Multiplexed x-ray calorimeter arrays with optimized energy resolution for Constellation-X

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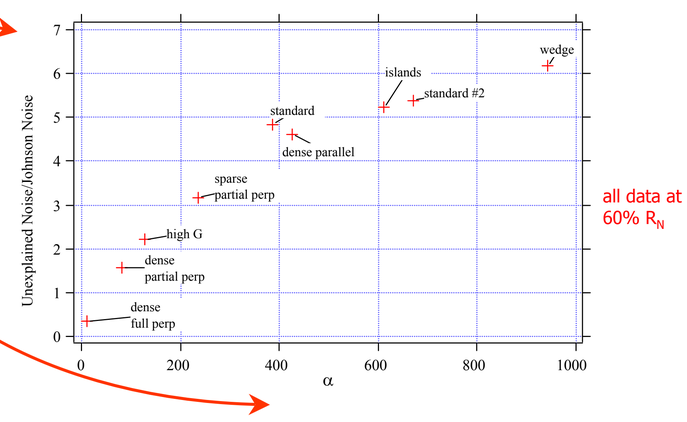
In collaboration with the GSFC microcalorimeter team

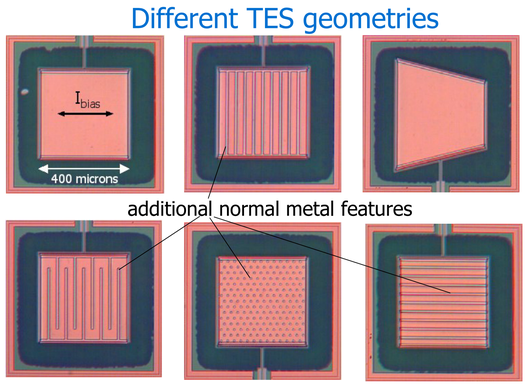
NIST
National Institute of Standards and Technology

Optimizing TES X-ray Calorimeter Resolution for Con-X: 2.4 eV at 6 keV

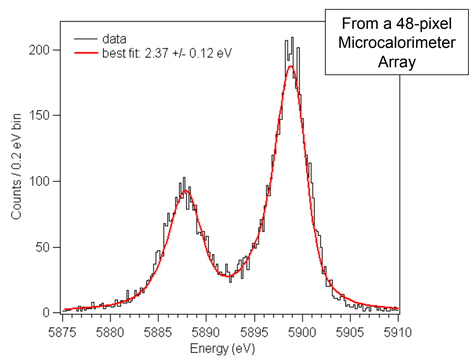
The noise (y) and sensitivity (x) of a TES can be optimized by the inclusion of normal-metal features



Different TES geometries



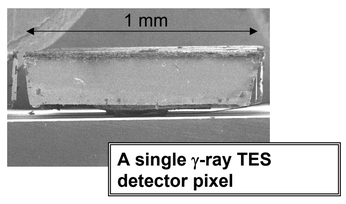
Choosingoptimal normal-metal features can be used to improve the calorimeter energy resolution



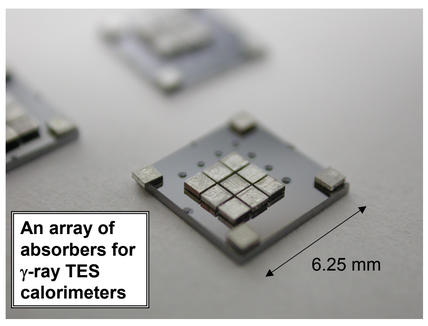
Energy resolution of 2.4 eV at 6 keV with included normal-metal features

Hard x-ray Calorimeters: 42 eV at 100 keV

Spectral resolving power of 4300 (E / half energy width)

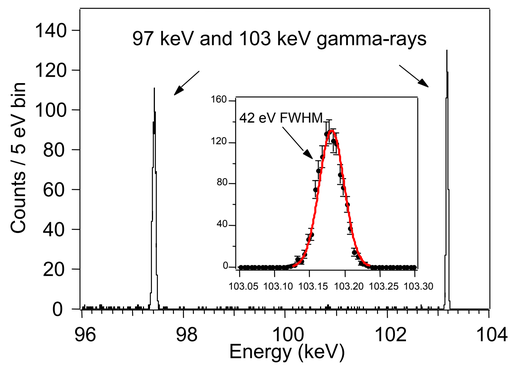


A single γ-ray TES detector pixel

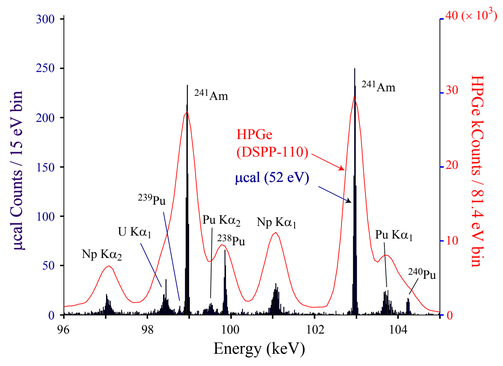


An array of absorbers for γ-ray TES calorimeters

Gd-153 source with steel attenuator

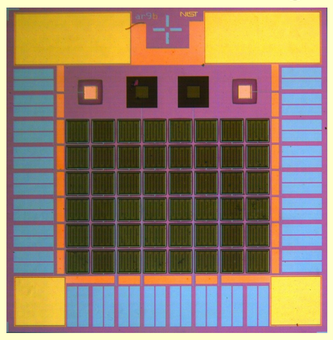


Pu spectrum with NIST μcalorimeter at LANL (compared to conventional HPGe)



