The Cryogenic AntiCoincidence detector for ATHENA X-IFU: improvement of the test setup towards the Demonstration Model

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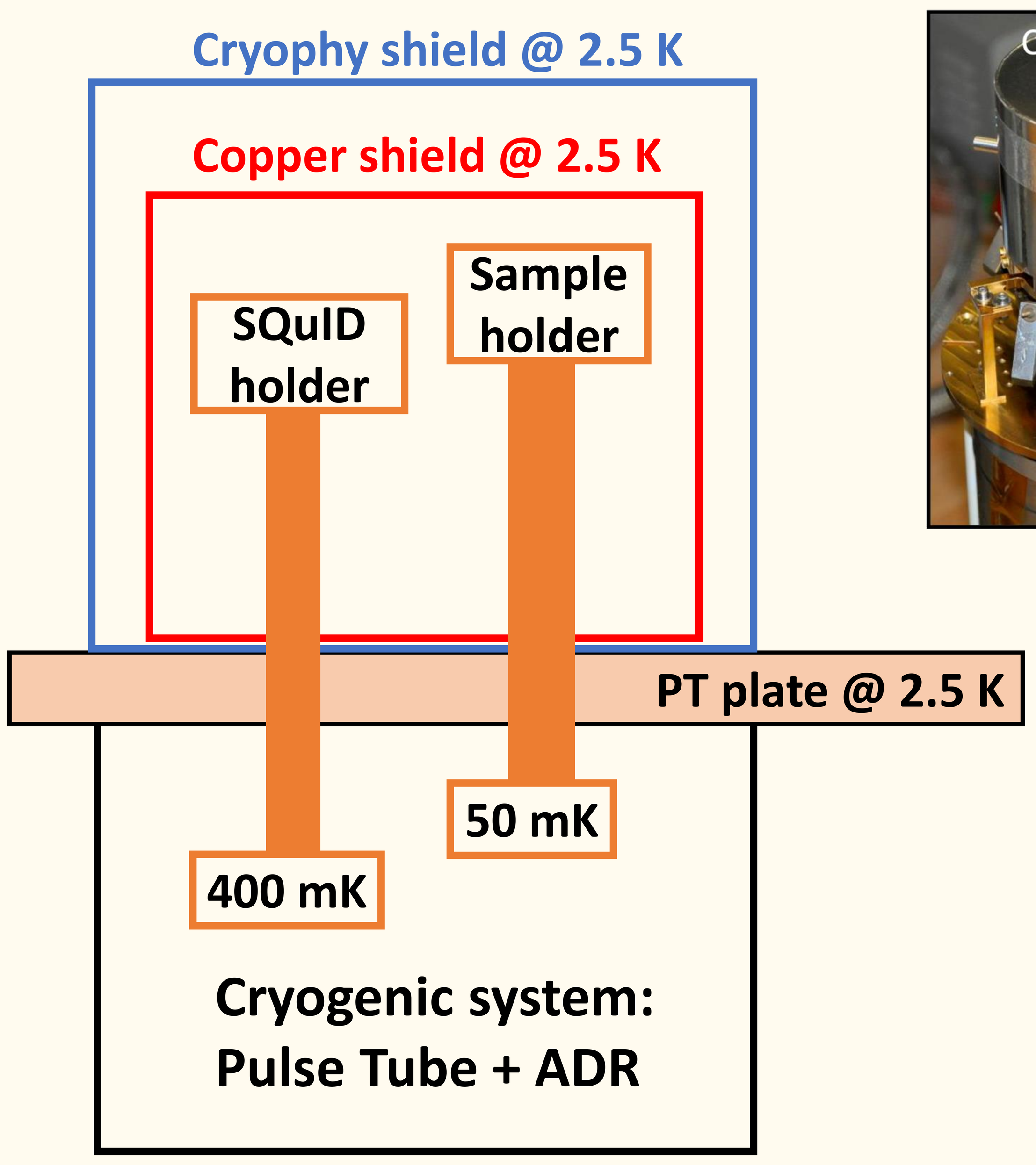
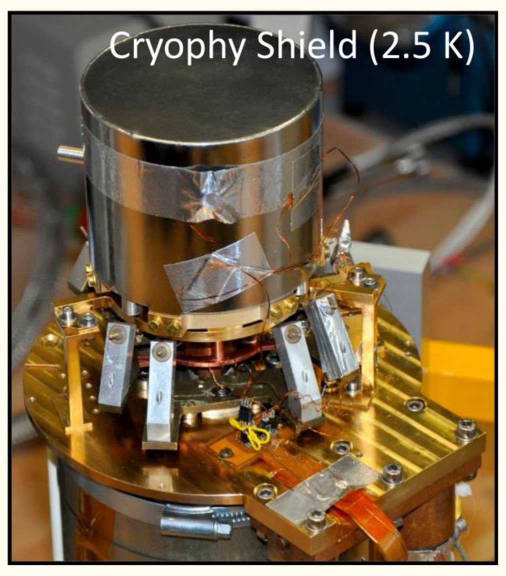
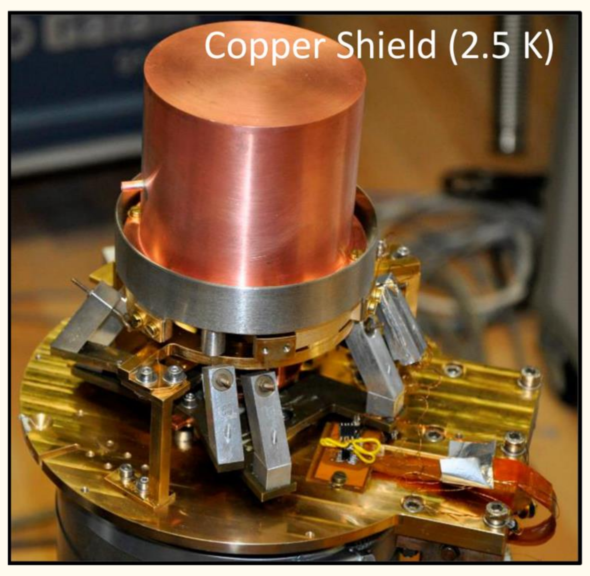
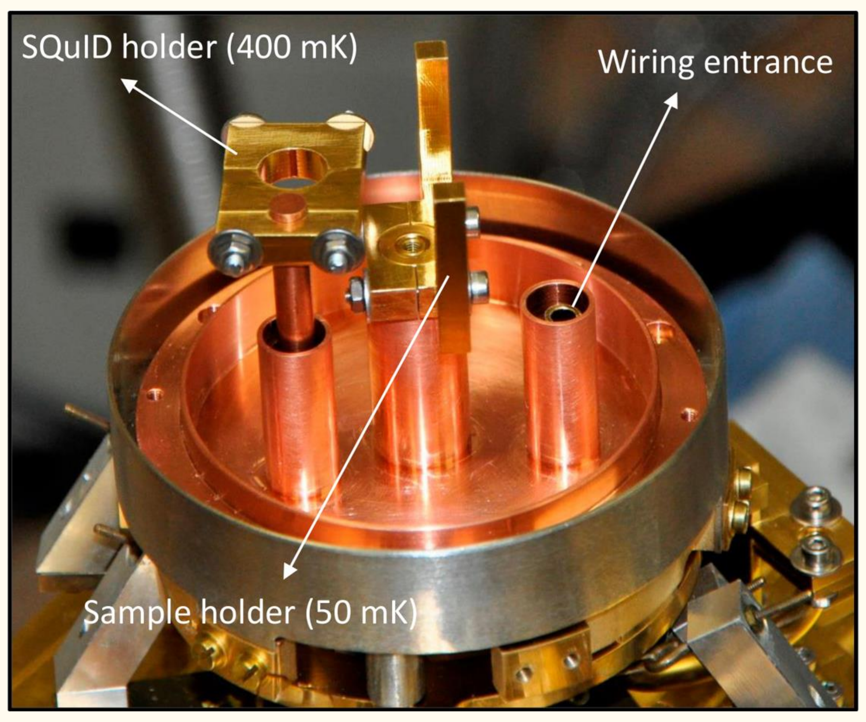
ATHENA is a large-class ESA mission, to be launched in 2028 towards an L2 orbit. One of the two on-board instruments is the X-ray Integral Field Unit (X-IFU), a cryogenic spectrometer based on a large array of TES microcalorimeters. The X-IFU incorporates a TES-based Cryogenic Anticoincidence detector (CryoAC), placed <1 mm below the main array. **The CryoAC development schedule foresees by the end of 2017 the delivery of a Demonstration Model (DM) to the SRON team having in charge the development of the Focal Plane Assembly DM, which will verify some representative detector requirements (see M. Biasotti poster: PE-47). Here we will report the improvement of the cryogenic test setup performed in INAF/IAPS towards the DM test and characterization activities.**

