

TES@INRiM for SIMP

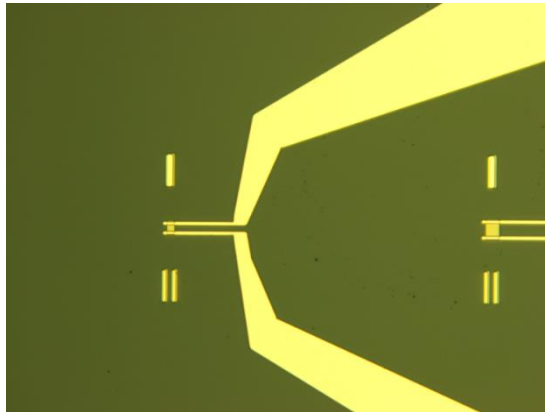
M. Rajteri

Nanoscience and Materials Division

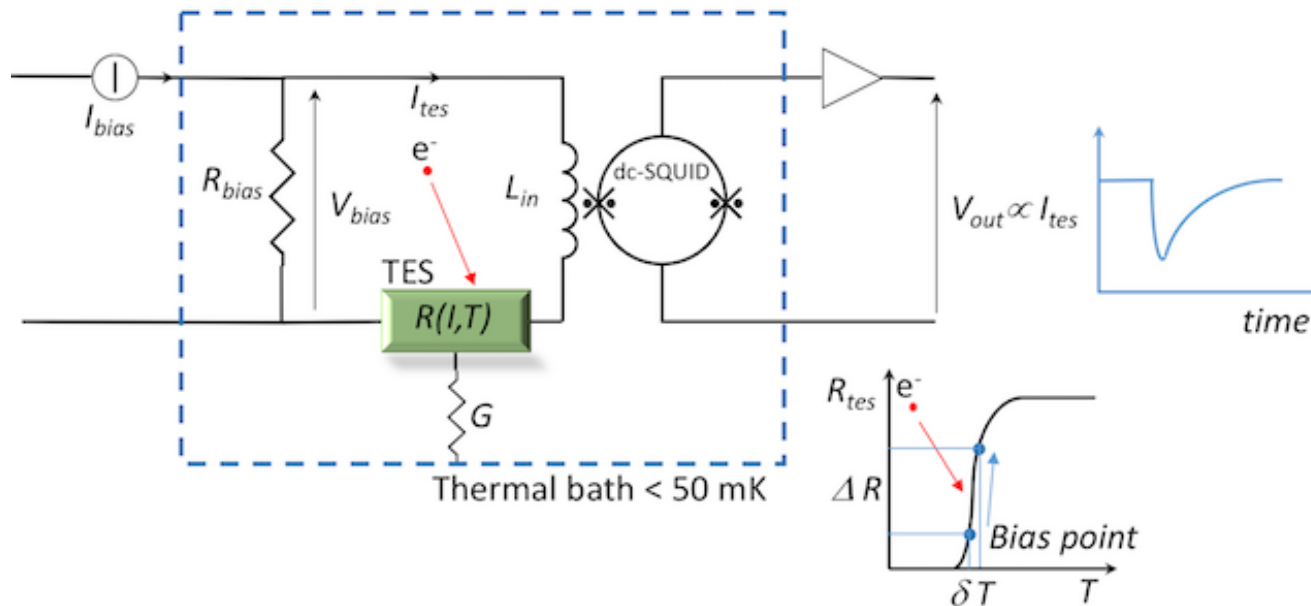


Strada delle Cacce 91
10135 Torino - Italy

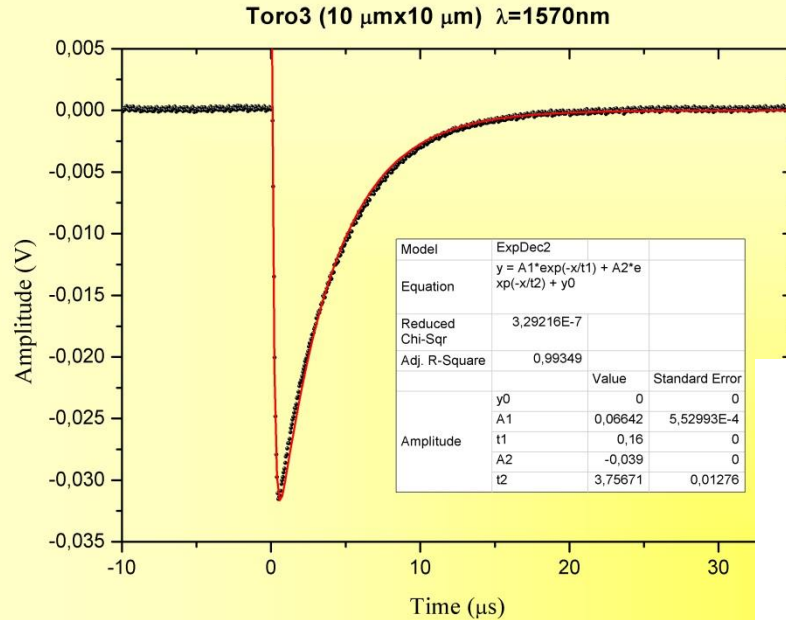
TESs as single photon detectors



20 μm X 20 μm



TES: High energy resolution



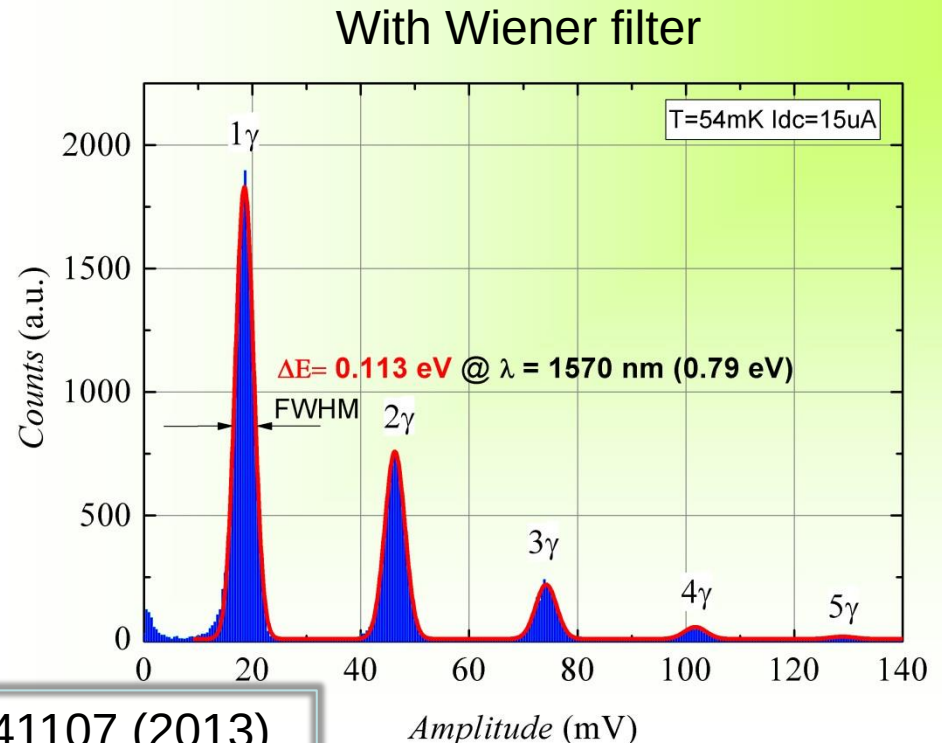
$$\tau_{\text{eff}} = 3.8 \mu\text{s}$$

$$C \sim 0.35 \text{ fJ/K}$$

$$G \sim 44 \text{ pW/K}$$

$$\Delta E = (0.113 \pm 0.001) \text{ eV}$$

$$\Delta E = 2\sqrt{2 \ln 2} \frac{\sigma_1 E_\gamma}{x_{2\gamma} - x_{1\gamma}}$$



L. Lolli et al., Appl. Phys. Lett. 103, 041107 (2013)

TES: Performances

Transition sharpness

$$\tau_{eff} = \tau_{th} \left\{ 1 + \frac{\alpha}{n} \left(1 - \frac{T_s^n}{T_c^n} \right) \right\}^{-1} \approx \frac{n}{\alpha} \tau_{th} \approx \frac{C}{G} \propto T_c^{-3} \quad \text{Effective response time}$$

