Alfvénic fluctuations in the solar wind: nonlinearities and kinetic effects

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Large amplitude, turbulent Alfvénic fluctuations have been commonly observed in the solar wind since the first in-situ measurements. An important but still unexplained property of such nonlinear fluctuations seen typically in the fastest streams is that, despite the large excursion of the magnetic field fluctuations, the magnitude of the total magnetic field remains nearly constant, a condition that corresponds to spherical polarization. How is this Alfvénic turbulent state achieved in the solar wind remains a fundamental open question of Heliophysics, and in all of Astrophysics.

Although nonlinear Alfvénic fluctuations have been studied for several decades, most of previous work has considered a plasma in thermodynamic equilibrium. The solar wind however displays many non-thermal features, such as pressure anisotropies and drifting populations of protons and heavy ions. After reviewing the fundamental properties of Alfvénic fluctuations in the solar wind, we investigate how non-thermal effects (in particular pressure anisotropy), the presence of different ion populations and nonlinearities affect their stability and nonlinear evolution in different plasma-β regimes.