

Background

Current satellite radiators have coolant moving through a singular joint and cannot be reclaimed, creating space debris.

Objective

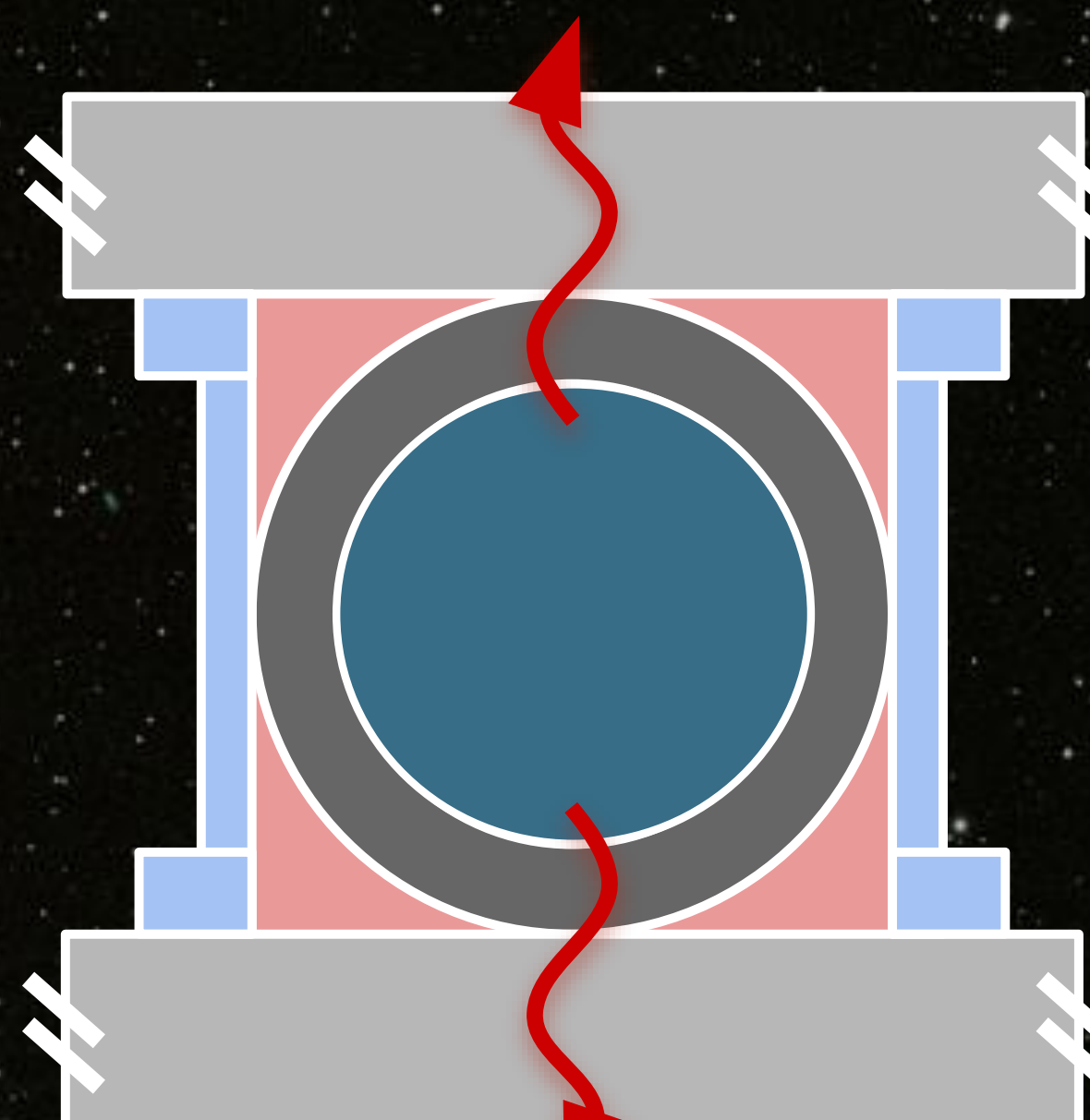
Create a proof-of-concept radiator capable of deploying, rotating, active fluid flow, and stowing. Will allow to maximize heat dissipation and reduce space debris.