↕ Trade-off between response time and energy resolution

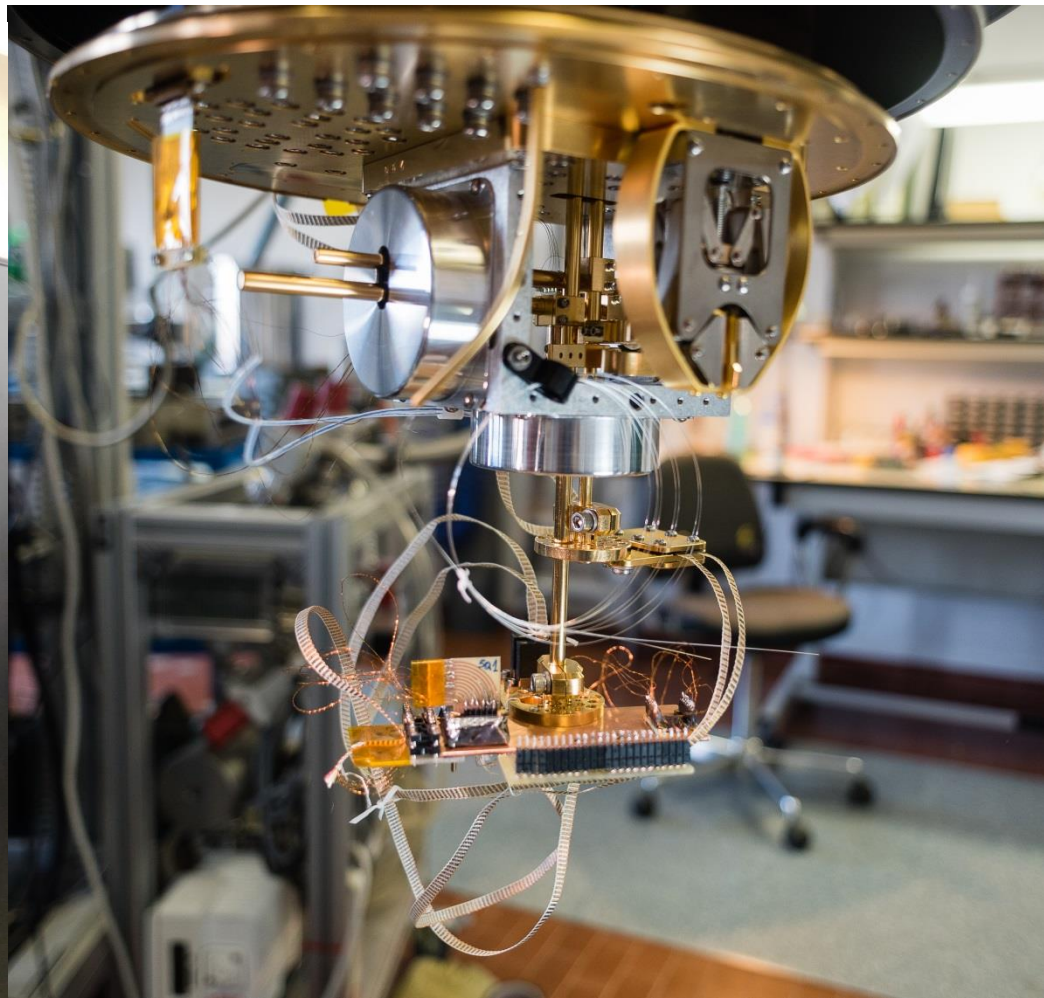
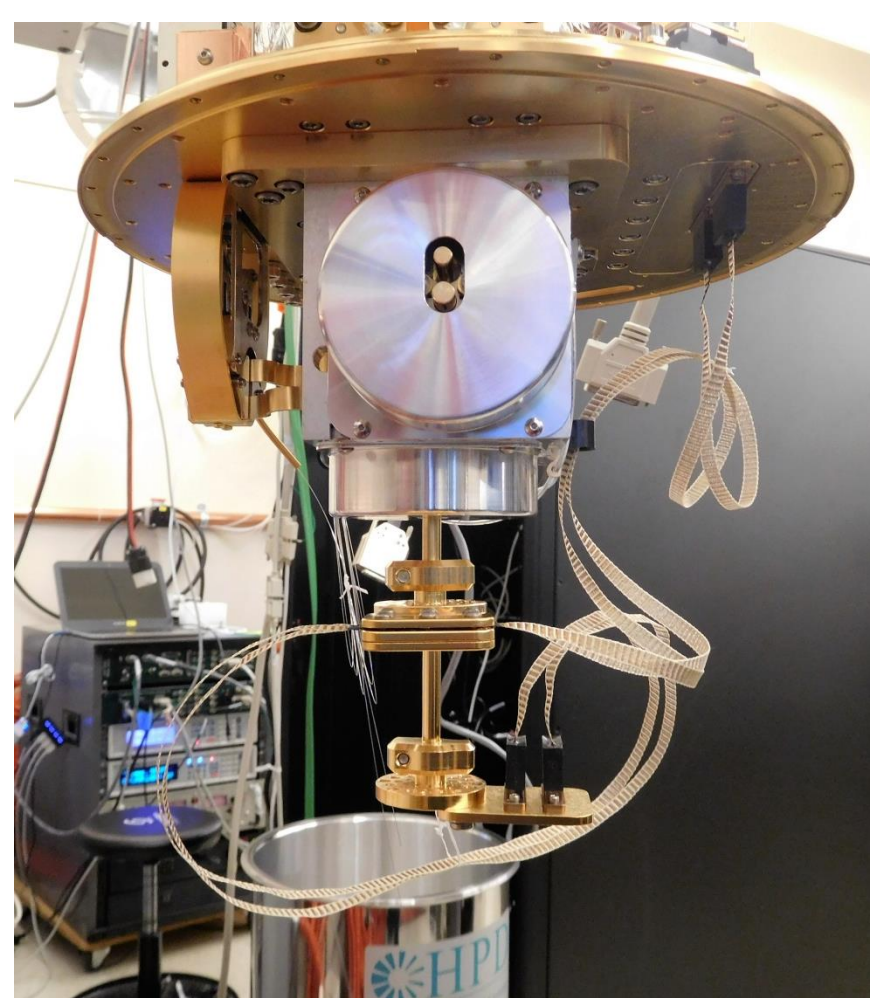
$$\Delta E_{FWHM} \approx 2.36 \sqrt{4kT_0^2 \frac{C_e}{\alpha} \sqrt{n/2}} \propto