Abstract title: Interplay among cavity modes in a microwave ion source influencing the plasma dynamics and the extracted ion beam

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Abstract

Generation and excitation of multiple cavity modes in an experimental microwave ion source chamber are reported. The frequencies of those cavity modes are close to the operating microwave frequency, 2.45 GHz. Their interactions with each other inside plasma control the microwave (MW) coupling, the plasma dynamics and influence the ion beam quality. The linear superposition of those close frequency cavity modes, recognized as phase modulation generates a new range of plasma oscillations with the same modulation frequency. Newly generated phase-modulated waves are verified from the signatures of experimentally measured frequency emission from the plasma and the hot electron population build-up. The increase of the hot-electron population is caused by the plasma resonance with the modulated waves. Furthermore, few cavity modes are having more power than the threshold value required for nonlinear superposition and causes parametric decay phenomenon (PD).PD is also responsible for generating the ion waves in the over-dense plasma condition and thus causes additional plasma fluctuations of the corresponding frequencies. These above-mentioned phenomena influence the plasma dynamics and its ion beam stability. The present work reports the experimental observations of the phase modulation and the parametric decay due to the interplay of multiple cavity modes and the corresponding ion beam oscillations. The experimental results are supported by analytical calculation and finite element method (FEM) simulation. The influence of above mentioned self-excited plasma oscillations of a microwave ion source on its beam property is never been reported before.

About the speaker

Dr. Chinmoy Mallick is currently working as a Senior Scientist in the Electric Plasma Propulsion Division at Bellatrix Aerospace and Society for Innovation and Development, Indian Institute of Science, Bangalore, India. He obtained a Bachelor of Engineering in Electrical Engineering from West Bengal University of Technology and Master's Engineering in Nuclear Engineering & Technology from Jadavpur University, India. Thereafter, he completed his Ph.D. from the Institute for Plasma Research in microwave ion source plasma physics & engineering. He has been working for more than 7 years in industry & academia on microwave plasma physics-related applications like ion source, microwave hall thruster's propulsion, microwave plasma chemical vapour deposition for diamond growth etc. He is involved in designing optimization of different microwave plasma devices specifically using COMSOL Multi-Physics software and validating the experimental setups for improving performance.