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# Observations of Plasma Stimulated Electrostatic Sideband Emission and Harmonic Distortion: Evidences of Over-dense Plasma Generation inside a Microwave Discharge Ion Source

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Microwave discharge ion source (MDIS) is used in many applications including accelerators based neutron generators on suitable target through D_D or D_T fusion. The electromagnetic (EM) pump wave (ω_0) can propagate beyond cut off plasma density by changing its polarity and/or decomposing into different daughter waves through which it transfer its energy thus producing over dense plasma. Role of electric field on power coupling through different decay channels during density jump from under-dense to over-dense is obtained by theoretical modeling. This is validated with experimentally obtained spectral features in the ion plasma frequency range. In the present experiment, the plasma stimulated emission spectra was measured in the frequency range 0.5ω_0to 3ω_0 to understand the different probable energy decay channels role; e.g. Electron Bernstein waves (EBWs), Ion cyclotron waves (ICWs), Lower hybrid oscillations (LHOs), Ion Bernstein waves (IBWs) and Ion Acoustic Waves (IAWs) etc. The energy decays through different ion-type waves by parametric instability is studied by observing the different side-bands generation around the pump frequency and also the electron cyclotron (EC) harmonic frequencies. The intensity and growth rate of IAWs/ICWs and harmonics (up to 3rd) from parametrically decayed ordinary (O) mode pump wave was used to get an estimate of electric field and localized electron temperature. The density threshold of each electrostatic IAWS/ICWs was measured by stepping pump wave amplitude and external magnetic field. The IAWs lines appear at lower density threshold than the ICWs emission lines. The measured IAWs and ICWs ranges from 317-397 kHz and 410-555 kHz respectively with a density jump from 9.3x1016/m3 to 4.9x1017/m3.At higher density (>3.3x1017/m3), the electrostatic ICWs lines dominates the IAWs thereby yielding negligible damping through ion waves.

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