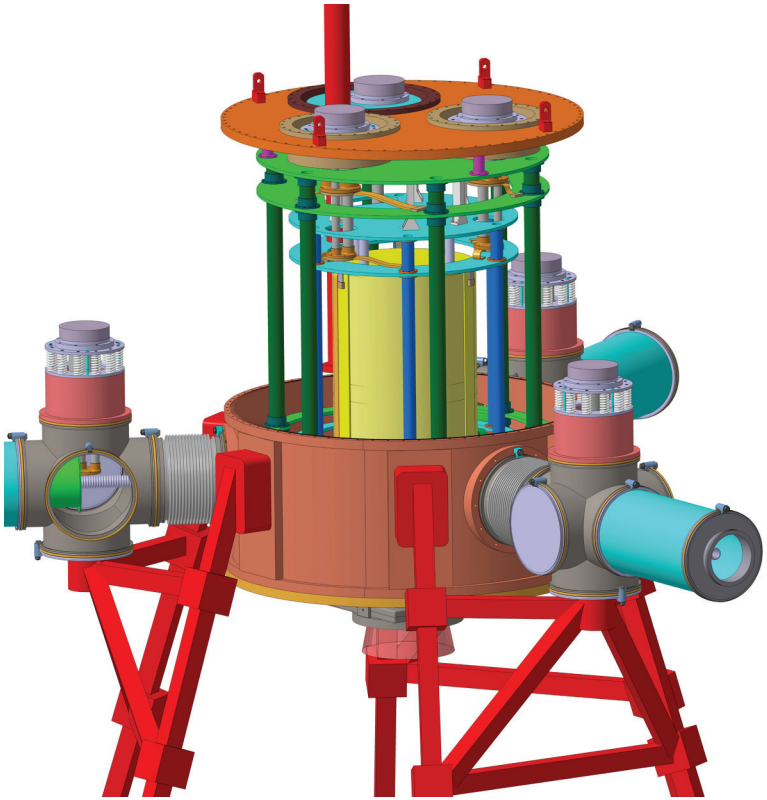
An extraordinary cryostat to characterize an extraordinary instrument

INTA-Cryostat for 2K Core Calibration team

INTA (Spain)



Conceptual scheme of the cryostat for testing and calibrating the Focal Plane Assembly of *Athena*/X-IFU. Credit: INTA – C2CC team.

Extraordinary space instrumentation requests extraordinary characterization tools. The *Athena*/X-IFU will be an engineering masterpiece. Its core, the Focal Plane Assembly (FPA), will be the most sensitive X-ray spectroscopic camera that ever flew on a space mission. Years before it departs from Earth, X-IFU must be tested and calibrated under exquisitely controlled conditions. These tests will provide critical information to unleash X-IFU's full resolution potential.

The goal of the INTA – C2CC (Cryostat for 2K Core Calibration) project is the development, manufacturing, integration, and verification of a cryostat for testing and calibration of the FPA and its readout electronics. This cryostat is the cornerstone for the validation and characterization processes. The tests performed inside this cryostat will provide the unique opportunity to verify the performance of X-IFU before its integration onto the science instrument module of *Athena*.

The project is an engineering challenge, due to the extreme sensitivity of the X-IFU's detection chain, any minuscule temperature or electromagnetic perturbation will affect and blur the instrument response. In fact, the C2CC cryostat must be almost completely isolated from the external environment. For instance, the C2CC must isolate the FPA from micro-vibrations. Any mechanical vibration dissipates heat and the FPA is extremely sensitive to minimal temperature variations in the detector support, even at micro-Kelvin level. It also needs to be isolated from electromagnetic fields, to which the detectors are similarly extraordinarily susceptible. Moreover, the cryostat must be compatible with other elements necessary for the calibration like: an external X-ray source; a number of delicate X-ray filters that should operate at representative temperatures; a harness that will be representative of flight conditions. Even more, the C2CC must reproduce all the processes and steps foreseen for the X-IFU operations, from initial deploying to operative conditions. This translates in maintaining the same stable conditions for months of calibration operations.

This project represents a multidisciplinary challenge in material science, chemistry, and engineering. It will provide solutions in the field of multifunctional structures optimising electromagnetic-thermal isolation and mechanical properties, key for optimising mass and performances and enabling their use also in future space missions.