

Microcalorimeter development in Italy

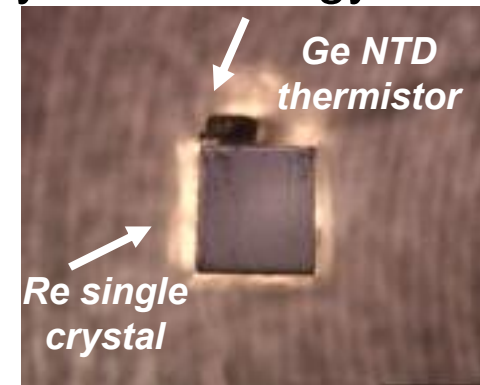
F.Gatti

University and INFN of Genoa

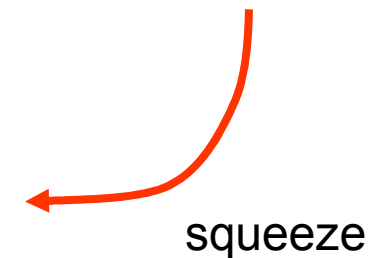
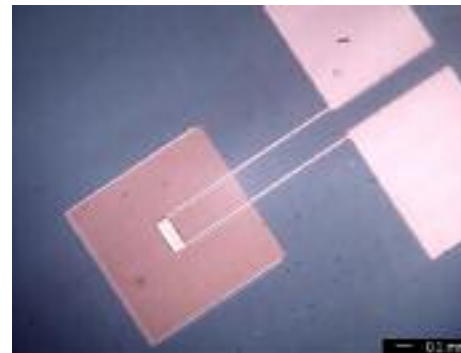
INFN & University-Genoa: Research activity

1. INFN: microcalorimeter for very low energy nuclear spectroscopy (since 1985).

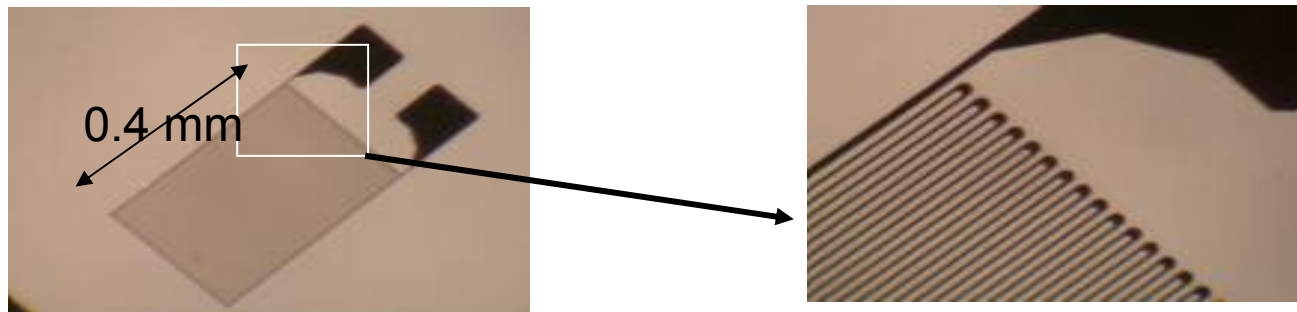
(1) Calorimetric Limit on Neutrino mass with ^{187}Re with sensitivity of $\sim 1\text{eV}/c^2$ - (2) Precise determination of BEFS and foundation of a technique for application to matter science – (3) Study of low energy decay ($^{163}\text{Ho}/^{166\text{m}}\text{Ho}/^{7}\text{Be}$) -> need of massive calorimeter with 5-10 eV resolution in the 50 eV- \rightarrow 3KeV.



2. TES (since 1997) AlAg and Ir
Now planar microcalorimetr
under development.

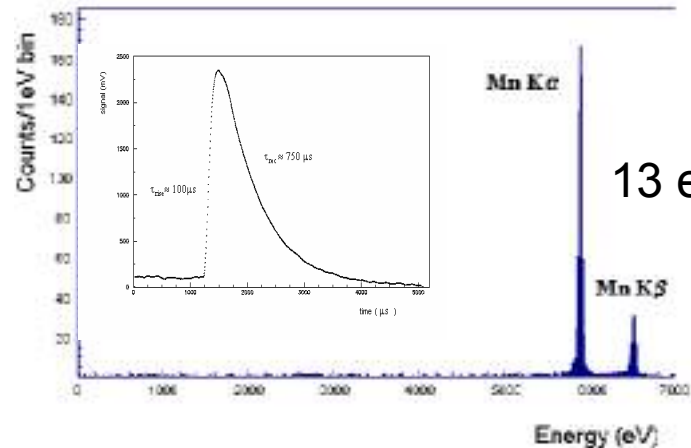


- Now 3 year project by the Min.of Sci. Research for development of microcalorimeters for specific space application: single pixel → small array (4x4) (INFN-Genoa/INAF-Rome)
- Use of High Z- High density superconducting material for absorber (Re,Os) → study of very thin crystal grown on phonon transparent substrate.
- Use of Ir TES technology already developed → tuning TES properties and noise contribution
- Microlithography processes tested: (figure below is an exercise)

