Ultra Low Power Cryo-Refrigerator for Space

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Overview

On this program, Creare will develop and demonstrate an innovative cryocooler that produces refrigeration at temperatures of 30 to 70 K and rejects heat at a temperature of 150 to 210 K with extremely high efficiency. The heat rejected can be absorbed by an upper stage cryocooler or rejected to space through a small cryo-radiator.

The demonstration system will include a combination of new and existing components. The Phase II testing will be structured to achieve a TRL of at least 5, and will include cryogenic performance testing and launch vibration testing. The cryocooler would be space-qualified during a follow-on Phase III project.

System Specifications

- Net refrigeration: 300 mW at 35K
- CCE Input power: 20 W at 28 VDC
- Cryo-compressor AC Input power 8.9W
- Efficiency: 11% of Carnot
- Total mass: 6.2 kg
  - TMU: 2.8 kg
  - CCE: 1.4 kg
  - Cryo-Radiator: 1.0 kg
  - Misc: 1.0 kg
- Radiation tolerance
  - 300 kRad at parts level
  - 0.125 in. aluminum shell
- Radiator area: 0.8 m^2

Acknowledgement

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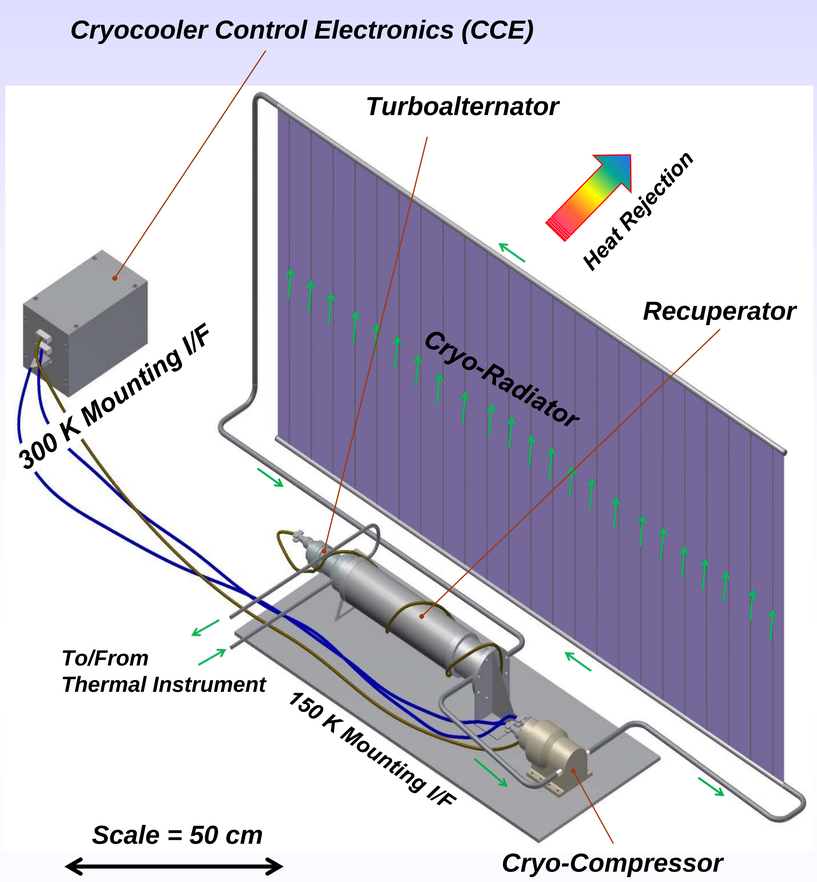
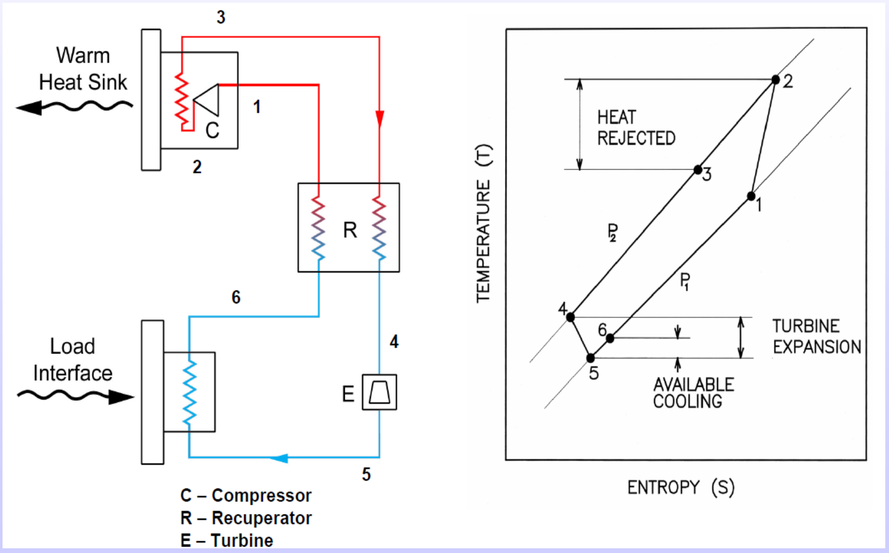
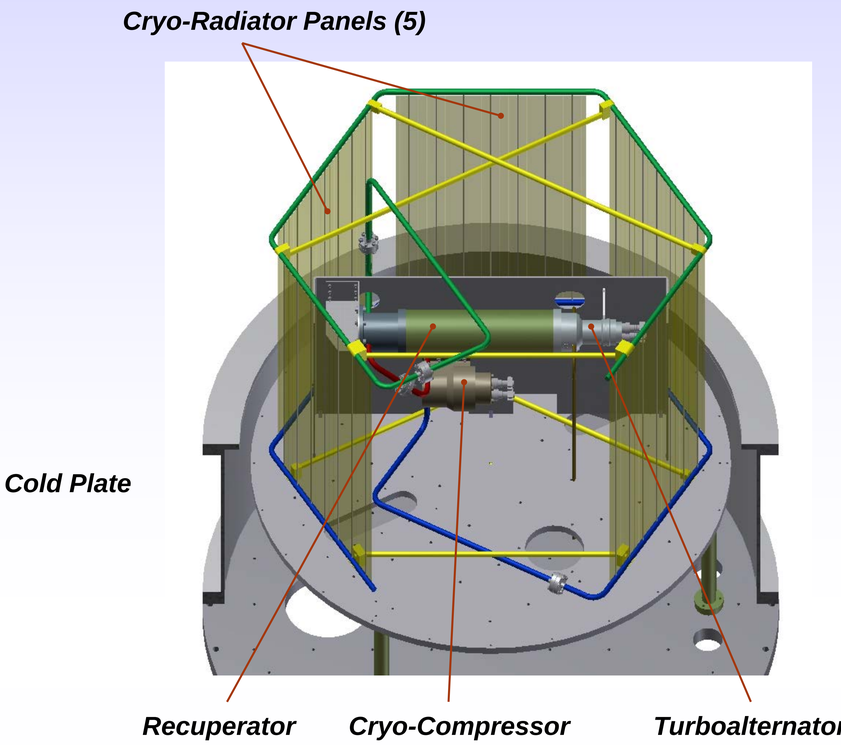
Conceptual System Layout

