Seminar

Institute for Plasma Research

Title : Nature of plasma turbulence and magnetic reconnection going from fluid to kinetic scales

Speaker: Dr. Kirit Makwana
DESY Zeuthen, 15738 Zeuthen, Germany

Date : 14th December 2018 (Friday)

Time : 3.30 PM

Venue : Seminar Hall, IPR

Abstract :

Turbulence and magnetic reconnection are ubiquitous phenomena in laboratory, space, and astrophysical plasmas. Turbulence involves transfer of energy from large to small scales via nonlinear interactions, for example in the solar wind. Magnetic reconnection involves conversion of magnetic energy to particle energy via change in magnetic topology, for example in solar flares. Both these phenomena involve a vast range of scales which makes numerical simulations indispensable but challenging. Furthermore, different simulation models need to be employed at different scales. At large scales the plasma can be treated as a conducting fluid described by the magnetohydrodynamics (MHD) model. However, at small scales the particulate nature of plasma becomes important which requires kinetic simulation models. There are several open problems related to how the fluid and kinetic physics couple. I will present numerical simulations of these phenomena done with MHD and kinetic particle-in-cell (PIC) models. We find that turbulence in inertial range is well described by MHD models, but kinetic-scale current sheets play a major role in the energy dissipation and particle energization process. These current sheets are expected to be undergoing magnetic reconnection at the very small scales. On the other hand, the inverse can also happen where turbulence at small scales can drive reconnection in very large scale current sheets. Finally, we study reconnection in large-scale magnetic islands where both the small-scale kinetic physics and the global MHD-scale geometry combine to determine the reconnection dynamics.