

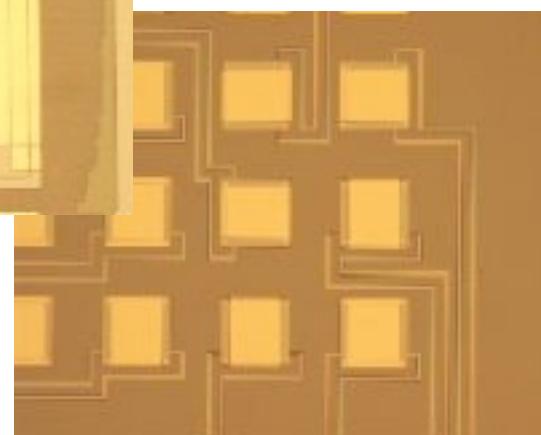
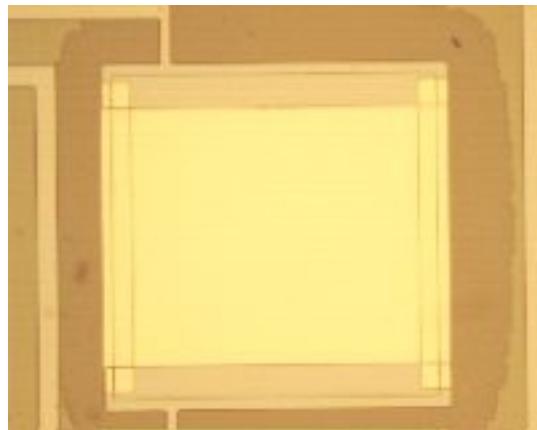
Performance of compact TES arrays with integrated high-fill- fraction X-ray absorbers

