KRAKEN

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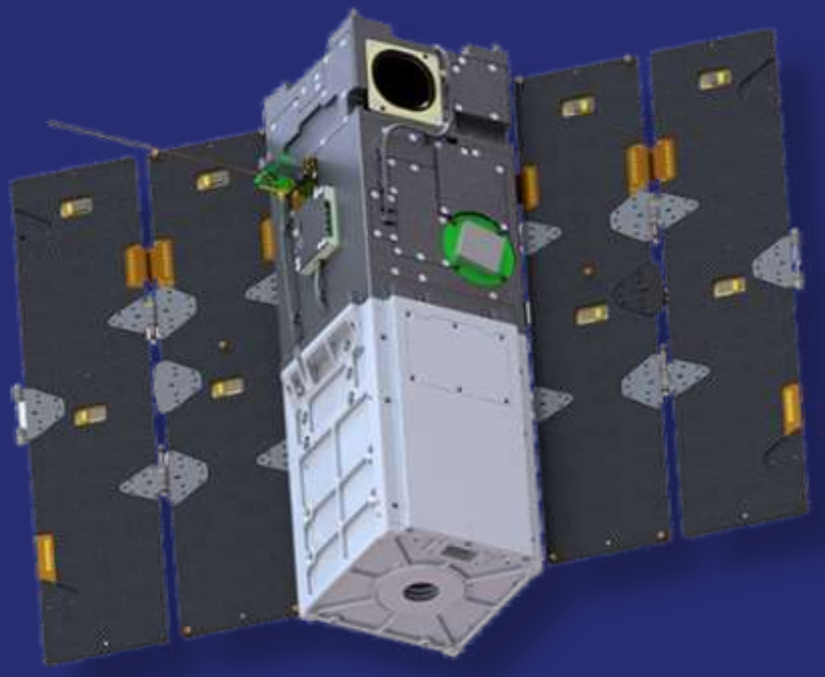
INADEQUATE THERMAL CONTROL SYSTEMS RESULT IN A LACK OF PRECISION FOR SATELLITE-BASED EXPERIMENTS.



