

Particle-in-cell simulation of incoherent scatter radar spectral distortions related to beam-plasma interactions in the auroral ionosphere

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An electrostatic parallel particle-in-cell (EPPIC) code that allows for particle beam injections and multiple boundary conditions is used to investigate the beam-plasma interaction and its manifestations in the incoherent scatter (IS) spectrum. Specifically, the code is used to investigate anomalous enhancements in the ion acoustic line through the destabilization of the plasma by injection (or precipitation) of low-energy electron beams. This enhancement of the ion acoustic line is a form of IS distortion commonly observed in the vicinity of auroral arcs called the naturally enhanced ion-acoustic line (NEIAL). Simulations confirm the parametric decay of Langmuir waves as a plausible mechanism, assuming a mechanism for the formation of dense low-energy (<10 eV) electron beams in the ionosphere. The spectral distortions are similar at aspect angles as large as $\pm 15^\circ$ from the beam direction. Simulations also show that the first Langmuir harmonic can have a power intensity higher than that