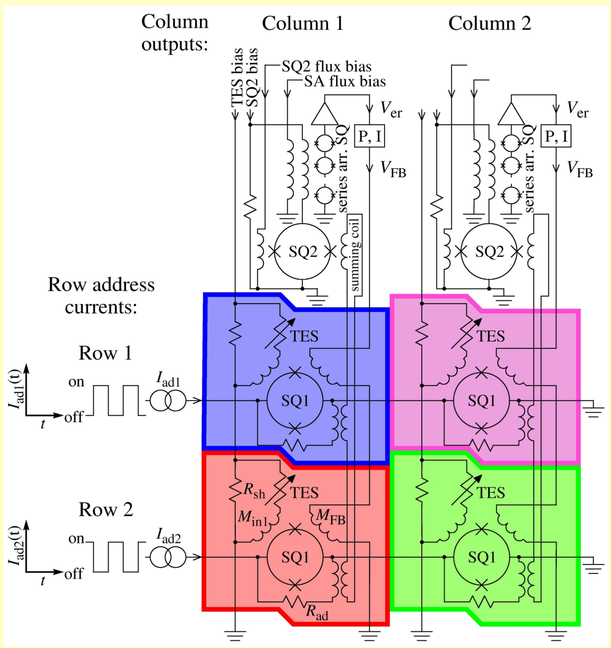
Building blocks of a multiplexed Constellation-X calorimeter array

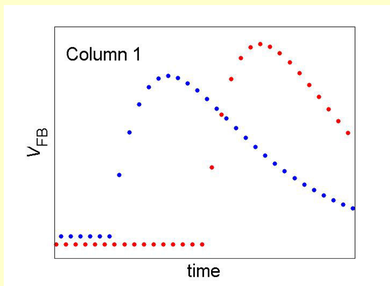
Arrays of close-packed TES pixels using bulk silicon micromachining

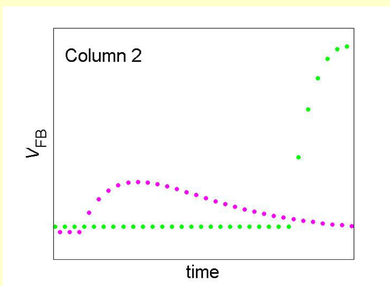


48-element array of TES microcalorimeters

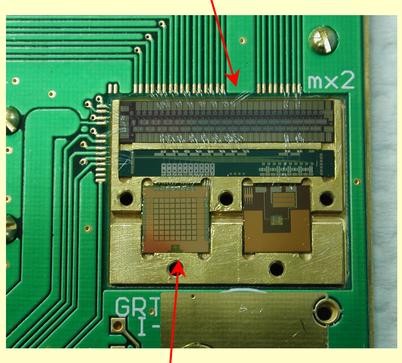
Time-division SQUID multiplexer (MUX) architecture





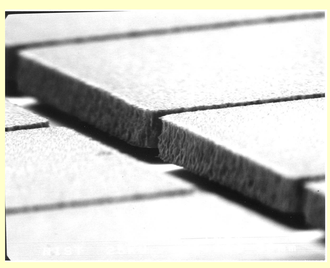


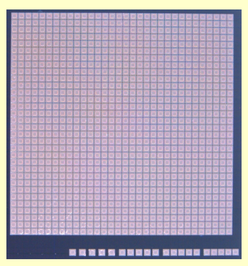
32-element SQUID multiplexer chip



64-element array of TES x-ray microcalorimeters

High fill factor, high efficiency "mushroom" Bi absorbers cantilevered over the leads

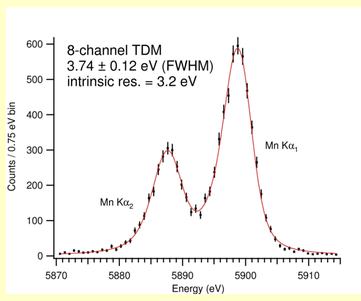


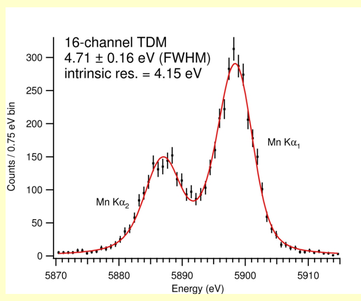


32 x 32 array of Bi mushroom absorbers

See 12.07, "High-density arrays of x-ray microcalorimeters for Constellation-X" for details

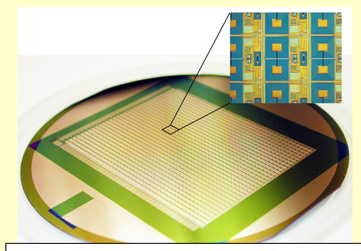
Current MUX status





The state-of-the-art SQUID MUX allows us to multiplex 8-16 calorimeters in one output channel. We are planning to develop circuits to multiplex *32 x-ray calorimeter per output channel* for Constellation-X

SCUBA-2: two multiplexed, 5,120-pixel arrays of TES bolometers for astronomy at 450 μm and 850 μm



1,280-pixel time-domain SQUID multiplexer

The SCUBA-2 TES bolometer camera, which will be deployed on the JCMT this year, is a pathfinder for large-format TES arrays