Effects of Wave-Particle Interactions on the Variability of the Outer Electron Radiation Belt

Horne, Richard B., R.Horne@bas.ac.uk, British Antarctic Survey, NERC, Cambridge, UK.

The relativistic electron flux in the outer radiation belt can vary by up to five orders of magnitude. The key questions are how are electrons accelerated to such high energies, and what controls the variability. Radial diffusion plays a major role in electron transport and wave-particle interactions play a major role in acceleration and loss processes but there is still considerable uncertainty over each process. Here we present the results from the BAS global radiation belt model that includes radial diffusion due to ULF waves, wave-particle interactions due to plasmaspheric hiss, whistler mode chorus and electromagnetic ion cyclotron (EMIC) waves. We describe wave models based on the analysis of data from 7 satellites. We show that radial diffusion alone cannot account for the variability of the radiation belts but that much better agreement is obtained when losses due to plasamaspheric hiss are included. Even so the peak flux is too low. We show that chorus waves provide electron acceleration inside geosynchronous orbit and are a key internal acceleration process. We show that in principle the outer electron radiation belt can be formed by wave acceleration from a very soft electron spectrum. We also show that EMIC waves cause significant loss for energies greater than 2 MeV but only for pitch angles lower than about 60 degrees and are therefore unlikely to set an upper energy limit to the outer radiation belt. Finally we comment on the importance of wave acceleration for the radiation belts at Jupiter and Saturn.