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Compact arrays for Con-X



Single TES on membrane

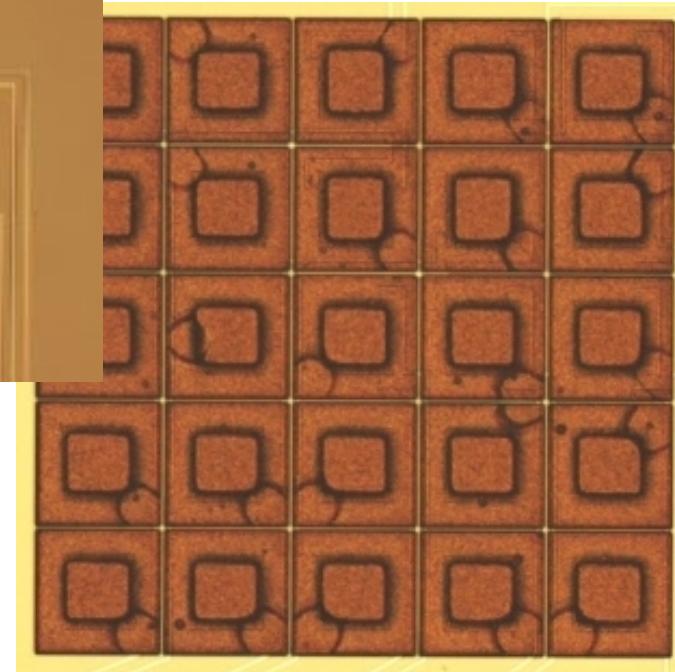


Array of TES pixels

fill factor: 97%

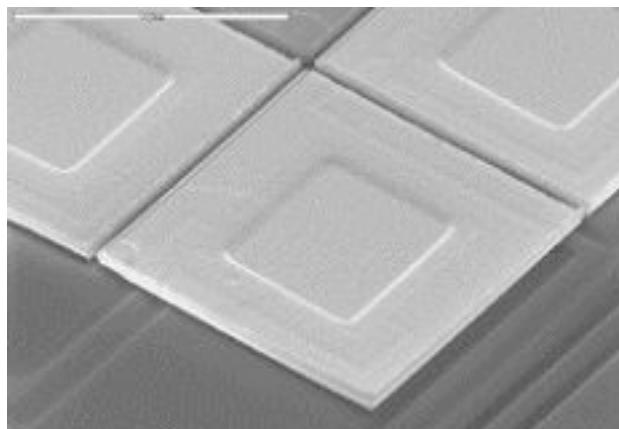


Array with absorbers



250 μm

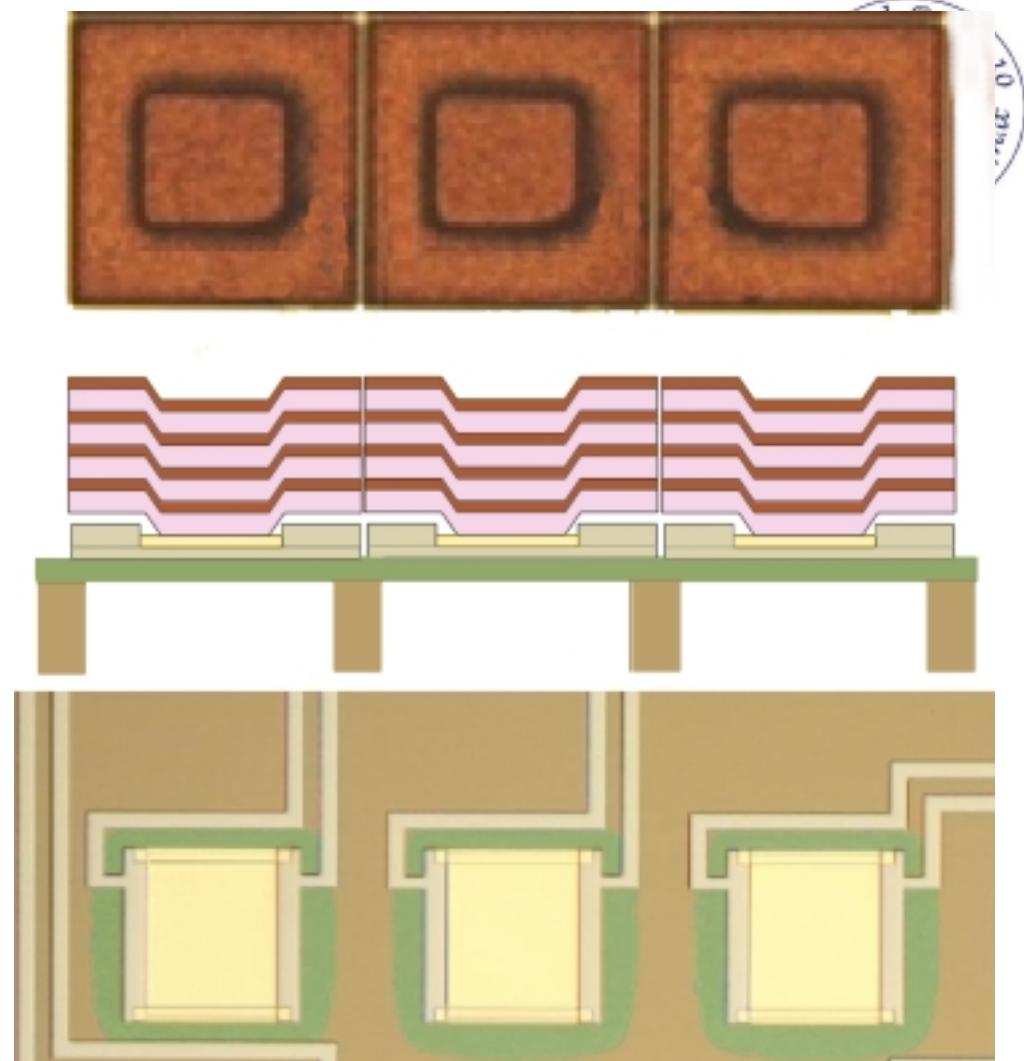