The new cryogenic magnetic shielding system for better quality measurements on CryoAC samples





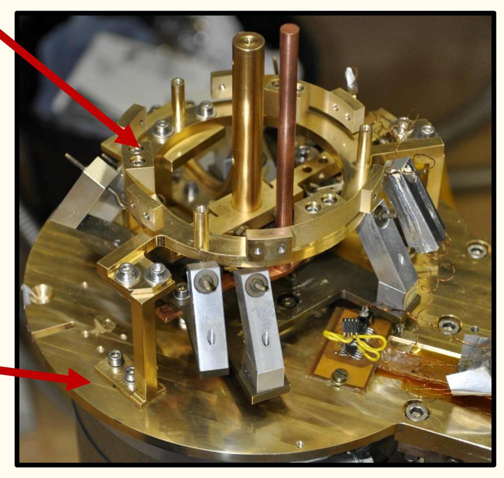




We have upgraded the cryostat at INAF/IAPS inserting a **cryogenic magnetic shielding system** at the 2.5 K level. The system is constituted by three main parts:

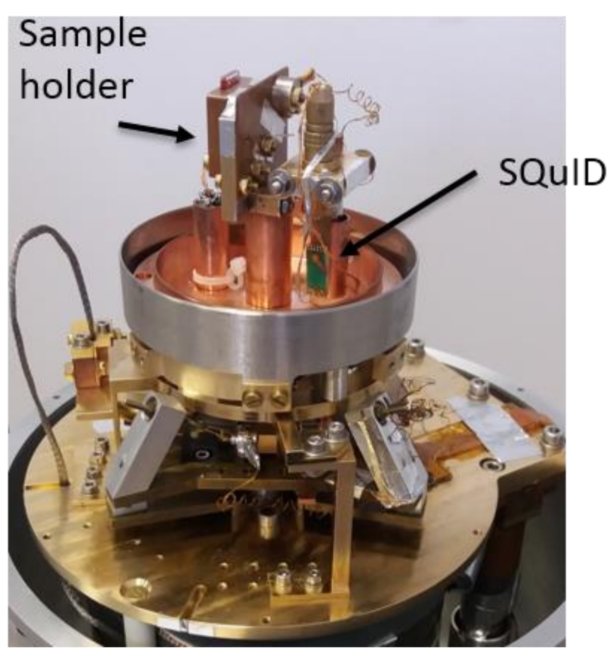
- An **external ferromagnetic shield made of Cryophy**, a nickel-iron soft alloy with high magnetic permeability (μ_r ~ 70000 at cold), suitable for static and low-frequencies magnetic shielding at cryogenic temperature.
- An **internal OFHC copper shield** that, if necessary, will be lead plated to operate as a superconducting shield.
- A **gold-plated copper support structure** designed to compensate the different thermal contractions of the shields.

