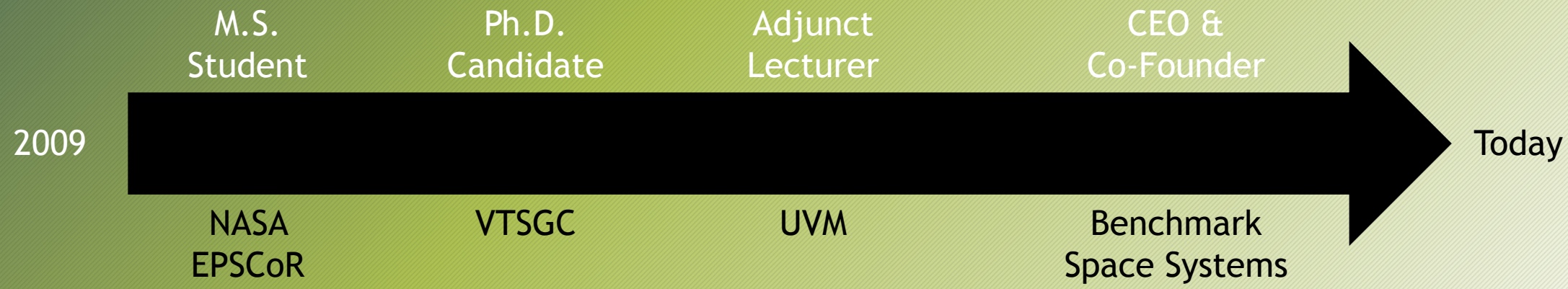
Small State, Small Satellites

Ryan McDevitt, Ph.D.

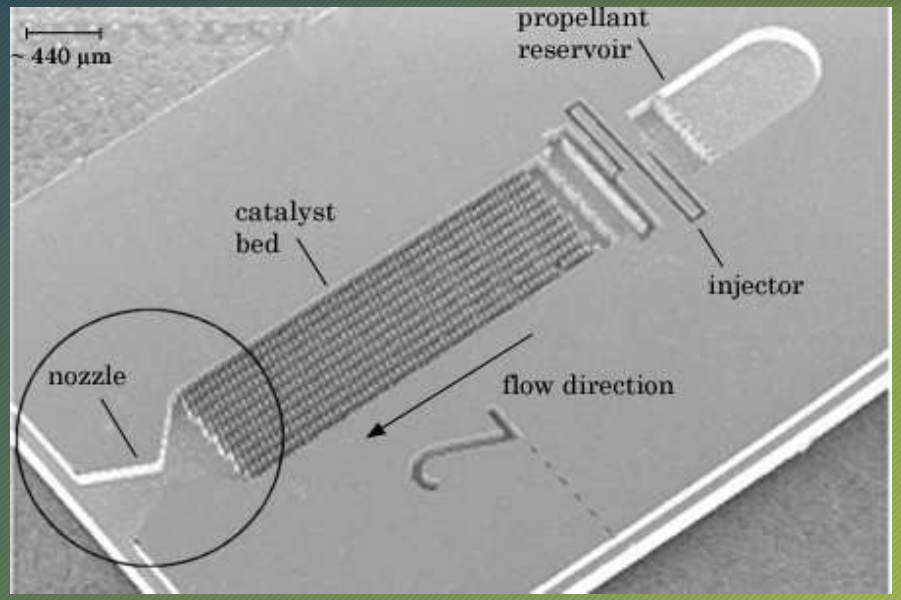
Overview

Two factors made this possible:

- Support of VTSGC/NASA EPSCoR
- Rise of small satellites

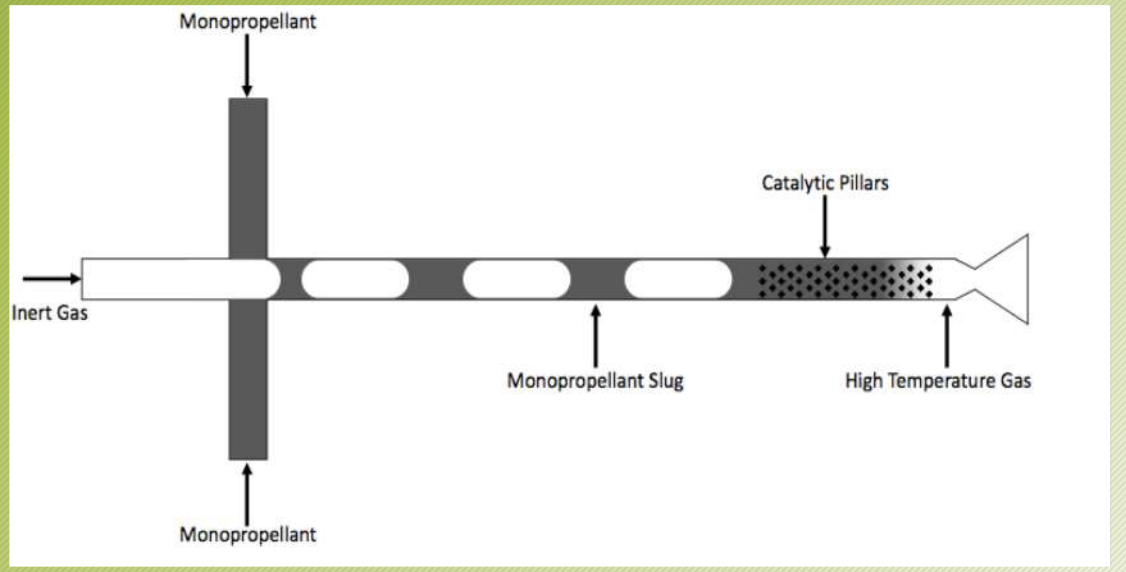


NASA EPSCoR: MEMS-Manufactured Thrusters



- Build off previous research to develop an improved MEMS-manufactured thruster
- Emphasis on non-toxic fuels and small impulse-bits
- Use novel fuel injection to enhance performance