Key Requirements

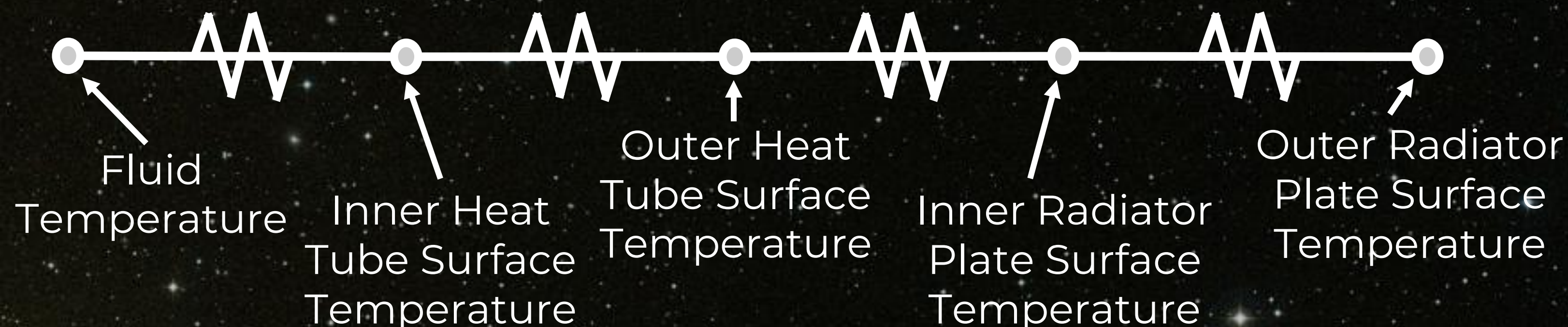
- ✓ Ability to deploy and stow
- ✓ Ability to recalibrate angle
- ✓ <50kg with an area <8m²
- ✓ Dissipates 1000W at 40°C
- ✓ Coolant pressure drop of <10psi operating at 50psi and 5.5L/min
- ✓ Rotation accuracy $\pm 1^\circ$ over 180° range
- ✓ Draws ≤ 100 W operating within 8.5-11V

Thermal System

- Panel for heat dissipation via radiative exchange with Sun, Earth, Deep Space
- Fluid loop and panel geometry optimized for maximum heat dissipation



