Numerical modeling of the antiproton radiation belt accounting radial diffusion of external interstellar and internal albedo antiprotons and inelastic scattering losses

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The possible existence of noticeable fluxes of antiprotons in the Earth magnetosphere is considered in this presentation on the base of numerical solution of diffusion equation by FDM (Finite Difference Method) method. The antiprotons geomagnetically confined in the inner magnetosphere at L-shells below L=7 are both the interstellar origin and locally generated antiprotons, i.e. the products of nuclear reactions of the high energy primary cosmic rays (CR) with constituents of the terrestrial atmosphere. The interstellar antiprotons penetrating into the Earth's magnetosphere are themselves secondary in origin, i.e. they are born in nuclear reactions of the same CR passing through 5-7 g/cm^2 of interstellar matter. Until now there was not found some special source of the primary antiprotons. The magnetospheric locally generated antiprotons are born at a pass length of dozens g/cm^2 matter in the residual Earth atmosphere, then, they are confined by the geomagnetic field and accumulated in the magnetosphere. One could expect that their fluxes significantly overcome the interstellar antiproton fluxes. However, just after the birth they undergone to several loss processes such as ionization losses, nuclear reactions and annihilation on the ambient atoms and a diffusion into and out of magnetosphere that makes it is difficult to predict which fluxes will be greater. These processes are included into diffusion theory and solution of the diffusion equation describes the trapped antiproton flux in magnetosphere accounting all above mentioned losses. We present the results of numerical simulation of diffusion equation solution for magnetospheric antiproton fluxes in the energy range from 10 MeV to several GeV originated from both sources: the locally produced and interstellar fluxes which diffused and directly penetrated into magnetosphere from the Earth vicinity. The estimates made show the space distribution of trapped antiprotons and a significant (up to two orders of magnitude) excess of magnetospheric antiproton fluxes over those formed in the interstellar media at energies < 1 to 2 GeV at determined L-shells.

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