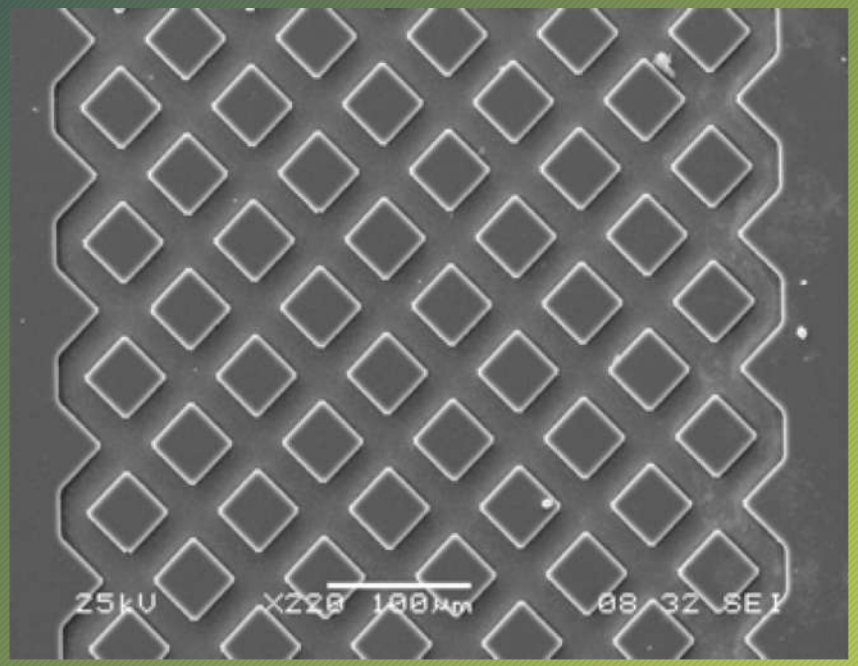
NASA Goddard & UVM MEMS Microthruster (2001)



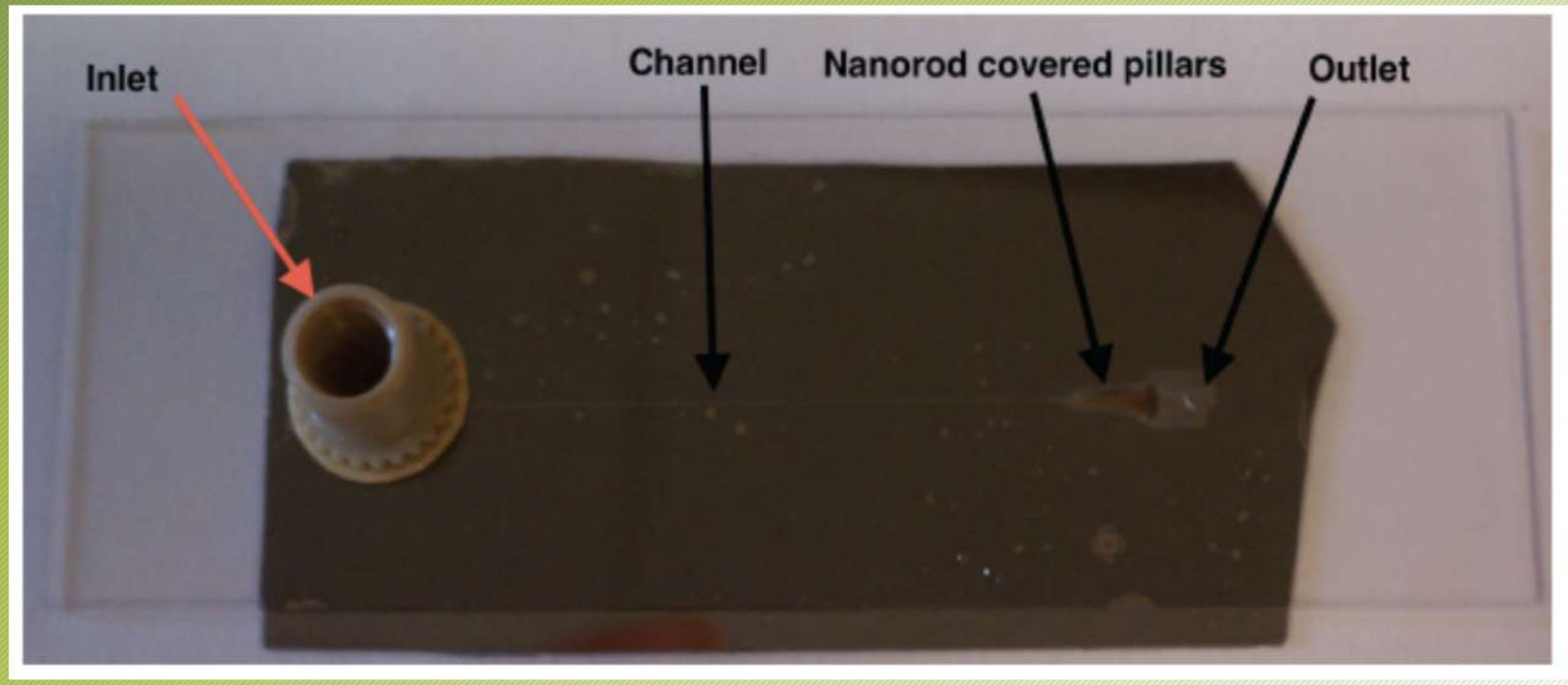
Discrete Thruster Concept (2009)

