

The Cryogenic Anticoincidence detector for the new Athena X-IFU instrument: a program overview.

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Athena (Advanced Telescope for High Energy Astrophysics) is an ESA Large Class mission, at present under a re-definition “design-to-cost” phase, planned to a prospective launch at L1 orbit on 2nd half of 2030s.

It will be an observatory alternatively focusing in its focal plane 2 complementary instruments: the X-IFU, a TES-based kilo-pixel array able to perform simultaneous high-grade energy spectroscopy ($\sim 3\text{eV}@7\text{keV}$) and imaging over $4'$ FoV, and the WFI, having good energy spectral resolution ($\sim 170\text{eV}@7\text{keV}$) and imaging on wide $40' \times 40'$ FoV.

Athena will be a truly transformational observatory, operating in conjunction with other large observatories across the electromagnetic spectrum available in the 2030s like ALMA, ELT, JWST, SKA, CTA, etc..., and in multi-messenger synergies with facilities like LIGO A+, Advanced Virgo+, LISA, IceCube and KM3NeT.

The Italian team is involved in both the instrument, having in particular the co-ship of the cryogenic instrument for which has to deliver the TES-based Cryogenic AntiCoincidence detector (CryoAC) necessary to guarantee the X-IFU sensitivity which is degraded by primary particle background of both solar and galactic cosmic ray (GCR) origins, and by secondary electrons produced by primaries interacting with the materials surrounding the main detector. Indeed, Geant4 studies outcome the necessity to adopt both active and passive techniques to guarantee the residual particle background at $5\text{E-3 cts/cm}^2/\text{s/keV}$ level in 2-10 keV scientific bandwidth. The CryoAC is a four-pixel detector made of Si-suspended absorbers sensed by IrAu TESes placed at < 1 mm below the main detector.

After a brief overview of the Athena mission, we will report on the particle background reduction techniques highlighting the impact of the Geant4 simulation on the X-IFU focal plane assembly design, then a broader discussion on the CryoAC program in terms of detection chain system requirements, production, test and programmatic.

Summary

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