Geophysical Research Abstracts
Vol. 17, EGU2015-2288, 2015
EGU General Assembly 2015


# Magnetic reconnection and kinetic effects in Vlasov turbulence

Sergio Servidio
University of Calabria, Italy (sergio.servidio@fis.unical.it)

The process of magnetic reconnection is ubiquitous in nature, being typical of large scale magnetic configurations. Recently [1], reconnection has been observed to emerge locally and intermittently in plasmas, being a crucial element of turbulence itself. Systematic analysis of MHD simulations reveals the presence of a large number of X-type neutral points, where magnetic reconnection occurs. More recently, the same phenomenon has been inspected within plasma models [2]. The link between magnetic reconnection and kinetic effects in the turbulent solar-wind has been investigated by means of multi-dimensional simulations of the hybrid Vlasov-Maxwell (HVM) code [3], using 5D (2D in space and 3D in velocity space) and full 6D simulations of plasma turbulence. Kinetic effects manifest through the deformation of the proton distribution function, with patterns of non-Maxwellian features being concentrated near regions of strong magnetic gradients.

Recent analyses [4] of solar-wind data from spacecraft aimed to quantify kinetic effects through the temperature anisotropy $T_\perp/T_{||}$ on the proton velocity distribution function. Values of the anisotropy range broadly, with most values between $10^{-1}$ and $10^{1}$. Moreover, the distribution of temperature anisotropy depends systematically on the ambient proton parallel beta $\beta_{||}$ (the ratio of parallel kinetic pressure to magnetic pressure), manifesting a characteristic rhomboidal shape. In order to make contact with solar-wind observations, temperature anisotropy has been evaluated from an ensemble of HVM simulations [5], obtained by varying the global plasma beta and fluctuation level, in such a way to cover distinct regions of the parameter space defined by $T_\perp/T_{||}$ and $\beta_{||}$. The HVM simulations presented here demonstrate that, when the distribution function is free to explore the entire velocity subspace, new features appear as complex interactions between the particles and the turbulent background. Comparison of numerical results with solar-wind data shows remarkable quantitative agreement. These results may be relevant for the process of turbulent dissipation at kinetic wavelengths, which today represents one of the challenging problems of space plasmas.

[1] S. Servidio et al., Phys. Rev. Lett. 102, 115003 (2009);

[2] S. Servidio et al., Phys. Rev. Lett. 108, 045001 (2012);

[3] F. Valentini et al., J. Comput. Phys. 225, 753 (2007);

[4] B. A. Maruca et al., Phys. Rev. Lett. 107, 201101 (2011);

[5] S. Servidio et al., APJ Lett. 781, L27 (2014).