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Kinetic effects of cold plasma of ionospheric origin on magnetospheric EMIC waves

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The Earth's magnetosphere is populated by plasma coming both from the solar wind and from the Earth's ionosphere. The ionospheric component is often composed of cold (below tens of eV) ions, and it has been shown that these cold ions introduce a shorter length-scale into plasma processes like magnetic reconnection, owing to their smaller gyroradius than hot magnetospheric ions. Electromagnetic Ion Cyclotron (EMIC) waves occur in the outer magnetosphere, often in association with ionospheric ions, and serve as a coupling mechanism to the ionosphere and inner magnetosphere. Using the MMS fleet, we investigate the dynamics of these waves when ionospheric ions are present, and compare them to cases without the cold ion component. The short separation between spacecraft plus the high time resolution of MMS allows us to resolve the kinetic properties of these waves with unprecedented detail. We infer the wavelength of the EMIC waves from four-spacecraft measurements, which we found to be related to (hot) ring current ion gyroradius. Therefore, the cold ions, which have a much smaller gyroradius, remain largely magnetized. This results in cold ion trapping that produces density enhancements, which in turn may be linked to the generation of whistlers.