T_c^{3/2} \quad \text{Energy resolution}$$

↕ Trade-off between energy resolution and saturation energy

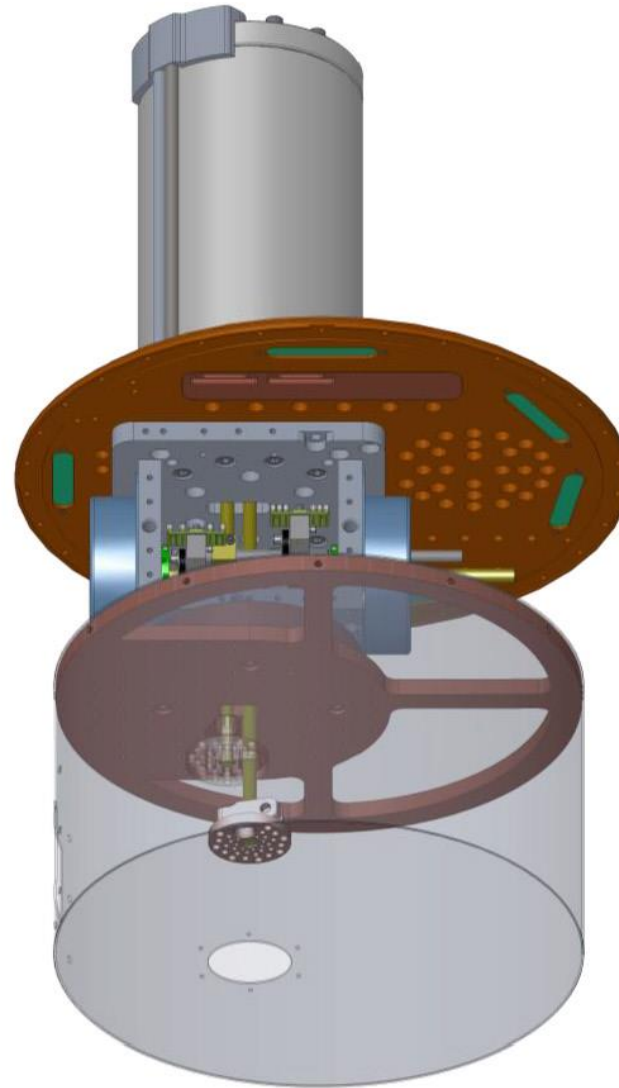
$$E_{\max} \approx \frac{CT_c}{\alpha} \quad \text{Saturation Energy}$$

