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Long-term average of energetic particle phase space densities in Saturn's magnetosphere

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Abstract

Saturn's magnetosphere has been studied extensively by the Cassini spacecraft during the last five years. We present fluxes of energetic protons and electrons taken by the MIMI/LEMMS instrument. This data has been averaged over the mission and converted to phase space densities at constant first and second adiabatic invariants. The latter quantity is physically more meaningful with respect to particle transport than the directly measured fluxes.

The distribution of particles is governed by radial diffusion. We will demonstrate that this is the only important mechanism outside at least $L=12R_S$ and that the profiles in this region can be described using a simple diffusion equation. Inside this distance, injection events are transporting particles to the inner magnetosphere, which can be introduced as a source term to the diffusion equation. Energetic particles are also depleted within the neutral torus and the E-ring. We will show that the main interaction is with the neutral torus. Protons interact via charge exchange, electrons cause impact ionization and experience bremsstrahlung losses. Only in the case of very energetic protons and very close to the equator mirroring electrons, the energy loss within ice grains of the E-ring shows a similar importance.