Design and development of the Astro-H 3-stage ADR

Peter J Shirron[1], Mark O Kimball[1], Bryan James[1], Donald Wegel[1], Michael J DiPirro[1], Raul Martinez[2], Dick Faulkner[2], Marcelino Sansebastian[2], Evan Kunes[3]

[1]*Cryogenics and Fluids Group, NASA/Goddard Space Flight Center, Code 552, Greenbelt, MD 20771 U.S.A.*

[2]*SGT, Inc., 7701 Greenbelt Road, Suite 400, Greenbelt, Maryland 20770*

[3]*ADNET Systems, Inc., 164 Rollins Avenue Suite 303, Rockville, MD 20852*

The Japanese Astro-H mission will include the Soft X-ray Spectrometer (SXS) instrument provided by NASA/GSFC. The SXS will perform imaging spectroscopy in the soft x-ray band using a 6x6 array of silicon microcalorimeters operated at 50 mK. The detectors will be cooled by a 3-stage adiabatic demagnetization refrigerator (ADR). The configuration allows the ADR to operate with both a 1.3 K superfluid helium bath and a 4.5 K cryocooler as its heat sink. Initially, when liquid helium is present, the two coldest stages of the ADR will operate in a single-shot mode to cool the detectors from 1.3 K. The 3rd stage may be used to transfer heat from the liquid to the cryocooler to extend its lifetime. When the liquid is depleted, the two warmest stages will operate in a continuous mode to establish a 1.3 K base temperature, from which the cold stage will operate in a single-shot mode to cool the detectors. This paper will describe the design and operating modes of the ADR, as well as details of individual components.