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

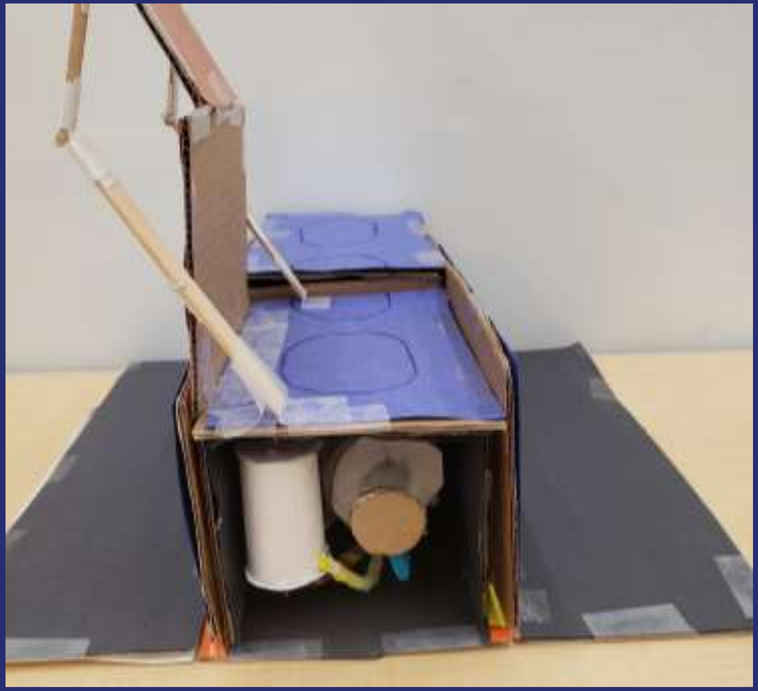
POSSIBLE SOLUTIONS

Active Cooling System

Helium Reservoir

Blackbody Radiators

OUR SOLUTION



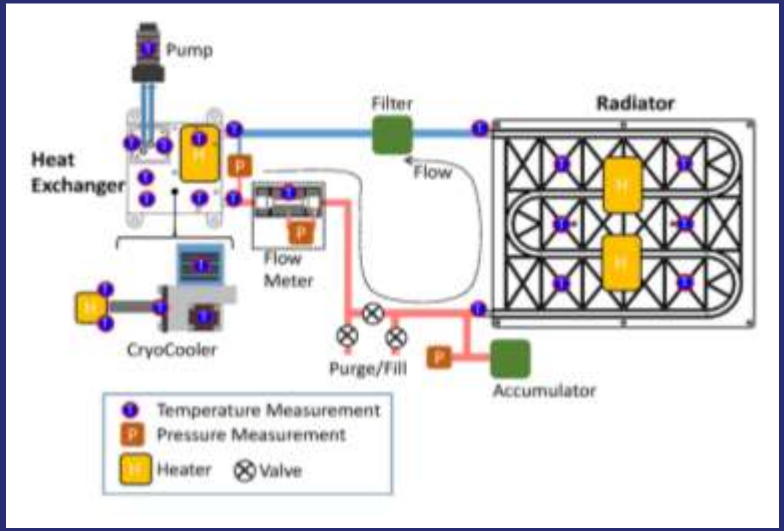
OUR SOLUTION – PASSIVE COOLING

- 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

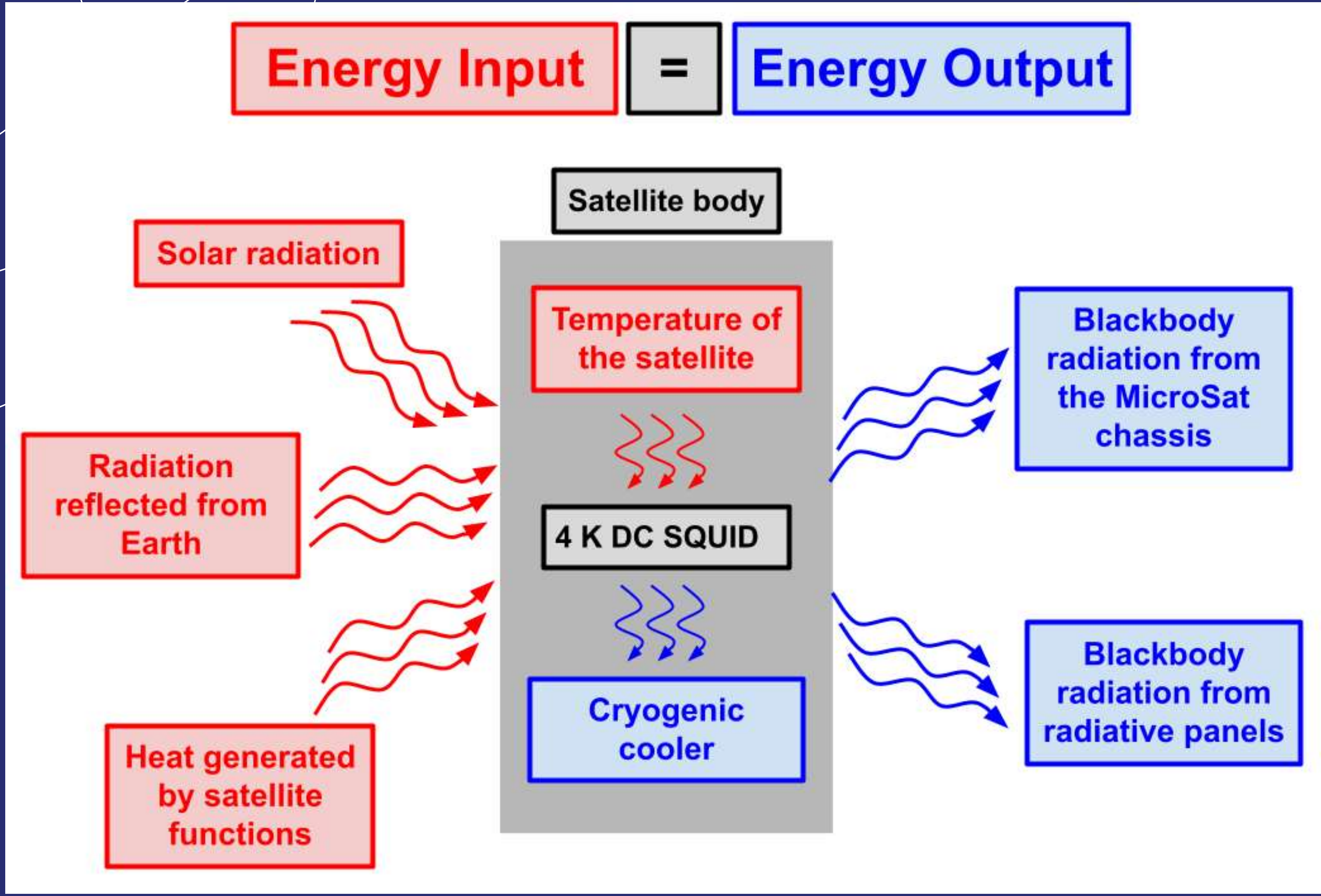
- Actively move heat from the magnetometer to the radiator
- 8 W of cooling power is required
- Thermally isolated from the chassis
- Helium is used as the refrigerant



