Demonstrating Enabling Technologies for the High-Resolution Imaging Spectrometer of the Next NASA X-ray Mission

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**Objectives and Key Challenges:**
- Develop large-format arrays of X-ray microcalorimeters and their readout that meet the challenging requirements of high-resolution X-ray imaging spectrometers for astrophysics.
- Advance the key components of an X-ray microcalorimeter imaging spectrometer from TRL 4 to 5, and advance a number of important related technologies to at least TRL 4.

**Significance of Work:**
- This solid demonstration of core technologies coupled with a demonstration of targeted enhancements will enable a number of mission concepts to be confidently considered.
- This development has enabled NASA participation in the ESA Athena mission.

**Approach:**
- Optimize SQUID time-division multiplexer (TDM) components and back-end electronics for low crosstalk, acceptable power dissipation, and bandwidth sufficient for frame times of 160 ns.
- Integrate state-of-the-art 32x32 TES arrays (Mo/Au TES with Au/Bi absorbers) with optimized multiplexed readout.
- Advance code-division multiplexer (CDM) readout.
- Investigate component technologies for focal-plane assembly.

**Key Collaborators:**
- (GSFC) 662: J. Adams, S. Bandler, R. Kelley, R.S. Porter, S. Smith, 553: J. Chervenak
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**Current Funded Period of Performance:**
- October 2012 – September 2015

**Recent Accomplishments:**
- Many improvements in the design of TDM and CDM components and systems, with all noise and bandwidth goals now met.
- Multiplexed 32 rows in a single column with an average resolution at 6 keV of 2.55 ± 0.1 eV.

**Next Milestones:**
- Demonstrate multiplexed (3 columns x 16 rows) readout of 96 different flight-like pixels with 0.25 mm pitch in a 32 x 32 array with > 95% of pixels achieving better than 3 eV resolution at 6 keV.

**Application:**
- Contribution to the X-ray Integral Field Unit instrument on the ESA Athena mission.
- Other potential missions needing high-resolution imaging x-ray spectroscopy.

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\text{TRL}_{\text{In}} = 4 \quad \text{TRL}_{\text{PI-Asserted}} = 4++ \quad \text{TRL}_{\text{Target}} = 5
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