Geophysical Research Abstracts
Vol. 19, EGU2017-13139, 2017
EGU General Assembly 2017

Variability of the magnetic field power spectrum in the solar wind at electron scales

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Solar wind magnetic fluctuations show the presence of several power laws. At the electron scales the power spectrum can be highly variable and the dissipation mechanisms of the magnetic field energy into the various particle species remain under debate. In this paper we investigate the morphology of the power spectrum at electron scales using data from the Cluster mission's Search coil magnetometer when the Cluster spacings were $\sim$ 10000km. By using wavelet coherence on the magnetic field data, times when the magnetic field signals are characteristic of certain phenomena such as whistler waves and coherent structures can be identified. Several different morphologies of the power spectrum are seen including: (1) two power laws separated by a break (2) an exponential cutoff near the Taylor shifted electron scales (3) strong spectral knees at the Taylor shifted electron scales .The different morphologies of the power spectrum are investigated by using wavelet coherence and show that in this interval a clear break and strong spectral knees are features which are associated with sporadic quasi parallel propagating whistler waves. Meanwhile when no signatures of whistler waves are present a clear break is difficult to find and the spectrum is often more characteristic of a power law with an exponential cutoff . The presence of these waves even for short times in an interval can affect the spectral shape drastically, and cause pitch angle scattering of electrons. The electron temperature and the electron heat flux measurements do not show unstable conditions to generate whistlers., however in several cases they are seen to be related to discontinuities in the large scale magnetic field. While large scale discontinuities are often seen at all spacecraft, not all spacecraft are accompanied with whistler waves which we interpret as being related to the geometry of the discontinuity and the path of the spacecraft through the plasma. It is possible that in the vicinity of these discontinuities, electron distribution functions are distorted and so unstable, but we cannot capture these distortions because of insufficient time, energy and angular resolution of the particle measurements.