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The numerical simulation of the cutoff boundaries determined by the solar wind and geomagnetic parameters

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Abstract

In this paper numerical method is used to study the cutoff boundaries at the high latitudes. We investigated the variations of the cutoff latitudes for energetic particles at 450 km altitude during three geomagnetic storms.

The numerical results show that the cutoff latitudes of energetic particles can spread widely depending on the interplanetary and geomagnetic conditions. Since the cutoff boundary is not a circular, an elliptical model is used to fit the shape of the cutoff boundary. It is found that the main parameters of this model are controlled by the interplanetary parameters such as interplanetary magnetic field (IMF), the solar wind pressure $Pdyn$, dipole tilt angle Ps, geomagnetic activity indices Dst and AE, IMF clock angle θ, and so on. The relationships between the elliptical parameters and the interplanetary conditions were studied, and also between the elliptical parameters and the geomagnetic conditions. Quantitatively estimating can make by using the parameters B_z, $Pdyn$, PS, Dst, AE, IMF clock angle θ and so on. We found that the relationship is substantially more complex than suggested by previous statistical studies. This result on the cutoff latitudes can be used for forecasting the variation of the cosmic rays at high latitudes during the geomagnetic storms.