

Seminar

Institute for Plasma Research

Title : Ion-flow driven instabilities in sheath-presheath of low temperature plasma
Speaker : Mr Vara Prasad Kella
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Date : 8th November 2017 (Wednesday)
Time : 03.30 PM
Venue : Seminar Hall, IPR

Abstract :

Ion-flow driven instabilities have been identified to be effective in influencing the ion dynamics in variety of plasma regions such as coronal plasmas, auroral ionospheric plasmas and presheath region of low temperature plasmas. These instabilities arise when there is a differential flow between ion species and or electrons exists. Ion-ion waves get excited, when there is a differential flow between ion species, whereas the ion-acoustic waves get excited when there is a differential flow between ions and electrons exists. These instabilities are proposed to be the probable mechanism as a source of anomalous heating of ion species in coronal and ionosphere plasmas [1, 2]. Apart from space plasmas, sheath-presheath region in a plasma is another favorable region for self-excitation of ion-flow driven instabilities. Recent experiments with Laserinduced fluorescence technology reveal, two different ion species reach the sheath edge with common speed in two-ion-species plasma [3]. Enhanced ion-ion collision friction generated by the two-stream instability is proposed to be responsible mechanism for reaching both ions to same speed [4]. However, direct experimental evidences of these instabilities in the presheath are non-existent. These different phenomenal instabilities (ion-ion co-streaming instability, ion-ion counter streaming instability and ion-acoustic instability) are connected together for the first time in this thesis work. A simple and flexible set-up is designed to study these instabilities in collisionless sheath-presheath region. A stainless steel mesh grid and Langmuir probe are used to produce and study sheath-presheath regime in a steady hot- cathode filament discharge plasma. After determining the sheath dimensions thoroughly using conventional and Laser-heated emissive probes [5], ion-ion counter streaming instability through mesh grid immersed in uniform plasma is studied in various conditions [6]. The effect of mass on the instability is investigated in different gas discharges and in two-ion-species plasma. Ion-ion co-streaming instability is observed at nearly ion concentrations in Ar+He plasma. The instability is validated experimentally in different ion concentration ratios and the measured wave number and frequencies are compared with the derived dispersion relations [7]. Ion-acoustic instability excited near the sheath edge is observed and the suitable parameters to sustain the instability are explored.

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 2. R. M. Winglee et al., J. Geophy. Research., Vol 94, p 8943, 1989.
 3. Chi-Shung Yip et al., Phys. Rev. Lett., Vol 104, p 225003, 2010.
 4. S.D. Baalrud et al., Phys. Rev. Lett., Vol 103, p 205002, 2009.
 - 5 V. P. Kella et al., Rev. Sci. Instrum., Vol 87, p 043508, 2016.
 - 6 V. P. Kella et al., Phys. Plasmas., Vol 24, p 032110, 2017.
 - 7 V. P. Kella et al., under internal review.
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