For 5 arc second resolution



Compact pixel overview



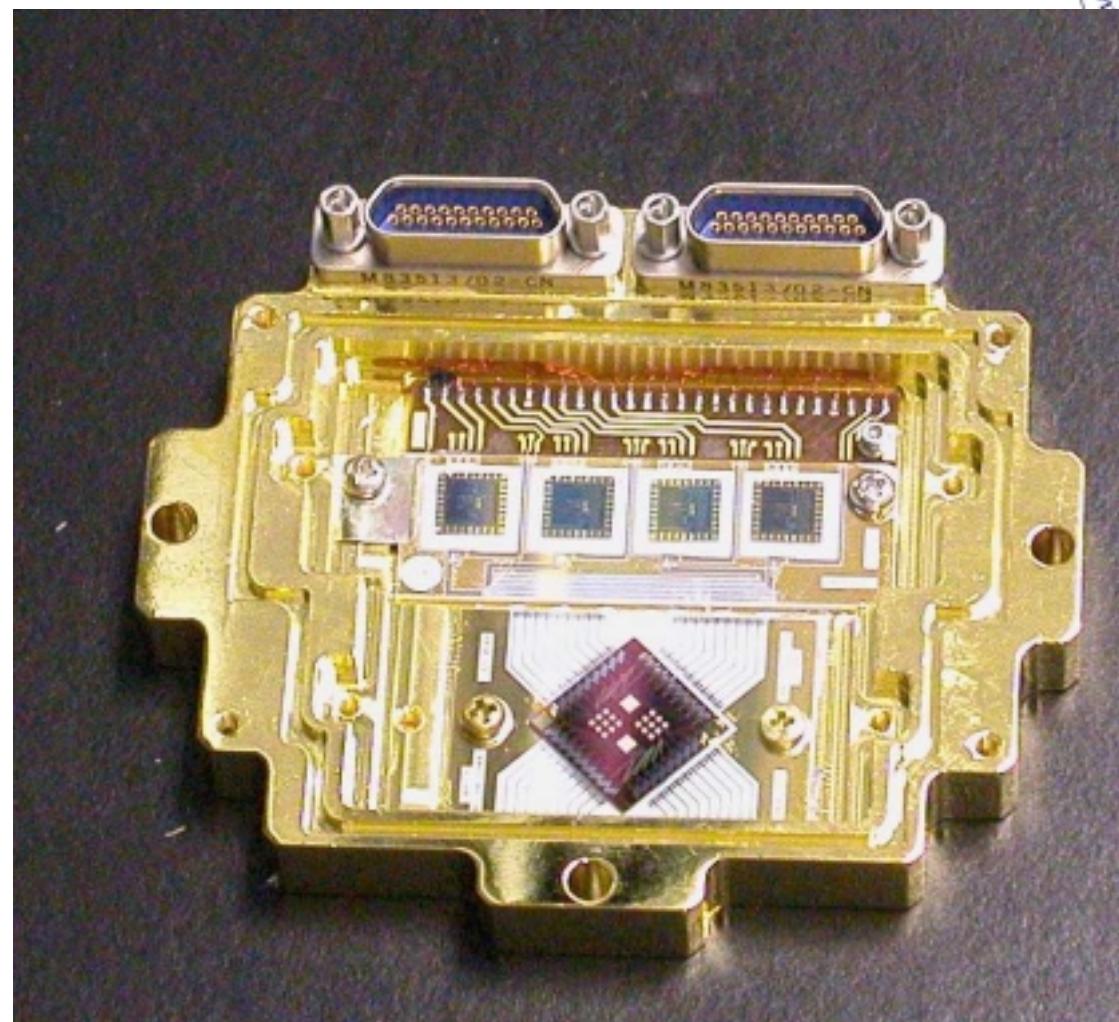
- Overhanging absorbers
 - 4 layers of Bi,
thickness: 2.25 or 2.0
microns
 - 4 layers of Cu,
thickness: 0.2
microns.
 - High absorption
efficiency
 - Good thermal
conductivity
- TES calorimeters
suspended on SiN
membranes