MEMS Manufacturing

- Photolithographic Mask Design
- Anodic bonding
- Microfluidic system design



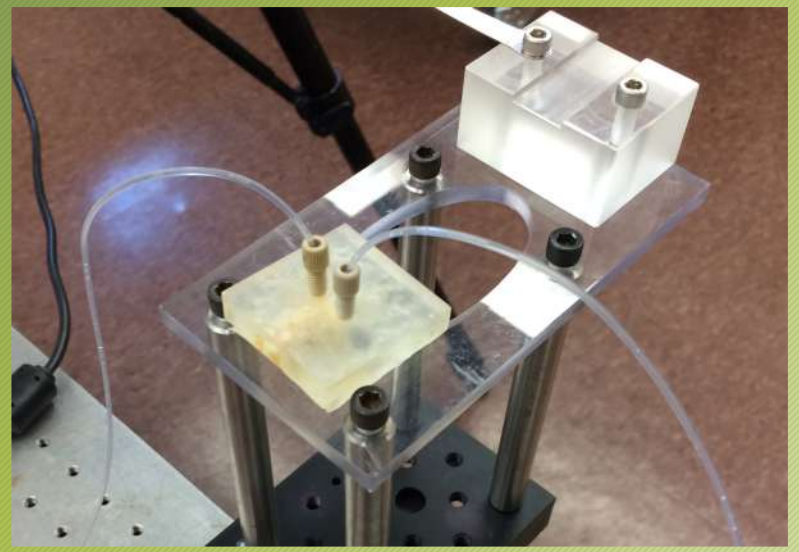
SEM Imaging

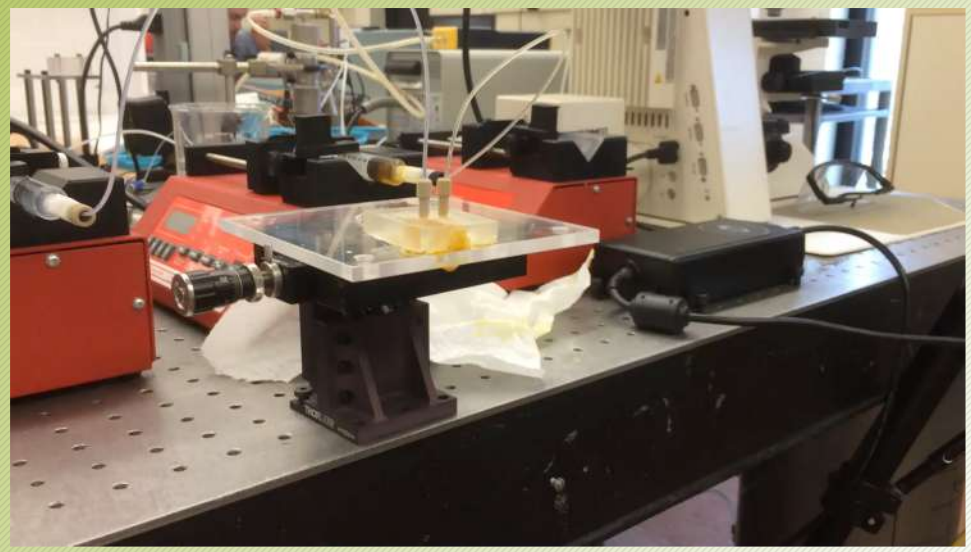


Prototype MEMS Thruster

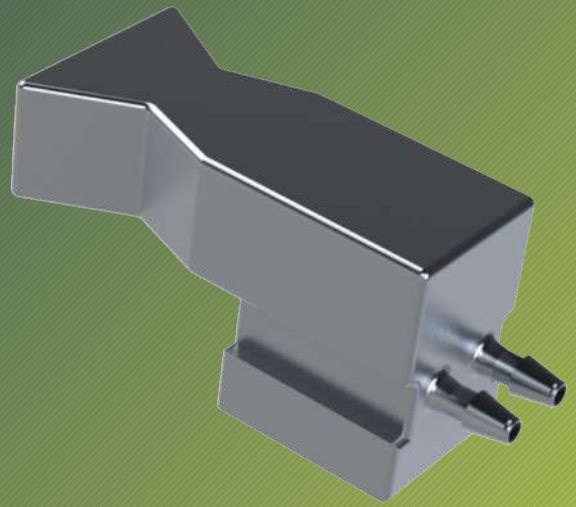
In the Lab

- High Speed Videography & Image Analysis
- 3D Printed Polymer Nozzles
- Rapid prototyping and testing

