Novel Plasma Diagnostic Method Using Spectroscopy for Hall Thruster Optimization

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We present preliminary tests in a parallel-plate argon discharge plasma of an optical diagnostic that provides non-invasive, time-resolved qualitative measurements of relative neutral and ionic species densities. The technique uses retroreflected intrinsic line emission as a source for absorption, with a ratio of reflected-and-absorbed emission strength to direct emission strength that decreases monotonically with absorbing species density. Time histories of this ratio clearly show low-frequency (100 mHz) oscillations driven in a $pd = 1.5$ cm-Torr argon discharge (at a plasma density of $2.5 \times 10^{13}/\text{cm}^3$ and electron temperature of 3.66 eV). Future experiments will add a parallel retroreflected line emission beam, interference-filtered photomultipliers, and high-speed beam chopping to provide a two-point plasma wave dispersion diagnostic for hollow cathode ion acoustic turbulence.

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