Instrumentation



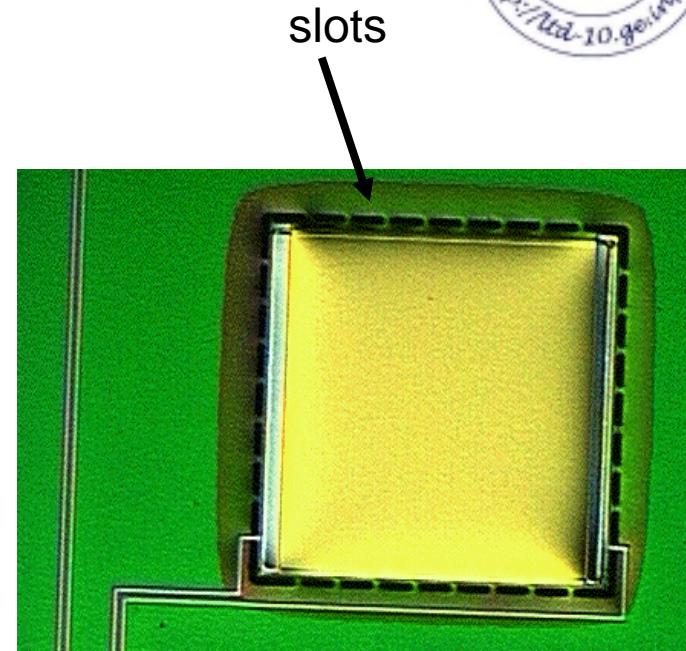
- Four channel 2 stage dc SQUID system
- Inductance: 40 nH in TES bias circuit