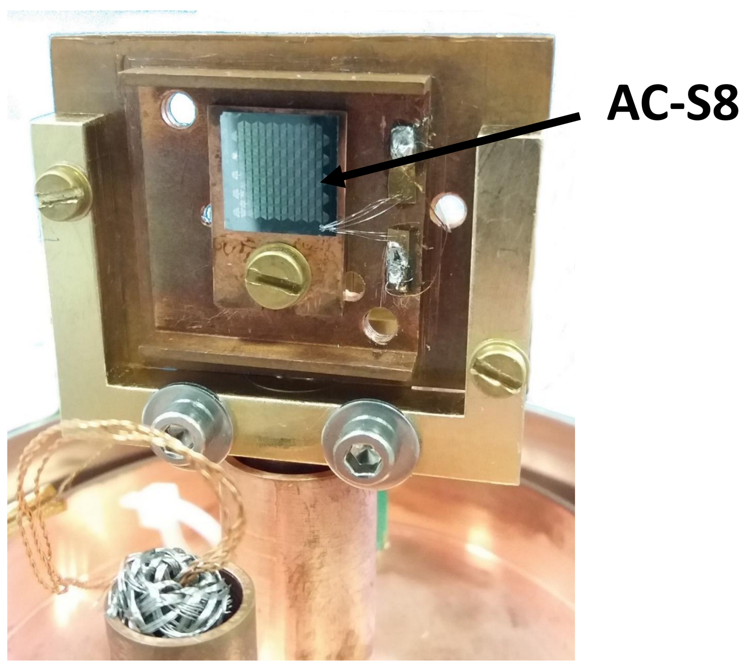
We have also upgraded the 2.5 K plate of the cryostat, moving from Aluminum to gold-plated Copper, in order to minimize thermal gradients within the plate and do not affect the Pulse Tube performances.