Heat Flow



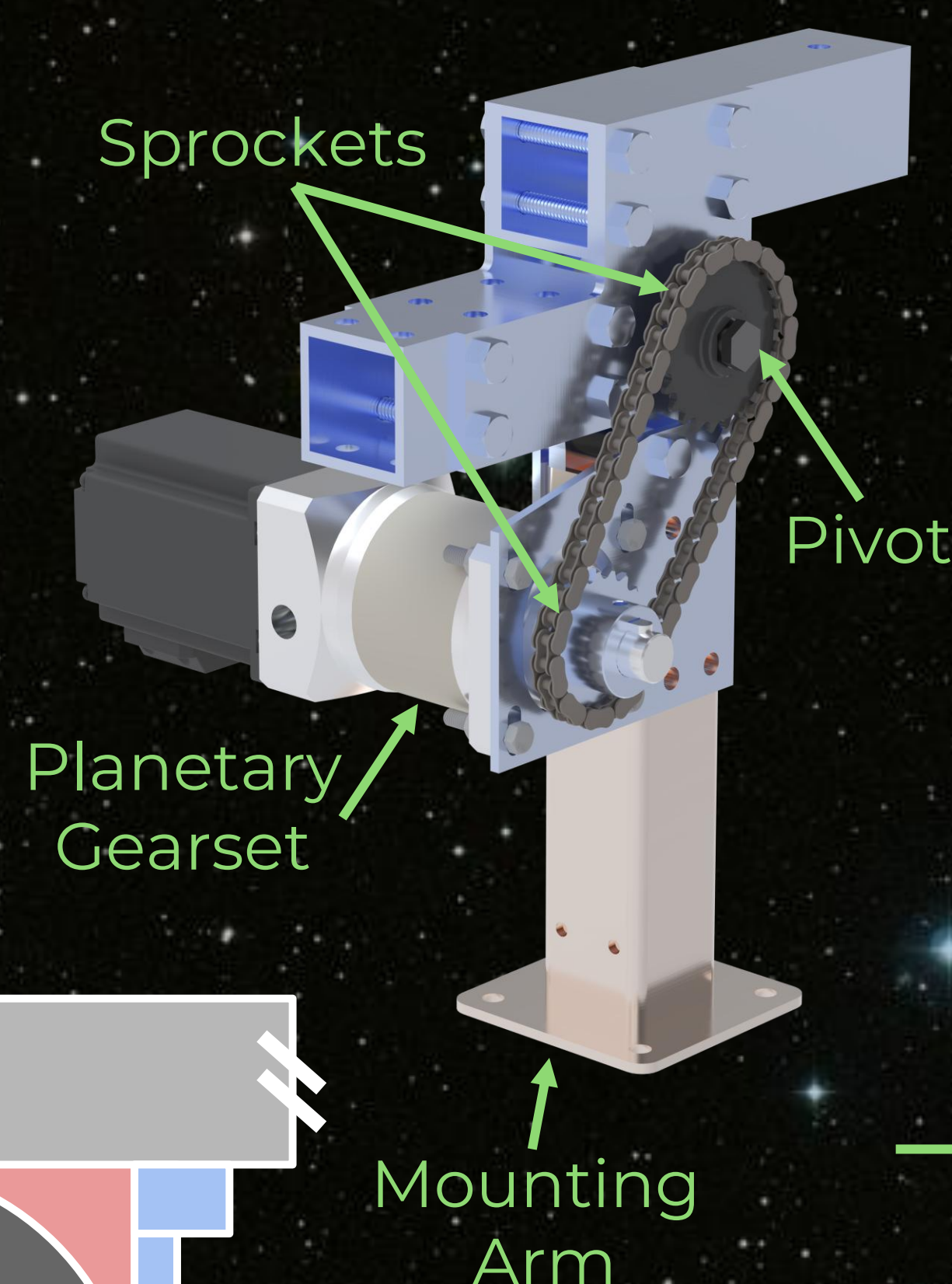
Software

Fluid System

- 0.5" OD, 3" bend radius
- Turbulent Flow with water
- External unconstrained flexible tubing
- Flexible tubing design allows for flow across both joints

Deployment

