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MMS observations of low-energy plasma composition and effects on electromagnetic ion cyclotron waves

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Many previous magnetospheric studies have associated electromagnetic ion cyclotron (EMIC) wave properties with ion composition. Modeling has been used to demonstrate how the presence of multiple heavy ion species of ionospheric origin influence the wave growth. Experimental studies using in situ spacecraft measurements have explored this topic as well, although most studies note that the lack of measurements of the elusive cold ions–which may match or exceed the abundance of the hot particles–limit analysis into how multiple cold and hot ion species participate in the wave activity and define the wave properties. We will discuss our methods to detect the presence of cold ions from our past studies [e.g. Lee and Angelopoulos, 2014] complemented by the new plasma composition and active spacecraft potential control capabilities enabled by MMS that will support a reinvigorated analysis into EMIC waves. We apply these methods to explore in detail the full range of plasma measurements during an interval of EMIC waves observed by MMS in the afternoon dayside outer magnetosphere. The detailed plasma data show the presence of cold heavy ions and support derivation of their partial ion densities, essential for comparing wave observations to modeling and for understanding how the plasma composition and other ambient properties support wave generation. In addition, multi-satellite MMS wave data support derivation of wave vector, enabling direct comparison to modeling results. We discuss how our methods can be applied to investigate waves at different magnetospheric locations and possibly reveal the effects of asymmetries in magnetospheric ion composition due to ion outflows on EMIC waves.