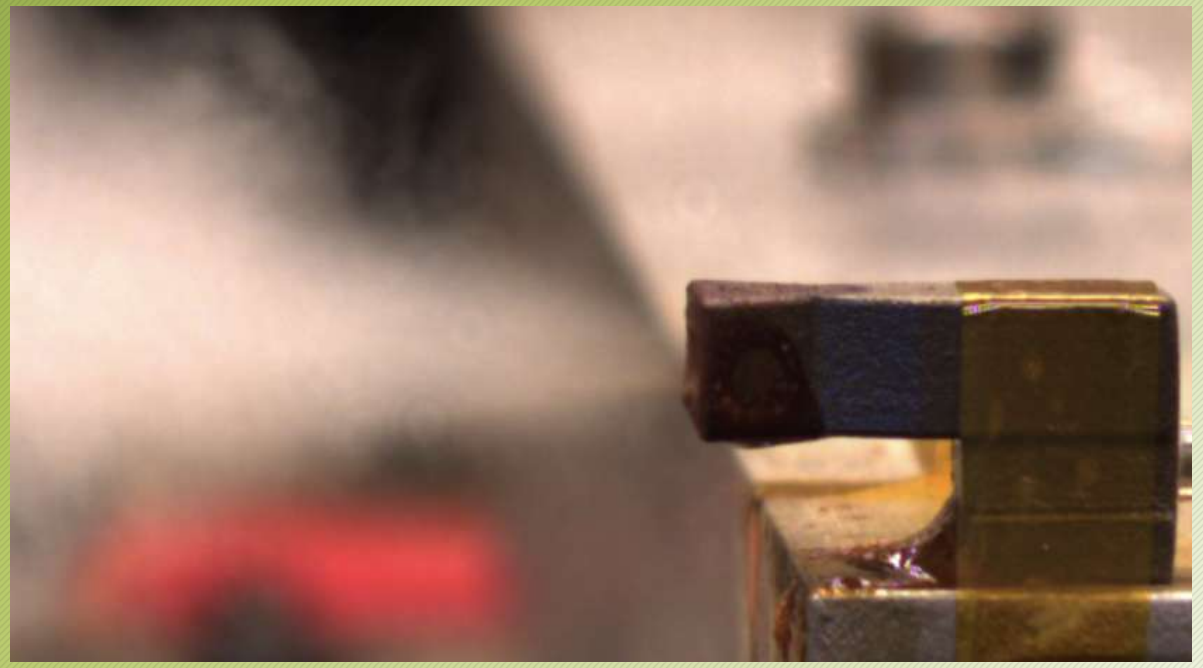




3D Printed Thrusters



3D Model

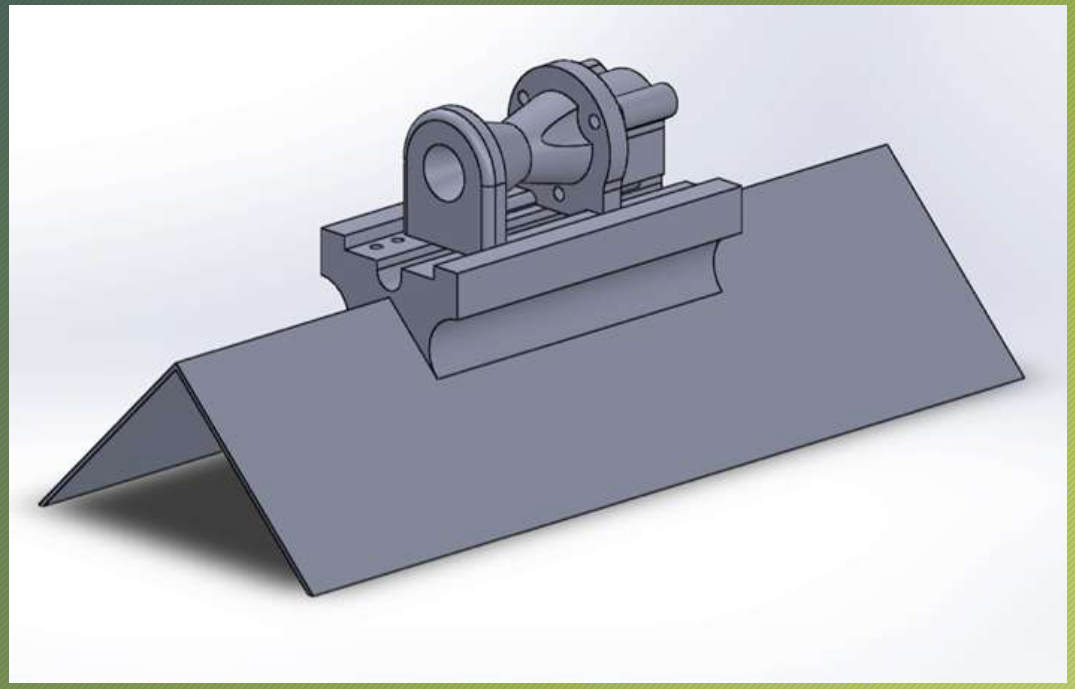


3D Printed Thruster Firing

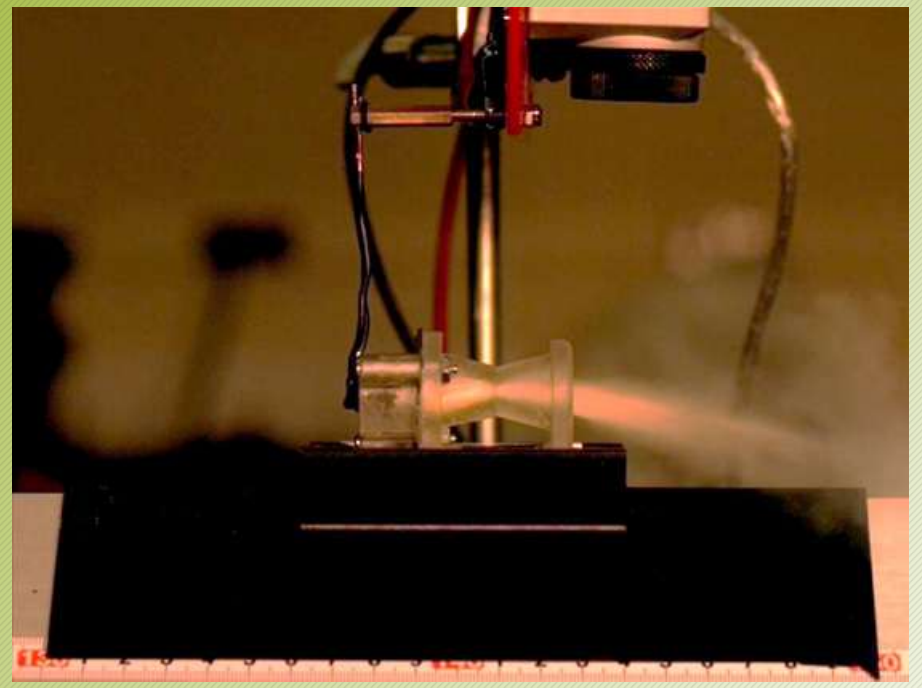
Vermont Space Grant Consortium

- Involved in a variety of student projects
  - Member
  - Supervisor
  - Advisor
- Development of various CubeSat propulsion systems
  - Monoprop
  - Warm gas
  - Solar sail

