Geophysical Research Abstracts
Vol. 19, EGU2017-620, 2017
EGU General Assembly 2017

Nature of Kinetic Scale Turbulence in the Earth's Magnetosheath

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We present new observations and theoretical results to investigate the nature of turbulence at kinetic scales in the Earth's magnetosheath. We have found from high resolution measurements by the MMS spacecraft, that in the first decade of the kinetic range, near ion scales, the turbulence is similar to that in the solar wind upstream of the Earth's bow shock: low-frequency, anisotropic, and kinetic Alfven in nature. A key difference, however, is that whereas in the solar wind the ion and electron temperatures are typically comparable, in the magnetosheath the ions are typically much hotter than the electrons as a result of processing by the Earth's bow shock. We have found that this leads to a new type of turbulence in the second decade of the kinetic range. We present a new set of nonlinear equations for this turbulence, and derive its spectral properties, which are in good agreement with the MMS observations. The implications of the results for plasma heating, as well as turbulence in other plasmas with similar parameter regimes will be discussed.