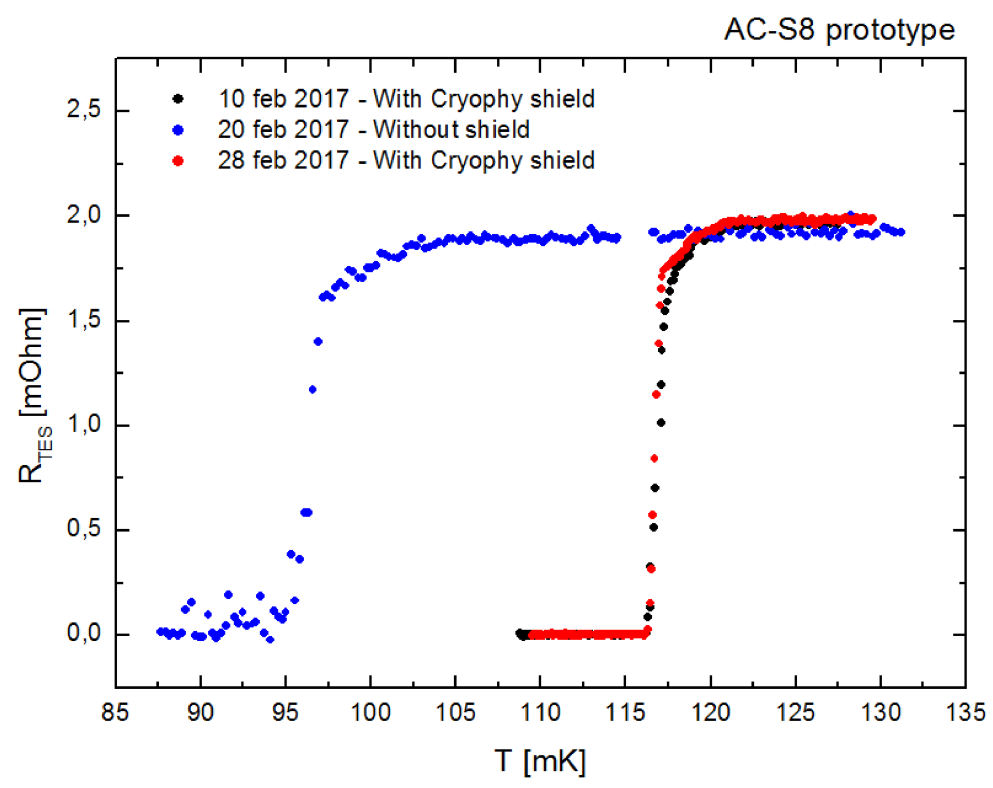


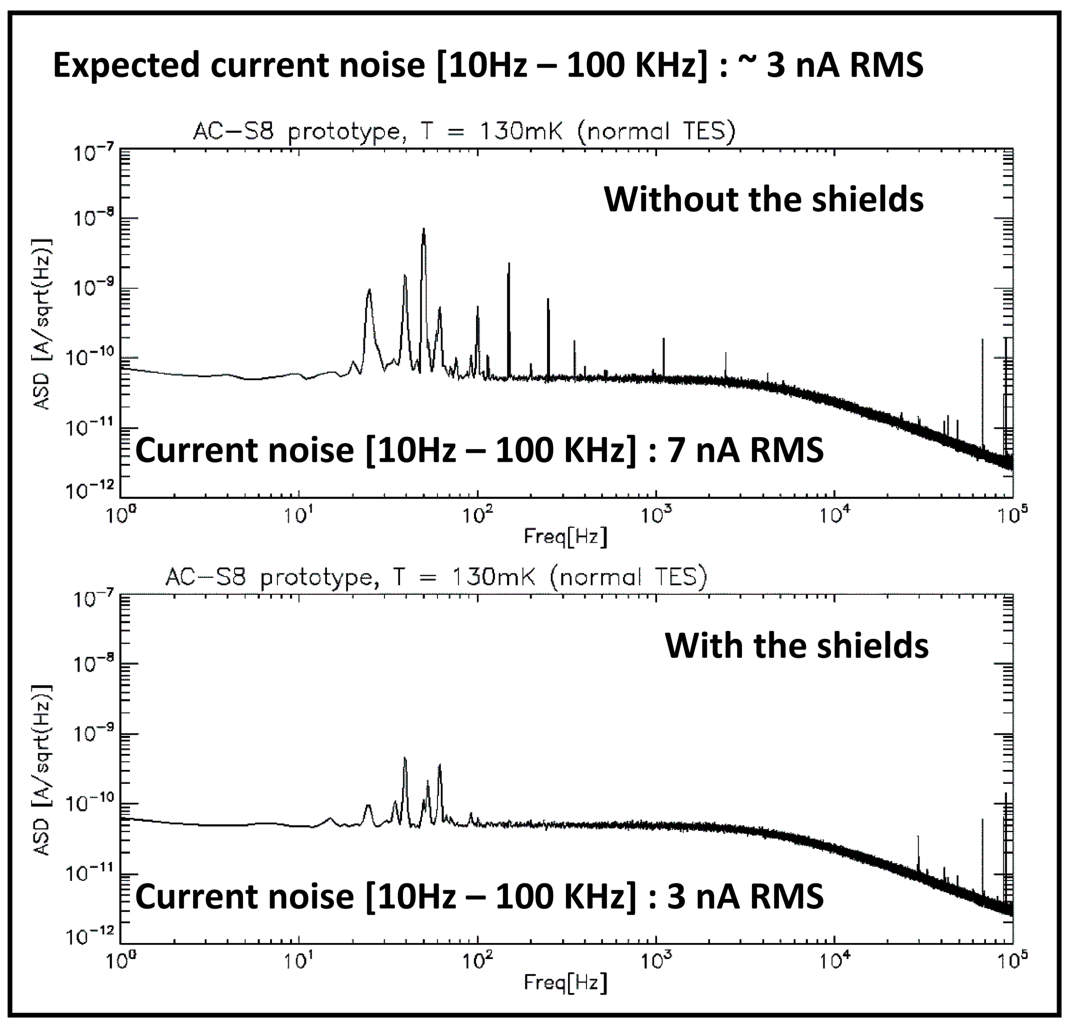
Preliminary performance test with the last CryoAC prototype (AC-S8)

We have tested the cryogenic shielding system integrating in the new setup AC-S8, the last CryoAC single pixel prototype (see M. D'Andrea poster: PE-52) .