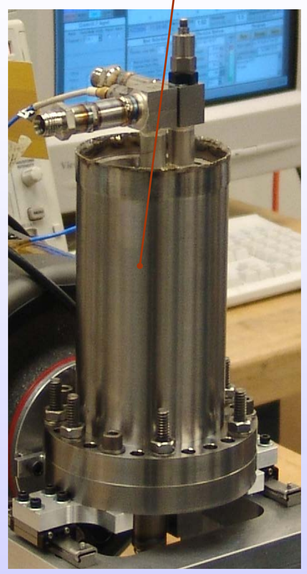


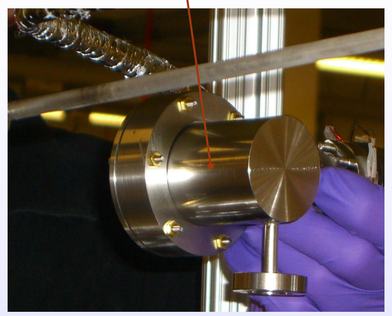
Single Stage Reverse Brayton Thermodynamic Cycle

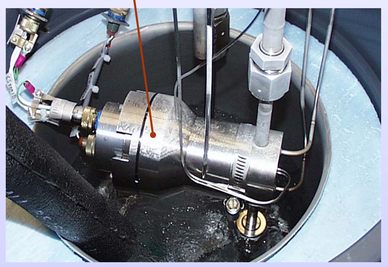


Demonstration System









Potential NASA Applications

Future satellites, probes and astronomical observatories utilizing superconducting bolometers, and infrared, far infrared, submillimeter and X-ray detectors.