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Design and Testing of a Propulsion System for 3U-CubeSat application

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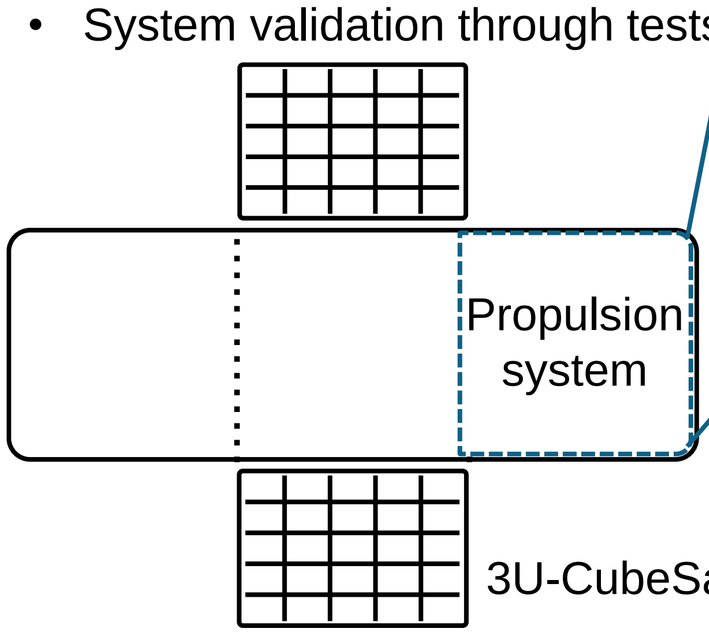
Motivation:

Problem: ↑ # of satellites → Space debris ↑
Goal: Clean space → Sustainability

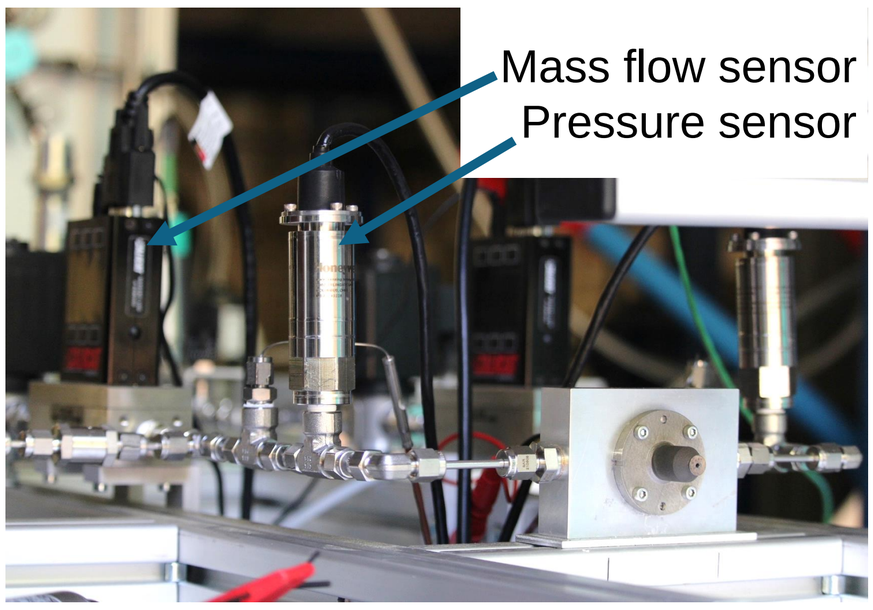
Solution:
Satellite Deorbiting System
→ Activated at end-of-life
→ Limits space debris

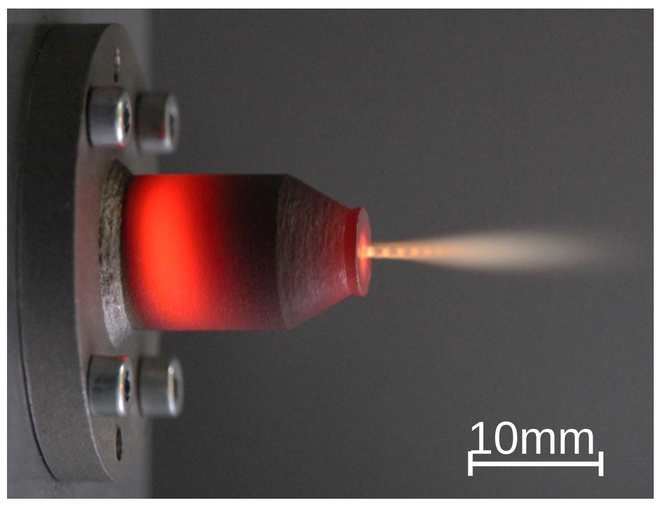
GLR's Implementation:
- Application for 3 Units (U) CubeSats
- 1U: H2O propulsion system
- System validation through tests



