PRECIPITATION OF TRAPPED ENERGETIC ELECTRONS IN THE MAGNETOSPHERE BY WHISTLER WAVES: OPTIMAL WAVE FREQUENCY AND THRESHOLD CONDITION

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In the magnetosphere, energetic electrons in the radiation belts are trapped by the Earths dipole magnetic field and undergo bouncing motion about the geomagnetic equator. Those very energetic electrons (in MeV level) have strong impact on passing satellites. The behaviors of the trajectories of these electrons interacting with a large amplitude whistler wave are explored, with the electron energy and wave amplitude and frequency as variable parameters. A surface of section technique is used to examine the chaoticity of the system graphically and the pitch angle time function is also plotted to verify if the electron can be scattered into the loss cone (assuming that the loss cone is around 30 degree) [1]. Once the electron wanders into the loss cone, it precipitates into the ionosphere and/or the upper atmosphere. The bouncing motion of the electron is a key factor to cause chaotic behavior in the interaction. The commencement of chaotic behavior in the electron trajectory for a given electron energy and region (i.e., a L value) requires the whistler wave to have a proper frequency and to exceed a threshold level. The dependency of the optimal wave frequency on the electron energy and L value and the dependence of the threshold condition on the electron energy are determined. The results show that the threshold wave magnetic field is in the range of about 0.001 of the geomagnetic field for precipitating those energetic electrons having kinetic energies larger than 1.5 MeV.

[1] S. P. Kuo, Paul Kossey, James T. Huynh, and Steven S. Kuo, Amplification of Whistler Waves for the Precipitation of Trapped Relativistic Electrons in the Magnetosphere, IEEE Trans. Plasma Sci., 32(2), 362-369, 2004.

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2. H - Waves in Plasma

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4. C - Contributed Paper, Program chair: Jay Albert, Greg Ginet, Gurudas Ganguli

5. No special instructions