Downstream Flow Analysis of High-Power Helicon Double Gun Thruster

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Motivation
Manned missions and fast missions to the outer planets require utilization of non-conventional, cutting edge propulsion system – electric propulsion. While chemical propulsion is necessary to overcome a planetary gravitational force, electric propulsion is essential in making frequent missions to inner and outer planets a reality. A plasma thruster that can operate in the 100 kW to several MW power regime can only be attained by increasing the size of the thruster, or by using an array of plasma thrusters.

This experiment examines whether simultaneously firing two helicon thrusters side-by-side would have a higher performance than firing a single thruster.

Experimental Setup
High power helicon thruster is an electrode-less propulsion system that uses a Nagoya type III helical antenna, made from 15 cm long quartz tube. Noble gas, such as Argon, is puffed into the source region. Helicon antenna is turned on by the power supply to create plasma at a frequency of 625 kHz with peak-to-peak current of 1.5 kA, for the duration of 200 µs. Plasma is then accelerated by the magnetic field generated by series of magnetic coils.

Downstream Flow Profile
Peak values of Right and Left Gun firing are comparable at 1.16 mA and 1.21 mA, respectively. Decrease in plasma density suggests increase in beam velocity.

Preliminary Time of Flight Measurement
Right Gun firing: 15 km/s
Left Gun firing: 13 km/s
Double Gun firing: 17 km/s
25% increase in velocity

Work in Progress
Analysis of the full time of flight sweep is underway. Retarding energy field analyzer will be used to obtain the ion energy measurement downstream of the plasma flow and to verify the time of flight measurement.

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