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Thesis: *Modeling, Design, and Development of a non moving part sub Kelvin† Active Magnetic Regenerative Refrigerator (AMRR) for space science applications*

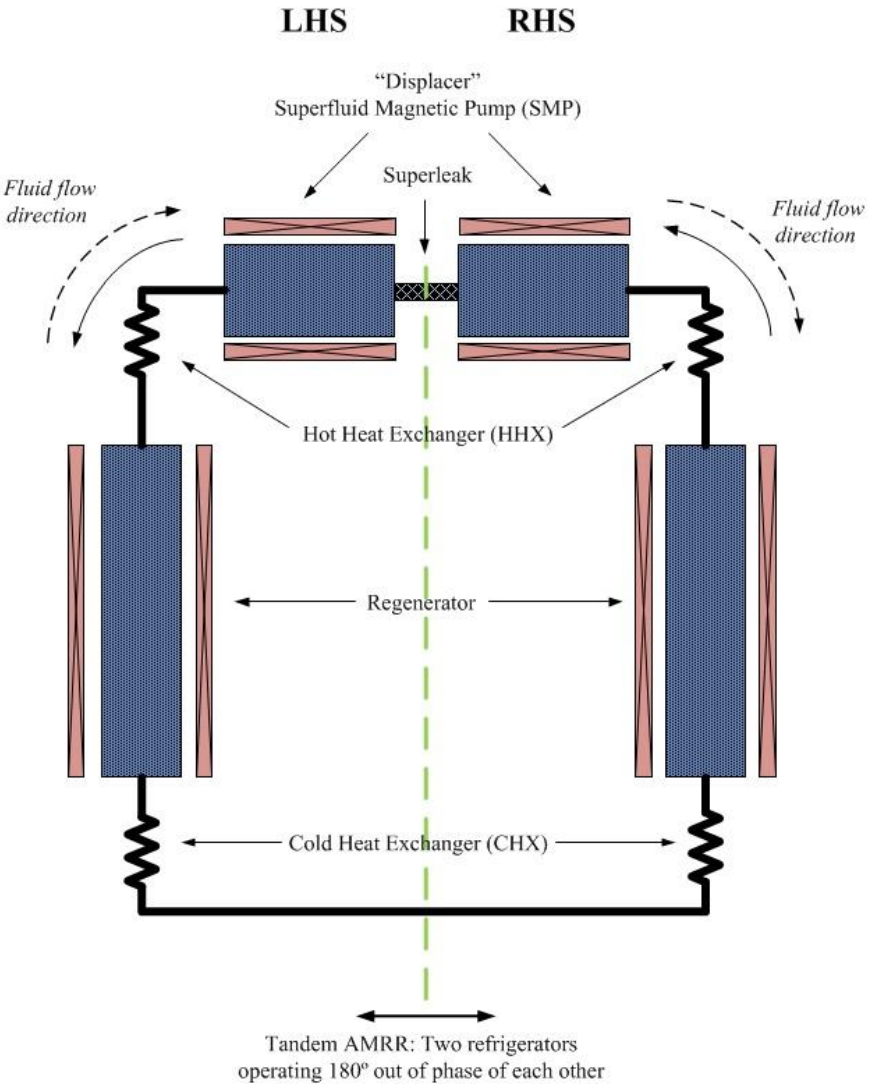
† Below 1 Kelvin

Motivation

- Sub Kelvin refrigeration systems are a key device in current and future x-ray and astrophysics missions.
- The objective of x-ray astrophysics missions are to explore the origin and structure of the universe.
- Space explorations are enabled by low temperature space detectors such as Transition Edge Sensor (TES) or micro-calorimeters.
- The lower the temperature of these detectors, the higher the sensitivity.
- Less moving parts in space science sub Kelvin coolers mean higher reliability.
- Space sub Kelvin coolers need to operate continuously.
- The newly proposed AMRR runs continuously and utilizes a novel non-moving part Superfluid Magnetic Pump (SMP) to move the thermodynamically active participant, He^3 , in a He^3-He^4 mixture.

Project: AMRR

- The AMRR consist of three heat exchangers (2 precooler/heater, and 1 cooler), 2 SMP, 2 regenerators, and a vycor glass superleak.
- The entire system has been experimentally verified in the past with bellows compressors instead of the SMP.



Objectives

- The SMP will be experimentally verified against results from the numerical model.
- Modeling is carried out in order to predict the performance of the AMRR.
- Parts of the AMRR will be fabricated and assembled to experimentally verify the performance of the entire system.
- The 1 K facility will be used as the heat sink for the entire refrigeration system.
- Experimental deviation from the theoretical results will be analyzed.