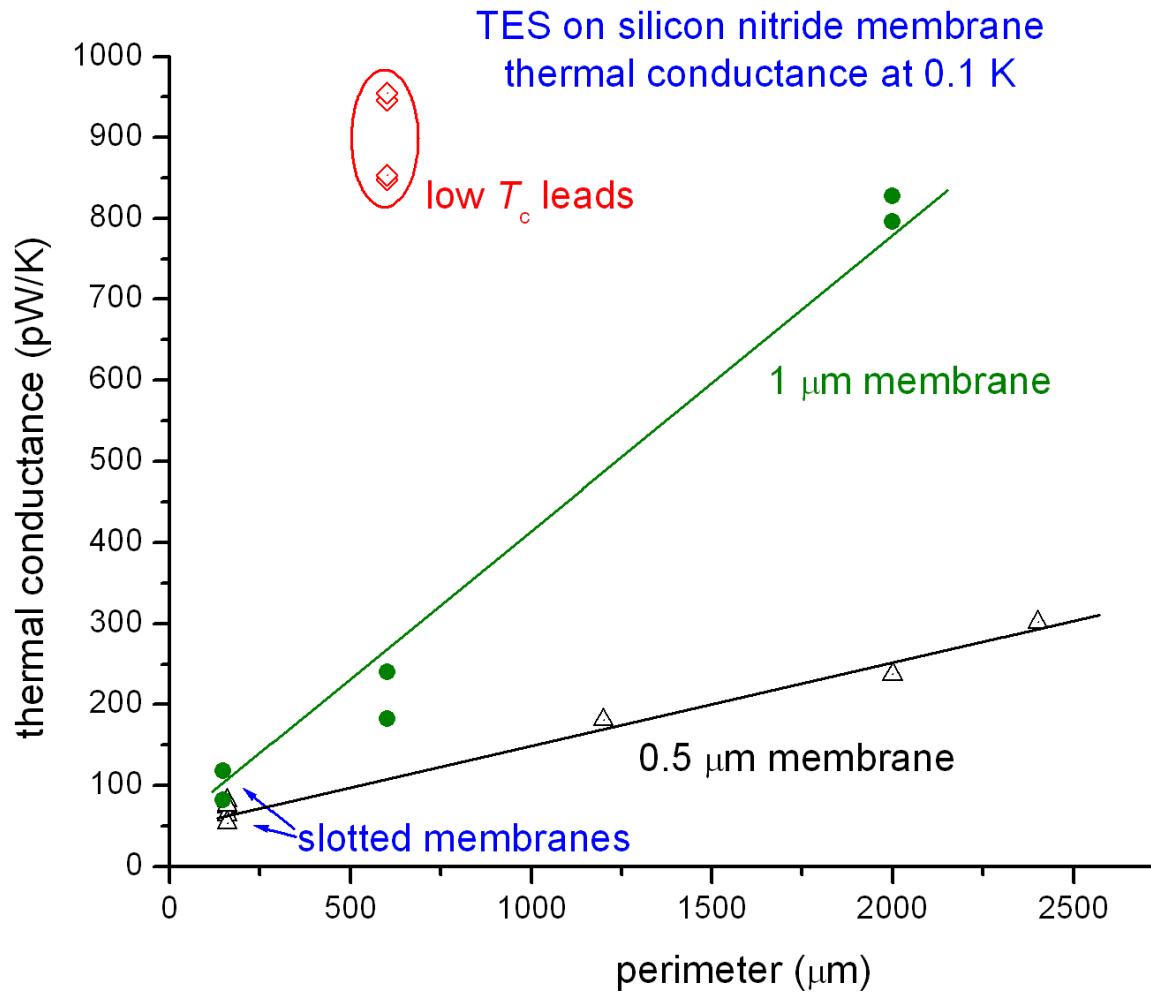
Engineered thermal coupling



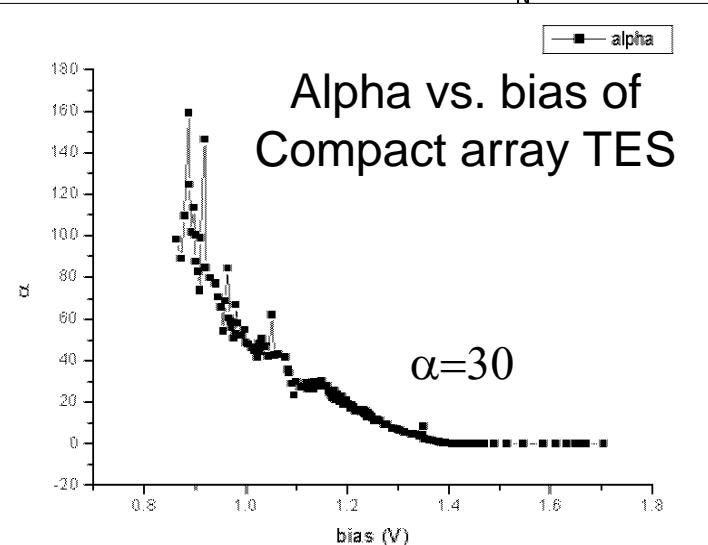
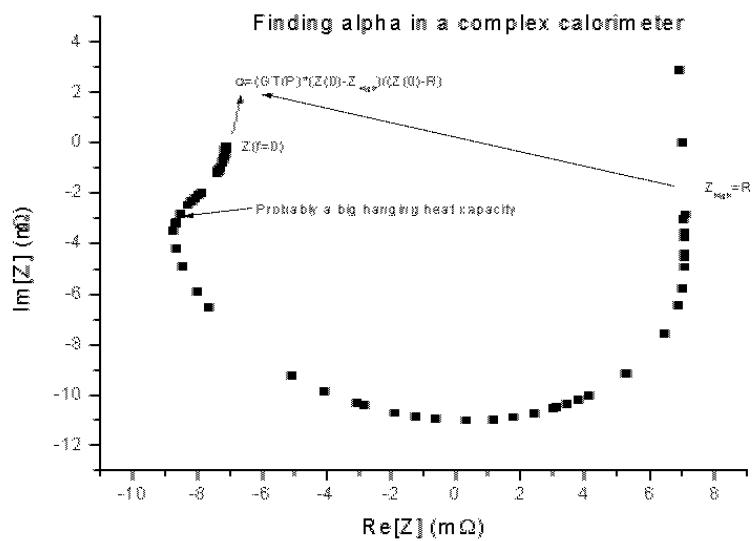
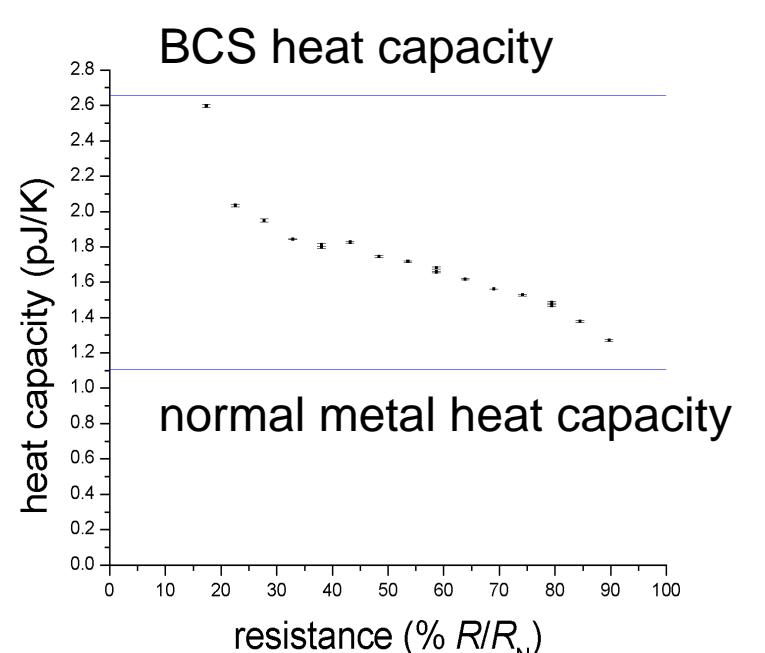
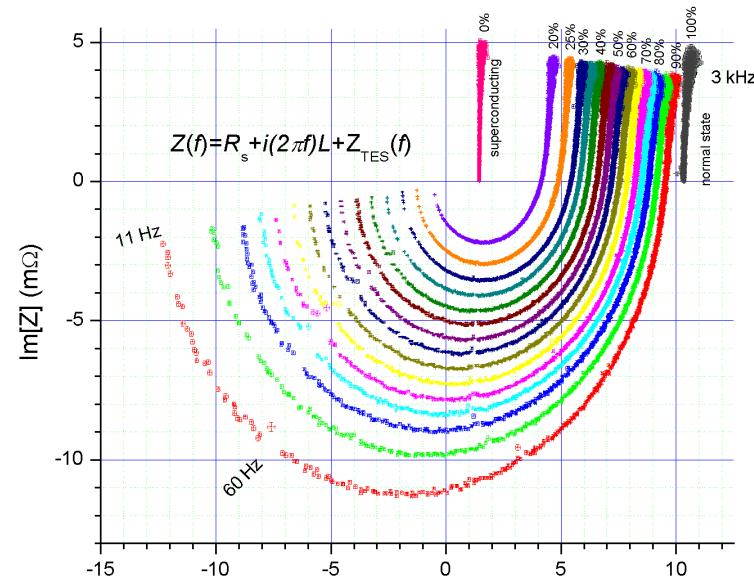
- Perimeter of TES to membrane and membrane thickness set thermal coupling
- Slotted membranes reduce thermal coupling
- Thermal coupling not limited by e-p or Kapitza
- T_c of leads > 900 mK to minimize electronic thermal conduction out leads



