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Depletion of multi-MeV electron and its relation to the minima in phase space density

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The Earth's outer electron radiation belt is populated by electrons, that reach energies of several MeV. During geomagnetic storms, the electron fluxes exhibit irregular variations over several orders of magnitude on time scales ranging from minutes to days. The analysis of such dynamics is complicated by the fact that some of the variations are reversible, or adiabatic, and others are irreversible.

Separating adiabatic and nonadiabatic changes can be achieved by inferring phase space density (PSD) as a function of three adiabatic invariants. At high radial distances, the total electron loss can be a combination of the loss to the interplanetary medium and outward transport of particles, whereas at lower radial distances it is traditionally assumed that particles are all lost to the atmosphere due to the pitch angle scattering. The rapid local losses of multi-MeV electrons are possible due to wave-particle interaction with electromagnetic ion cyclotron (EMIC) waves, which may play a dominant role in the observed dropouts. Such interaction can be accompanied by a unique "bite-out" signatures of the pitch-angle distribution and by minimum of the PSD profile.

In this study, we analysed variation of the electrons fluxes based on the REPT measurement from the Van Allen Probes during multiple storms. We found the more storms resulting in a depletion of the electrons at low pitch angles. Additionally, we analysed PSD profiles and electron flux at different pitch angles during the multi-MeV electron dropout events. We found that there are more depletion events associated with the PSD minima at high adiabatic invariant K which corresponds to the localized losses at low equatorial pitch angles.