

5-Stage ADR Cooler for the Athena Space Mission: Design and Preliminary Characterization

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Athena is a L-class mission from the European Space Agency (ESA) dedicated to the study of the hot and energetic universe. One of its instruments, the X-ray Integral Field Unit (X-IFU), needs temperatures as low as 50 mK for its detectors to reach the required sensitivity. In its newly proposed design, X-IFU uses a 50 K cryostat cooled thanks to radiative cooling. Mechanical coolers provide 20 K and 5 K interfaces within this cryostat.

This article focuses on the multistage adiabatic demagnetization refrigerator (ADR) system planned within this cryostat and operating from a 5 K interface down to 50 mK. The proposed design is based on a succession of 5 ADR stages providing cooling interfaces at 1.8 K, 325 mK and 50 mK for the focal plan unit hosting the detector. Preliminary design of the cooler is discussed as well as experimental results on elementary components that provide key design justifications. Finally, we present the next steps on this long-term project.