A fundamentally new approach for imaging x-ray spectroscopy:

- Measure energies of individual x-ray photons as heat
- Measure position using array of calorimeters

Spectral resolution of ~ 2 eV possible throughout 1-10 keV band with ~ arcsec imaging at the focus of IXO.

The Implementation of an Imaging X-Ray Spectrometer for the International X-Ray Observatory

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X-Ray Calorimeter Technology – Transition Edge Sensor

Superconducting Transition Edge Thermometer

Transition at ~ 100 mK and only about 1 mK wide.

NASA/Goddard

8 x 8 array of TES devices

HEMTs mounted above and below the transition edge sensor to counterfract and provide high thermal isolation.

Micromachined MOSFETs

TES x-ray calorimeter: Mo/Au superconducting thermometer with Au Bi absorber

TES technology well-suited for high-speed SQUID multiplexing.

Reference Design:

- High Technology Readiness Reference Design:
  - 32 x 32 TES microcalorimeter array
  - MUX SQUID readout
  - Continuous ADR
  - Cryocooler

- Multi-stage ADRs

- Multi Absorber TES - 1 TES, 4 absorbers

- Simple approach to extend focal plane coverage: Separate absorbers (e.g., 4) connected to a single TES, each with a different thermal conductance.

- Rise times easily distinguished: ~ 5-6 eV already demonstrated!

- Multi-stage adiabatic demagnetization refrigerator (ADR) works by continuously transferring heat of magnetization to “upstream” salt pill, and eventually to cryocooler. Continuous removal of up to 5 µW at 50 mK.

- Cryocondenser

- 115V 110V Throttle

- 600 W input

- 9.5 W output

- Cryocooler: Peltier...