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Kinetic plasma turbulence in the fast solar wind measured by Cluster

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Several intervals of fast solar wind are investigated using polarization analysis and the k-filtering method. A correction for the presence of alpha-particles is used since it is possible for heavier species to stream faster than protons and affect the bulk velocity measurement. K-filtering is used to obtain the wave vectors , the frequencies obtained by Doppler shifting to the plasma frame are very low compared to the proton gyroradius and the turbulence is found to be highly anisotropic with $k_\perp >> k_\parallel$. Once the wave vector is found polarization in the plane perpendicular to $\mathbf{k}$ is investigated and compared to that obtained from linear Vlasov theory. The polarization is shown to be predominantly right handed polarization both above and below $\theta_{kB} = 90^\circ$ with short periods where it changes to be left handed. Although the polarization of Kinetic Alfvén waves is expected to be the opposite above and below $\theta_{kB} = 90^\circ$ it is within the error limits. An alternative hypothesis is presented; that these are Alfvén vortices. To investigate this idea more thoroughly the polarization is investigated in the plane perpendicular to the mean magnetic field $\mathbf{B_0}$. The merits and limitations of both the Kinetic Alfven wave interpretation and the Alfvén vortices interpretation are presented and discussed.