Study of a Conical Pulsed Inductive Thruster with multiple modes of operation

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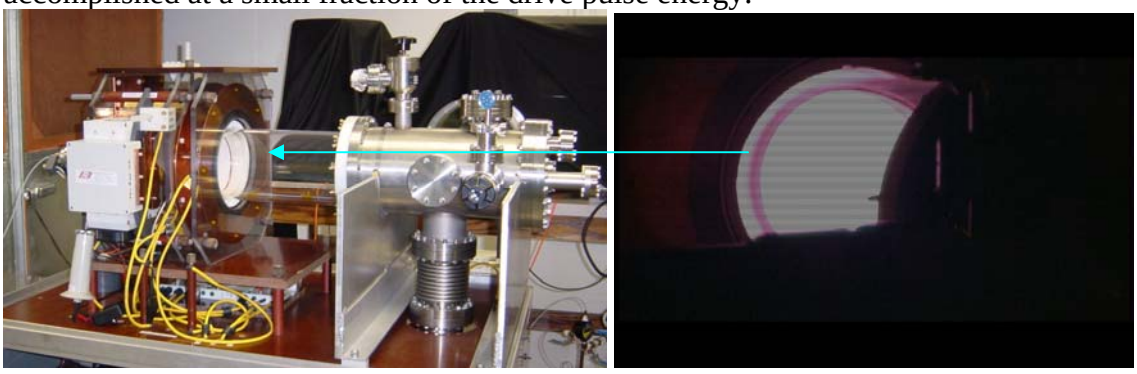
An electrodeless, pulsed, inductively coupled thruster has several advantages over current electric propulsion designs. The efficiency of a pulsed inductive thruster is dependent upon the pulse characteristics of the device. Therefore, these thrusters are throttleable over a wide range of thrust levels by varying the pulse rate without affecting the thruster efficiency. In addition, by controlling the pulse energy and the mass bit together, the ISP of the thruster can also be varied with minimal efficiency loss over a wide range of ISP levels. Pulsed inductive thrusters will work with a multitude of propellants, including ammonia. Thus, a single pulsed inductive thruster could be used to handle a multitude of mission needs from high thrust to high ISP with one propulsion solution that would be variable in flight.

A conical pulsed inductive lab thruster has been built to study this form of electric propulsion in detail. This thruster incorporates many advantages that are meant to enable this technology as a viable space propulsion technology. These advantages include incorporation of solid state switch technology for all switching needs of the thruster and pre-ionization of the propellant gas prior to acceleration. Pre-ionizing will significantly improve coupling efficiency between drive and bias fields and the plasma. This enables lower pulse energy levels without efficiency reduction. Pre-ionization can be accomplished at a small fraction of the drive pulse energy.



a.) b.)

Figure 1.a.) The PT-1 Thruster. 1.b.) Plasma produced by PT-1 at 30 Joules in theta pinch mode operation.

PT-1 has both drive & bias magnetic field coils wound on a common conical form at a 15 degree cone angle. Since the bias and drive coils are independent circuits, they may be pulsed in any timing sequence and in either same or opposing current directions. This will allow the thruster to be tested in a field reverse current mode, a theta pinch current mode, and in a simple pulsed inductive thruster mode with no bias field. Thus, the comparative operation of the thruster between the three modes can be studied. Current testing plans include testing the thruster with drive pulse energies from 30 Joules to 270 Joules.