Foaming Thruster

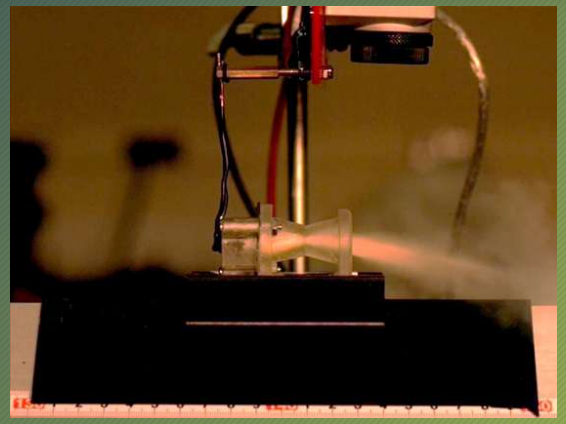


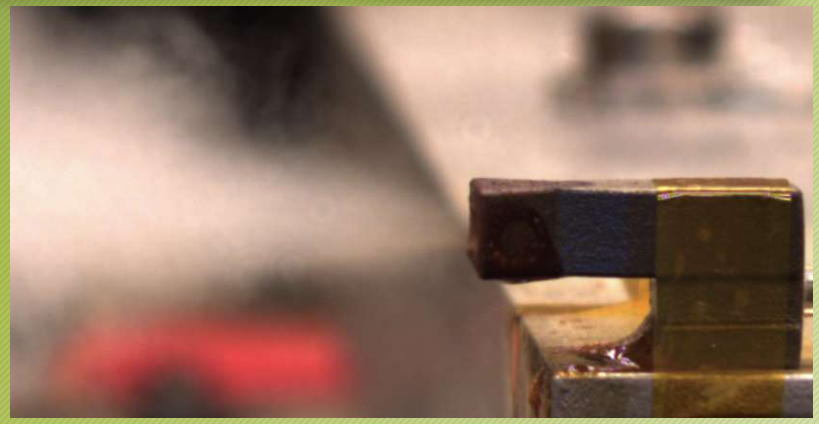
3D Rendering of Test Apparatus



Foaming Thruster Test Fire

Technology Transfer





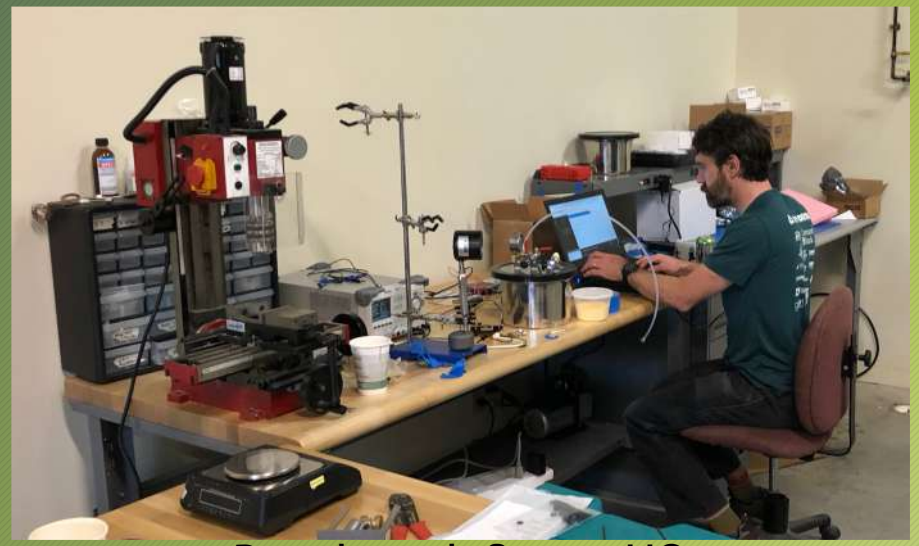
CubeSat Propulsion

Small Satellite Propulsion

Propulsion Product Line

Benchmark Space Systems

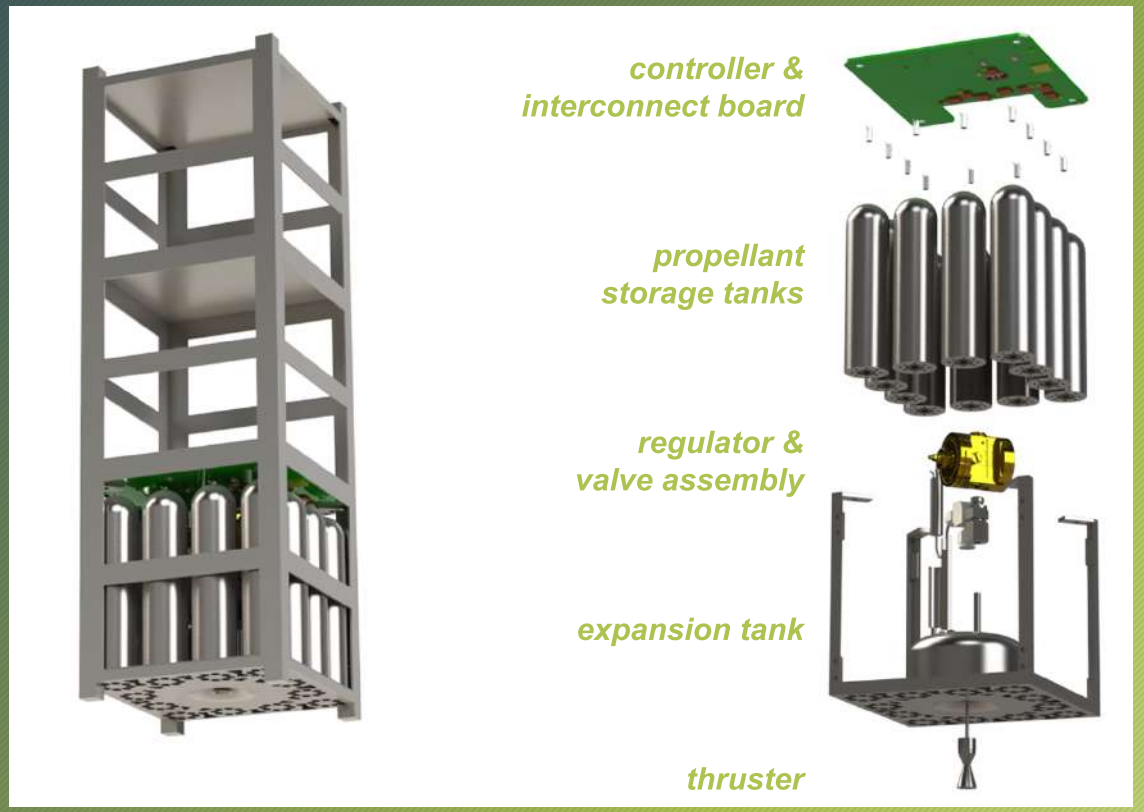
- Founded in June 2017
- 5 Full Time Employees
- Working with 5 of the 8 largest small satellite manufacturers
- Supporting spacecraft from 3U – 200 kg



