the 1-st variant (for this we need data for at

least two components with different coupling functions). For the 2-nd variant we need data for at least three components with different coupling functions. We show that for these purposes can be used data of total intensity and some different multiplicities, but better to use data from two or three NM with different cut-off rigidities. We describe in details the algorithms of the program "FEP-Research/Spectrum". We show that after founding the spectrum at different moments of time can be determined the time of ejection, diffusion coefficient in the interplanetary space and energy spectrum in source of SEP. We consider several possibilities: 1) one of these three parameters is unknown, 2) two of these three parameters are unknown, 3) all these three parameters are unknown. We show that in the first case is necessary to determine energy spectrum of SEP on the Earth in two different moments of time and from two equations automatically can be determined the unknown parameter (energy spectrum in source or diffusion coefficient, or time of ejection; determination is made from one equation, and other is used for control of used model). In the second case is necessary to determine energy spectrum of SEP on the Earth in three different moments of time and from three equations automatically can be determined two parameters (for example, the energy spectrum in source and diffusion coefficient in the interplanetary space). In the third case by using data for four different moments of time can be determined all three unknown parameters (time of ejection, diffusion coefficient in the interplanetary space and energy spectrum in source of SEP), and one equations can be used for control of model. We describe in details the algorithms of the programs "SEP-Research/Time of Ejection", "SEP-Research /Source" and "SEP-Research/Diffusion". We show how worked these programs on examples of some historical great SEP events. On the basis of these programs on-line can be determined the time of ejection, diffusion coefficient in the interplanetary space and energy spectrum in source of SEP. To extend the obtained information in the region of very small energies, we use simultaneously with NM data also available satellite one-minute data. We show how on the basis of these results can be made forecasting of expected radiation hazard for computers, electronics, solar batteries, technology in space on different distances from the Sun and on different helio-latitudes. We show that the same can be made for satellites on different orbits in the magnetosphere with taking into account the change of cut-off rigidities along the orbits (for people health, solar batteries, computers, electronics, technology). By the method of coupling functions for different altitudes in the atmosphere we describe principles of radiation hazard forecasting on-line for air-planes on regular and non-regular lines in dependence of altitudes and cut-off rigidities, and value of shielding. On-line will be made forecasting of radiation hazard on the ground for people health and technology in dependence from the cut-off rigidity and atmospheric pressure. If for some cases the calculated radiation hazard will be expected higher than some definite level of dangerous, will be on-line send special Alerts. We show how

worked these programs on examples of some historical great SEP events.

This research is supported by COST-724