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Inverse ion-cyclotron damping and excitation of multiharmonic ion-cyclotron waves in the northern magnetospheric cusp

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We have investigated a case of inverse ion-cyclotron damping taking place in the northern terrestrial magnetospheric cusp, exciting waves at the ion-cyclotron frequency and its harmonics. Magnetosheath influx in the cusps and the effect of convection and magnetic mirroring give rise to parallel velocity shears, $dv_{\parallel}/dx_{\perp}$, often associated with instabilities in the plasma and corresponding ion-cyclotron waves, whose evolution is described by a damping factor. This damping factor depends on, for example, the wave numbers and the velocity shear itself and can under certain conditions be negative, hence describing inverse damping (or wave growth). However, an additional required condition for inverse ion-cyclotron damping is a velocity shear in the magnetic field-aligned ion-bulk flow, and this condition is only met for magnetosheath influx in the northern cusp, as oppose to the southern cusp.

The ion-cyclotron waves are primarily seen as peaks in the magnetic-field spectral densities, as presented by Slapak et al., [GRL (2016), doi:10.1002/2016GL071680]. The corresponding peaks in the electric-field spectral densities are not as profound, suggesting a background electric field noise or other processes of wave generation causing the electric spectral densities to smoothen out more compared to the magnetic counterpart. We note that some ion-cyclotron wave activity is present in a few similar shear events in the southern cusp, which indicates that other mechanisms generating ion-cyclotron waves may also be present during such conditions.