Geophysical Research Abstracts
Vol. 18, EGU2016-3783, 2016
EGU General Assembly 2016

Modeling the effects of the dust rings and plasma waves on the electron radiation belts of Jupiter

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ONERA has been modeling radiation belts since the 90's through the 3D physical model Salammbô. The model requires a good knowledge and modeling of the interactions between the trapped particles and the inner magnetosphere environment. Here we report on the investigations that have been performed about the roles of the dust rings and plasma waves around Jupiter on the electron radiation belts.

Prior to this work, the surface potential of the dust grains have been argued to deflect the electrons, so that there are no collisions between electrons and dust grains. We dismiss the previous argument, the possible surface potentials being negligible compared to the relativistic kinetic energies of the trapped electrons. The dust grain size distribution was then constrained by the normal optical depth of "large" particles measured by the Galileo NIMS experiment. We will show that this constraint and the Pioneer 11 electron flux measurements indicate that "very large" grains (radius >10mm) are not likely to exist. It leads to the conclusion that electrons with energies higher than a few MeV are not influenced by the rings.

The Galileo PWS data has been used to determine representative characteristics (localization and frequency spectrum) of the plasma waves that can be encountered between the orbit of Io (6 Rj) and the numerical box limit of Salammbô (9.5 Rj). We then benefited from the experience ONERA has in modeling the effects of waves on the Earth radiation belts. In particular, the WAPI (WAve-Particle Interaction) code, that uses the quasi-linear theory to compute the pitch angle and energy diffusion coefficients, has been adapted to the Jupiter environment.

Finally, Salammbô has been used to investigate the influence of each process on observation data: electron fluxes measured by the Pioneer 10, 11 and Galileo missions and synchrotron radiation images obtained by the VLA (at 5000 and 1424 MHz in May 1997) and LOFAR (127-172 MHz in November 2011).