Thermal coupling & perimeter



TES parameters



Putting it together



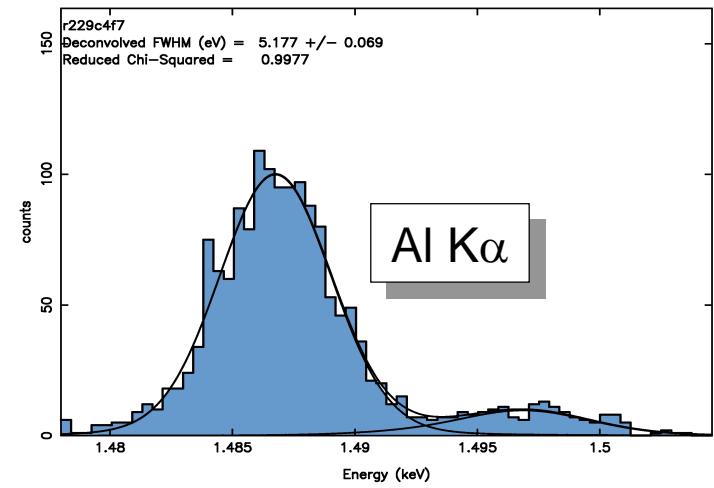
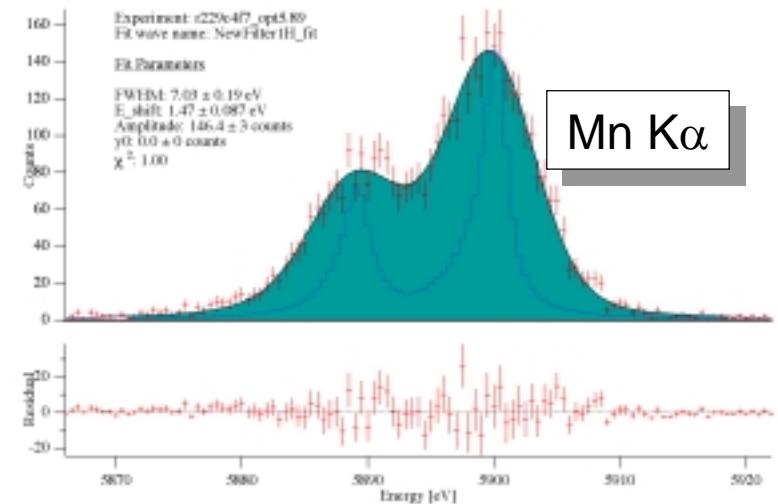
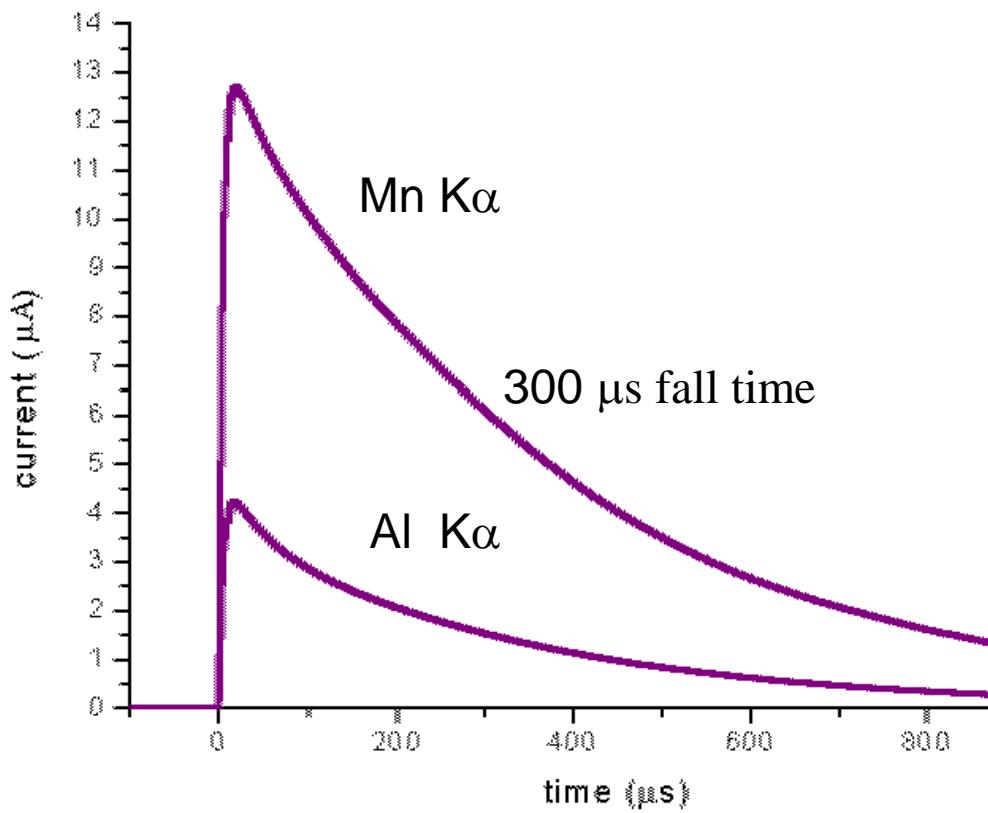
Design compact array for Constellation-X:

- Good energy resolution
- 300 μ s fall time
- Robust membranes
- Low cross talk
- High quantum efficiency
- High fill fraction

