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Kinetic interaction of cold and hot protons with an oblique EMIC wave near the dayside reconnecting magnetopause

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We report observations of the ion dynamics inside an Alfven branch wave that propagates near the reconnecting dayside magnetopause. The measured frequency, wave normal angle and polarization are within 1% with the predictions of a dispersion solver, and indicate that the wave is an electromagnetic ion cyclotron wave with very oblique wave vector. The magnetospheric plasma contains hot protons (keV), cold protons (eV), plus some heavy ions. The cold protons follow the magnetic field fluctuations and remain frozen-in, while the hot protons are at the limit of magnetization.

The cold proton velocity fluctuations contribute to balance the Hall term in Ohm's law, allowing the wave polarization to be highly-elliptical and right-handed, a necessary condition for propagation at oblique wave normal angles. The dispersion solver indicates that increasing the cold proton density facilitates generation and propagation of these waves at oblique angles, as it occurs for the observed wave.