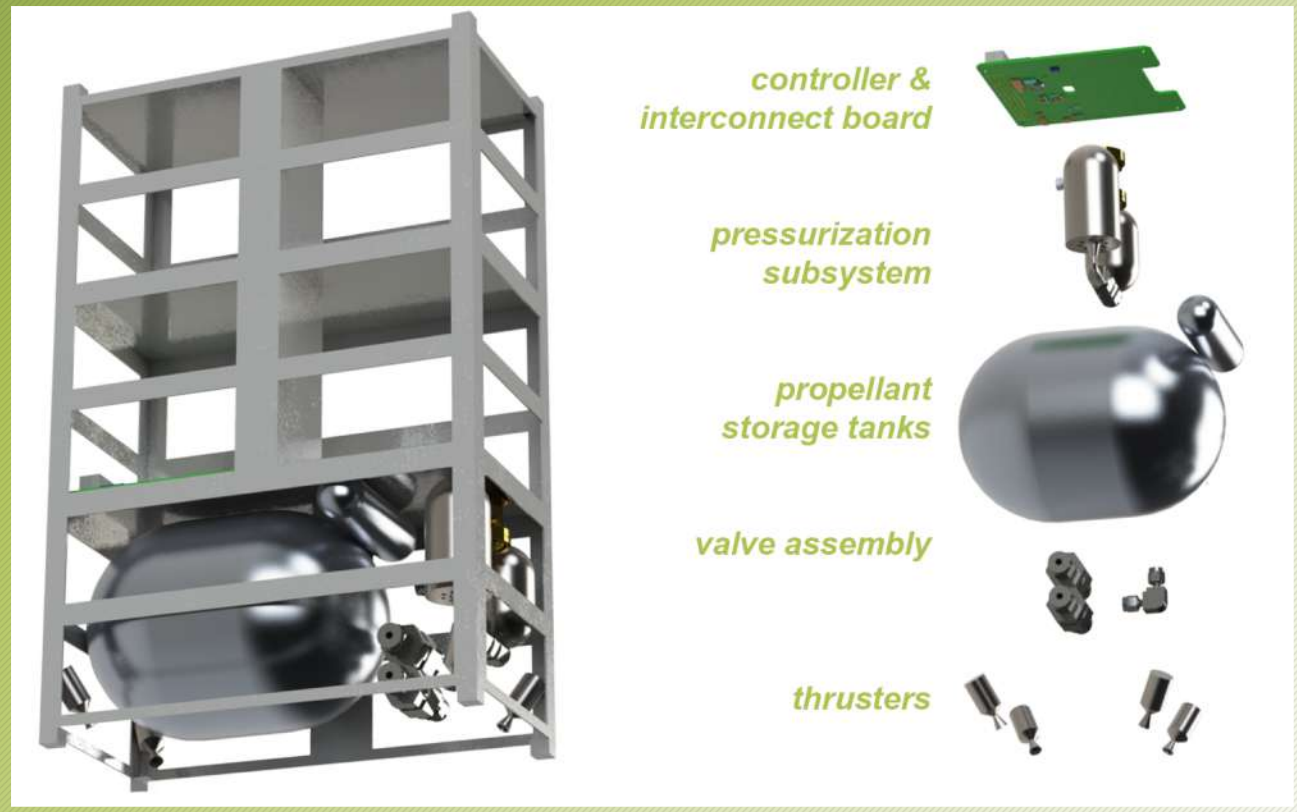
Benchmark Space HQ

Benchmark Space at SmallSat 2018

Benchmark Space Systems - Products

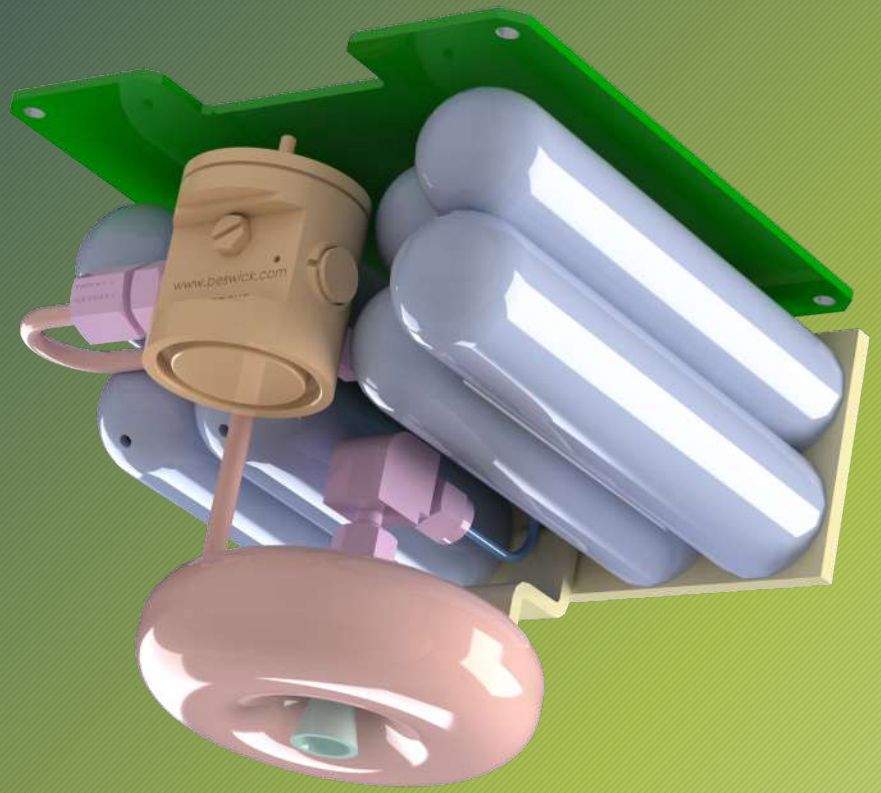


DFAST Propulsion System



B125 Propulsion System

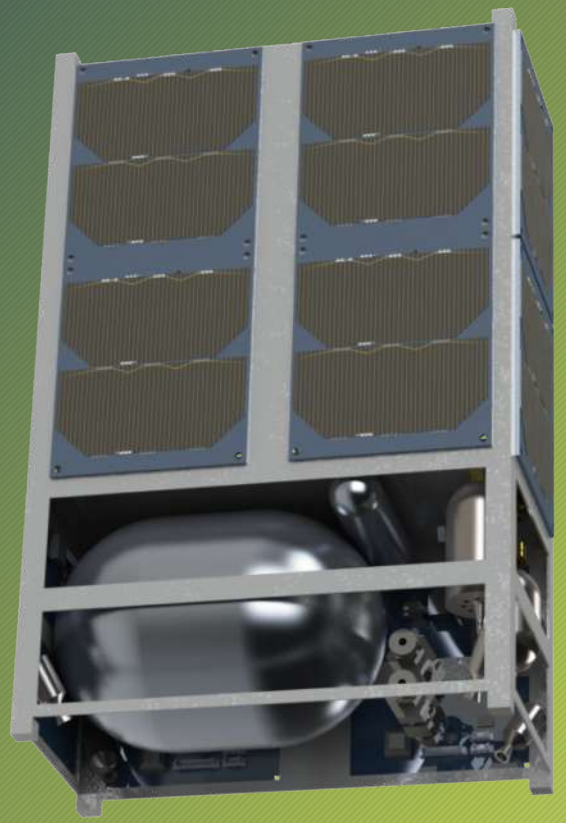
First Launch: H2 2019



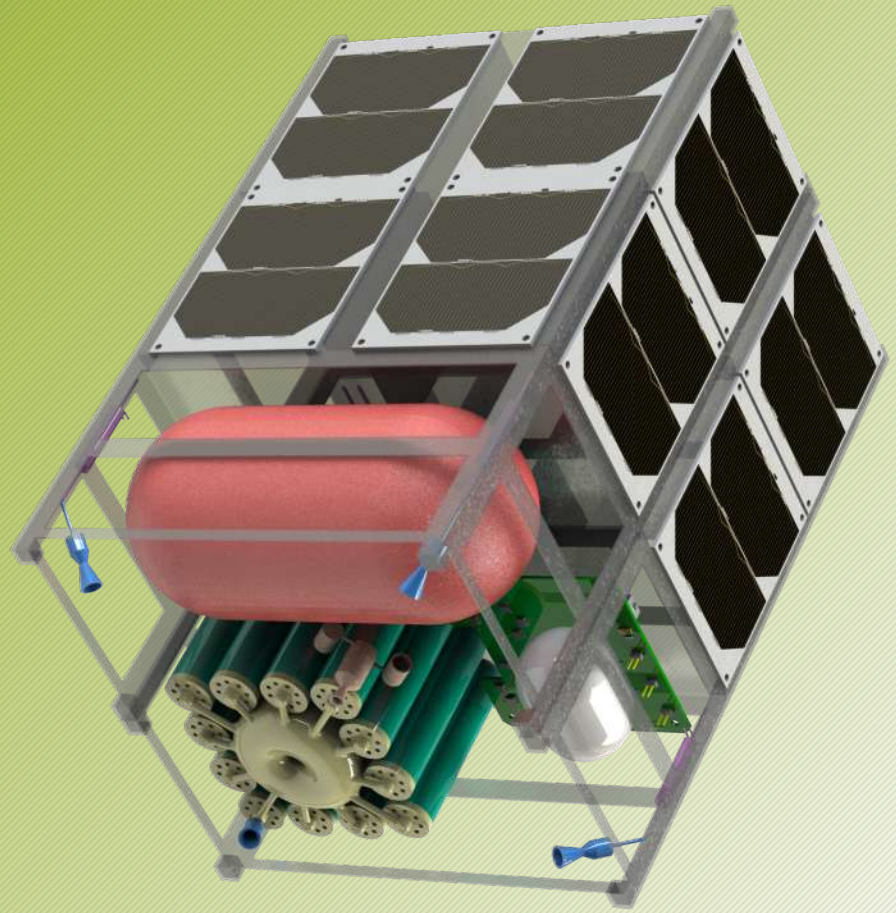
3D Rendering of 0.5U DFAST System

Test Hardware

Future Missions



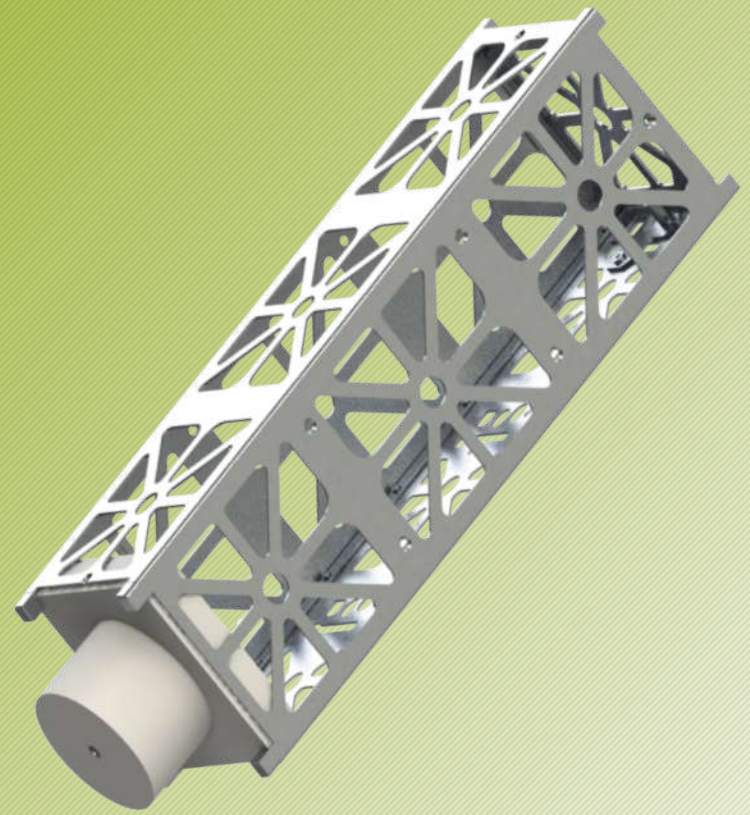
6U Constellation



12U Constellation

Conclusion

- Aerospace development can happen anywhere
  - CubeSats/Small Sats are an increasingly important part of the aerospace ecosystem
  - COTS hardware and software are increasingly accepted
- Support from VTSGC and NASA EPSCoR made Benchmark Space Systems possible
  - My graduate education
  - My research
  - Projects that I was able to participate in



Thank you!

- Angela Des Jardins
- Darren Hitt
- Debra Fraser
- UVM OTC
- Bill Lakin