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Demonstration of Electrostatic to Electromagnetic Conversion through Induced Nonlinear Scattering by Thermal Plasma[1]

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The nonlinear conversion of electrostatic (ES) to electromagnetic (EM) waves in the whistler branch through induced scattering by thermal electrons is an important contribution to the evolution of plasmas in weak turbulence when the wave amplitude is large enough for linear/quasi-linear approaches to break down. It has been theoretically shown that in isothermal low beta turbulent plasmas the rate of induced scattering by particles is much larger than three-wave coalescence and decay processes. It is particularly important to near-Earth space plasma evolution during disturbed times when wave amplitudes cross the threshold for nonlinear scattering. The change in k vector and group velocity of the waves resulting from the conversion from ES to EM enhances the efficiency of pitch-angle scattering, which plays a dramatic role in regulating the trapped energetic electron fluxes in the Earth's radiation belts. This nonlinear process is being studied in the NRL Space Physics Simulation Chamber, demonstrating the induced nonlinear scattering of quasi-electrostatic pump waves by thermal electrons. The experimental results support theoretical predictions of the nonlinear interaction.

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