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Study of Breathing Oscillations in a Hall Thruster[1] SCOTT KELLER, YEVGENY RAITSES, AHMED DIALLO, Princeton Plasma Phys Lab — Breathing oscillations are the most powerful low frequency (10-30 kHz) oscillations that are typically observed in different types of Hall thrusters [1,2]. We report on investigations of the effects of both natural and artificially driven breathing oscillations on the discharge and plasma properties of a cylindrical Hall thruster. In order to produce artificially coherent oscillations, a sinusoidal modulation up to 30 V_{AC} of the anode potential in the range of 5-30 kHz is applied to the thruster. These driven modes are studied in operating regimes with and without naturally occurring oscillations. The imposed periodicity allows for measurement of the time-dependent ion velocity distribution through a novel heterodyne approach to laser-induced fluorescence (LIF) using phase-sensitive detection. Further comparison between natural and driven modes is performed through the analysis of the discharge and ion currents, as well as high-speed imaging data. Results serve both to validate the LIF technique and to improve understanding of breathing oscillations. In particular, we show oscillations of the ion velocity distribution function due to breathing oscillations and explain their correlation with oscillations of the discharge and ion currents.

[1] J. P. Boeuf and L. Garrigues, J. Appl. Phys. 84, 3541 (1998).
[2] Y. Raitses *et al*, Phys. Plasmas 16, 057106 (2009).

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Scott Keller
Princeton Plasma Phys Lab

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