Date: February 7

Time: 12:00 noon

Location: Ames 234

Speaker: Annick Pouquet, NCAR

Title: “Is there universality in the presence of waves? The case of magnetohydrodynamic turbulence: From weak to strong?”

In the presence of a strong uniform magnetic field, Alfven waves propagate and their resonances determine the interactions that can take place and that can be computed in the framework of the weak turbulence approximation. However, the domain of applicability of such exact ``kinetic'' equations is limited to a finite range of scales, after which strong turbulence prevails.

A review of the essential steps leading to an exact closure in the case of weak turbulence, and of the way the approximation breaks down will be given.

The link to what we know in the case of strong turbulence will be made, relying on the generalization to MHD of the three scaling laws derived by Kolmogorov (1941) for Navier-Stokes flows, namely for their energy spectrum, for the decay of energy and finally an exact law involving third-order structure functions. In these approaches, homogeneity, isotropy, incompressibility, stationary are assumed and the limit of large Reynolds numbers is taken.

Iroshnikov and Kraichnan independently proposed in the mid-sixties a modification to the Kolmogorov phenomenology for magnetohydrodynamic (MHD) turbulence. They took into account the fact that in the presence of a large-scale magnetic field, only oppositely-propagating Alfvén waves along the field interact nonlinearly. The ensuing total (kinetic+magnetic) energy spectrum, and decay law can be derived. The MHD relationship corresponding to the exact “4/5th” law of Kolmogorov involves cross correlations between the velocity and the magnetic field.

Time permitting, the consequences of such laws for the anomalous scaling of higher-order structure functions, and the role they play in the study of spatio-temporal intermittent structures will also be mentioned, in particular in the context of photospheric magnetic fields inside active regions where topological changes of such fields can be viewed as a prelude to large flare