Results: nice X ray spectra



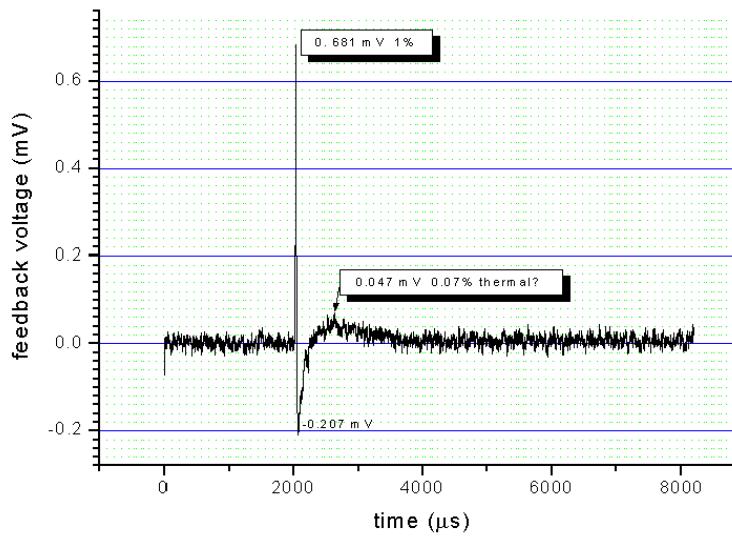
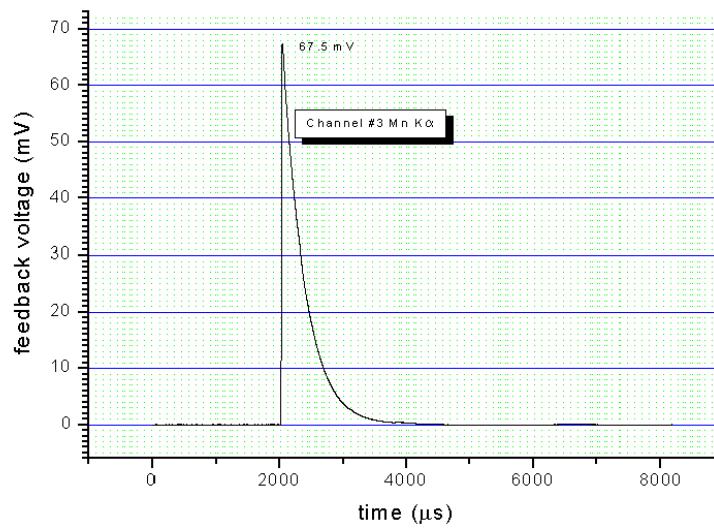
FWHM resolution:
5 eV at 1.5 keV, 7 eV at 6 keV



Crosstalk



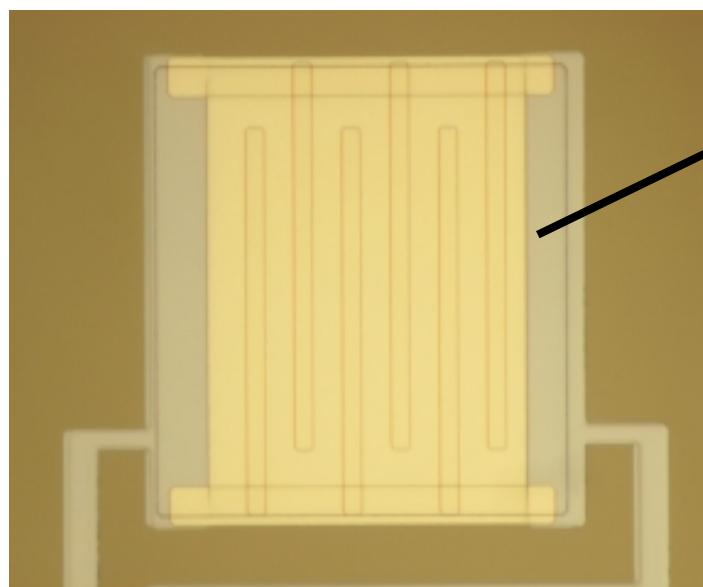
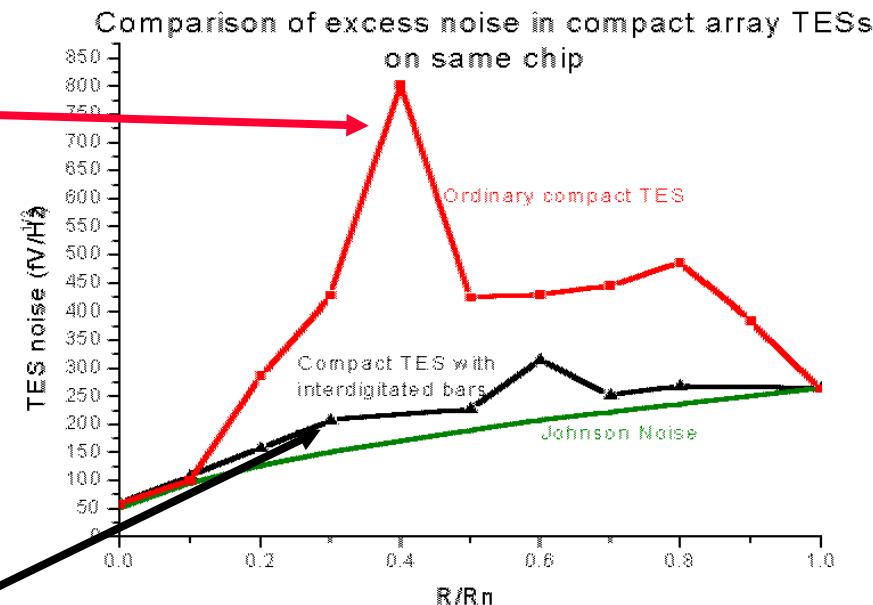
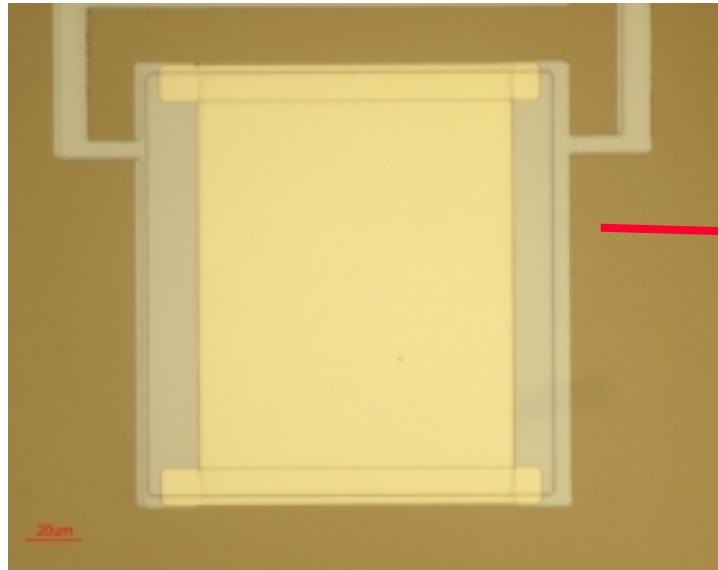
- Thermal crosstalk less than 1/1000
- little electronic crosstalk in band
- Averaged hundreds of measurements to see crosstalk



