

Parabolic Flight Testing of Hard Disk Drive Reaction Wheels

*Flight Opportunities Lightning
Talk
SmallSat 2024*

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Kylie Cooper
Abhay Negi
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**3-axis attitude control
for low-cost
spacecraft**

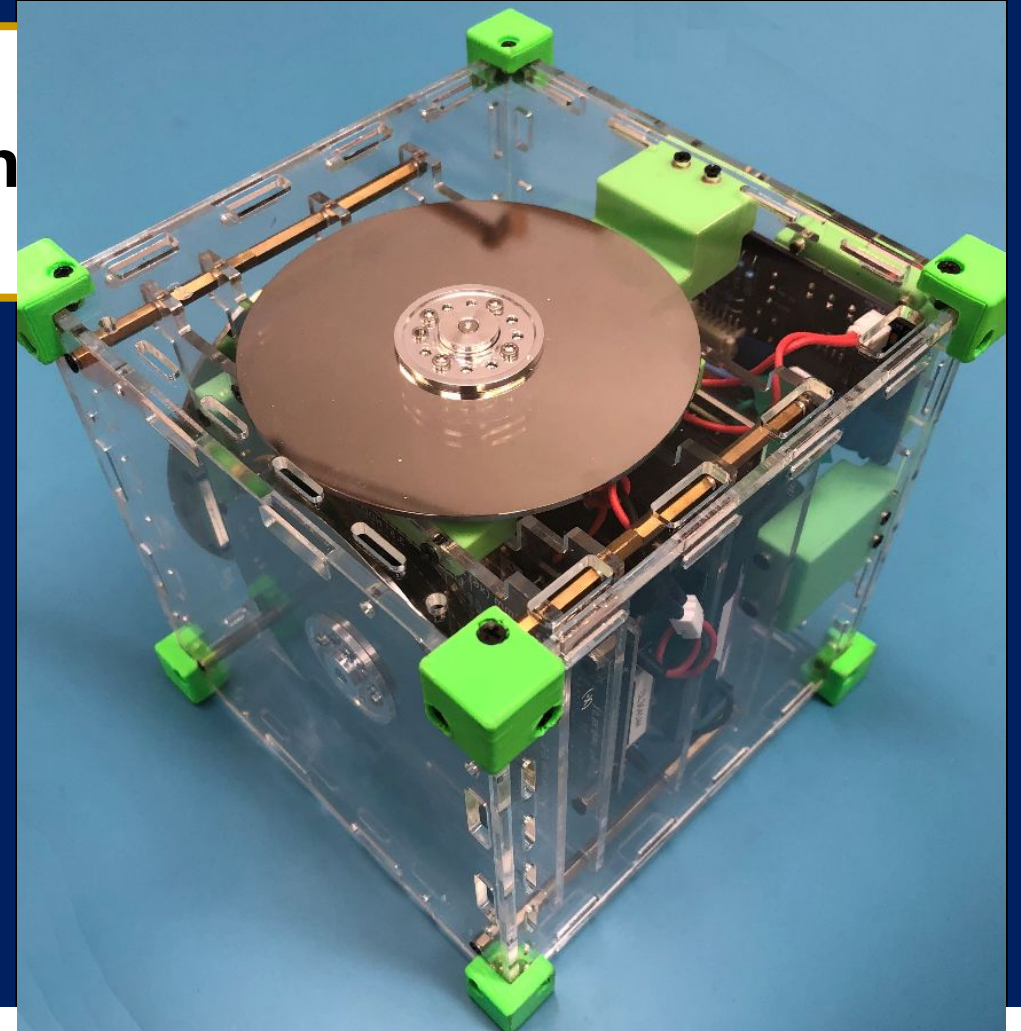
**Hard Disc
Drive Reaction
Wheels**

6 flights across 3 flight campaigns

FC1: Linear Ramp Testing, Dec '21

FC2: Stabilization Testing, Jun '22

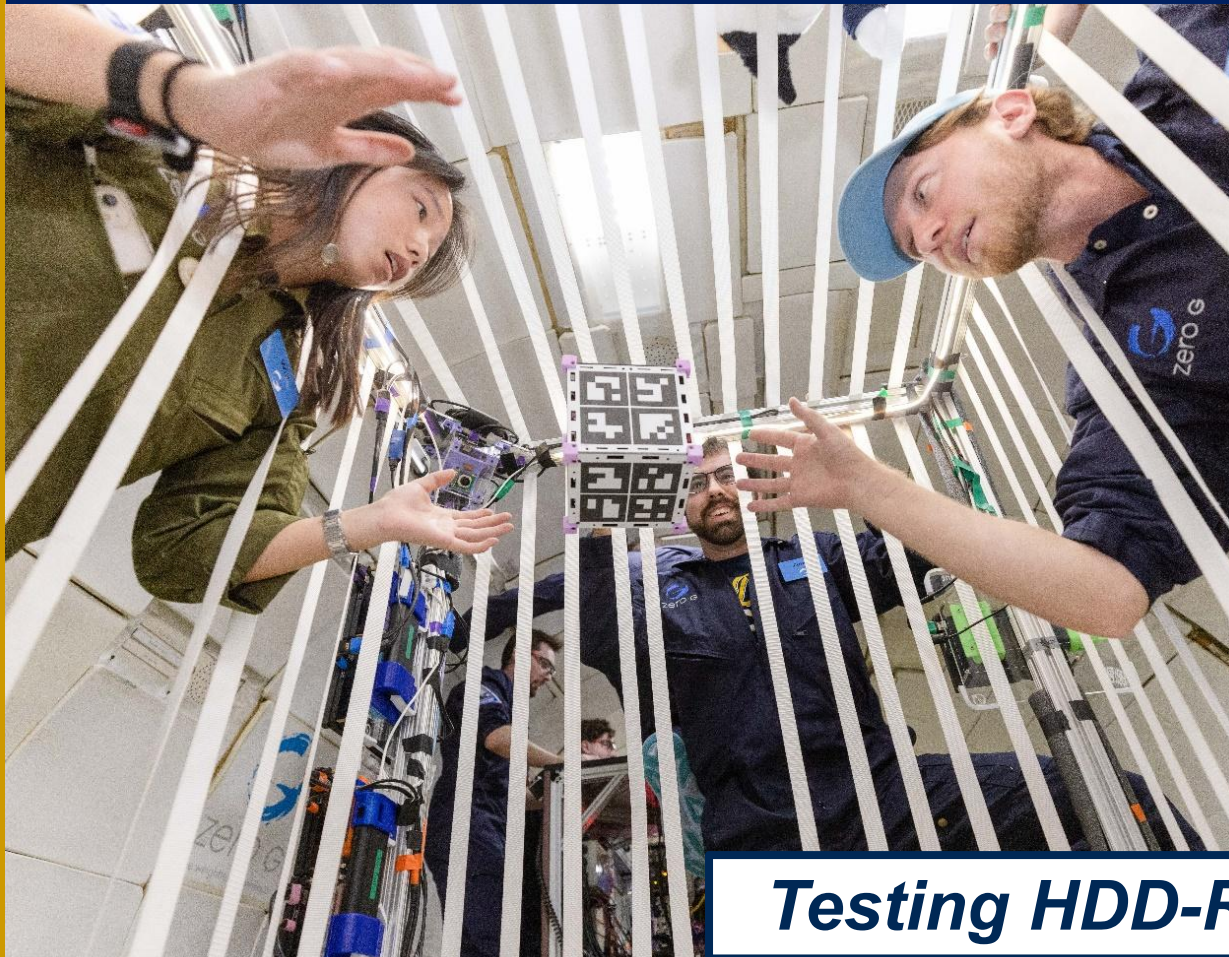
FC3: Pointing Testing, Nov '22



Prototype CubeSat with HDD-RWs

