BRIEFING CHART

NASA SBIR/STTR Technologies

Micromachined Active Magnetic Regenerator for Low Temperature Magnetic Coolers

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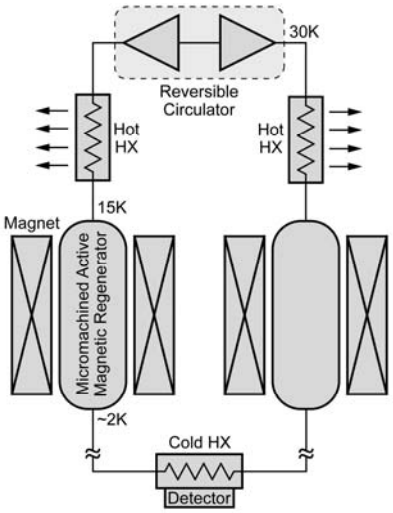
Identification and Significance of Innovation

- A lightweight, reliable, efficient Active Magnetic Regenerative Refrigeration (AMRR) system for space applications.
  - Cooling temperatures in the range of 2 K
  - Heat sink temperatures higher than 15 K
  - Vibration-free and long-life operation
  - Much higher efficiency than current mechanical coolers
  - Ability to provide remote/distributed cooling
  - Much simpler and lighter than a multistage ADR
- Propose to develop an innovative Micromachined Active Magnetic Regenerator (MAMR).
  - Enable efficient operation of the AMRR
  - Increase AMRR heat sink temperature

Expected TRL Range at the end of Phase II Contract: 4–5



System Schematic of an AMRR

- A reversible cryogenic circulator module was successfully developed under a prior NASA SBIR project.
- Here we propose to design and build the highly effective MAMR.
- In Phase III we will demonstrate the operation of an AMRR.

Phase I Results

- Practical microfabrication approaches for high-aspect-ratio microchannels in the MAMR.
- Thermal and fluid analysis showing the high performance of heat transfer surfaces in MAMR.
- An optimum MAMR design that enables an AMRR to achieve maximum efficiency.

Phase II Work Plan

- Finalize microfabrication technologies to further increase machining speed and improve microchannel aspect-ratio.
- Separate effects tests to evaluate the designs of key features in the MAMR.
- Fabricate full-size MAMR.
- Characterize thermal and fluid performance at prototypical cryogenic conditions.

NASA Applications

- Cooling systems for cryogenic detectors for sensing X-ray, infrared, and sub-millimeter radiation (bolometers and microcalorimeters).
- International X-ray Observatory (IXO) and Single Aperture Far-Infrared Observatory (SAFIR).

Non-NASA Applications

- Cooling systems for:
  - Material microanalysis
  - Cryogenic particle detectors
  - Biomolecule mass spectrometry
- Coolers for hydrogen liquefaction.

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