- 50:1 Planetary gearset supplying 25 ft·lb of torque
- Joint pivots 0° to 90°



Stepper Motors

Hard Stop

- Recalibration aid

Satellite Interface Plate

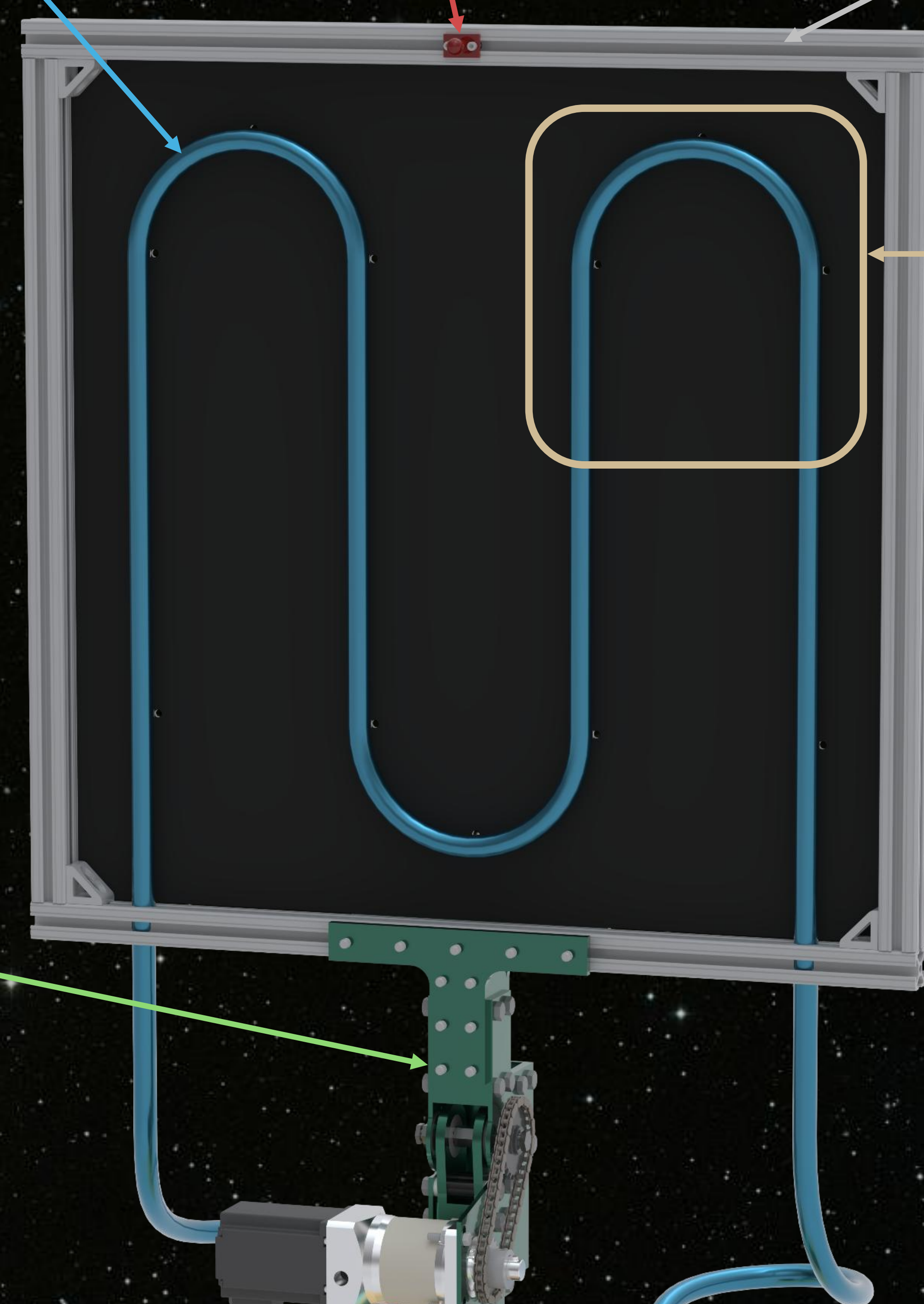
- Pillow block for gear shaft alignment
- Fluid and electrical passes through to satellite

