

Lightweight Magnetic Cooler With a Reversible Circulator Contract No. NNX08CA24C

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Identification and Significance of Innovation

- A lightweight, reliable, efficient Active Magnetic Regenerative Refrigeration (AMRR) system for space applications
 - Remote distributed cooling
 - Low cooling temperatures in the range of 2 K
 - Heat sink temperatures higher than 15 K
 - High cooling capacity: 70 mW
 - High efficiency
 - Light weight
 - Simple integration with spacecraft thermal management system
- An innovative long-life, vibration-free, circulator enables the efficient operation of the AMRR
 - Circulate gas bi-directionally
 - Operate at cryogenic temperatures

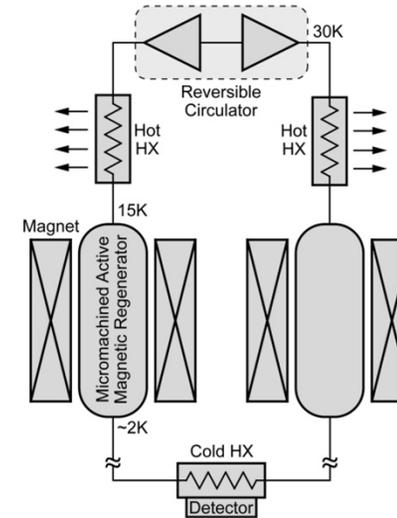
Expected TRL Range at the end of Contract (1-9): 4

Technical Objectives

- Obtain performance data for the gas bearings
- Demonstrate flow rate, pressure rise, and efficiency of the circulator
- Finalize the AMRR system design with the Phase II circulator

Phase II Accomplishments

- Demonstrated the operation of a circulator module at very high speeds under the challenging conditions of 80 K and 0.2 bar
 - The low operating pressure is the key to enabling the AMRR to achieve a low cooling temperature of about 2 K
- Demonstrated head-flow performance required for an AMRR system
- Demonstrated efficient operation of the circulator module
- Updated AMRR system design
 - Predicted COP is about 36% of a Carnot cycle



System Schematic of an AMRR With a Reversible Circulator. The circulator switches the flow direction that cycles in concert with the magnetic fields.

NASA Applications

- Cooling systems for infrared, X-ray, and gamma ray detectors
- International X-Ray Observatory (IXO) and the Single Aperture Far-Infrared Observatory (SAFIR)

Non-NASA Applications

- Cooling system on military space-based surveillance and missile detection systems
- Cooling systems for material microanalysis and cryogenic particle detectors
- Reversible circulator has many stand-alone cryogenic applications

Firm Contact

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NON-PROPRIETARY DATA