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Session BI2 - Space Plasmas.
INVITED session, Monday morning, November 11
Salon 3-4, Rosen Centre Hotel

[BI2.004] Anisotropic MHD Turbulence in the Interstellar Medium and the Solar Wind

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The interstellar medium (ISM) and solar wind is permeated by a magnetic field that renders MHD turbulence anisotropic. The precise forms of the anisotropic energy spectra has been a subject of considerable debate in recent years. In the classic work of Iroshnikov and Kraichnan, it is assumed that the turbulence is isotropic, and an inertial range energy spectrum that scales as k^-3/2 is deduced based on the nonlinear interaction between Alfvén wave packets. Much insight can be gained in this subject by analysis and high-resolution numerical simulations of such interaction. In the weak-turbulence limit in which three-wave interactions dominate, analytical and high-resolution numerical results based on random scattering of shear-Alfvén waves propagating parallel to a large-scale magnetic field demonstrate rigorously an anisotropic energy spectrum that scales as k_\perp^-2. Anisotropy is also found with respect to the local magnetic field in the case without a uniform background field, even when the energy spectrum is globally isotropic. Because of anisotropy, the weak turbulence assumption in the Iroshnikov-Kraichnan theory is subject to question. We study the strong turbulence regime by means of simulations and phenomenological arguments. In the two-dimensional case, we obtain the Iroshnikov-Kraichnan spectrum, rather than the Kolmogorov spectrum, despite local anisotropy. The same technique is also used to study turbulence in electron MHD (EMHD), and results will be compared to the those in MHD. Comparisons are made with scintillation measurements in the ISM and in situ data from the solar wind.

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