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Development of a Plasma Microthruster

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The development of a Microplasma Microwave MicroThruster (3MT) is presented below. The goal of this research is to develop a low-power and low-cost micro-propulsion system. The microplasma source, based on split-ring resonators, generates a small plasma inside the thruster using Argon as the propellant. Currently we are measuring the microplasma parameters in order to understand thruster performance and testing different nozzle designs optimize the amount of thrust produced.

Key Findings

Microthruster

Fig. 1 Exploded view of thruster model

Three nozzle designs have been chosen for testing: a converging only, a conical nozzle, and a bell shape nozzle. The chamber will also act as the converging part of the nozzle.

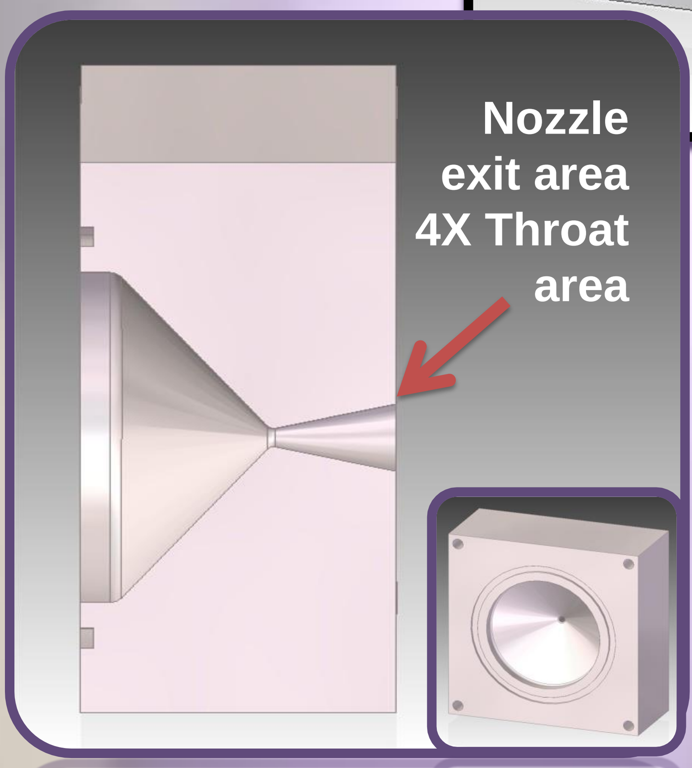


Fig. 2
15˚ Conical Nozzle

Fig. 3
80% Bell Nozzle

The thrusters are 3D printed in ABS plastic in the UAH student machine shop. This allows for the parts to be made quickly which gives the flexibility of multiple designs to be tested.

