Thermal Filters for the X-IFU detector on board of ATHENA: concpetual design and ongoing development activitiesArgan

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ATHENA is a next generation X-ray observatory selected by ESA as the second large class mission within its Cosmic Vision program, and aims to pursue the science theme "Hot and Energetic Universe" (launch scheduled in 2028). One of the two instruments which will alternatively operate at the focal plane of the ATHENA large area telescope is the X-ray Integral Field Unit (X-IFU), an array of Transition Edge Sensor (TES) microcalorimeter detectors with high energy resolution (2.5 eV @ 6 keV) in the energy range 0.3÷12 keV.

The array of microcalorimeters operates at temperatures below 100 mK, and thus requires the use of a sophisticated cryostat. To allow the x-ray photons to reach the X-IFU detector at the focal plane, windows have to be opened on the cryostat thermal and structural shields surrounding the cold stage. As a consequence, X-ray transparent thermal filters need to be mounted on these windows to reduce the radiative heat-load from warm surfaces onto the cold detector array.

Such thermal filters are critical items in the operation and full exploitation of the X-IFU. They define the low energy detector response, provide the IR attenuation necessary to minimize radiative heat-load and photon shot noise, attenuate RF EMI on TES sensors and SQUID front-end electronics, and protect the detector from contamination. Thermal filters also significantly reduce the UV/VIS radiation from target sources.

In this paper we review the ongoing development activities driving the conceptual design of the X-IFU thermal filters, including optical modeling, thermal, EMI and mechanical analysis, filter samples procurement, as well as preliminary test results. We will also discuss activity plans for the TRL consolidation and development of the Engineering Model filter set.