Push Lock

- Secures panel when restowed

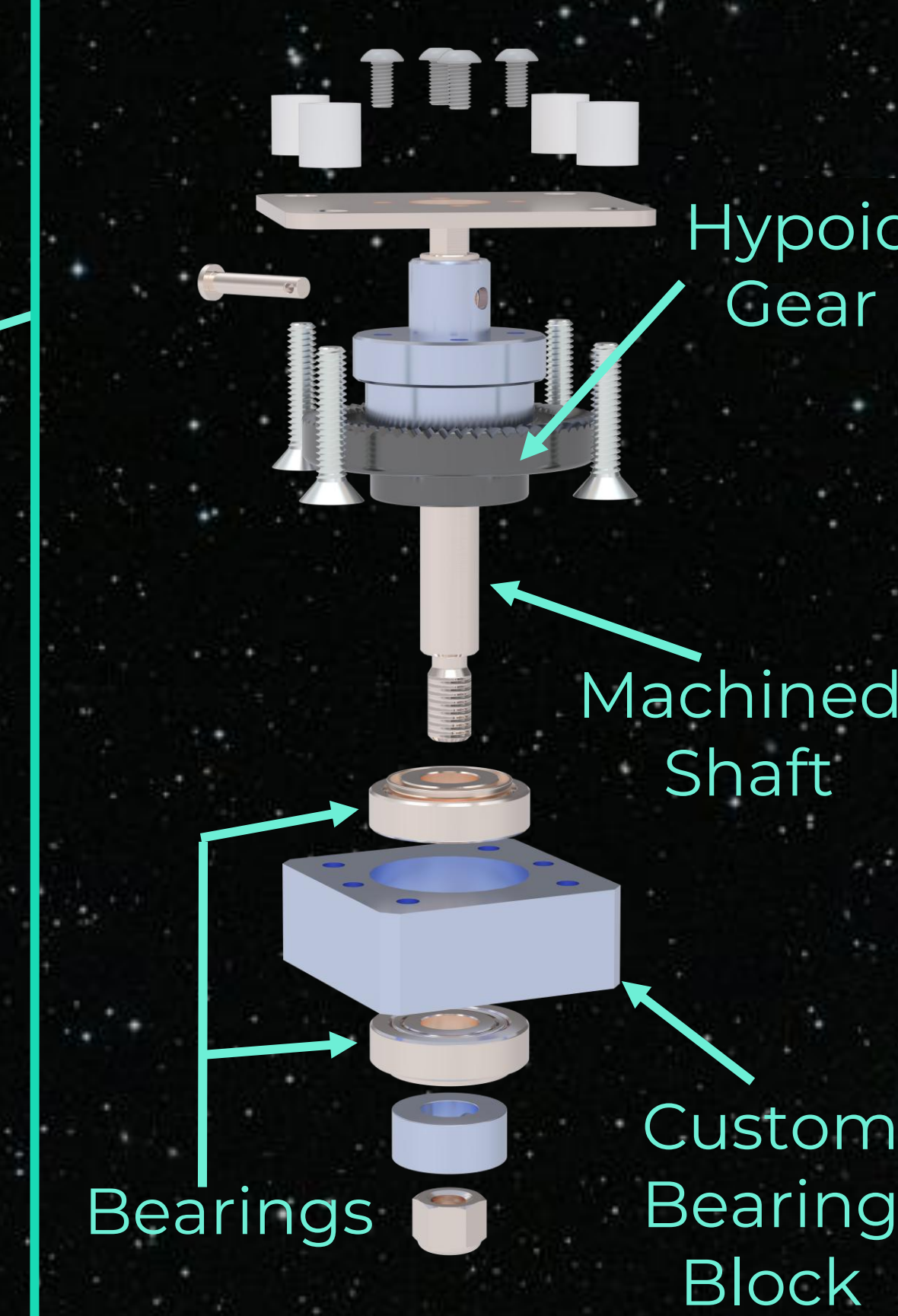
Downscaled Panel

- 24" x 24"
- 7% of flight panel



Rotation

- Angular contact bearings for stability
- Precision machined shaft for alignment