Cryogenfree ADR

$T_{\min}=30$ mK - Hold time @ $T=50$ mK : 39 h - Hold time @ $T=100$ mK : >150 h

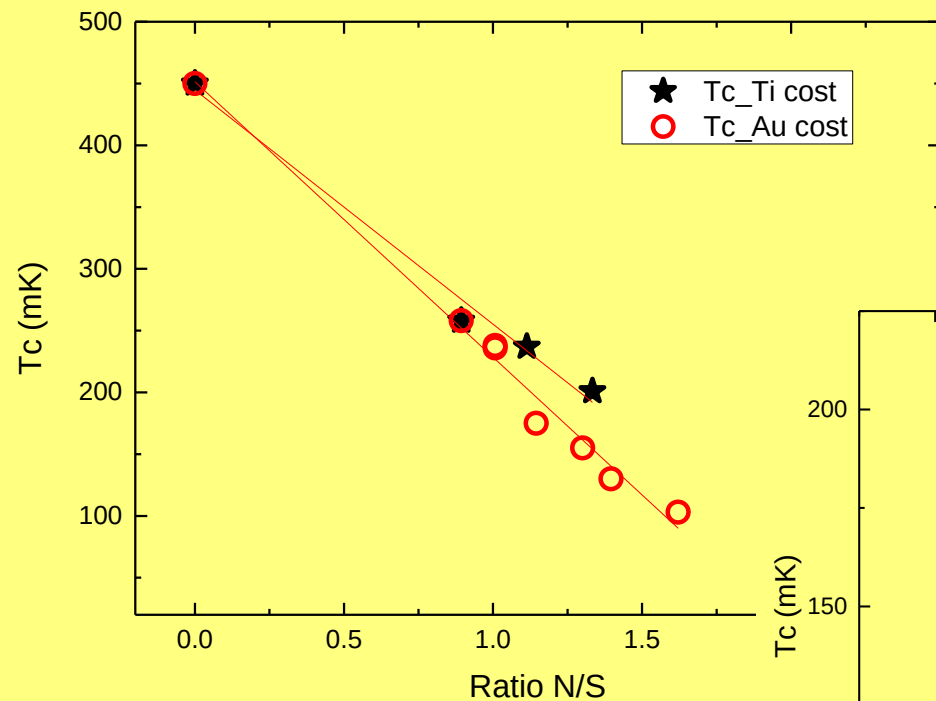


ADR: magnetic shield

