Laboratory Study of Chirping Whistler Waves*

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Understanding the dynamics of the Earth's radiation belts is an integral part of understanding the complex flow of energy and particles from the Sun to the Earth. The Van Allen Probes have shown clear evidence of local acceleration of electrons due to interactions with electromagnetic waves in the radiation belts. Observations of large amplitude whistler waves in the radiation belts, and the fact that cyclotron resonant interactions can efficiently energize electrons to relativistic energies, have renewed interest in nonlinear wave-particle resonant interactions. Whistler chorus waves, which are themselves thought to be generated by the nonlinear cyclotron resonant interaction between whistler waves and energetic electrons, are amongst the most intense natural plasma instabilities generated in the Earth's magnetosphere and have been shown to be a dominant contributor to the electron dynamics of in the outer radiation belts.

Experiments conducted in the Space Physics Simulation Chamber at the Naval Research Laboratory using an electron beam propagating in a non-uniform magnetic field and an antenna launching counter-propagating Whistler waves have demonstrated nonlinear Whistler amplification and triggered emissions due to nonlinear wave-particle interactions. When the antenna was not used, chorus-like chirped Whistler waves were observed. These experiments provide a good testbed for understanding the generation mechanism for Whistler chorus waves. These results and results from other experiments demonstrating chirped Whistler waves will be presented.

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