Nonlinear wave damping of chorus emission around 0.5 electron gyrofrequency demonstrated by 2D general curvilinear particle-in-cell simulation

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Whistler mode chorus emissions are usually observed in the Earth’ s inner magnetosphere with a gap around 0.5 electron gyrofrequency (f_{ce}) seperating upper-band and lower-band chorus. One of the mechanisms of the gap is the nonlinear wave damping via Landau resonance, which occurs in oblique chorus wave-particle interactions. Chorus emissions initially generate with broadband frequency at the equator and then damp at 0.5 f_{ce} during propagation toward higher latitudes. Evidence of the mechanism has been shown by observation of the Geotail satellite [1] and test-particle simulation [2]. In this study, we apply self-consistent two-dimensional general curvilinear particle-in-cell (2D gcPIC) simulation, and we well reproduced the formation of the gap of a slightly oblique chorus emission. Analyzing the simulation results, we confirm that the damped wave energies accelerate resonant electrons through Landau resonance. The energy exchanges occur on the perpendicular component of the wave electric field and perpendicular electron velocities.

References:
[1] Yagitani, S., T. Habagishi, & Y. Omura (2014), Geotail observation of upper band and lower band chorus elements in the outer magnetosphere, J. Geophys. Res. Space Physics, 119. https://doi.org/10.1002/2013JA019678.
[2] Hsieh, Y.-K., & Omura, Y. (2018). Nonlinear damping of oblique whistler mode waves via Landau resonance. Journal of Geophysical Research: Space Physics, 123. https://doi.org/10.1029/2018JA025848.

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