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Overview of Recent Progress on Optical Diagnostics for Hall Thrusters at NASA JPL[1] VERNON CHAPLIN, ROBERT LOBBIA, PARKER ROBERTS, TIMOTHY SIMKA, ALEJANDRO LOPEZ ORTEGA, IOANNIS MIKELLIDES, RICHARD HOFER, JAMES POLK, Jet Propulsion Laboratory —
Non-invasive optical measurements of plasma properties in Hall thrusters are the preferred method for validating hydrodynamic and hybrid particle-in-cell (PIC) modeling codes used to understand life-limiting surface erosion processes. We present an overview of recent work at NASA Jet Propulsion Laboratory (JPL) advancing laser-induced fluorescence (LIF) and passive optical emission spectroscopy (OES) diagnostics. Time-resolved LIF measurements of ion dynamics during both periodic and aperiodic global discharge oscillations were achieved by using transfer function averaging in Fourier space to obtain useable signal-to-noise ratios and synchronize data taken at multiple ion velocities and positions in the plasma. At operating conditions without large-amplitude oscillations, spatial integration of the steady state kinetic equation for ions, starting from the upstream velocity distribution measured by LIF, has revealed evidence of non-classical heating in the acceleration region. To support electron diagnostics using OES, collisional radiative models of neutral and singly-ionized xenon were developed, yielding new predictions of density dependence in neutral line intensity ratios and fundamental bandwidth limitations for time-resolved electron temperature measurements using OES.

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