High Time Resolution Laser Induced Fluorescence in Pulsed Argon Plasma

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Motivation/Objectives
A high time resolution Laser Induced Fluorescence (LIF) method for obtaining the temporal evolution of the ion velocity distribution function in pulsed argon plasma with an internal tomographic probe has been developed. A single-mode tunable ring dye laser pumped by a 6 W argon-ion laser is used to excite a classic three-level Ar II LIF scheme: 3d(2P) to 4p(2P) to 4s(2D). An LIF system used for steady-state plasma is slightly modified by addition of a digital oscilloscope and by replacing the mechanical chopper with a high frequency acousto-optic modulator. Ion velocity distribution measurements as a function of time during the rf pulse are obtained by taking temporal slices of the LIF signal amplitude (a. u.) and ion flow velocity (red) at 20 cm downstream of the junction of the helicon source and diffusion chambers. P = 750 W, B = 700 G, f = 9.5 MHz, and Pressure = 1.5 mTorr.

Pressure Dependence and Temporal Evolution of Double Layer Formation

Effects of AOM Frequency and Lock-In Settings on LIF Signal-to-Noise

Summarary
- Double layer observed downstream of source at pressures on the order of 1.5 mTorr.
- Formation of the double layer occurs late in the discharge in a sine wave modulated pulsed discharge (contrary to observations of DL formation in square wave modulated discharges). This suggests a threshold RF amplitude is required for DL formation.
- Shape of accelerated ion population in Vpar, Vperp space suggests a beam population begins slowed by collisions and not pitch-angle scattering.