Seminar

Institute for Plasma Research

Title : Plasma flow equilibria in 2D cylindrically symmetric expanding magnetic field

Speaker: Ms. Sneha Gupta
Institute for Plasma Research, Gandhinagar

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Time : 03.30 PM

Venue : Committee Room 4, (New Building), IPR

Abstract :

The setups with a magnetized plasma exiting a source region along a spatially weakening magnetic field (diverging field lines) are of interest because of the acceleration of steadily outflowing ions which is often achieved via a gridless mechanism as required in applications like space propulsion thrusters. In this work the steady-state flow equilibria of such magnetized plasma exiting through an expanding magnetic field are investigated by means of 2D Particle in Cell (PIC) numerical simulations using the 2D PIC code OOPIC (Object Oriented Particle In Cell). To start with, a plasma source model is presented to describe a source which is localized in a finite volume with specified plasma parameters such as power and pressure, for estimating density, temperature and corresponding outflow velocity at source exit to be used in the simulations. In experimental expanding plasma setups, the plasma is usually produced by RF sources (for e.g Helicon or ECR based plasma sources). The plasma thus generated is often localized and may not uniformly cover the entire physical volume of the bounded source chamber. In order to explore the effects of change in the localized plasma source region dimension, and an associated plasma transit length in the upstream uniform-magnetic field region, various cases with different axial lengths of the dielectric plasma source region, distinct from the location of physical expansion, are simulated. The axial potential profiles presented at various radial locations show development of a step-wise axial potential drop, producing plasma (ion) acceleration in the corresponding regions. Considering the relevance of the studied flow equilibria to the thrust generation schemes for space propulsion, a formal estimate of thrust values associated with plasma outflow is also done for the cases simulated.