# Theory of Turbulence in Solar System Plasmas: Observations of Solar Wind Turbulence and Connections to MHD Relaxation, Intermittency and Dissipation

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## Abstract

A brief review is given of the observed properties of MHD scale turbulence in the corona and solar wind. From a theoretical point of view, the interpretation emphasizes time scales, spectra and distinctive correlations that can be understood on the basis of MHD turbulence theory and simulation. Local turbulence properties are fully developed by 1 AU and evolve with heliocentric distance. Transport equations for MHD turbulence in a weakly inhomogeneous medium suggest that the cascade is driven by shear in the inner heliosphere and wave particle interactions associated with pickup ions of interstellar origin in the outer heliosphere. The features of several candidate MHD relaxation process are described, including recent results that show these processes frequently occurring locally and rapidly in spatial patches. Local relaxation favors production of Alfvenic, force-free, Beltrami states, and produces nonGaussian statistics. This suggests a dynamical route to intermittency. The characteristic coherent structures include current sheets between interacting magnetic islands. The probability distributions and waiting times associated with these dynamically formed current structures are analyzed in simulations and in the solar wind -- in the inertial range of separations, the properly normalized pdfs and waiting times distributions are almost identical. This provides evidence that structures frequently observed in the solar wind may be a dynamically produced component of the turbulence. Both coronal and solar wind turbulence are anisotropic, with current sheets (and gradients) forming preferentially in the plane perpendicular to the large scale magnetic field. Anisotropy strongly influences the type of dissipation mechanisms that are likely to be important in establishing the highly nonadiabatic character of the solar atmosphere. Finally, some properties and possible origins of the frequently observed interplanetary "1/f" noise signal will be reviewed, with an emphasis on its impact on predictability.

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Selected Publications ( from about 300 total, h-factor = 54) :

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