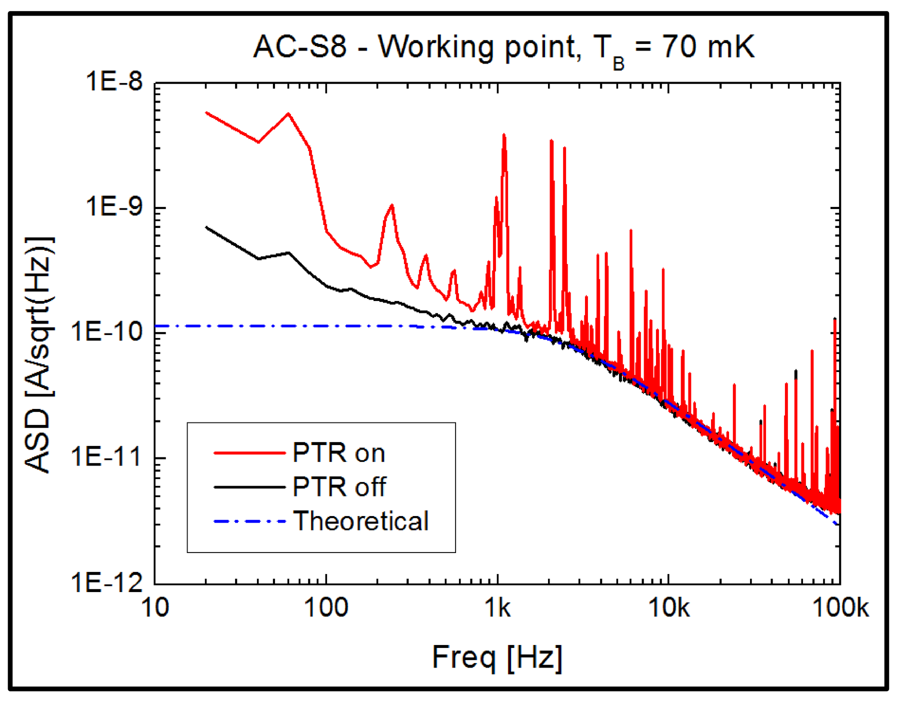




→ We have found that inside the shielding system the detector shows a critical temperature higher than the one measured without the shields. This is an **evidence of the better magnetic environment**.

→ The new cryogenic shielding system has also led to a **significant reduction in the spectral noise lines.**

