Sub-ion scale measurements of compressible turbulence in the solar wind MMS Observations

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Compressible plasma turbulence is investigated at sub ion scales using both the Fast Plasma Investigation instrument on the Magnetospheric MultiScale mission as well as using calibrated spacecraft potential. The data from FPI allow inertial and a small region of sub-ion scales to be investigated before the instrumental noise becomes significant near 3Hz. In this work we give a detailed description of the spacecraft potential and how it is calibrated such that it can be used to measure the electron density. The key advantage of using the calibrated spacecraft potential is that a much higher time resolution is possible when compared to the direct measurement. This allows a measurement down to 40Hz for a measurement of the electron density. This is an improvement of an additional decade in scale. Using a one hour interval of solar wind burst mode data the power spectrum of the density fluctuations is measured from the inertial range to the sub ion range. At inertial scales the density spectrum shows similarities with the magnetic field power spectrum with a characteristic Kolmogorov like power law. In between the ion inertial and kinetic scales there is a brief flattening in the spectra before steepening in the sub ion range to a spectral index comparable to the trace magnetic field fluctuations. The morphology if the density spectra can be explained by either a cascade of Alfvén waves and slow waves at large scales and kinetic Alfvén waves at sub ion scales, or by the presence of the hall effect. Using electric field measurements the two hypotheses are tested.