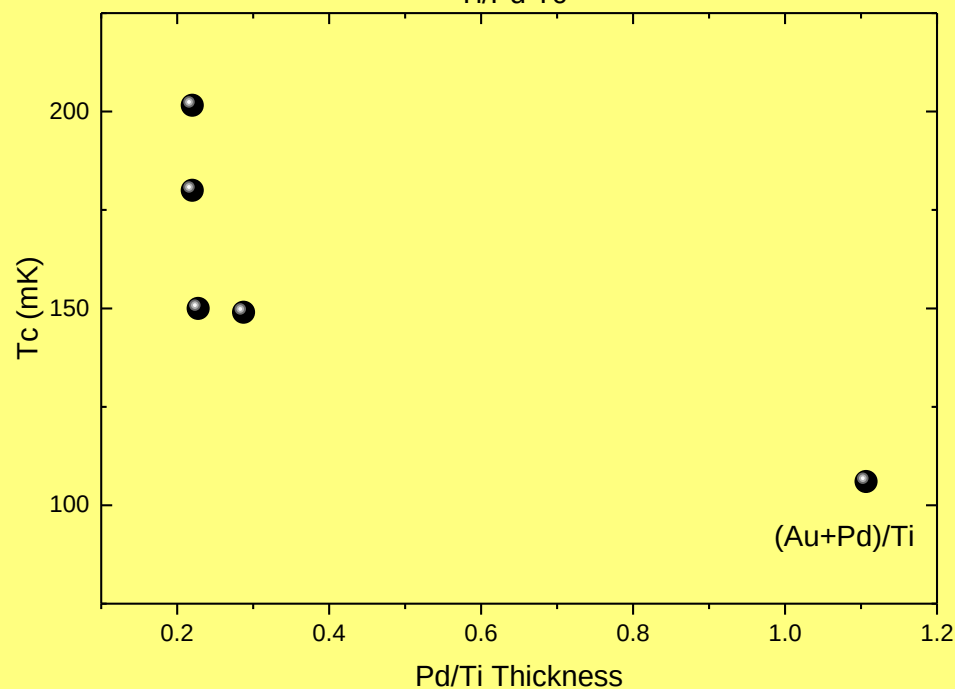


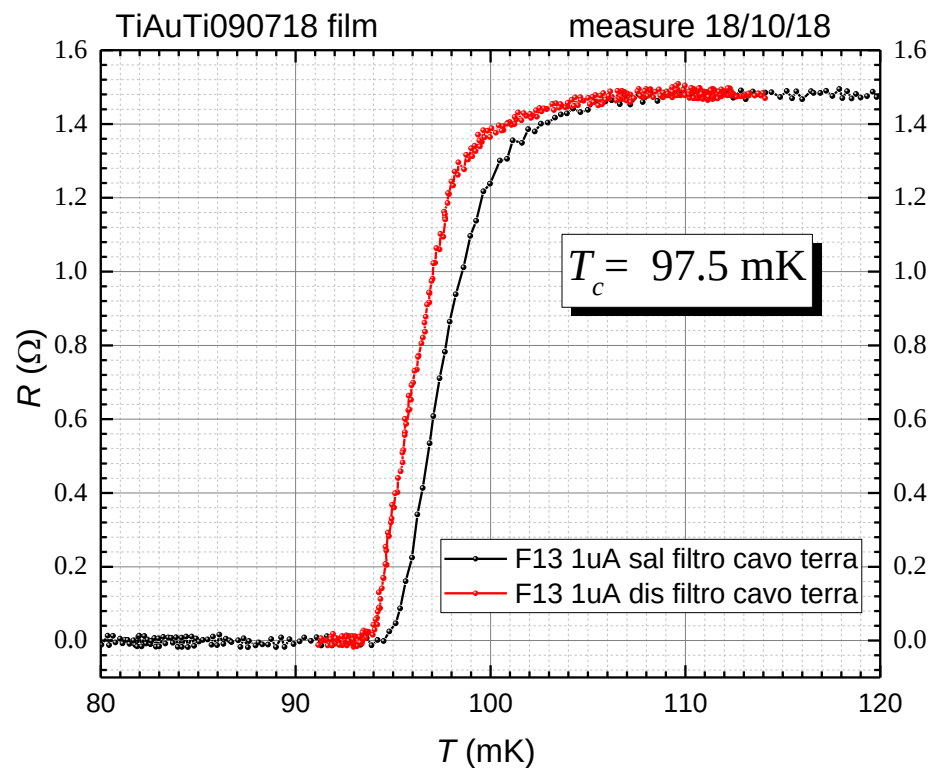
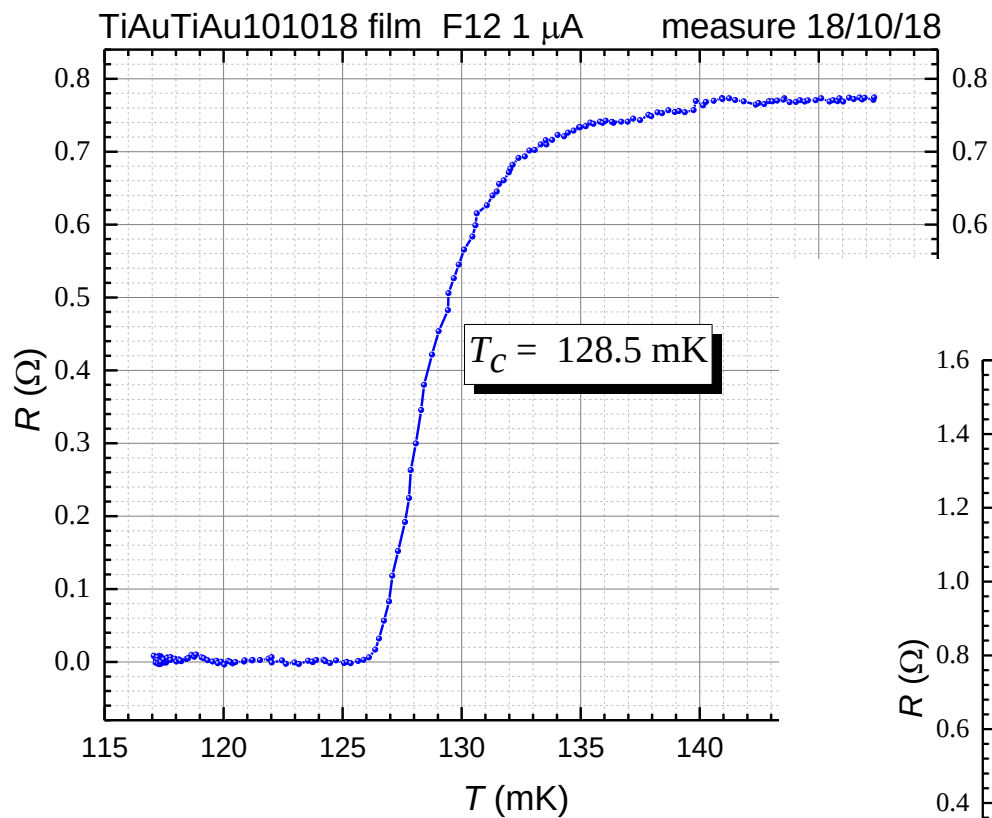
Ti/Au and Ti/Pd film T_c

