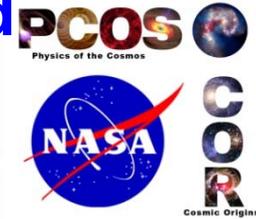


Technology Development for an AC-Multiplexed Calorimeter for ATHENA

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Objectives and Key Challenges:

- Increase TRL of AC-biased Transition-Edge Sensor (TES) X-ray microcalorimeters from 3 to 4
- To achieve this, we seek to demonstrate that AC-biased TESs can meet the anticipated performance requirements of ESA's ATHENA mission, and in particular that AC-biased TESs can routinely achieve energy resolutions of 2.5 eV or better at 6 keV
- The key challenge is that, so far, TESs under AC-bias do not have as good energy resolution as under DC-bias

Significance of Work:

- AC-biased TESs and Frequency Division Multiplexing (FDM) are the baseline readout architecture for ATHENA; the performance of this approach strongly impacts mission design and success

Approach:

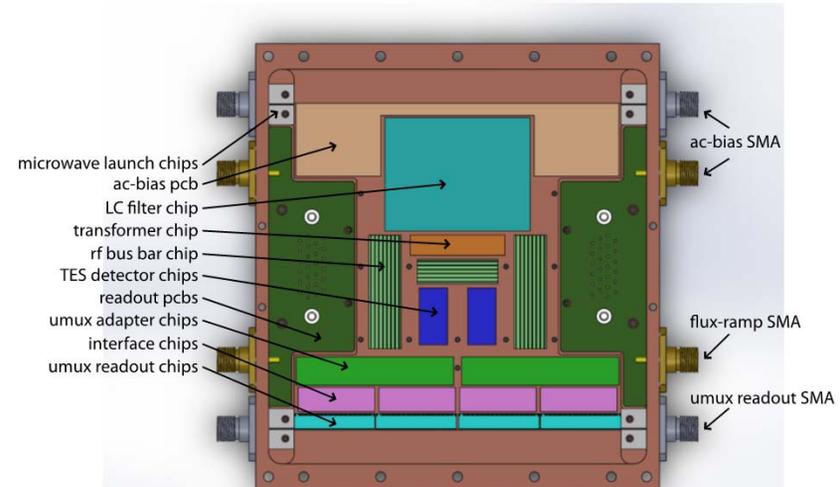
- Study the behavior of single GSFC TESs under AC-bias
- In one experiment, maximize the use of readout components from the European ATHENA team
- In a second experiment, separate the effects of the readout system from the TES by using a novel, open-loop readout architecture based on microwave SQUID amplifiers
- Study interactions among small numbers of AC-biased TES sensors

Key Collaborators:

- Caroline Kilbourne, Simon Bandler, and Richard Kelley (GSFC)
- Kent Irwin (Stanford University)

Current Funded Period of Performance:

FY 2015 – FY 2016



Sample box design for readout of AC-biased TESs using open-loop microwave SQUIDs

Recent Accomplishments:

- ✓ Good coordination with European ATHENA team and exchange of personnel and components
- ✓ Improved single pixel performance under AC-bias and 2-pixel multiplexing
- ✓ End-to-end demonstration of microwave readout and progress towards full bandwidth measurement

Next Milestones:

- Refabricate microwave SQUID amplifier (Q2 FY16)
- First operation of AC-biased TES (Q2 FY16)

Applications:

- ATHENA and future X-ray missions based on TES microcalorimeters

$TRL_{In} = 3$ $TRL_{Current} = 3$ $TRL_{Target} = 4$