Kinetic Inductance Detector Arrays for Far-IR Astrophysics

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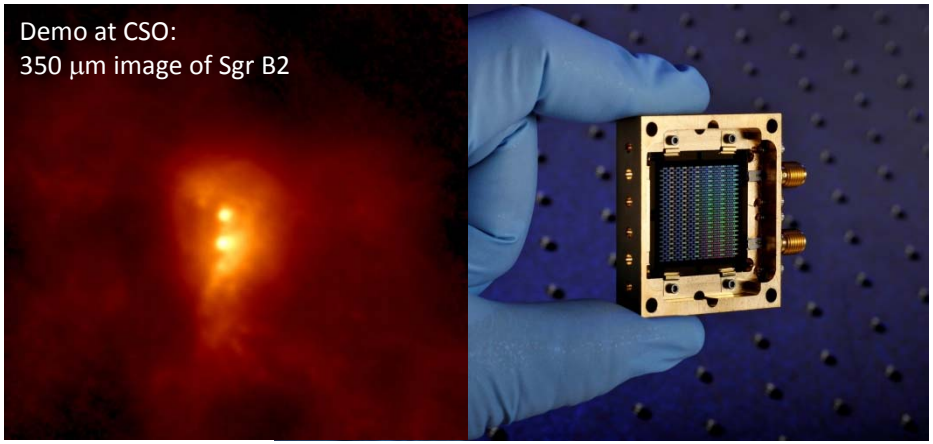
Objectives and Key Challenges:

- Half of the electromagnetic energy emitted since the big bang lies in the far-IR. Large-format far-IR imaging arrays are needed to study galaxy formation and evolution, and star formation in our galaxy and nearby galaxies. Polarization-sensitive arrays can provide critical information on the role of magnetic fields.
- We will develop and demonstrate far-IR arrays for these applications

Significance of Work:

- Far-IR arrays are in high demand but are difficult to fabricate, and therefore expensive and in short supply. Our solution is to use titanium nitride (TiN) and aluminum absorber-coupled, frequency-multiplexed kinetic inductance detectors.



Approach:

- Raise the TRL of these detectors so investigators may confidently propose them for a variety of instruments:
  - Ground telescope demo, 350 μm, 3×10^{-16} W $Hz^{-1/2}$
  - Lab demo for space, 90 μm, 5×10^{-19} W $Hz^{-1/2}$

Key Collaborators:

- Goutam Chattopadhyay, Peter Day, Darren Dowell, and Rick Leduc (JPL)
- Chris McKenney (JPL/NIST)
- Pradeep Bhupathi, Matt Holllister, and Attila Kovacs (Caltech)

Current Funded Period of Performance:

Mar 2013 – Dec 2016 (no-cost extension after original 2-year project)

Recent Accomplishments:

- ✓ Successful 350 and 850 μm demos on telescope (350 μm image above)
- ✓ Photon-noise-limited 350 μm lens-coupled arrays
- ✓ Low-cost, high-yield multiplexing of 500-pixel arrays
- ✓ Process improvement (high yield) in aluminum KID for space-background operation
- ✓ Demonstration of new chirped readout technique at telescope

Next Milestone:

- Optical tests of space-sensitivity arrays (through end of project)

Applications:

- Future space missions, *e.g.*, Far IR Surveyor
- Suborbital projects: SOFIA instruments, and balloon payloads
- Cameras and spectrometers for ground-based telescopes
- CMB arrays, now under development at Columbia University

TRL_{In} = 3 $TRL_{PI\text{-}Asserted}$ = 3, 6 TRL_{Target} = 4-6