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Quantifying low-energy ion and electron populations with FPI

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Cold plasma of ionospheric origin has been observed in most parts of the magnetosphere, and it is often composed of protons, He^+, O^+ and electrons. These ionospheric populations mass-load the magnetosphere and change its main properties, in the first instance density, temperature and composition. They participate in magnetic reconnection with the solar wind and in the magnetotail, and have implications for magnetospheric processes such as the generation and transport of waves. The Fast Plasma Investigation (FPI) suite of instruments onboard the MMS mission samples a full distribution function every 30 ms for electrons and 150 ms for ions, in the range $\sim$10 eV - 30 keV. Its time resolution is about two orders of magnitude larger than any other spacecraft mission ever flown. FPI is not designed to resolve the mass of the detected ions, but under certain conditions they can be discriminated and quantified either based on their drifting energy or on differences in electron and ion density estimates. Studying the cold ionospheric plasma is also difficult owing to their low energy, which is often close or even below the instrument lower energy limit. Function of the cold ion temperature and spacecraft potential, an additional wake effect often has to be accounted for. We illustrate and analyze the main caveats related to these effects when aiming to quantify cold plasma impact on magnetospheric dynamics.