Understanding Earth's Radiation Belt Electron Dynamics and its Relation to Solar Wind Conditions

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The highly dynamical evolution of the Earth's outer radiation belt electron fluxes is due to a competition between various loss and acceleration processes. Identifying which process is dominant under various solar wind conditions is critical to understand the influence of solar activity on the Earth's radiation belts. In this study, we focus on analyzing a few interesting events observed by the Van Allen Probes, including a few very rapid electron acceleration events up to multi-MeV energies within ~12 hours, and a gradual electron transport event where the peak in electron fluxes slowly moves inwards closer to the Earth. Using the UCLA 3D particle diffusion code, we simulate the evolution of the electron phase space density by including the most important physical processes, such as electron energy diffusion and pitch angle scattering caused by whistler-mode chorus waves and plasmaspheric hiss and radial diffusion driven by ULF waves, to quantify the role of each physical process in each type of event. We further discuss the preferential solar wind conditions that lead to the rapid electron acceleration up to multi-MeV and the gradual electron radial transport towards the Earth.