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Solar Wind Turbulence and the Role of Circularly Polarized Dispersive Alfvén Wave

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Abstract : We intend to study the nonlinear evolution of the parallel propagating finite frequency Alfvén wave (also called Dispersive Alfvén wave/Hall MHD wave) propagating in the solar wind regime of the solar region when a perpendicularly propagating magnetosonic wave is present in the background. The finite frequency Alfvén wave behaves differently from the usual non-dispersive behavior of the Alfvén wave. To study the nonlinear processes (such as filamentation) taking place in the solar regions such as solar wind, the dynamical equation of both the waves are derived. Numerical simulation involving finite difference method for the time domain and pseudo spectral method for the spatial domain is then performed to analyze the transient evolution of these waves. The power spectra of the Dispersive Alfvén wave is also investigated. The power spectra shows the distribution of the magnetic field intensity of the Dispersive Alfvén wave over different wave numbers. For DAW the spectra shows a steepening for scales larger than the proton inertial length. This means that the wave energy gets transferred to the solar wind particles as the wave reaches higher wave numbers. This steepening of the power spectra can be explained on account of the finite frequency of the Alfvén wave. The obtained results are consistent with the observations made by CLUSTER spacecraft.

Keywords : solar wind, turbulence, dispersive alfven wave
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