"Ion and neutral dynamics of the "breathing mode" in Hall effect thrusters via time-resolved laser induced fluorescence"

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Hall Effect discharges exhibit a variety of natural coherent and incoherent plasma structures and instabilities when operated under certain conditions. One of the strongest oscillatory regimes is the so-called “breathing mode”, characterised by current oscillations in the 10–50 kHz range and triggered by the interplay between avalanche ionisation and neutral gas transport. Aiming at the understanding of the underlying physics, recent research effort has been dedicated to developing time-resolved plasma diagnostics methods able to resolve the time evolution of plasma properties at these time scales.

The seminar focuses on time-resolution schemes for Laser-Induced Fluorescence (LIF) diagnostics applied to the mapping of the ion and neutral velocity fields in Hall Effect Thrusters during breathing mode oscillations. Strong fluctuations in measured ion velocity and metastable ion and neutral densities throughout the discharge current cycle are observed. The spatio-temporal evolution of the ion velocity distribution function suggests a propagating acceleration front undergoing periodic motion nearby the thruster exit plane.

The developed time-resolution methods can be applied to a multitude of discharges characterised by transient or oscillating plasma physics phenomena.