# KRAKEN


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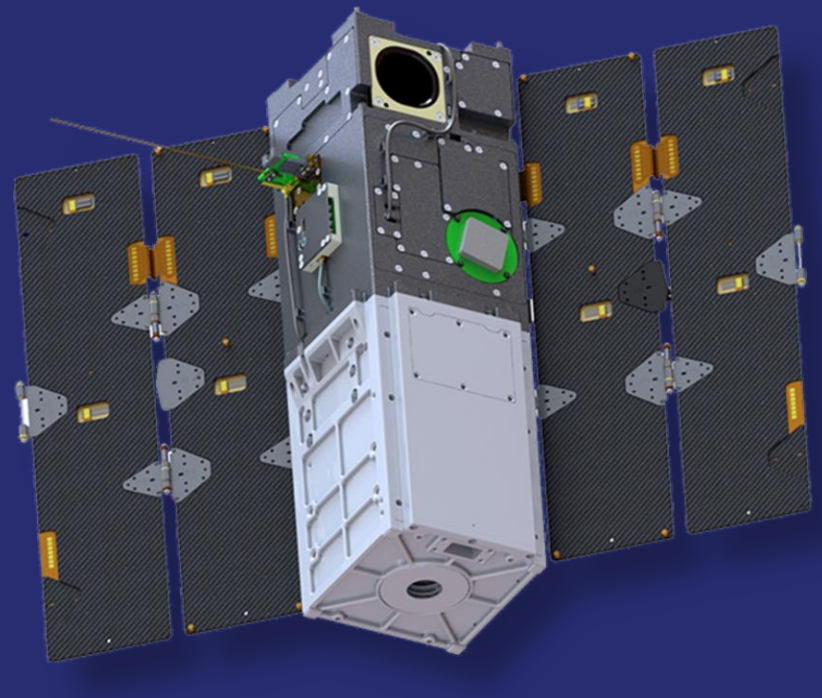
# INADEQUATE THERMAL CONTROL SYSTEMS RESULT IN A LACK OF PRECISION FOR SATELLITE-BASED EXPERIMENTS.



Our goal is to enable precise data collection over the duration of a CubeSat’s lifespan.

