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WAPI : A new model for the WAve Particle Interaction

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Abstract

The wave-particle interaction is of great interest to the radiation belt's scientific community. It is the best candidate at present to explain the dynamics of the high energy electrons in the outer radiation belt. The waves we consider in this study (Whistler, EMIC, Hiss and VLF) propagate at frequencies below the electron gyro frequency. Their interaction with the trapped particles leads to modify the energy and the pitch angle of these last. Thus, these waves constitute a good way to precipitate particles into the loss cone and can accelerate particles under stormy conditions. Using a quasi-linear theory, the wave-particle resonant interactions can be described in terms of energy and pitch angle diffusion coefficients [1][2]. These diffusion coefficients can be used to determine the time scale of loss or acceleration of the electrons. The wave-particle interaction is a resonant interaction and is based on two main equations: the resonance condition and the dispersion relation.

Several existing models allow evaluating these diffusion coefficients. Some of them use the 'high density' approximation in order to simplify the calculation of diffusion coefficients. For other models, the direction of wave propagation is assumed to be parallel to the magnetic field. The WAPI code, developed at ONERA/DESP, is based on different existing models [3][4] and different set of equations found in the literature and allows calculating energy and pitching angle diffusion coefficients due to wave particle interaction for any particle energy and pitching angle and located on any drift shell. WAPI is valid in the case of interactions of electrons and protons with Whistler, Hiss, EMIC and VLF waves, in the cold magnetized plasma, whatever the plasma density, the wave propagation angle and the number of resonance are. Results of WAPI will be shown and particularly the effect of the different input parameters on the diffusion coefficients. Moreover, WAPI extending to make it suitable to Jovian and Kronian environments will be discussed.

References

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