Rapid Precipitation of Relativistic Electrons caused by EMIC Rising-tones

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On 23 February 2014, Van Allen Probes sensors observed quite strong electromagnetic ion cyclotron (EMIC) waves in the outer dayside magnetosphere. The maximum amplitude was more than 14 nT, comparable to 7% of the magnitude of the ambient magnetic field. The EMIC waves consisted of a series of coherent rising tone emissions. Rising tones are excited sporadically by energetic protons. At the same time, the probes detected drastic fluctuations in fluxes of MeV electrons. It was found that the electron fluxes decreased by more than 30% during the 1 min following the observation of each EMIC rising tone emissions. Furthermore, it is concluded that the flux reduction is a nonadiabatic (irreversible) process since holes in the particle flux levels appear as drift echoes with energy dispersion. We examine the process of the electron pitch angle scattering by nonlinear wave trapping due to anomalous cyclotron resonance with EMIC rising tone emissions. The energy range of precipitated electrons corresponds to the presumed energy for the threshold amplitude for nonlinear wave trapping. This is the first report of rapid precipitation (<1 min) by the mechanism of relativistic electrons by EMIC rising tone emissions and their drift echoes in time observed by spacecraft.