Vacuum Chamber Testing

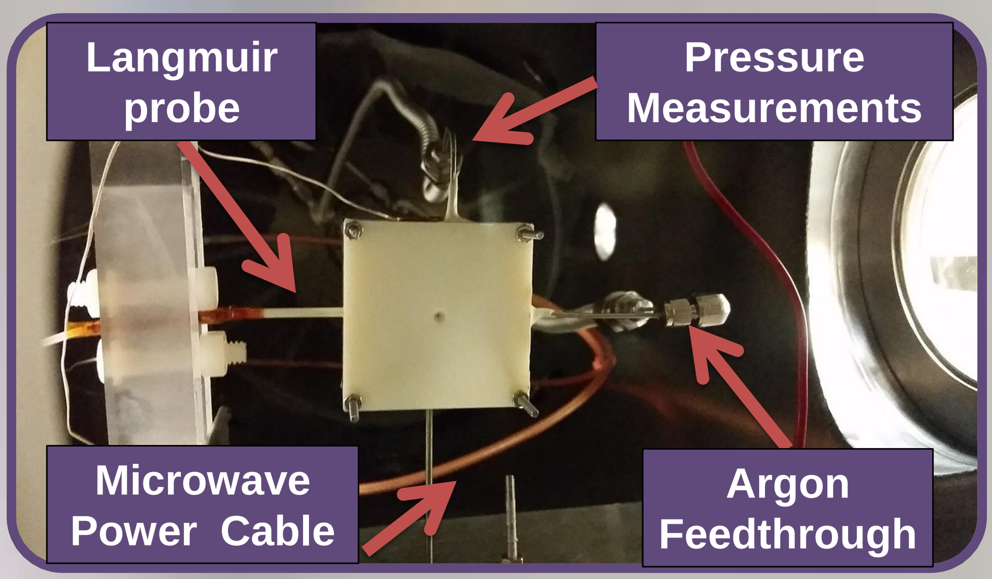


Fig. 4
Vacuum Chamber Test set up

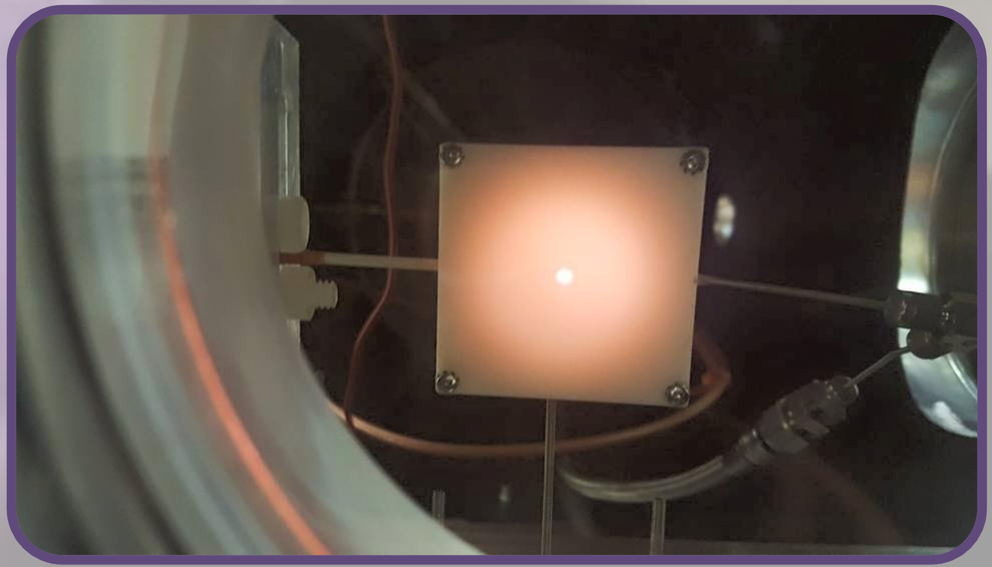
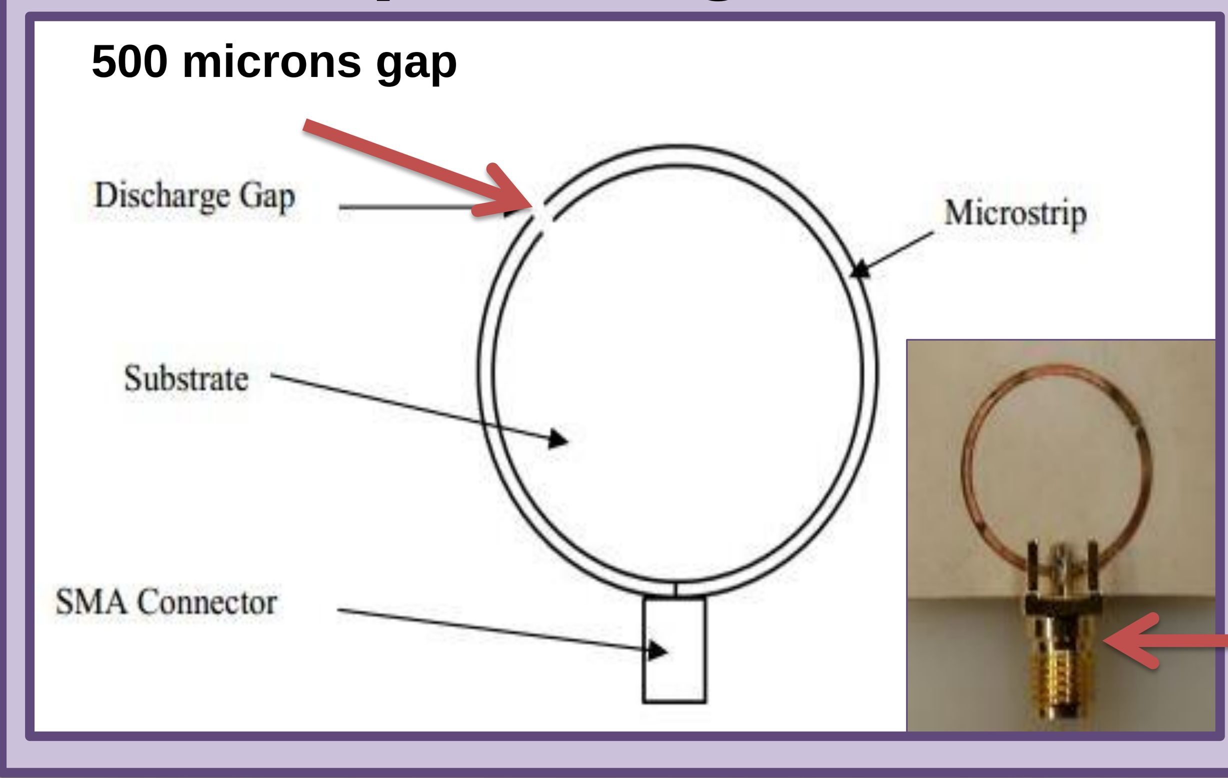


Fig. 5 Plasma vaporization during testing

Split-Ring Resonator



Plasma is produced by microwave ionization in a small air gap in the ring. Microwave power at a resonant frequency is provided through an SMA connector connected to the resonator ring and ground plate on the backside. Changing the thickness of the ring, flow rate, and microwave power controls the plasma properties and thus thruster performance.

Future Development and Impact

The objective of this project is to optimize the split-ring resonator and the microthruster. The success of this project has applications in small satellites such as CubeSats that have provided inexpensive access to space for experiments in orbit. Having more efficient propulsion units allows for longer duration missions and orbit maneuvering. Detailed results will be presented at the 2016 AIAA SciTech Conference.

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