Geophysical Research Abstracts
Vol. 19, EGU2017-14863, 2017
EGU General Assembly 2017

Model for Reduced Power Spectra of Critically Balanced Solar Wind Turbulence with Damping by Kinetic Alfvén Waves.

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The observed spectral structure of magnetic turbulence at electrons scales in the solar wind is still not sufficiently understood. Analytical dissipation models for solar wind turbulence are usually derived in the three-dimensional wavenumber space. However, in-situ observations of magnetic fluctuations are obtained in a reduced form in the frequency space, where various wavevectors contribute to the spectral energy density at a certain frequency. Due to this sampling effect, dissipation processes at electron scales influence the spectral scaling of the sub-ion range particularly for small field-to-flow angles.
Based on a forward modeling approach by von Papen & Saur (2015), we calculate reduced spectral energy densities from a three-dimensional energy distribution in wavenumber space under the assumption of critically balanced turbulence and damping via wave-particle interactions of kinetic Alfvén waves. The damping is described through the imaginary part of the kinetic Alfvén wave frequency, which we obtain from linear Vlasov theory. We compare the spectral energy densities to a set of observations in frequency space obtained from magnetic field measurements of the Cluster spacecraft analyzed in Alexandrova et al. (2012).