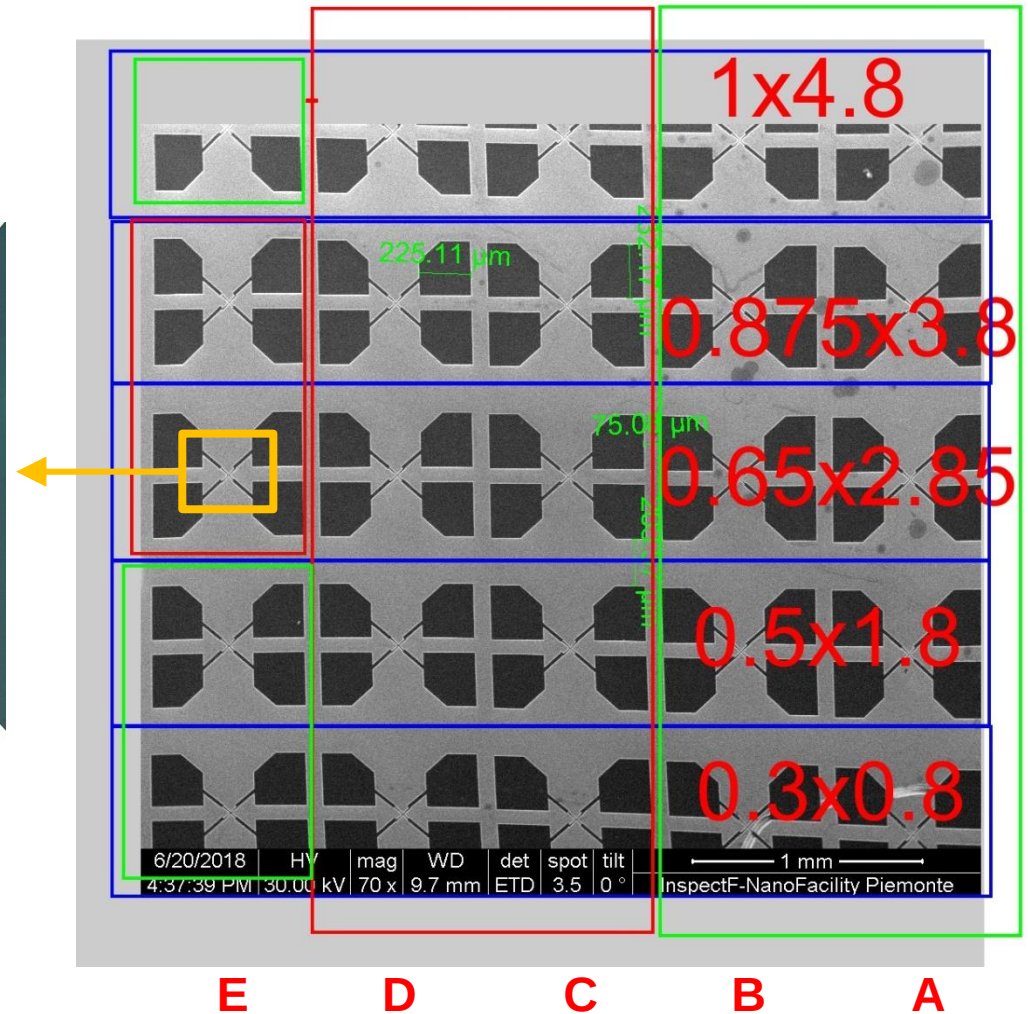
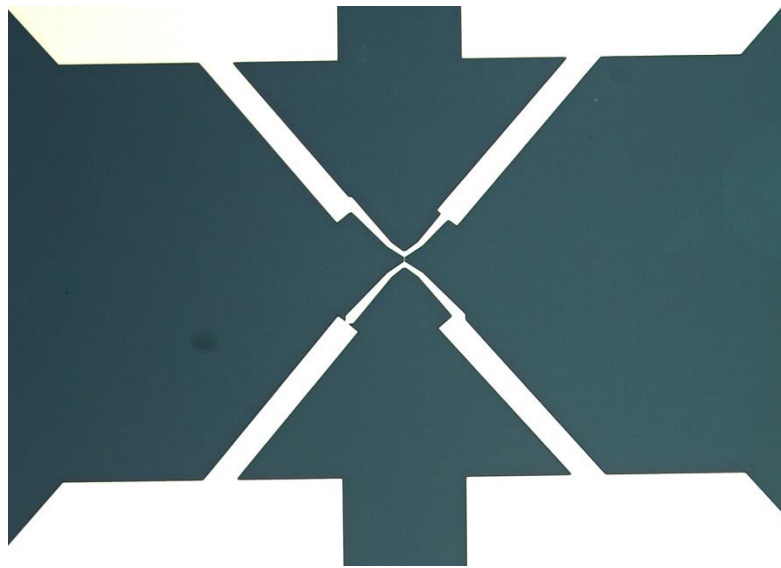
TiAuTiAu Critical Temperature

