Geophysical Research Abstracts
Vol. 17, EGU2015-5331, 2015
EGU General Assembly 2015

Plasma turbulence and instabilities at ion kinetic scales

Petr Hellinger (1), Lorenzo Matteini (2), Simone Landi (3), Andrea Verdini (3,4), Luca Franci (3), Pavel Travnicek (5,1)

(1) Astronomical Institute, AS CR, Ondrejov/Prague, Czech Republic (petr.hellinger@asu.cas.cz), (2) Imperial College, London, UK, (3) Universita di Firenze, Italy, (4) Royal Observatory of Belgium, Brussels, Belgium, (5) SSL, University of California, Berkeley, CA, United States

In situ observations in the solar wind indicate existence of many bounds on plasma parameters which are often compatible with constraints expected from theoretical linear predictions for kinetic instabilities in homogeneous plasmas. Relationship between these instabilities and ubiquitous large-amplitude turbulent fluctuations in the expanding solar wind remains to large extent an open problem. We will present results from a two-dimensional, large-scale hybrid expanding box simulation of the solar wind plasma turbulence. We impose an initial ambient magnetic field perpendicular to the simulation box, and we add an isotropic and balanced spectrum of large-scale, linearly polarized Alfvén waves with relatively strong amplitudes and we let the system evolve in a slowly expanding medium. A turbulent cascade rapidly develops with a Kolmogorov-like spectrum on large scales and a steeper spectrum on smaller scales. The turbulent spectrum heats protons both in parallel and perpendicular directions but this heating is not sufficient to overcome the double-adiabatic perpendicular cooling due to the expansion. This generates an important proton parallel temperature anisotropy which eventually leads to a fire hose-like instability which locally develops and reduces the temperature anisotropy. The present work demonstrates that fire hose can coexist with turbulence and even in the regime of strong turbulence constrains the plasma parameter space. This supports the interpretation of the many observed bounds being consequence of constraints owing to kinetic instabilities.