# ExB PROBE ANALYSIS OF NITROGEN HALL THRUSTER

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## Abstract

The ten-week summer project attempted to find the efficiency of a nitrogen propelled thruster by characterizing its plume. An ExB Probe analysis was used and set up in a vacuum chamber. The experiment set up included the student-designed nitrogen hall thruster, a cathode and the ExB probe. Conclusive results could not be attained within the time frame due to Cathode constraints.

## Objectives

To find out the energy distribution of each ion species in the nitrogen hall thruster plume.

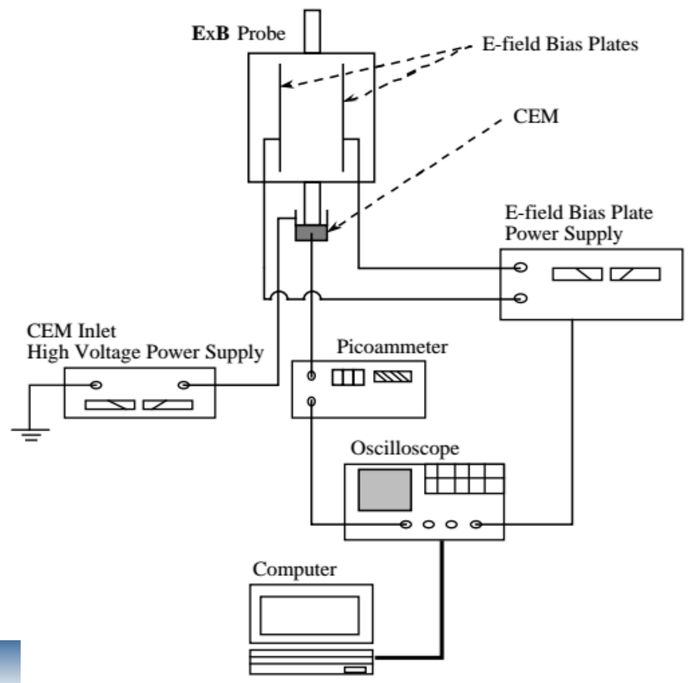
By measuring the rate of multiple ionization, we would determine:

- Thruster efficiency
- Extent of damage to the thruster and spacecraft

## MOTIVATION

Nitrogen is less expensive than other more often used propellants (xenon and krypton), it's abundant and readily available in Lower Earth Orbit (LEO).

## Methods




**ExB probe/Wien Filter**: uses the electric and magnetic fields inside it to filter out ions not travelling at desired velocity by deflecting them into the walls of the probe.

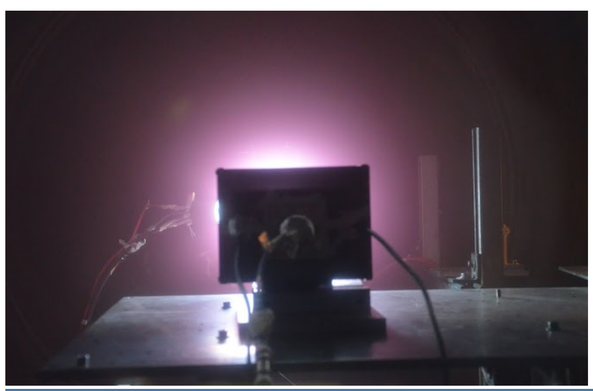
- Ions only pass through the probe when their velocity is such that the electric and magnetic fields cancel, resulting in zero net force on the ion.
- Current traces collected at the exit of the probe (CEM) is obtained when voltage on the plates is ramped from 0v upwards .
- Deflections are proportional to charge state of an ion, thus different species of ions ejected from the thruster are deflected in the probe at different velocities, so this trace has a number of peaks equal to the number of possible charge states of the ions

## Experiment Set-up

The components of the experiment included the nitrogen hall thruster, an ion-tech cathode and the ExB probe box. The thruster was run on xenon since the cathode that was able to run the nitrogen propelled thruster ceased to function.

**Student designed thruster**

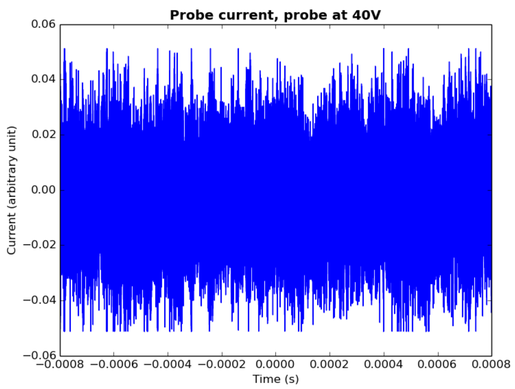
The probe entrance was laser aligned to the center of the thruster about 40cm down. The thruster was run at approximately 70V, 3A with a mass flow rate of 5 sccm.



## Results

Results of characterizing the nitrogen propelled thruster plume could not be attained due to cathode failure. The xenon set-up yielded very noisy results and actual data could not be resolved from the results.

## Conclusion




Individual ion species peaks could not be resolved from the noisy data attained.

## Future Work

**<u>Improvements in the Set-up</u>**

Run on Nitrogen with appropriate cathode.
Float the ExB probe
Align probe with thruster channel (not axis).
Vent the ExB probe, 3,5mm holes on each side equally spaced.
Dual programmable power supply for the bias plates.
Lock-in reading with pre-amp.

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## References

Kim, Sang-Wook. *Experimental Investigations of Plasma Parameters and Species-Dependent Ion Energy Distribution in the Plasma Exhaust Plume of a Hall Thruster.* 1999.