

# The Thermal-Structure design issues on a cryostat for a milli-Kelvin TES sensor tests

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## ABSTRACT

The X-IFU instrument, for mission ATHENA, use TES (Transition Edge Sensor) sensors in its focal plane, which require temperatures of tens of milli-Kelvin in operation. Therefore, the focal plane needs an extremely efficient thermal isolation. The complete detector assembly (focal plane, cold electronic, and the close refrigerators for the thermal conditioning in the assembly), perform such thermal isolation, from 2K to milli-K. The very low conductive suspension of the focal plane and the TES detection characteristics does relevant the dynamic behaviour of structure, which is converted in TES temperature, thus in the detection efficiency. Levels of micro-g at low frequencies (< 300Hz), implies variations of temperature of micro-K, enough to disturb the detection.

INTA is designing a cryostat for on ground characterization of the XIFU detector assembly. It should provide enough volume (circa 0.1 m<sup>3</sup>) with thermal interfaces a 2K. The mechanical interface should be compatible with a frequency spectrum bellow of 10<sup>-6</sup> g at frequencies bellow of 300Hz, to warrant temperatures fluctuations below of micro-K. The cryostat isolates and cool down the detector assembly (up to the interface temperature), by means of two intermediate thermal-structural shells cooled by pulse tube refrigerators up to 4K, while a Joule-Thomson refrigerator put the final interface of 2K. As it has been mentioned, all the cryostat structure, as well the thermal hardware, shall isolate the detector assembly from the vibrations induced externally at the cryostat: seismic vibration (coming from earth, close transport or operations on the room), and vibrations transmitted by the pulse tubes refrigerators and vacuum system pumps. We will present the solution propose for thermal isolation: holding systems and thermal anchors that shall be compatible with the dynamic requirements, and give a reasonable cool down time, around a week. Flexible thermal links and thermal switch shall be designed as such effects.