- 60:1 hypoid gear train for high torque
- Joint rotates while allowing fluid flow



Electronics

High-Voltage Motor Controllers

High-Current Power Input

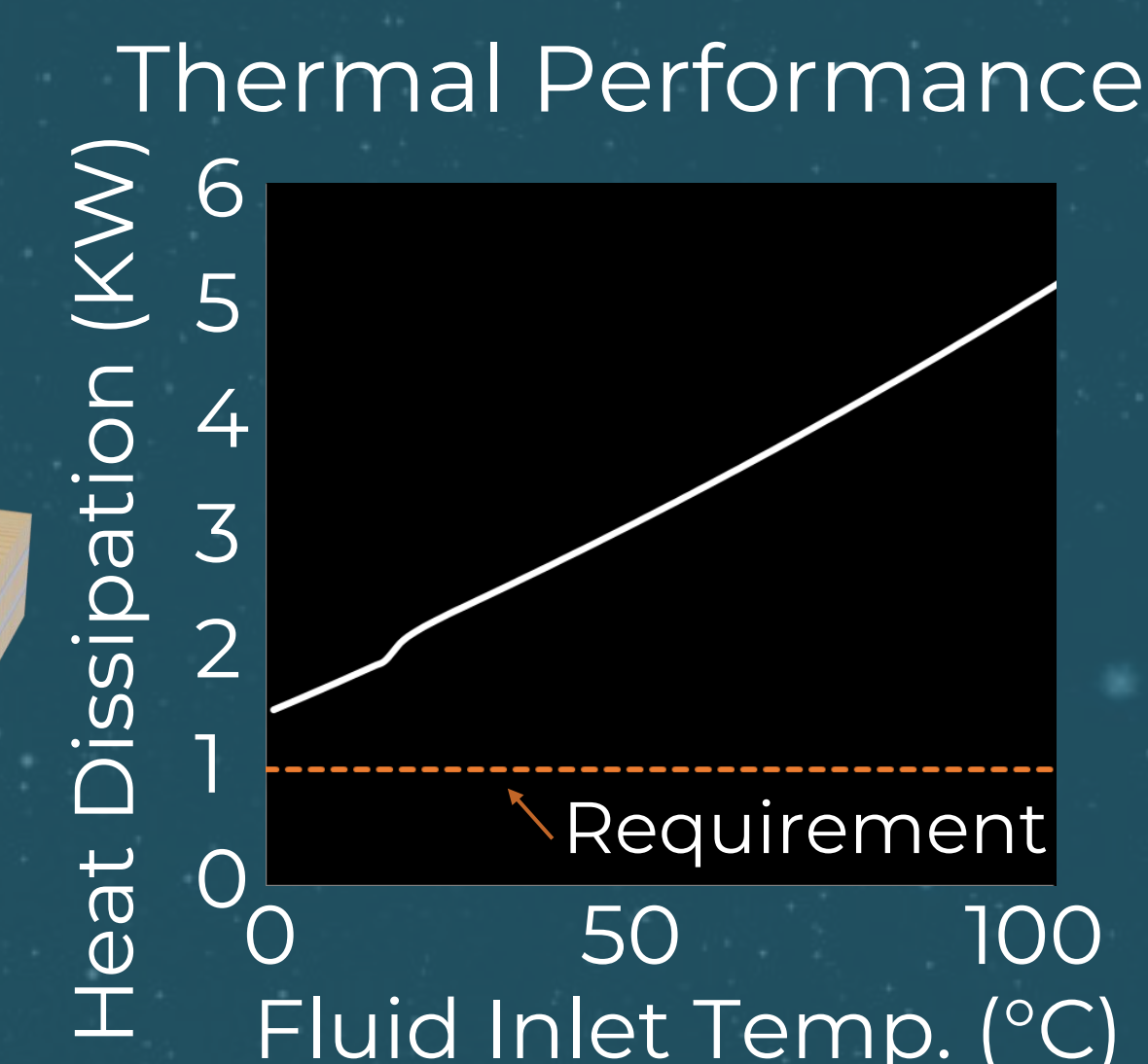
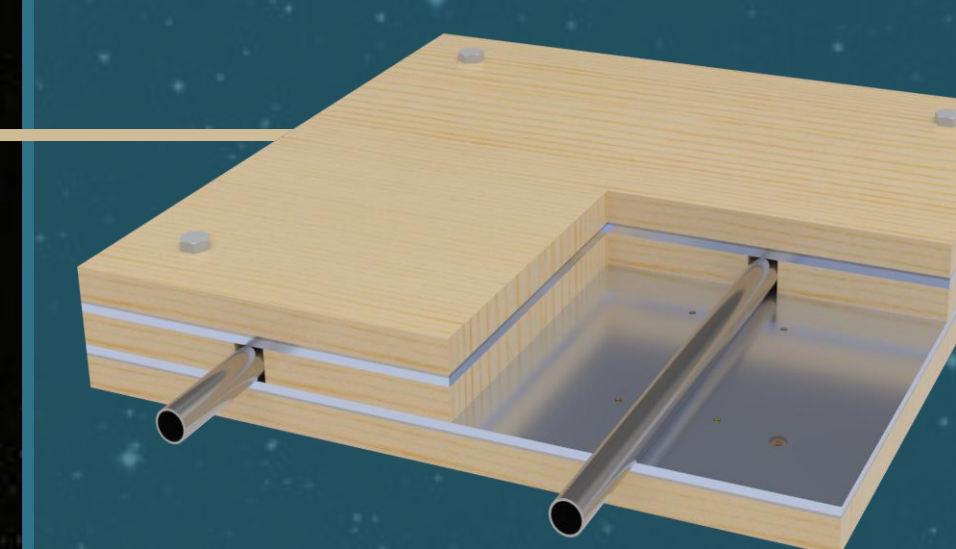
Microcontroller