# REQUIREMENTS

- Maintain temperature of 4 K for the magnetometer

- Fit within a 1.5U chassis

- Power consumption below 28 W

- Measure temperature inside the apparatus and adjust accordingly

- Last the duration of the satellite’s lifespan

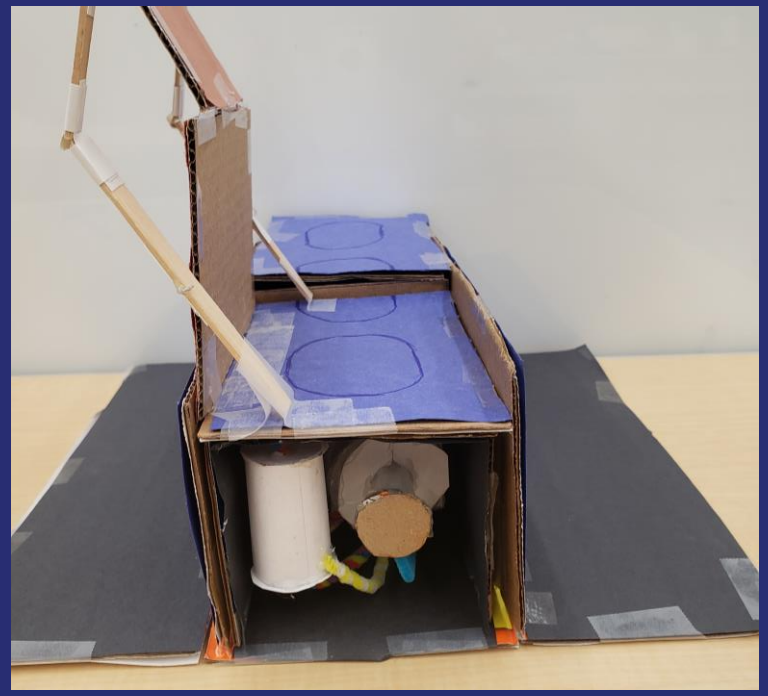
# POSSIBLE SOLUTIONS

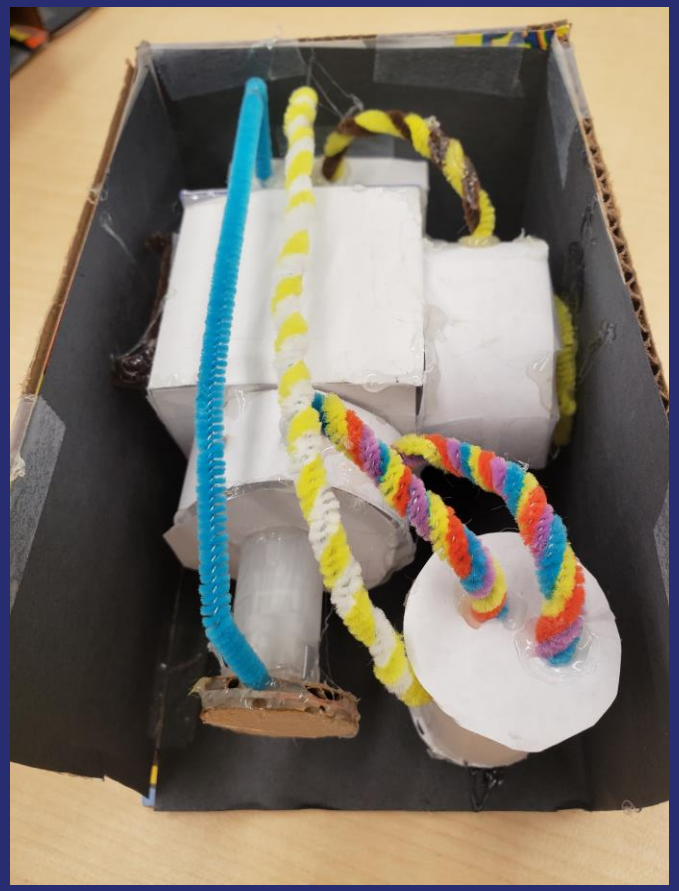
Active Cooling System

Helium Reservoir

Blackbody Radiators

# OUR SOLUTION



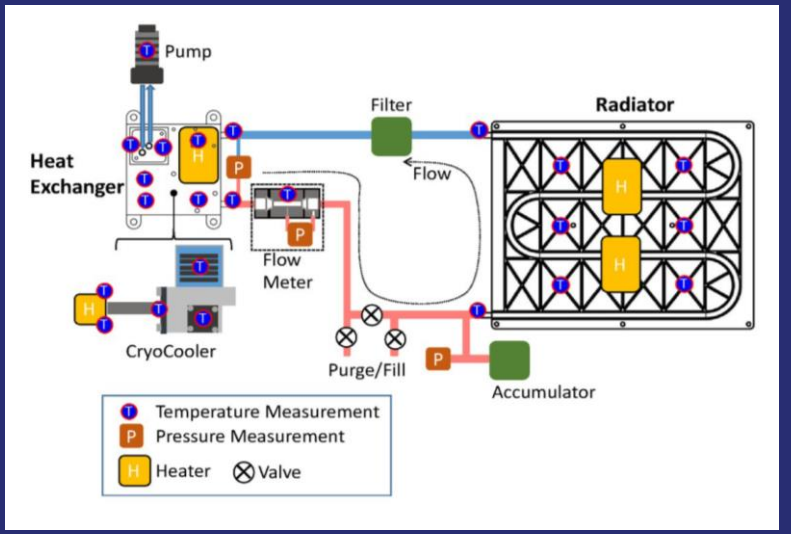


# OUR SOLUTION – PASSIVE COOLING

- Solar Shield
  - limits absorbance of solar energy
- Blackbody Radiator
  - solves issue of zero exchange medium
  - transforms heat energy into infrared waves
- Gets to 150 K

# ACTIVE COOLING – CRYOGENIC COOLER

- Actively move heat from the magnetometer to the radiator
- 8 W of cooling power is required
- Thermally isolated from the chassis
- Helium is used as the refrigerant