Test Bench:

- Designed for H2/O2 thrusters
- GH2 / GO2 / GN2
- Operation modes:
  - Stationary
  - Blow-down → Buffer H2/O2 tanks
- Maximum pressure: 20 bar
- Nominal mass flow: 0.2 g/s
- Diagnostics on thermal management: Thermal camera
- Diagnostics on flow field: Schlieren system





Main Thruster:

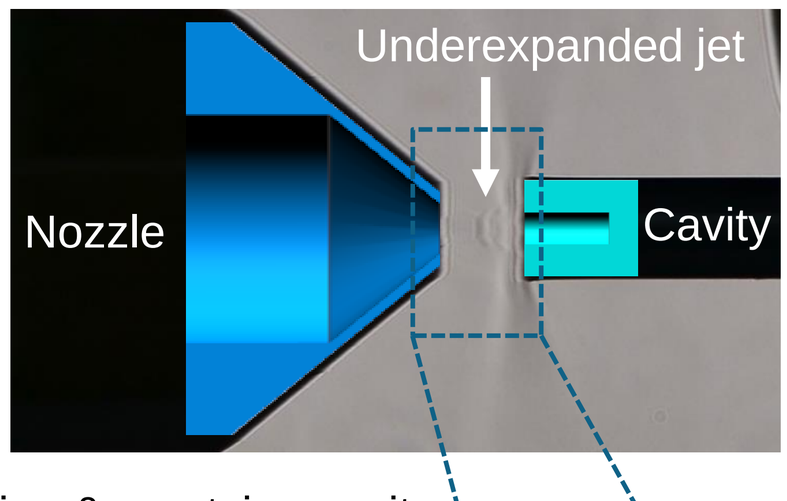
- Additive manufacturing
- Inconel 718
- Thrust < 1 N
- Burn time < 3 s
- Oxidizer-Fuel ratio: 7
- Comb. pressure: 3.5 bar
- Throat diameter: 1.3 mm

Resonance Ignition:

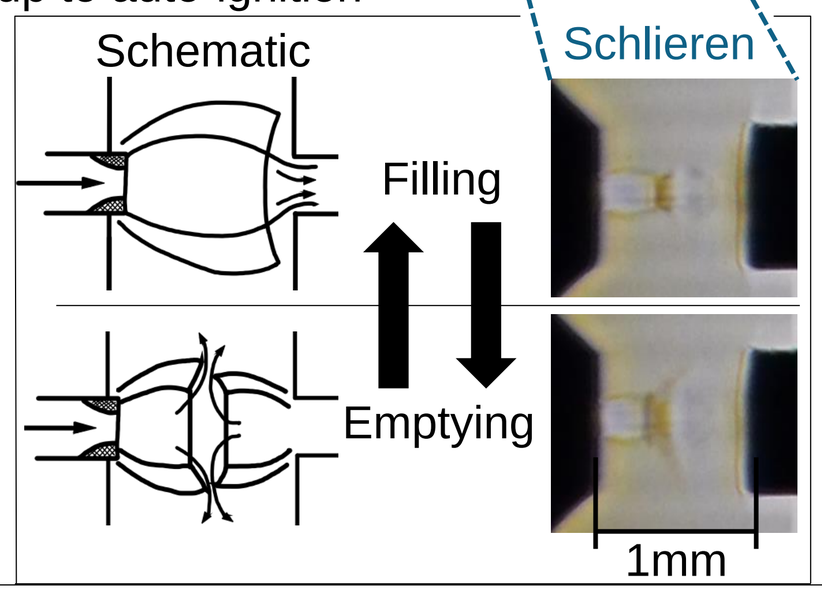
- No active parts needed
- Simple set up: Nozzle & cavity

→ Potentially reliable

Key Design Factors:
- Cavity length & geometry
- Ratio cavity / nozzle diameter
- Nozzle – cavity distance
- Pressure ratio over nozzle



Aimed Result: Series of cycles filling & emptying cavity
→ Formation of underexpanded jet downstream of nozzle
→ Loss mechanisms heat up gas up to auto-ignition temperature



Achievements & Findings:
- Formation of underexpanded jet characterized
- Proper settings detectable through frequency analysis
- Heat generation proven (170°C)
- Additional effects complicate temperature increase due to miniaturization

→ Further optimization needed

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