A Two-photon Absorption Laser Induced Fluorescence diagnostic for atomic H in a helicon plasma device

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The Resonant Antenna Ion Device (RAID) [1] is a linear basic plasma experiment at the Swiss Plasma Center. Among its research goals are the study of helicon plasmas as a source of negative ions for Neutral Beam Heating for fusion devices, the investigation of neutral dynamics which may limit the plasma density in high-power helicon discharges, as well as the study of plasma detachment, a regime of operation in tokamak divertors characterized by low heat and particle flux to the walls. Owing to the possibility of steady-state operation and ease of access for diagnostics, RAID is particularly well suited to perform detailed measurements in plasmas similar to those in the divertor and scrape-off layer of tokamaks.

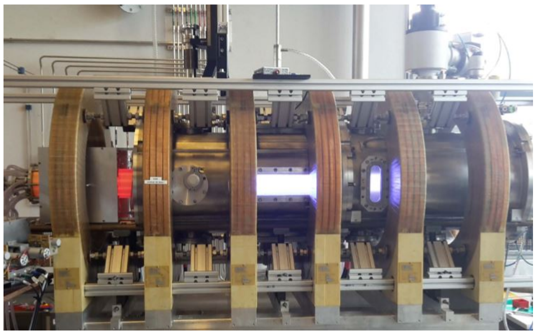

Figure 1: *An argon plasma generated in RAID*

The design of a Two-photon Absorption Laser Induced Fluorescence (TALIF) diagnostic is presented along with first measurements performed in H_2 plasmas. The TALIF diagnostic uses a picosecond pulsed laser to excite ground state atomic H. The excited states decay by emitting fluorescence at the H_α wavelength which is detected by an Intensified Charge Coupled Device (ICCD camera), thus allowing spatially resolved measurements of the density and temperature of atomic H [2, 3]. The width of the fluorescence emission line, mainly determined by Doppler broadening, is related to the neutral temperature. The intensity of the fluorescence line can be related, through calibration with Kr gas [4], to the density of atomic H. The density measurements must be corrected for collisional quenching, which includes all other decay mechanisms of the pumped state apart from fluorescence emission. The quenching rate can be experimentally determined from the fluorescence decay time, requiring time-resolved measurements.

References

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