Cosmic-Ray Proton and Antiproton Spatial Distributions Simulated in Radiation Velts

Michio Fuki[1], Ayako Kuwahara[2]

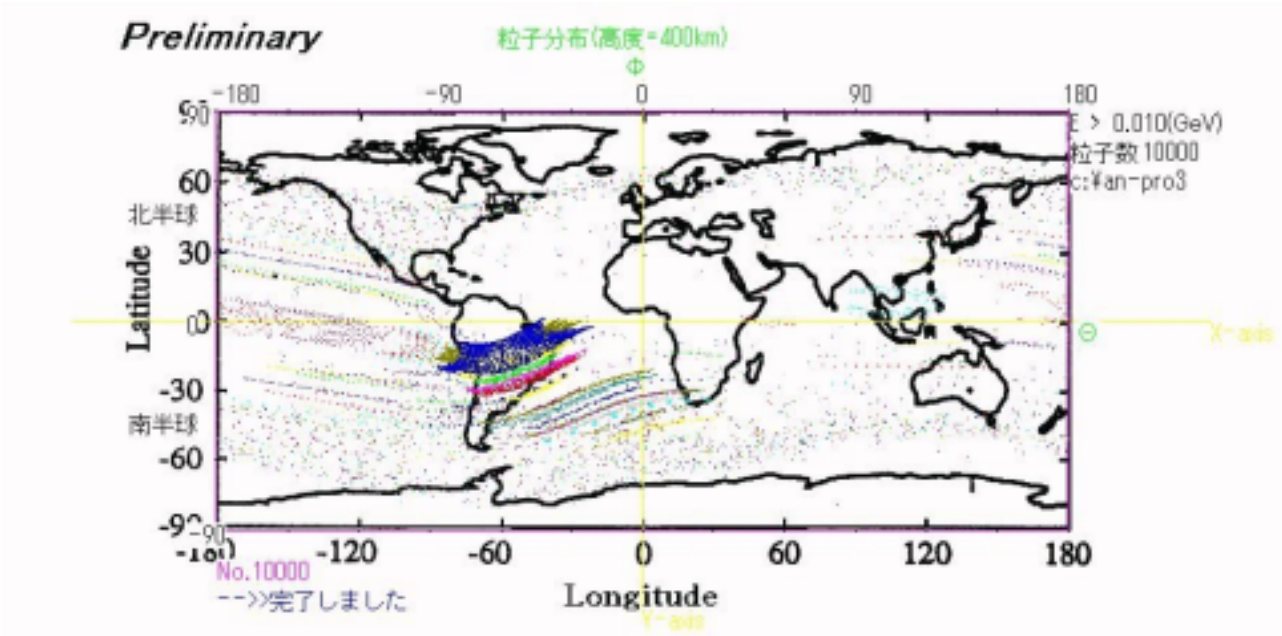
[1] Sci Edu, Education, Kochi Univ, [2] Life Env., Sch Edu, Kochi Univ.

http://www.kochi-u.ac.jp/~fuki/

The recent BESS balloon experiments (Fuke et al, 2002) have been disclosing the energy spectra (10MeV - 10GeV) of antiprotons around the Earth. The observation of spatial distribution and energy spectra of antiprotons are planned in the near future international space station obserbatory. In the radiation velts the high energy nuclear components of protons so on, including antiprotons are trapped. These have been accumulated long in the geomagnetic field by the Earth's magnet. The spatial distributions of protons and electrons are measured at the height of the space stations (Takada et al, 1998), then the influences of solar acivities are investigated. The protons are supplied from both primary cosmic-rays and solar particles, but it is believed that the antiprotons are mainly originated from the collisions of high energy cosmic rays with interstellar matter.

We carrid out the computer simulation study in order to expect the spatial distribution of antiprotons around the Earth. We used the magnetic field of IGRF to calculate the magnetic field components and to study the motion of charged particles by solving the Lorentz equation in this field. We supposed the three Monte Carlo models for the initial conditions of partilce's energy, momenta and positions. The first model is cosmic ray protons coming uniformly from the outer geomagnetic space. The second is albedo protons produced from the collision with the atomosphere. The third is decayed protons from albedo neutrons produced from the collision. After investigating the spatial distributions around the earth by the these models, the first shows that protons are apt to gather to the both magnetic polar regions. The second shows that they distributes uniformly and the third shows concentrating into the south Atlantic anomaly (SAA) region. We find that the third model well explains the proton spatial distributions at the space station height (400 km). So this suggests that the antiprotons decayed from albedo antineutrons should be trapped in the radiation velts.

We computed the spatial distributions of antiprotons in consideration of this assumption with experimentary energy spectra. In the results the antiprotons concentrate at the nothern-west part in the SAA region (preliminary in Fig.1), as the most of antiproton energy are higher than 1 GeV. And their heights are lower than the protons. The obserbation of antiprotons will become a new important probe which solve the origine problem or that bring the modulation study in the solar physics.


Preliminary
粒子分布(高度=400km)
Φ
-180
-90
0
90
180
E > 0.010(GeV)
粒子数 10000
c:¥an-pro3
90
60
30
0
-30
-60
-90
北半球
南半球
Latitude
Θ
X-axis
-120
-60
0
60
120
180
No.10000
-->>完了しました
Longitude
Y-axis