Seminar

Institute for Plasma Research

Title : Investigation on nonlinear dynamics of self-excited plasma oscillations obtained from a DC glow discharge plasma

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Date : 28th August 2017 (Monday)

Time : 10.30 AM

Venue : Seminar Hall, IPR

Abstract :

Conventional approaches to understand plasma phenomena are usually by measurement of equilibrium parameters like density, temperature, potential, and other features related to plasma waves like frequency and dispersion relation. But to explain certain phenomena like plasma transport and to achieve feature like chaos control in plasma, one require information about the underlying dynamics of plasma which can be extracted from the plasma parameter fluctuation. In this work, effects of dipolar magnetic field produced by a bar magnet and internal plasma noise on plasma dynamics have been investigated by a series of experiments in a glow discharge plasma device. A localized cathode glow is seen in the presence of a bar magnet near the cathode surface. Formation of localized glow was due to enhancement in the local ionization near cathode surface. With the increase in the field strength by moving the magnet incrementally closer to the cathode, the floating potential fluctuations went from being periodic, through a cascade of period-doubling bifurcations, to being chaotic. The transit to chaos was accompanied by a localized glow near the cathode surface that grew brighter with increasing field. In another scenario, during the excitable condition of system floating potential fluctuation showed the characteristic behaviour of canard and mixed mode oscillations. These observations are mainly due to internal plasma noise which was observed to increase with magnetic field strength. Since an excitable system is very sensitive to noise, we have seen the effect on internal noise here but not in the earlier case. In the absence of dipolar field, we have shown the emergence of intrinsic noise induced coherence resonance in a plasma system. With the change in discharge voltage, internal noise level increased. Thus, we have observed intrinsic noise induced phenomena. So far it is observed in plasma by external noise forcing. A FitzHugh-Nagumo (FHN) like macroscopic numerical model derived from the basic plasma equations is used to explain observation of mixed mode oscillation and coherence resonance. To explain the origin of period doubling bifurcation, a numerical model for ion dynamics by considering trapping of ions inside the potential structure formed due to the localized flow near the cathode surface is used. Our studies showed that plasma fluctuations are contaminated with the noise and any signal consists of two parts: coherent part and incoherent noisy part. So, we have developed empirical mode decomposition based technique to separate out the coherent and incoherent part of a chaotic time series data. We have applied this technique to different plasma fluctuation data to see its efficiency.