ACTIVE COOLING – TEMPERATURE REGULATION

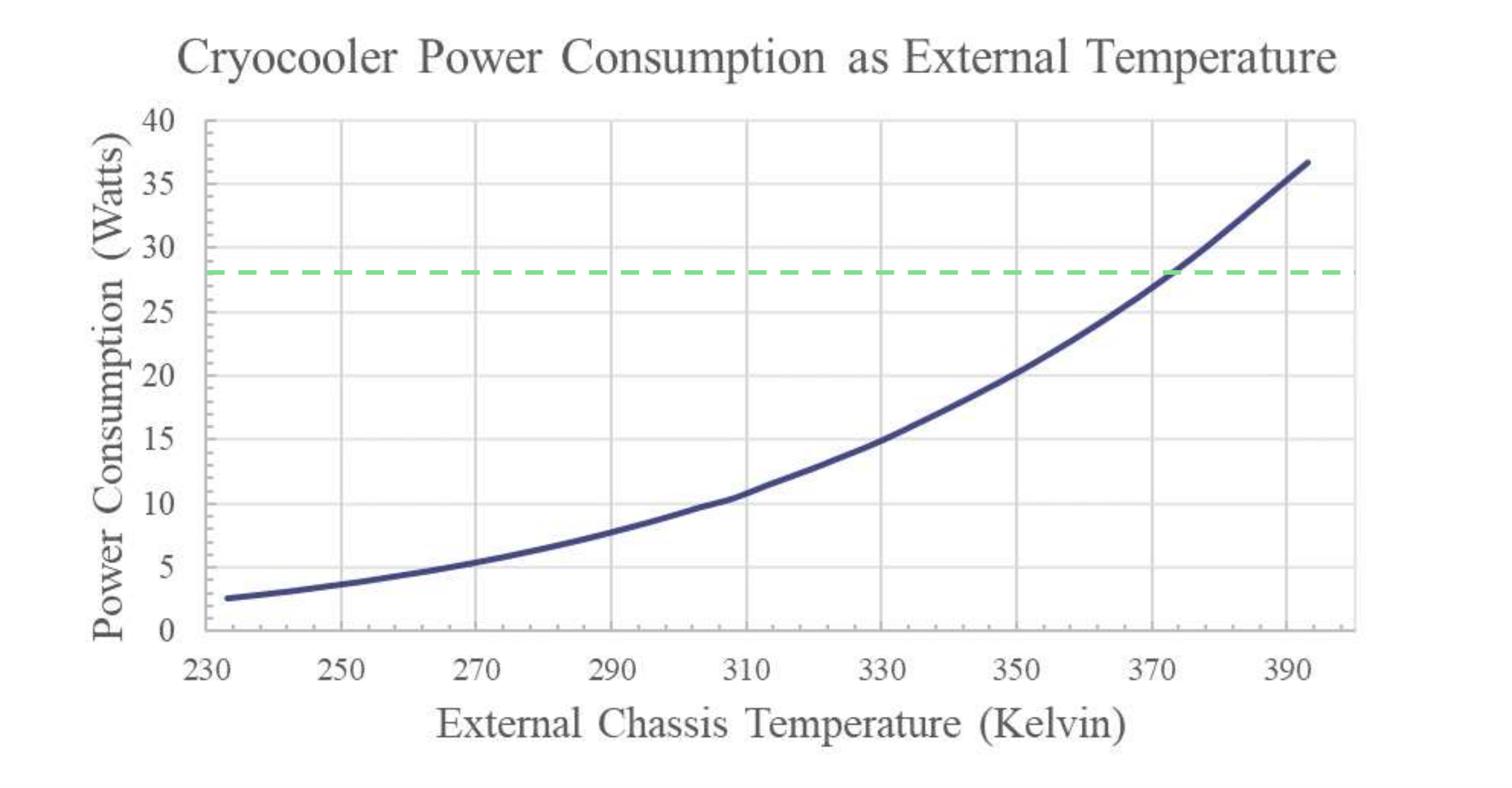
- Always needs to cool, but at different rates
- PWM input to create constant temperature
- Prototyped system demonstrates temperature regulation

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

PROOF OF CONCEPT



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)