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The Demonstration Model of the ATHENA X-IFU Cryogenic AntiCoincidence Detector

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ATHENA is a large ESA mission selected for launch in 2031. One instrument of the payload is the X-IFU, a cryogenic spectrometer providing spatially resolved high-resolution X-ray spectroscopy. The core of the instrument is a 3kilo-pixels TES array operated at 50 mK thermal bath. Since the expected particle background would degrade the instrument performance, advanced reduction techniques have been adopted to reduce it by a factor ~ 50 . Most of the background reduction is achieved thanks to the Cryogenic AntiCoincidence detector (CryoAC), a 4 pixels TES microcalorimeter placed <1 mm below the TES array. The CryoAC is a sort of instrument-inside-the-instrument, with independent electronics and dedicated data processing chain. It shall have a wide energy band (from 6 keV to 1 MeV TBC) and a low downtime (1%), while respecting several constraints to ensure mechanical, thermal and electromagnetic compatibility with the TES array.

The X-IFU development plan foresees to build an instrument Demonstration Model (DM) before the mission adoption. In this respect, we have developed the CryoAC DM, a single pixel detector based on a large area (1 cm²) Silicon absorber. To obtain a well-defined conductance towards the thermal bath, the absorber is connected to a silicon rim through 4 narrow silicon bridges (100x1000 μm^2), achieving a suspended structure. This is sensed by a network of 96 Ir:Au TES in parallel configuration. The network is designed to achieve an efficient athermal phonons collection, and it features anti-inductive Nb wirings. Platinum heaters are also embedded on the absorber. If necessary, they could be used to increase the local temperature and reduce the current needed to operate the TES network, limiting crosstalk effects on the TES array.

Here we present the main results of the test performed on the CryoAC DM and an update about the status of the detector, which in April 2019 has been delivered to SRON for the integration in the X-IFU Focal Plane Assembly DM.

Less than 5 years of experience since completion of Ph.D

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