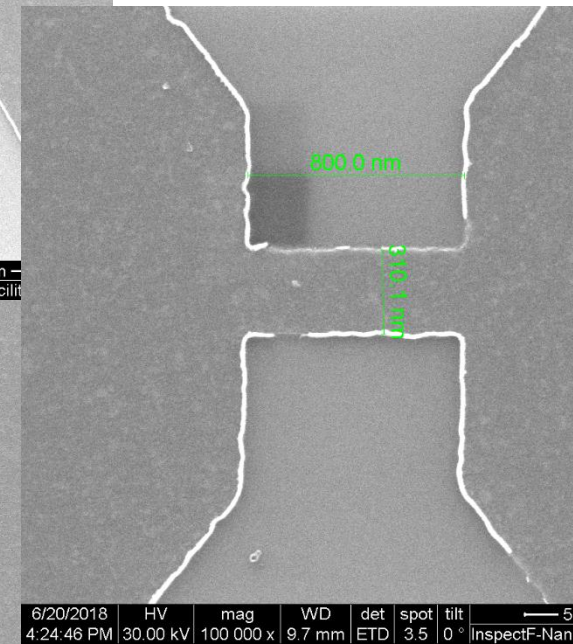
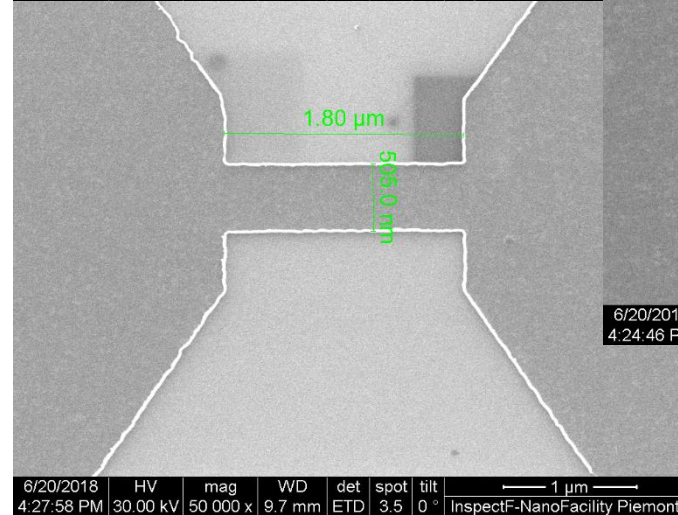
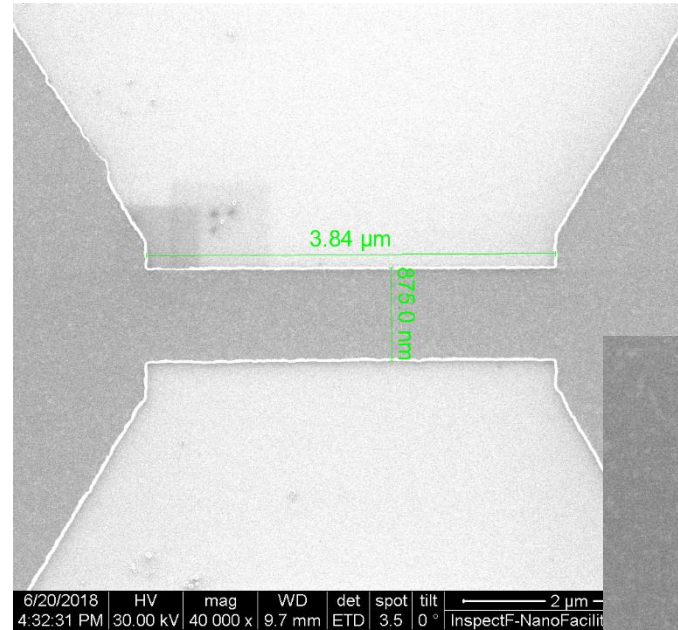
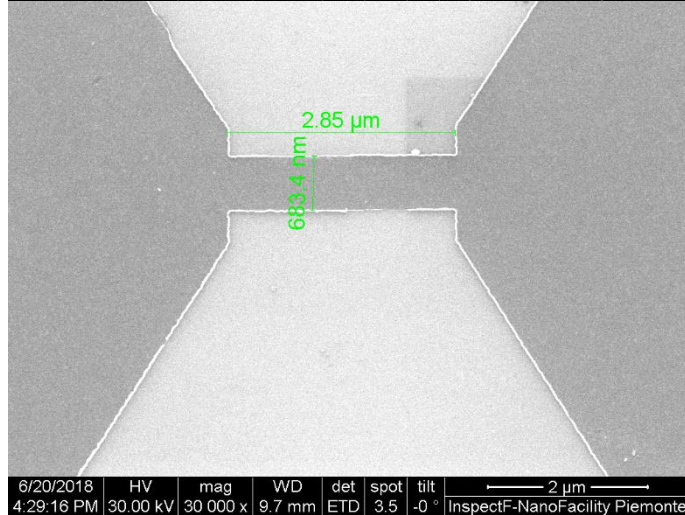
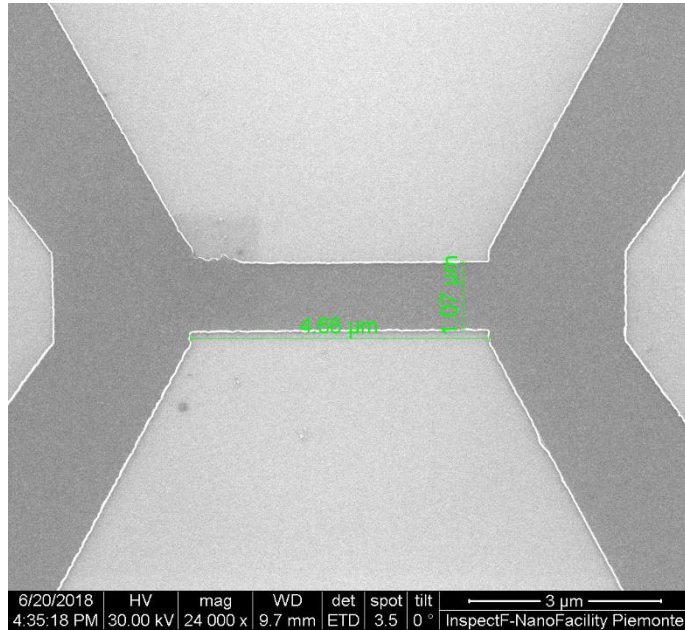


