Chloe Gunderson

Masters of Science
Mechanical Engineering
Room 1337 ERB

Email: cmgunderson@wisc.edu
Hometown: St. Paul, MN

A ^{3}HE/^{4}HE REFRIGERATION SYSTEM FOR CONTINUOUS SUB-KELVIN COOLING OF SPACE SCIENCE INSTRUMENTATION

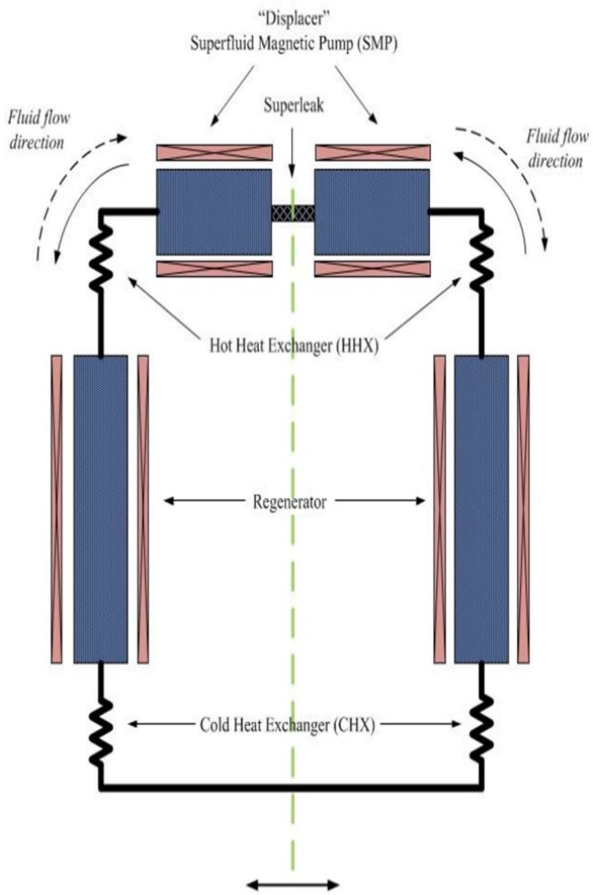
Motivation

A variety of space science instrumentation require cryogenic operating temperatures. Consistent and reliable cooling of these instruments is critical in order to ensure top performance.

Current solutions do not cool continuously due to necessary periodic recycling leading to interrupted operation. An additional weakness is the high weight associated with the substantial amount of magnetic shielding required to protect the detector.

The development of a refrigeration system that could provide continuous sub-Kelvin cooling and/or reduce the amount of magnetic shielding needed would be a significant advancement over current technologies. Such improvements would enable NASA to provide continuous and efficient sub-Kelvin cooling for uninterrupted operation of cutting edge detectors both in space and on the ground.

Background



Tandem AMRR: Two refrigerators operating 180° out of phase of each other

The development of an Active Magnetic Regenerative Refrigerator (AMRR) could address low-temperature refrigeration weaknesses. A $^{3}He/^{4}He$ mixture is circulated through the system to provide continuous cooling.

As shown, an AMRR is composed of a displacer, hot heat exchangers, regenerators, and cold heat exchangers. The regenerators and displacer contain canisters of GGG (a paramagnetic material) surrounded by superconducting magnets. Magnetization and demagnetization results in flow and temperature changes in the system.

A Superfluid Magnetic Pump (SMP) has already been developed and tested in the SEL.

Jahromi, A. (2015). *Development of a Proof of Concept Low Temperature Superfluid Magnetic Pump with Applications* (Doctoral dissertation). University of Wisconsin, Madison.

Objectives

1) Develop an AMRR model to properly size remaining components (i.e. regenerator)

2) Machine remaining components and finish AMRR assembly

3) Test AMRR and analyze experimental results