# ACTIVE COOLING – TEMPERATURE REGULATION

```
Temperature: 252.15 K
Temperature: 247.97 K
Temperature: 250.08 K
Temperature: 248.10 K
Temperature: 250.29 K
Temperature: 249.79 K
Temperature: 251.55 K
Temperature: 248.93 K
Temperature: 251.35 K
Temperature: 248.28 K
Temperature: 252.57 K
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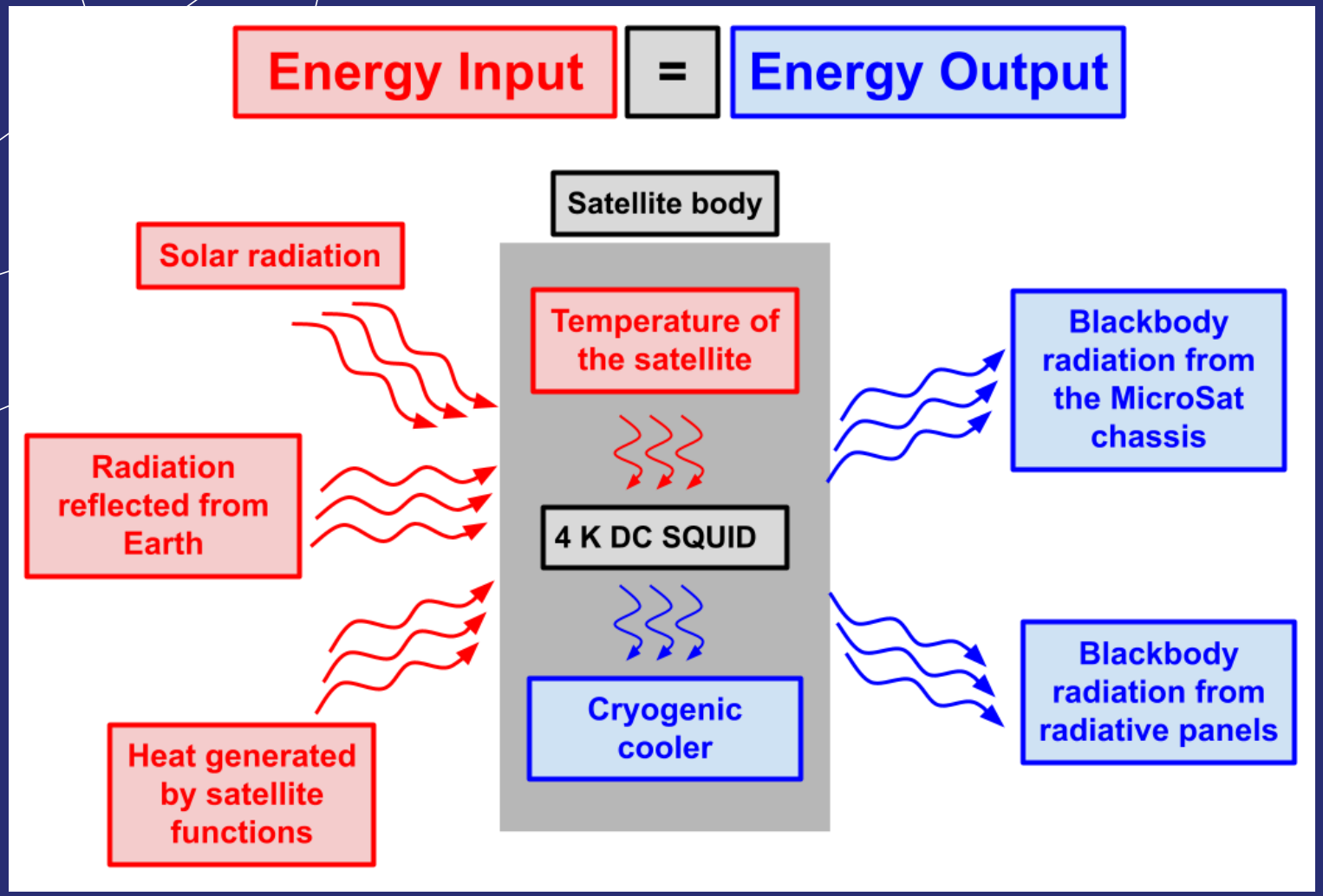
- Always needs to cool, but at different rates
- PWM input to create constant temperature
- Prototyped system demonstrates temperature regulation

# PROOF OF CONCEPT




- Surface of CubeSat can range from 285 K (12°C) to 292 K (19°C) during orbit
- Cryocooler will consume 7-8 W of power

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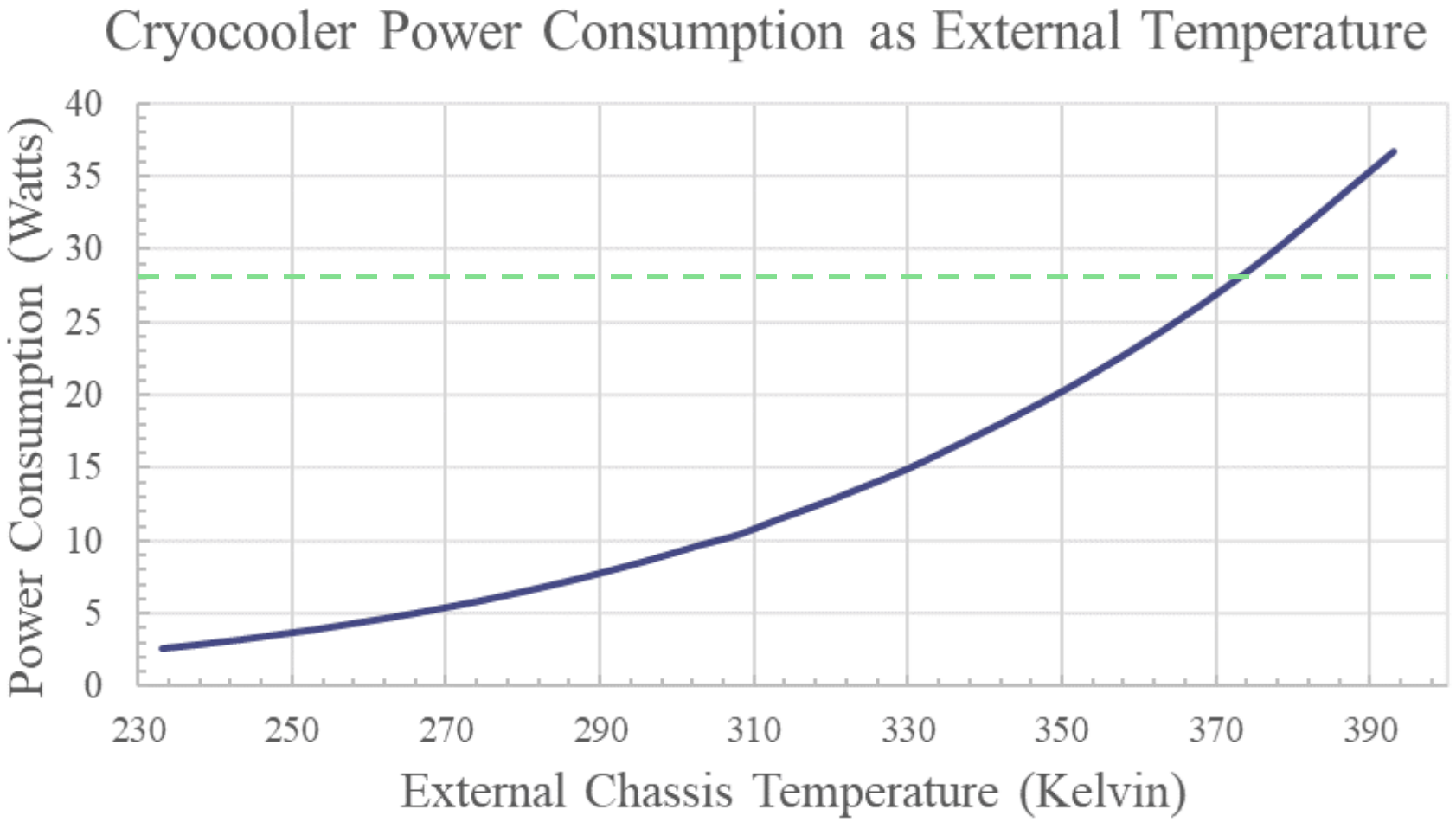

# COMPETITIVE EDGE

**Unique Product**

- Only product that is constrained to 1.5U that can achieve the desired temperature level

**Cross functional usage**

- Can be used with various superconductor-based devices

**Modularity**

- Can be added to existing CubeSats as a system module to enable cooling to 4K

**Growing Industry**

- Half of operational satellites are common model CubeSats
- Increasing demand for higher precision data

# GOING FORWARD

- Determine if a multistage cryocooler system would work more efficiently within space constraints
- Swarm of CubeSats
- Determine most optimal material for Blackbody radiation

# CITATIONS


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Storyblocks

# Questions?

# TABLES

| | Light Side of Earth | Dark Side of Earth |
|---|---|---|
| **Heat Absorption from Sun** | 2.1 W | 0 W |
| **Heat Absorption from Earth** | 0.5 W | 0 W |
| **Heat from Satellite Functions** | 30 W | 30 W |
| **Total Heat** | 32.6 W | 30 W |
| **External Chassis Temperature** | 292.4 K (19.2 °C) | 285.1 K (11.9 °C) |
| **Heat Transfer to SQUID** | 0.010 W | 0.0094 W |
| **Heat Transfer to Radiator** | 10.61 W | 9.71 W |
| **Power to run Cryocooler** | 7.9 W | 7.2 W |
| **Total Heat Transfer to Radiator** | 18.5 W | 16.9 W |
| **Temperature of Radiator** | 262.2 K (-11.0 °C) | 255.2 K (-18.0 °C) |