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Simulating chorus generation via Particle-in-cell simulations

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Chorus emissions are whistler mode waves propagating through the Earth's magnetosphere in two distinct frequency bands, typically in the range of 0.1-0.8 f_{ce}, where f_{ce} is the equatorial electron gyro-frequency. Chorus consists of discrete elements, which are normally rising tones, each of which lasts for a few tenths of a second. Chorus is predominantly observed during the onset of the substorm expansion phase when energetic electrons are injected into the magnetosphere. As these electrons drift eastward around towards noon, their distribution becomes unstable to the ampli?cation of whistler mode waves. It is thought that the amplification process proceeds via the Doppler-shifted cyclotron resonance interaction. Particle-in-cell (PIC) simulations, which simulate the motion of groups of similar particles on a two dimensional grid subject to the self-consistent electric and magnetic fields generated by their spatial distribution and motion, are used to simulate the amplification of whistler-mode waves propagating along the magnetic field. A population of electrons having a velocity distribution with a thermal anisotropy is injected into the plasma and the growth of the resulting waves is investigated.