E115-042 **Room: 201B** **Time: May 17 15:00-15:15**

Acceleration mechanism of relativistic electrons in the radiation belts by chorus emissions

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At times of magnetic field disturbance of the Earth's magnetosphere, energetic electrons with energy greater than a few tens of keV are injected into the inner magnetosphere, and a series of coherent waves called whistler-mode chorus emissions are generated. We review the recent progress in our understanding of chorus emissions and associated relativistic electrons in the radiation belts. We show that coherent nonlinear wave trapping plays a significant role in both the generation of whistler-mode chorus emissions and the acceleration of radiation belt electrons to relativistic energies. We have performed particle simulations that successfully reproduce the generation of chorus emissions with rising tones. During this generation process we find that a fraction of resonant electrons are energized very efficiently by special forms of nonlinear wave trapping called relativistic turning acceleration (RTA) and ultra-relativistic acceleration (URA). Based on a test particle simulation of relativistic electrons interacting with a coherent chorus element, we evaluate long time evolution of the relativistic electron flux in the radiation belts.