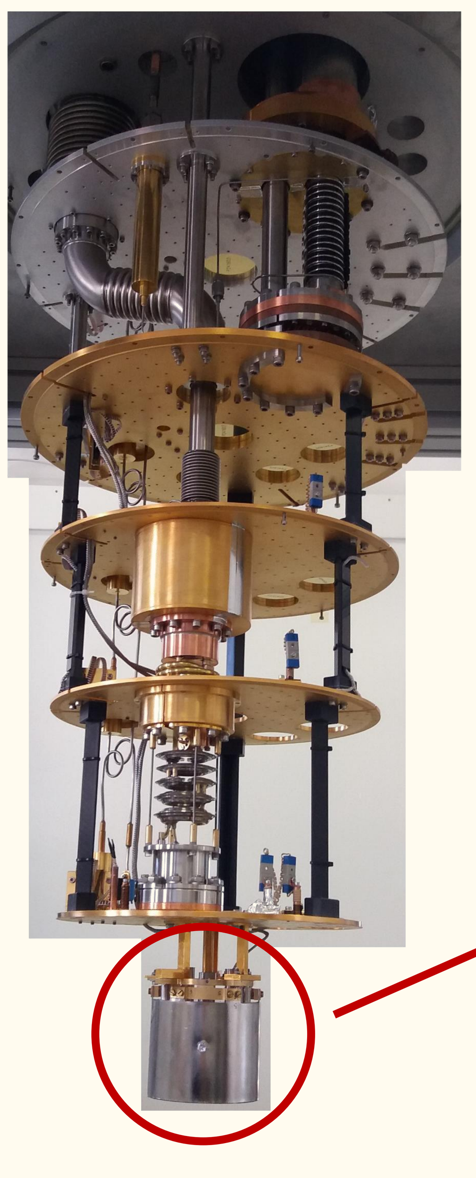
The effect of Pulse Tube operation



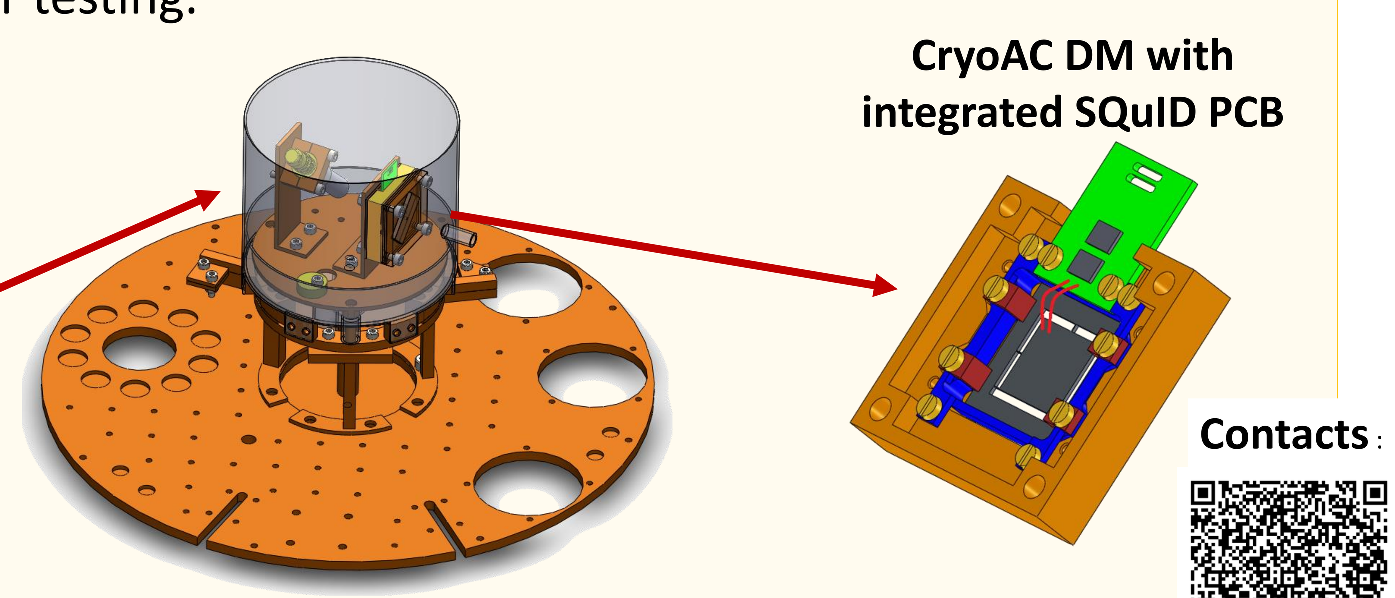
→ Despite the improvement of the cryogenic setup, we have found that **the Pulse Tube Refrigerator (PTR) operation has a dominant impact on the detector noise spectra.**
This is probably due to the micro-vibration induced on the cryostat cold stages by the PTR.

→ We are able to properly operate the detector **only switching off the PTR** for a small time (typically 15 min with the ADR at 50 mK)

The next step: the Demonstration Model integration



To integrate and test the CryoAC DM **we have decided to move the cryogenic shielding system in a new Dilution Refrigerator**, in order to have more available cooling power (450 µW @ 100 mK) and could also operate for more time with the PTR switched off (several hours with the cold stage at 50 mK).
The entire shielding system has been placed at the Mixing Chamber level (minimum temperature ~ 10 mK) and it is now under testing.



Contacts :