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Nonlinear waves and turbulent spectra in space and astrophysical plasmas

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Waves and instabilities play very important role in space and astrophysical plasma. There are lot of observations of turbulence in different regions of magnetosphere, auroral regions, solar wind and even in laboratory where some features are common like scaling and the break points in spectra. Although a single physical mechanism is difficult to identify to explain these features but many features can be attributed based on waves and instabilities in plasma. The magnetised hot plasma supports variety of waves and they have different dispersive properties. Similarly there are different mechanisms of nonlinearity also in plasmas. Using these two important mechanisms one can calculate the characteristic scales in the evolution of nonlinear structures and their dependence on plasma parameters like beta of plasma etc. This talk will present models based on the nonlinear waves and associated instabilities mechanisms to identify the physics behind break points in spectra and scalings in the different parts of the turbulent spectra in space and astrophysical plasmas. Role of kinetic Alfven waves and whistler waves in particular will be highlighted. Nonlinear dynamical equations will be presented in hot magnetised plasma and their numerical and semianalytical solutions will be presented to study the nonlinear structures and calculate the ensmable averaged magnetic and electric power spectra in the quasi steady state. Effect of initial conditions and plasma parameters on these will also be elaborated. The particle heating model based on Fokker Planck equation and velocity space diffusion coefficient will also be presented.