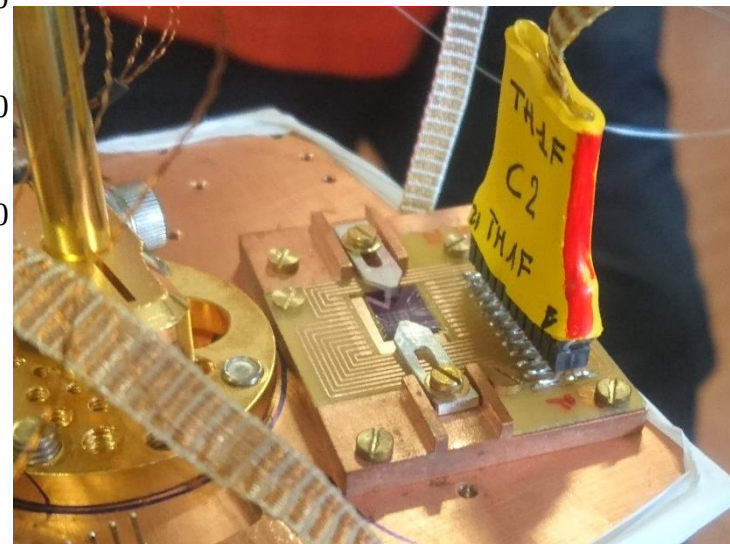
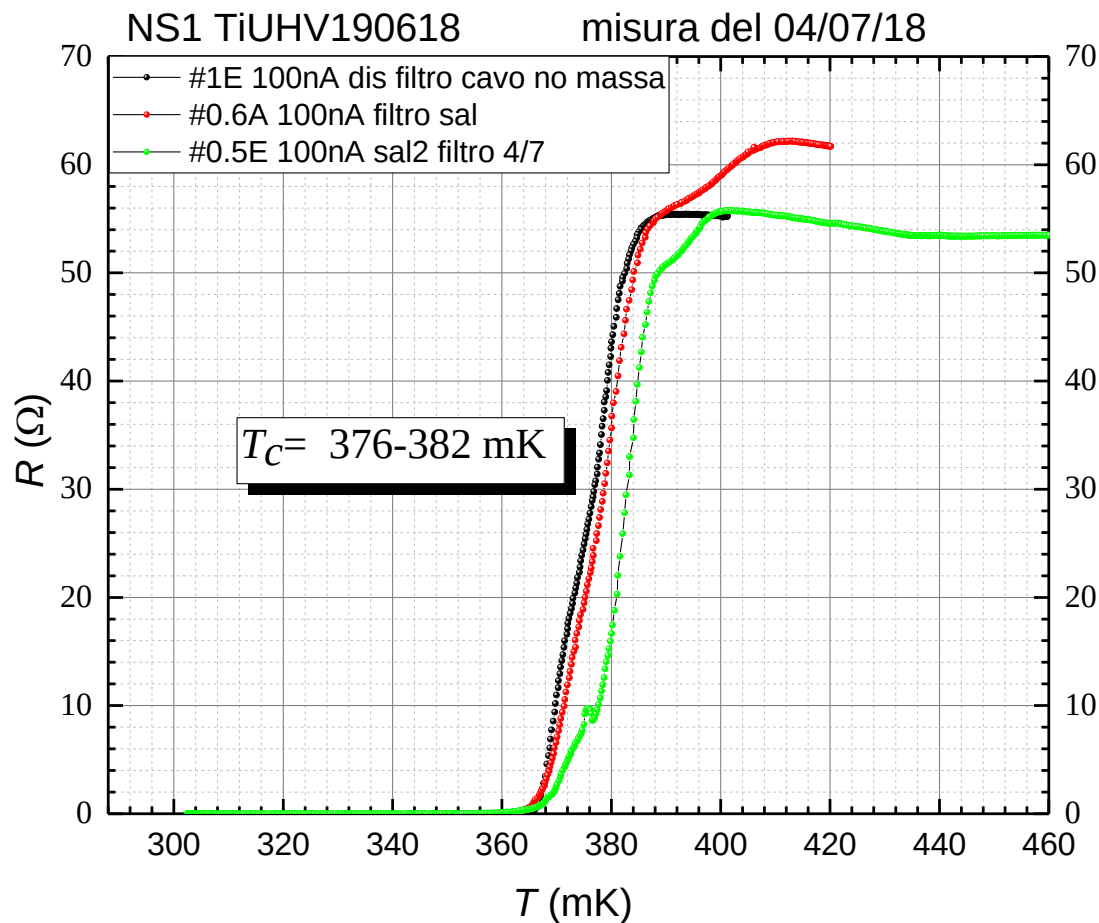
Ti/Pd T_c











SIMP request

Target: $\Delta E = 0.02$ meV @ 0.4 meV (100 GHz)

Sviluppi per 2019:

Fabbricazione di film con
 T_C ridotta a 40-50 mK

Fabbricazione e
Caratterizzazione
nanostrip con misure a 4
fili

Miglioramento del
sistema di misura:
schermi e filtri

Test di lettura con dc-squid