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Resonant interaction of energetic ions and relativistic electrons with electromagnetic ion-cyclotrone waves

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1 *Extended Abstract*

We study the cyclotron resonant interaction of energetic ions and relativistic electrons in the Earth's radiation belts with ion-cyclotron wave packets with varying frequency. Time evolution of the wave packet and dipole model of Earth magnetic field are taken into account; the influence of plasma composition on the interaction efficiency is also analyzed. The equations describing the interaction of test particles with a given wave packet are solved numerically.

Using known analytical solutions, we obtain the necessary conditions for non-linear electron trapping for a range of particle energies and pitch angles and for different wave packet structures. It is shown that for wave packets with a varying frequency those conditions can be fulfilled for electrons with broader energy spectrum. We run numerical simulations for a large number of test particles and on the basis of their results we analyze the probability of electron trapping when the non-linear trapping conditions are fulfilled. The simulations show that the dependence of electron trapping probability on system parameters (particle energy, pitch angle, and wave packet structure) can be fairly complicated and difficult to compare with simple analytical expressions. It is shown that, depending on electron energy, trapping by a wave-packet with constant amplitude can be both more and less effective than trapping by a wave-packet with varying amplitude.

The energy and pitch-angle variation in the trapping and untrapped regimes are studied for both ring current ions and relativistic electrons. Conditions, under which effective electron scattering into the loss cone is possible, are obtained and analyzed. The results are compared with the numerical simulations reported previously by other authors [1, 2] and with current experimental data [3].

References

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