Low noise compact arrays



red @ 12/12/2012



New design demonstrates low noise

Summary

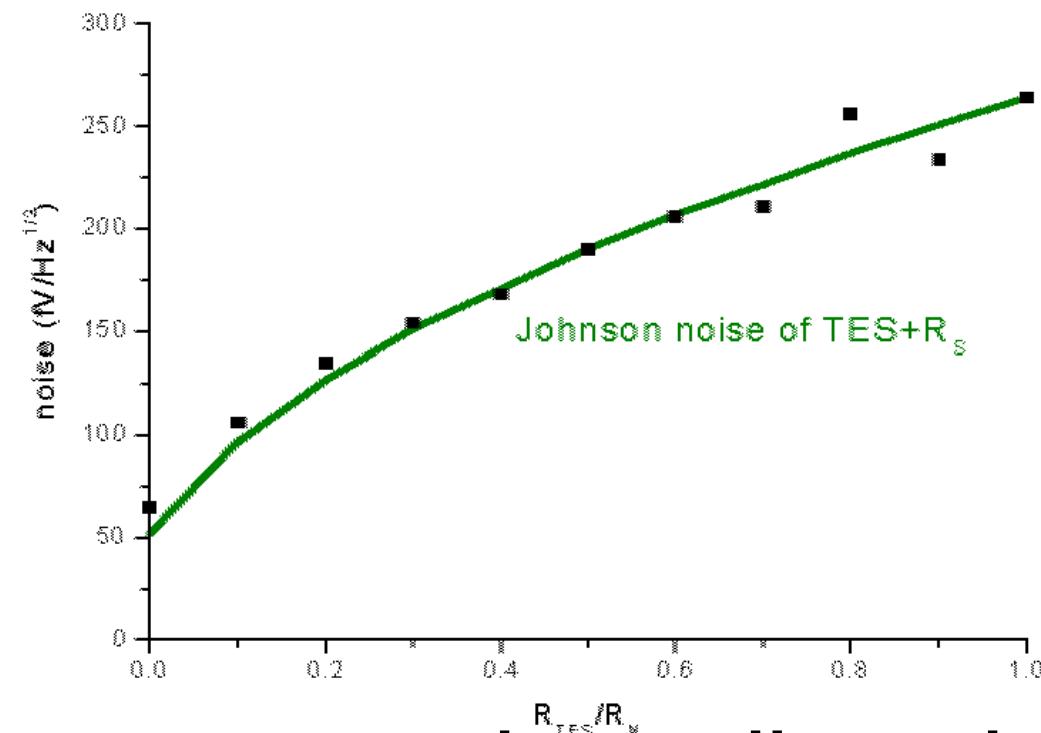
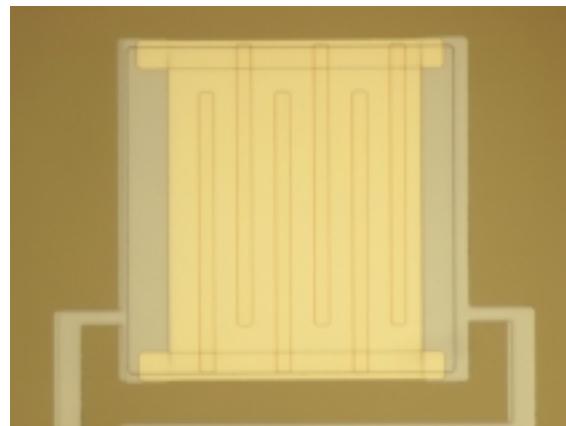


- High fill factor compact arrays of TES calorimeters
- Bi / Cu overhanging absorbers worked
- Engineered membranes for strength and thermal conductance
- Multi-channel readout with little crosstalk
- Achieved 5 eV @ 1.5 keV in compact array with 300 μ s fall times
- New low noise TESs point the way to further improvement

Characterization and reduction of noise in Mo /



Au transition edge sensors -- M. A. Lindeman, et al.



Little or no excess broadband
noise in striped TES