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Testing HDD-RWs during FC3



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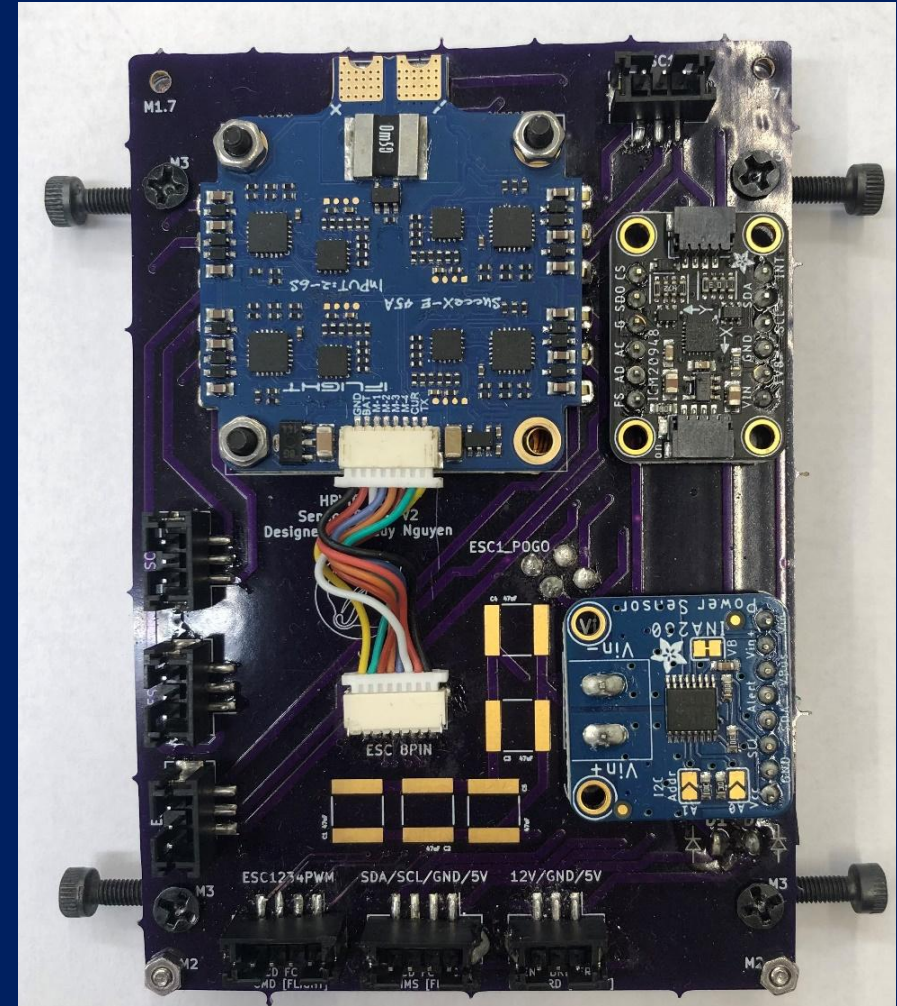
HDD-RW Orbital Flight

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After Zero-G flight campaigns,
orbital demo to raise TRL

Upcoming 1-axis demo on a
6U CubeSat built at JSC

Launch October 2024



HDD-RW prepared for orbit

Lessons Learned

- **Short (3 - 7 s) zero-g periods guided experiment design**
 - Controller gains for attitude maneuvers
 - Streamlined data interface
- **Practice is critical for success**
 - “Choreography” of experiment
 - Including with personnel incapacitated; cross-training
 - Stress-test equipment
- **Prepare for malfunctions**
 - Spare hardware accessible in-flight
 - Replacement hardware and tools on-site
 - Budget travel accordingly
- **Read Kylie Cooper’s and Abhay Negi’s theses!**

To Learn More

TSC at table U-19

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Kylie Cooper, 2023

“Computer Vision System and Experimental Design for Parabolic Flight Demonstration of Hard Disk Drives as CubeSat Reaction Wheels”

Abhay Negi, 2023

“CubeSat Attitude Control Using Hard Disk Drives as Reaction Wheels”