Relative contribution of ULF and chorus waves to the radiation belt variation

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Earth’s radiation belt exhibits a dramatic variation during the active condition of the magnetosphere such as magnetic storms. The dynamic variation of the radiation belt is, in part, contributed by various wave-particle interactions, including: (1) the radial diffusion of electrons driven by ultra-low-frequency (ULF) waves in Pc5 frequency ranges (1.6-6.7 mHz) and (2) the local acceleration caused by wave-particle interactions between whistler-mode chorus waves and radiation belt particles. Over the past decade, multi-point observations have separately shown the evidence for the contribution of ULF and chorus waves to the relativistic electron flux enhancement. However, comparison of the relative contribution of ULF and chorus waves has not been extensively studied yet.

Here we investigate the relative contribution of both waves to the relativistic electron flux enhancement during a specific magnetic storm. The target event is 27 May 2017 storm, which is triggered by coronal mass ejections. Both Arase (post-midnight) and Van Allen Probe (RBSP)-B (dusk) detect the significant increase of relativistic electron fluxes during the early recovery phase. Then the relativistic electron fluxes further enhance especially at L˜4 during the middle recovery phase. The flux enhancement is hardly seen during the late recovery phase. We examined L-value dependence of wave power during each orbit. During the early recovery phase, ULF wave activity is high in wider L range (L=3.5-6), while chorus waves distribute around L=4. On the other hand, ULF wave activity is low during the middle recovery phase, whereas chorus wave activity is higher than the early recovery phase.

We also perform the comprehensive ring current model (CRCM) coupled with Block-Adaptive-Tree Solar-Wind Roe-Type Upwind Scheme (BATSRUS) simulation in order to grasp the global contribution of waves. The simulation well reproduces the global distribution of ULF waves. We also simulate the energetic electron dynamics. The estimated temperature anisotropy is large during the period when chorus waves are observed by Arase and RBSP-B, especially with the energy of 10-40 keV. In this presentation, we will further discuss how observed chorus wave power can be estimated from the simulated electron dynamics.