

Improved environment radiation models

R.A. Nymmik

Skobeltsyn Institute of Nuclear Physics, Moscow State University, 119899, Moscow, Russia
(nymmik@sinp.msu.ru / Fax: 7-495-9390896 / Phone: 7-495-9328861)

Of special importance in the practice of planning space missions and designing space vehicles and stations, intended for flights in the inner heliosphere, are the issues of radiation effect of high-energy particles of two cosmic radiation components – Galactic Cosmic Rays (GCR) and Solar Energetic Particles (SEP). This circumstance gives rise to ever growing attention to developing and updating the models for calculating the fluxes of these particles for purposes of forecasting radiation conditions on the routes of future flights, including missions to the Moon and Mars.

A basis for developing radiation models are continuous experimental data and, first of all, monitor measurements of duration of one solar activity cycle (11 years) and greater. It is these measurements, which make it possible to elucidate the character and regularities of the dependence of particle fluxes on the solar activity – the main cause of changing of GCR fluxes and of the probability of SEP events occurrence. Because of complexity of measurements of particle fluxes and determination of their energy in space environment, for greater reliability of results, it is worthwhile to have the results of simultaneous measurements of particle fluxes by several instruments.

An important characteristic of models, from the viewpoint of practical application, is their attribution to solar activity characteristics. Proceeding from such a viewpoint, the models, which are still being developed as closed ones and do not directly depend on well-known quantitative (rather than qualitative) solar activity parameters, must become open (disclosed) with due time. This implies that they must be capable to forecast, as reliably as possible, the fluxes of particles for the next decade, rather than to describe only the fluxes of particles of some kind proceeding from already recorded fluxes of particles of other kind or other energies. At the same time, the closed models also play important part in finding the regularities inherent in the processes resulting in the dynamics of particle fluxes in the inner heliosphere.

Since the requirements to the techniques of radiation protection in space flights are different with respect to Galactic Cosmic Rays and Solar Energetic Particles events, of special importance becomes the problem of the balance of particle fluxes of various origin in the course of solar activity variation. This problem can be solved correctly only by means of open models, which use identical parameters as the input data.

An important characteristic of models, from the viewpoint of their users, is their simplicity, that is, the possibility of obtaining the results by means of relatively simple

calculations. This possibility suggests that, along with complicated and lasting calculations, the model developers should envisage, without a great loss of accuracy, the possibility of offering the users the versions of models, which are simpler for implementation. It is also desirable to have the output data of models in the form, that allows to further calculate the radiation effects (the penetration to Earth satellite orbits or outside the screening areas, the radiation doses, the spectra of linear energy transmission – LET, etc) in the online mode.

In this report an attempt is made to analyze the available models of GCR and the models of SEP proceeding from the principles and requirements stated above.