Motor Encoder Inputs

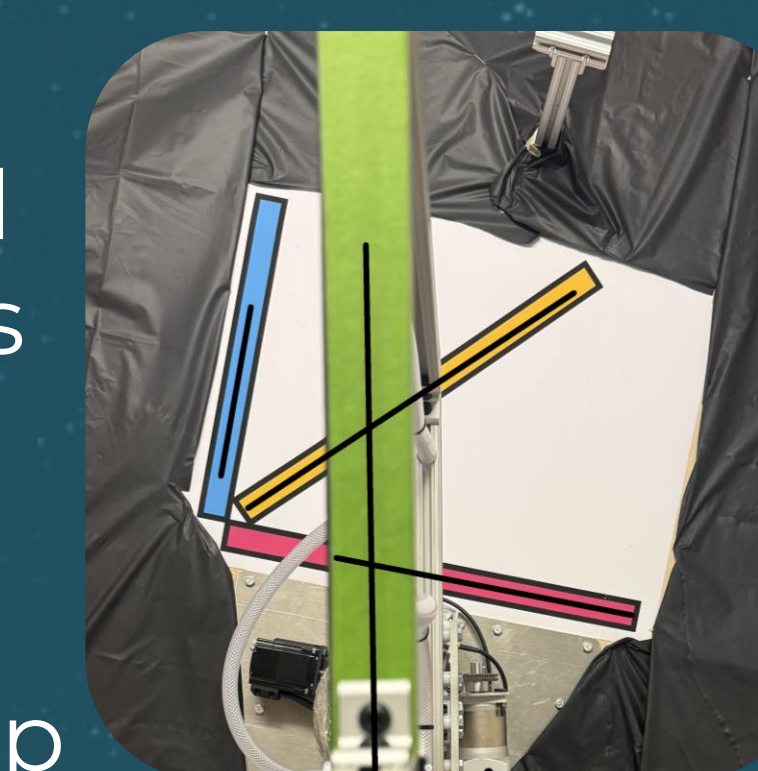
Custom PCB

Hard Stop Inputs

Testing Thermal

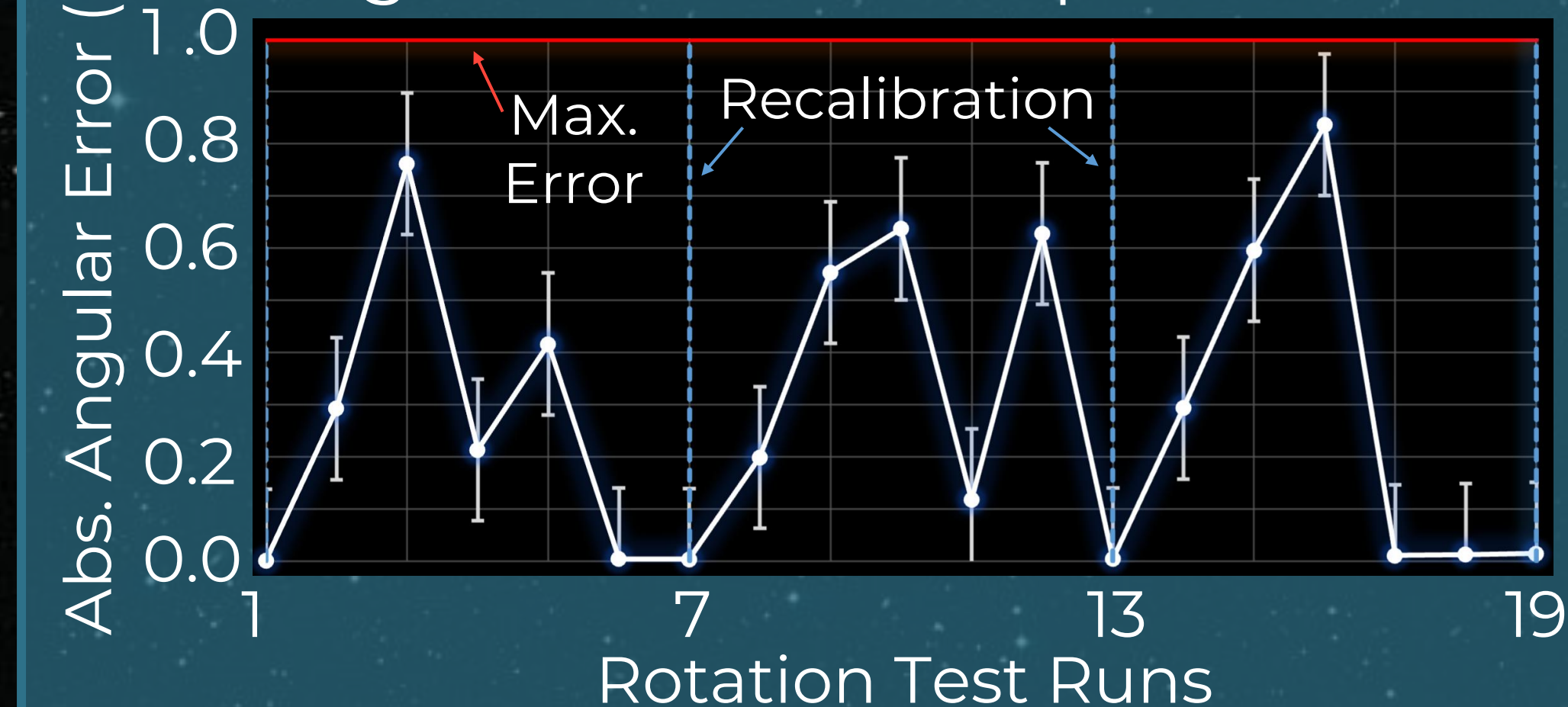


- Steady-state thermal resistance test to validate 1D model
- Panel section constructed from conductive materials



Mechanical

Angular Error Stack Up



- Maximum observed rotation accuracy is 0.8° after 5 rotations. Recalibration resets angular error to $\leq 0.1^\circ$

Future Improvements

- Testing with more precise sensors
- Building full scale panel
- Expanding space-ready model