



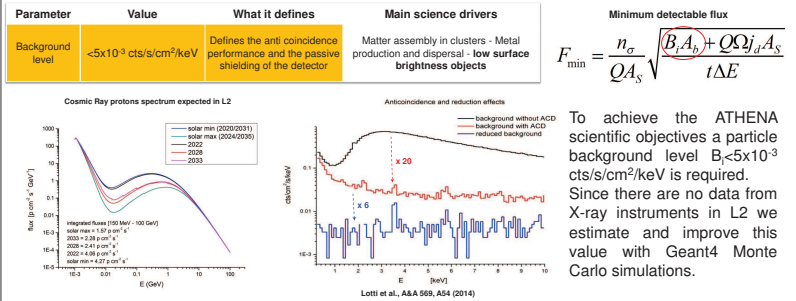
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The reduction techniques of the particle background for the ATHENA X-IFU instrument at L2 orbit: Geant4 and the CryoAC.

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We present the particle background reduction techniques aimed to increase the X-IFU sensitivity, which is reduced by primary protons of both solar and Cosmic Rays origin, and secondary electrons. The adopted solutions involve Monte Carlo simulation by both Geant4 toolkit related to the "expected" background at L2 orbit through the payload mass model and the ray tracing technique to evaluate the soft protons components focused by the optics to the main detector, and the development of an active Cryogenic AntiCoincidence detector and a passive electron shielding to meet the scientific requirements.

The Geant4 simulation



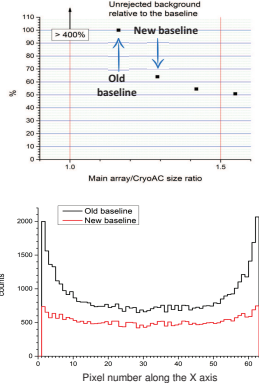
Impact to CryoAC design (2)

Another issue regarding the old baseline was the presence of an increased background level at the edges of the main detector.

This was caused by high energy particles with very skew trajectories that the CryoAC could not intercept.

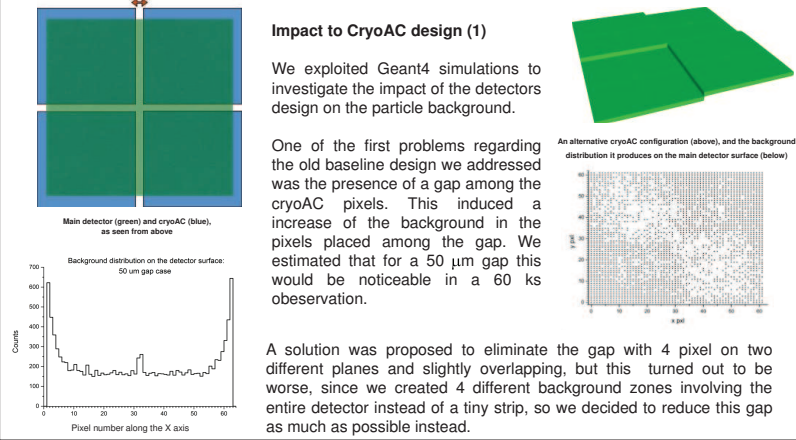
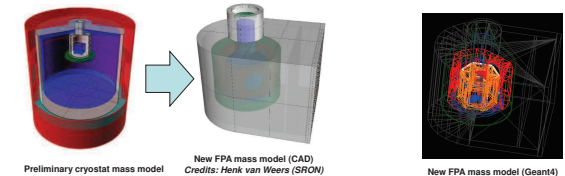
To address this problem we studied the impact of the CryoAC size on the background level, and decided to increase the CryoAC size by 40%.

This allowed to obtain a more homogeneous background level along the whole detector surface.



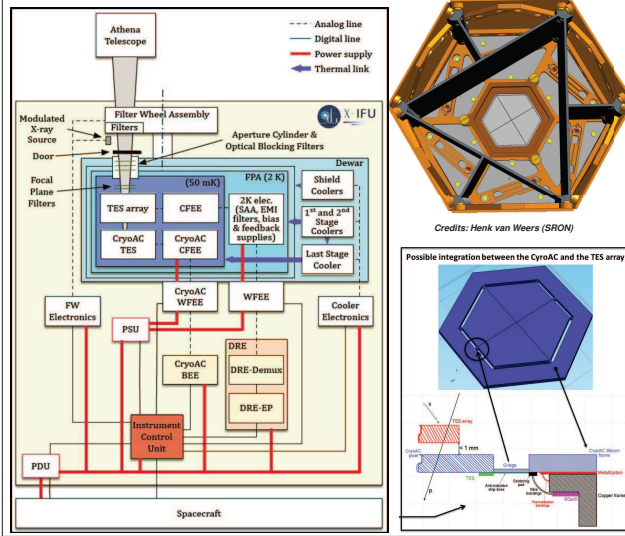
Ongoing activities:

- Satellite, cryostat and FPA mass models update
- Relevant physics models validation/update
- Inclusion of the ray-tracing code in Geant4 to estimate the low energy particles contributions to the particle background
- FPA improvement and L2 environment models improvement
- CryoAC performances improvement



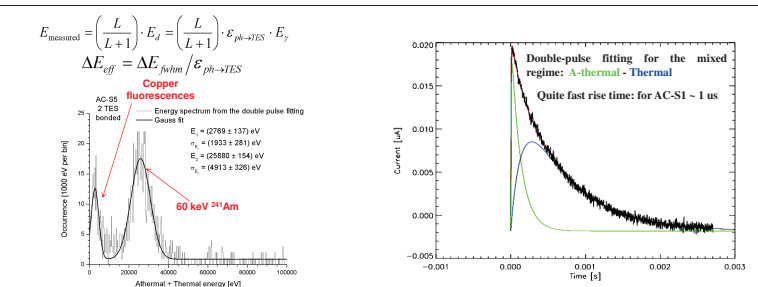
The CryoAC: an instrument inside another instrument.

- 4 pixels made of Silicon absorber sensed by Ir TES. Btath = 50 mK
- CFEE: SQUID + RF filtering
- SQUID (from VTT): We adopt a single stage SQUID, Series Array, at 50 mK
- RF filtering at 2K to reduce EMI towards the FPA
- WFEE (1 board-for-4 pixels) it biases the CryoAC pxl and the SQUIDs; standard FLL
- WBEE (2 boards: N + R) will process the analog pulses from the WFEE, and HK to the ICU;
- No VETO onboard. It manages the WFEE in diagnostic mode (FLL, V-PHI, test pulses...).



CryoAC Specifications

Size:	5.2 cm ² (in 4 pixel, each ~ 1.3 cm ²), no Multiplexing
Thickness:	500 μ m
Distance from X-IFU:	< 1 mm
Rise Time constant:	< 30 μ s
Time constant Decay:	< 300 μ s (Goal)
Bandpass:	20 keV - 0.5 MeV



The past samples

AC-S1	Collecting area (cm ²) 16.5	TES array 1x1	Abs Thickness 300 μ m
AC-S2	Collecting area (cm ²) 100	TES array 1x1	Abs Thickness 380 μ m
AC-S3,4	Collecting area (cm ²) 100	TES array 1x1	Abs Thickness 380 μ m
AC-S5	Collecting area (cm ²) 42	TES array 1x1	Abs Thickness 300 μ m

Last sample - 2015 - produced: AC-S7 and AC-S8: 1cm2 area