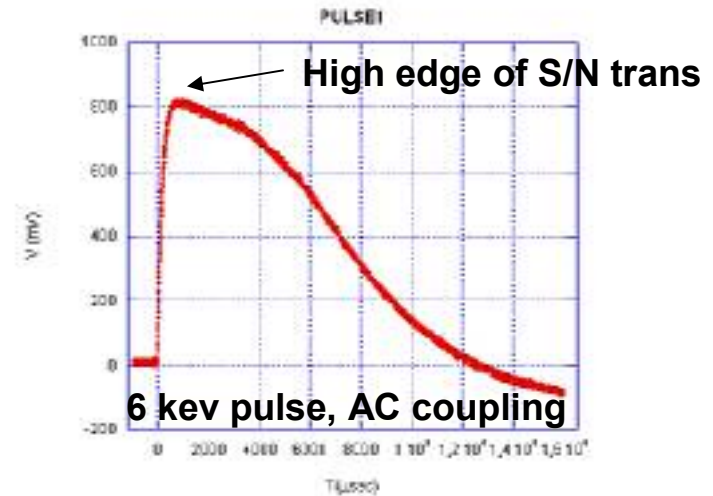


- Performance: 0.3 mK (10-90%) transition width, 13 -15 eV fwhm resolution (thick prototype with Sn (poly) and Re (single))
- Tested at Grenoble ESRF @ 1KHz rate.

Thick microcal



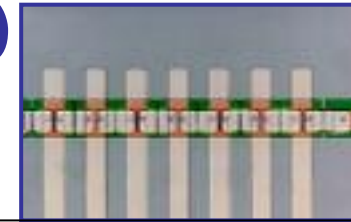
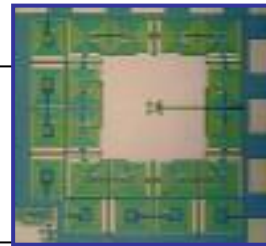
Planar Microcal



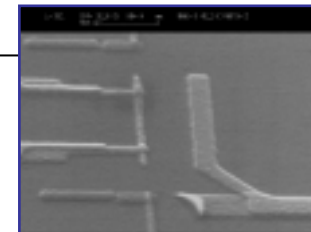
- Prototype of planar microcal are under test with High Bandwidth SQUID.
(6 keV → saturation): energy resolution? From S/N 3-5 eV possible. The work in progress.
- Facilities:
 - 2 laboratories in Genova (160 m²) production(Clean Room, Film Grow, Microlit., wet and dry etching), Testing (3 dilution fridges, 1ADR)
 - 1 laboratory in Rome (100m²) Testing(ADR), X-ray beam

INF Research Activity (300 m² CR 100/1000, lith., film dep.)

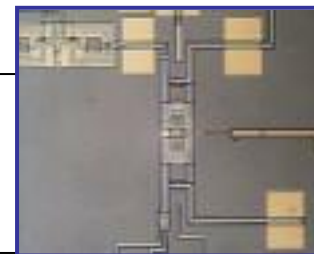
Josephson Junctions



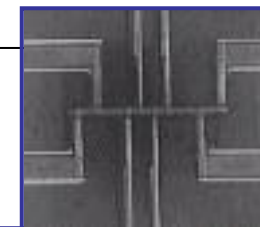
• SQUIDS



• Single Electron Devices



• Superconducting Qubits



• Electronic Microcoolers and Microbolometers

- Expertise in single SQUID production ($\Phi_n = 5.5 \times 10^{-8} \Phi_0 / \sqrt{\text{Hz}} \rightarrow 44 \text{ fA}/\sqrt{\text{H}}$)

On going studies:

- Study on fast and cold electronics for multiplexed SQUID readout (MESFET, MOSFET, HEMT, GeFET, JFET)
- Study of not-SQUID read-out TES signal (presently $11 \text{ pA} / \sqrt{\text{Hz}}$, 10 KHz BW matched with $1\text{-}3 \text{ ohm}$ TES): will be use in multichannel (300 microcalorimeters) "ground based" experiment in 2005.

