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# Operational Characteristics and Plasma Measurements in a Low-Energy FARAD Thruster

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## ABSTRACT:

inducing a plasma current sheet in propellant located near the face of the coil. The propellant is accelerated and expelled at a high exhaust velocity (order of 10 km/s) through the interaction of the plasma current with an induced magnetic field.

The Faraday Accelerator with RF-Assisted Discharge (FARAD) thruster [1,2] is a type of pulsed inductive plasma accelerator in which the plasma is preionized by a mechanism separate from that used to form the current sheet and accelerate the gas. Employing a separate preionization mechanism in this manner allows for the formation of an inductive current sheet at much lower discharge energies and voltages than those found in previous pulsed inductive accelerators like the Pulsed Inductive Thruster (PIT).

An integrated-system, laboratory-model FARAD thruster was designed following guidelines and performance scaling parameters presented in Refs. [3,4]. The thruster, which is presented in Refs. [5] and [6], was constructed in part to verify the effectiveness of those guidelines and demonstrate efficient plasma acceleration at a low energy level per pulse (~100 J/pulse).

In this paper, we present measurements aimed at quantifying the thruster's overall operational characteristics and providing additional insight into the nature of operation. Measurements of the terminal current and voltage characteristics during the pulse (like those shown in Figs. 1 and 2) help quantify the output of the pulsed power train driving the acceleration coil. A fast ionization gauge is used to measure the evolution of the neutral gas distribution in the accelerator prior to a pulse. The preionization process is diagnosed by monitoring light emission from the gas using a photodiode, and a time-resolved global view of the evolving, accelerating current sheet is obtained using a fast-framing camera. Local plasma and field measurements are obtained using an array of intrusive probes. The local induced magnetic field and azimuthal current density are measured using B-dot probes and mini-Rogowski coils, respectively. Direct probing of the number density and electron temperature is performed using a triple probe.

## REFERENCES

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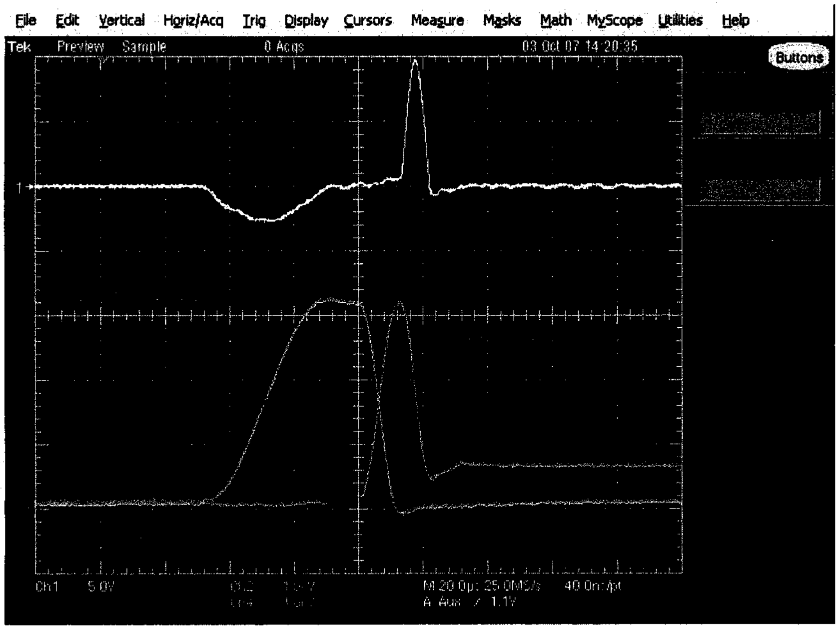

**Figure 1:** Acceleration coil current (upper trace) and capacitor voltages (lower traces) using a pulse compression ring power train.

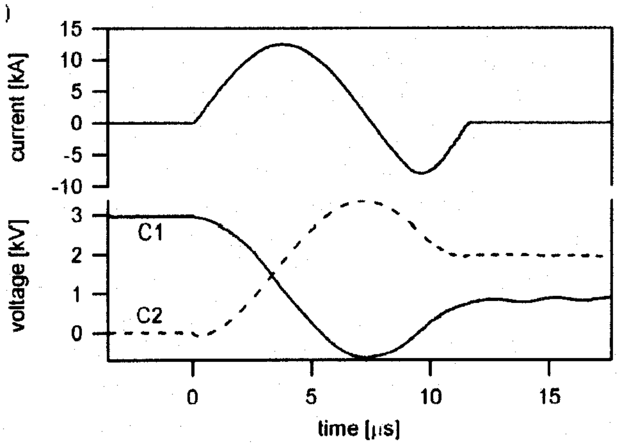

**Figure 2:** Acceleration coil current (upper trace) and capacitor voltages (lower traces) using a Bernardes and Merryman power train.