Simulation study on dynamics of high-energy particles in the Earth's magnetosphere

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With the development of the world, more and more countries have putting their eyes on the Space Exploration. Now, there are plenty of satellites and spacecrafts in the space near the Earth. But we have to face a serious problem made by high energy particles of Radiation Belt which are full of trapped energetic charged particles. Because they can reduce the life time of satellites, causing the wrong operations, understanding the high energy particle dynamics is quite important.

Especially, high energy particles can be injected from the magnetotail into the inner magnetosphere associated with the substorms. However, there are still many uncertainties about the mechanisms of producing ring current and accelerating the particles to the very high energy level of Mev.

We used a 3-dimensional model to perform the test particle simulations of the high energy particles' dynamics in the magnetosphere and tried to understand more clearly. Figure1 shows the model of the present computer experiment.

We performed test particle simulation code in the simple dipole magnetic field model and realistic magnetic field model by using the IGRF code and Tsyganenko 1996 code. In addition to the magnetic field, we also incorporated the Large-scaled convection electric field and found out the particles' dynamics was totally different from the cases which had magnetic field effect only. Figure2 shows the trajectory of electron which is injected from the magnetotail region into the inner magnetosphere under the actions of electric and magnetic field.

Using these models, we also performed the test particle simulation code to investigate the particle injection phenomenon under the conditions of different convection electric field and different geomagnetic activity levels. The particle injection happens more effectively during the more intense geomagnetic activities levels ($Kp > 4$). If the $Kp > (6, 6+, 7-)$, then the particle injection can be quite effective, we can see clearly the particles transfer from the tail region into the inner magnetosphere. The effective region of the Large-scaled convection electric field in x direction is from the tail region until the dipole field area about 3~5 radii on the night side of the Earth. If the electric field region extends longer in y and z directions, the particles can be accelerated much more.

Figure3 shows mirror points trajectories of 8 electrons' which had the same initial kinetic energy and different pitch angles under the intense condition.

REFERENCES

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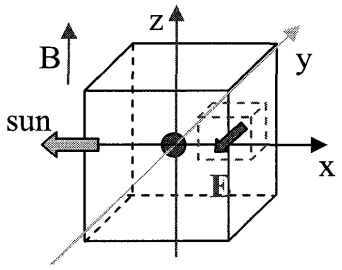

Figure1

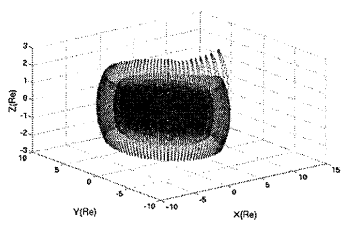

Figure2

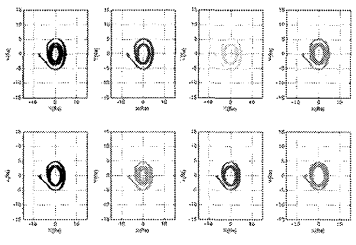

Figure3