DPP16-2016-000158

Abstract for an Invited Paper
for the DPP16 Meeting of
the American Physical Society

Instabilities and transport in Hall plasmas with ExB drift[1]

ANDREI SMOLYAKOV, University of Saskatchewan

Low temperature plasma with moderate magnetic field, where the ions are not or just weakly magnetized, i.e. the ion Larmor radius being larger or comparable to the characteristic length scale of interest (e.g. the size ofthe system), have distinctly different properties from strongly magnetized plasmas such as that for fusion applications. Such parameters regimes are generally defined here as Hall plasmas. The natural scale separation between the ion and electron Larmor radii in Hall plasma, further exploited by the application of the external electric field, offers unique applications in various plasma devices for material processing and electric propulsion. Plasmas in such devices are in strongly non-equilibrium state making it prone to a number of instabilities. This talk presents physics description of the dominant unstable modes in ExB Hall plasmas resulting in highly turbulent state with nonlinear coherent structures and anomalous electron current. Since ions are un-magnetized, fundamental instabilities operating in low temperature Hall plasmas are very different from much studied gradients (density, temperature and magnetic field) driven drift-wave turbulence in strongly magnetized plasmas for fusion applications. As a result the nonlinear saturation mechanisms, role of the ExB shear flows are also markedly different in such plasmas. We review the basic instabilities in these plasmas which are related to the ion-sound, low-hybrid and anti-drift modes, discuss nonlinear saturation and anomalous transport mechanisms. The advanced nonlinear fluid model for such plasmas and results of nonlinear simulations of turbulence and anomalous transport performed within a modified BOUT++ framework will be presented.

[1]Research supported by NSERC Canada and US AFOSR FA9550-15-1-0226.