

Cooling Concept for the X-ray Microcalorimeter Spectrometer on the International X-Ray Observatory

Contracting Office Address

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Description

REQUEST FOR INFORMATION (RFI)

The International X-ray Observatory (IXO) is an astrophysics mission under study by a collaboration of NASA, ESA, and JAXA (ref. 1). The X-ray Microcalorimeter Spectrometer (XMS) instrument on IXO requires cooling of its detectors to 50 mK (ref 2). The purpose of this document is to solicit design concepts for the portion of the cryogenic cooling chain (the Cooling System) that cools the detector from room temperature to a nominal temperature of 5 K, and acts as the heat sink for an Adiabatic Demagnetization Refrigerator (ADR). The project anticipates carrying one or more concepts forward as part of the planning and development of the instrument and observatory concepts. This document should not be construed as a commitment by the Government, nor will the Government pay for the information solicited. This call is open to domestic sources only.

Design Requirements

The Cooling System shall meet all of the following requirements:

- Operate in a closed loop system – no expendable cryogenes
- Provide a nominal cooling capacity of 20 mW at 5 K with a stability of ± 0.1 K
- Provide a heat shield cooling capacity consistent with a Dewar operating at room temperature, and which minimizes the radiation load at the 50 mK stage.
- Meet all performance requirements after 50 full range temperature cycles
- Operate for 5 years continuously on-orbit with a 10 year goal

Mass and reliability requirements have not been specified however reliability and mass will be of primary importance in system trades.

The Cooling System, excluding compressors and electronics, should fit in a Dewar approximately 0.8 m diameter x 0.9 m and allow room for intermediate stage heat shielding, the ADR and the detector assembly. Reference 2 describes the current instrument configuration, including the volume currently allocated for the Cooling System.

The Cooling System must meet requirements in a dewar operating in a standard laboratory environment and in a Dewar operating at 150K , which is the anticipated on orbit operational environment. The capacity of the Cooling System cannot be supplemented by external refrigeration sources.

The technologies in the design concept should currently be at a technology Readiness Level (TRL) of 5 or above. See reference 3 for TRL definitions.

Information Requested

The response to this RFI should be a description of the Cooling System and include:

- Cooling System mass, itemized for components such as the cryocooler, associated compressor(s) and electronics
- Cooler System power consumption during normal operating conditions and any anticipated high power operating scenarios, such as cool down. Itemize for components such as the cryocooler, associated compressor(s) and electronics
- Reliability prediction for 5 years of continuous operations and a 10 year goal, with substantiation.
- Current TRL assessment and rationale; plans to mature to TRL 6.
- Physical dimensions. Itemized for components such as the cryocooler, associated compressor(s) and electronics. Include dimensioned figures.
- Temperature vs. cooling capacity prediction for the range of cold end temperature from 4 to 6 K.
- Temperature stability at cold end during normal operations
- Cost estimate including basis and confidence level

This information will be used for system trades. Any sensitive or proprietary material provided must be clearly marked as such. Information that is not sensitive or proprietary may be provided to international partners.

In order for responses to be evaluated within the project formulation timeframe, responses should be returned less than 6 weeks from the RFI initiation date and not exceed 20 pages. Additional material may be referenced.

Reference Documents

1. [The International X-ray Observatory Activity submission in response to the Astro2010 Program Prioritization Panel RFI](#)
2. [Overview of NASA XMS Reference Design](#)
3. [NASA Research and Technology Program and Project Management Requirements, Appendix J \(NPR 7120.8\)](#)