Geophysical Research Abstracts
Vol. 17, EGU2015-14389, 2015
EGU General Assembly 2015

Perpendicular cascade of initial parallel Alfvén-cyclotron wave spectrum

Yana Maneva (1), Leon Ofman (2,3), Adolfo Vinas (2), and Stefaan Poedts (1)

(1) CmPA, Department of Mathematics, KU Leuven, 3001 Heverlee, Belgium, (2) Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, (3) Department of Physics, Catholic University of America, Washington DC, DC 20064, USA

Solar wind turbulence at ion and electron scales often shows anisotropic nature throughout the heliosphere, with different power in parallel and perpendicular direction with respect to the orientation of the background magnetic field. The ratio between the power of the magnetic field fluctuations in $k_{\|}$ and $k_{\perp}$ at the ion scales may vary with the heliospheric distance and depends on various parameters, such as the plasma compressibility, waves properties and the non-thermal plasma features, such as temperature anisotropies and relative drift speeds. In this work we perform 2.5D hybrid simulations to study the importance of relative drifts and a gradual solar wind expansion in a multi-species plasma, consisting of fluid electrons, kinetic (particle-in-cell) protons and a drifting population of kinetic He^{++} ions. At the beginning of the simulations we impose a turbulent spectrum of strictly parallel propagating Alfvén-cyclotron waves, co-existing with the drifting multi-species plasma. In the course of nonlinear evolution of the system we observe substantial anisotropic cascade of the magnetic field power spectra towards perpendicular wave numbers. The nature of the anisotropic turbulent cascade depends on the differential streaming between the different ion populations and is affected by the solar wind expansion. In the case of sub-Alfvénic differential streaming the perpendicular wave power is enhanced and the anisotropic cascade occurs at smaller parallel wave numbers. In the non-drifting case in addition to the perpendicular cascade there is also a prominent inverse parallel cascade towards larger scales. A direct parallel cascade is observed when relative drifts are present. Similar parallel cascade can be found in hybrid and compressible MHD studies in the context of nonlinear parametric instabilities scenario.