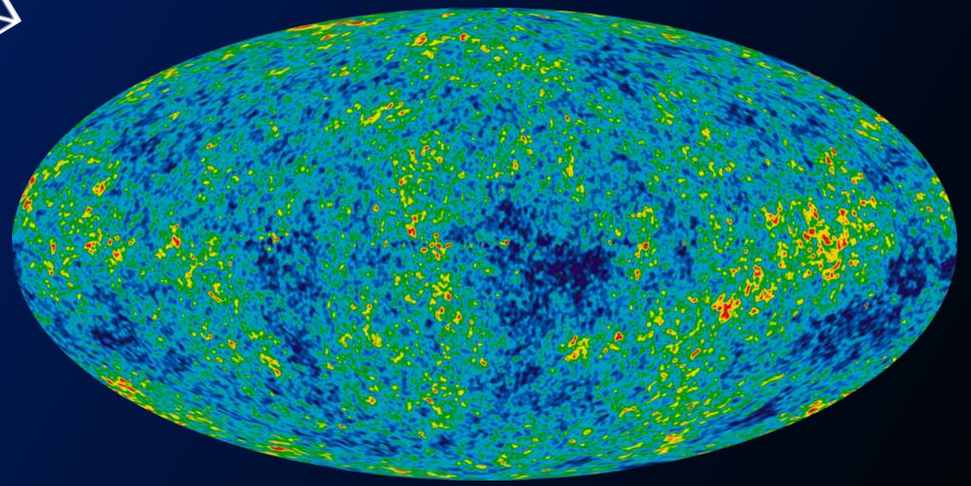
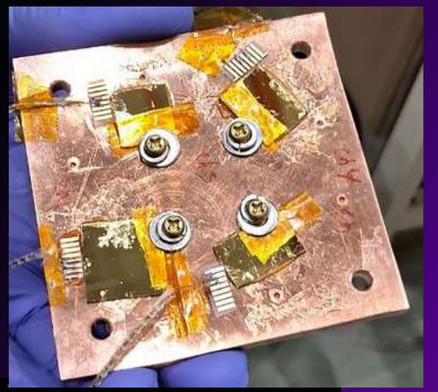
Detecting Faint Signals with

TRANSITION EDGE SENSORS (TES)

0.0006 eV, 2.7 K



TES



LiteBird

Srijeeta Barua, *Under the guidance of:* Prof. Akamatsu, Dr. Fujino & Igarashi San (QUP)

Img: Canva, JAXA & NASA / WMAP Science Team

VERY SENSITIVE TEMPERATURE SENSORS!

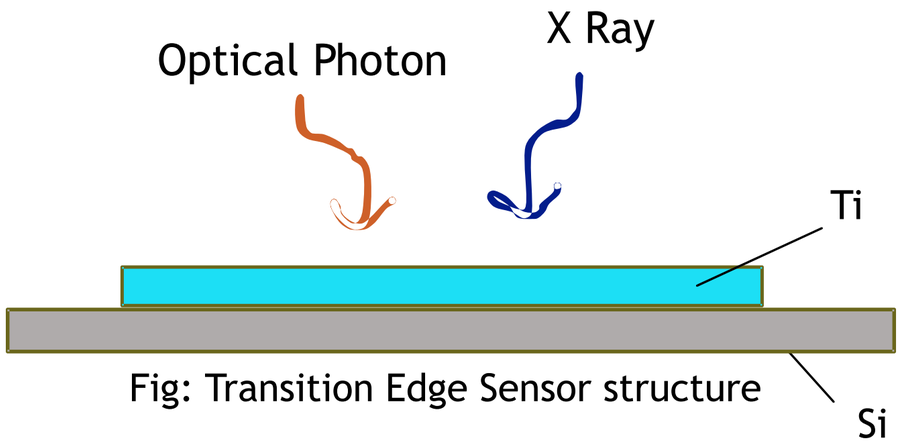
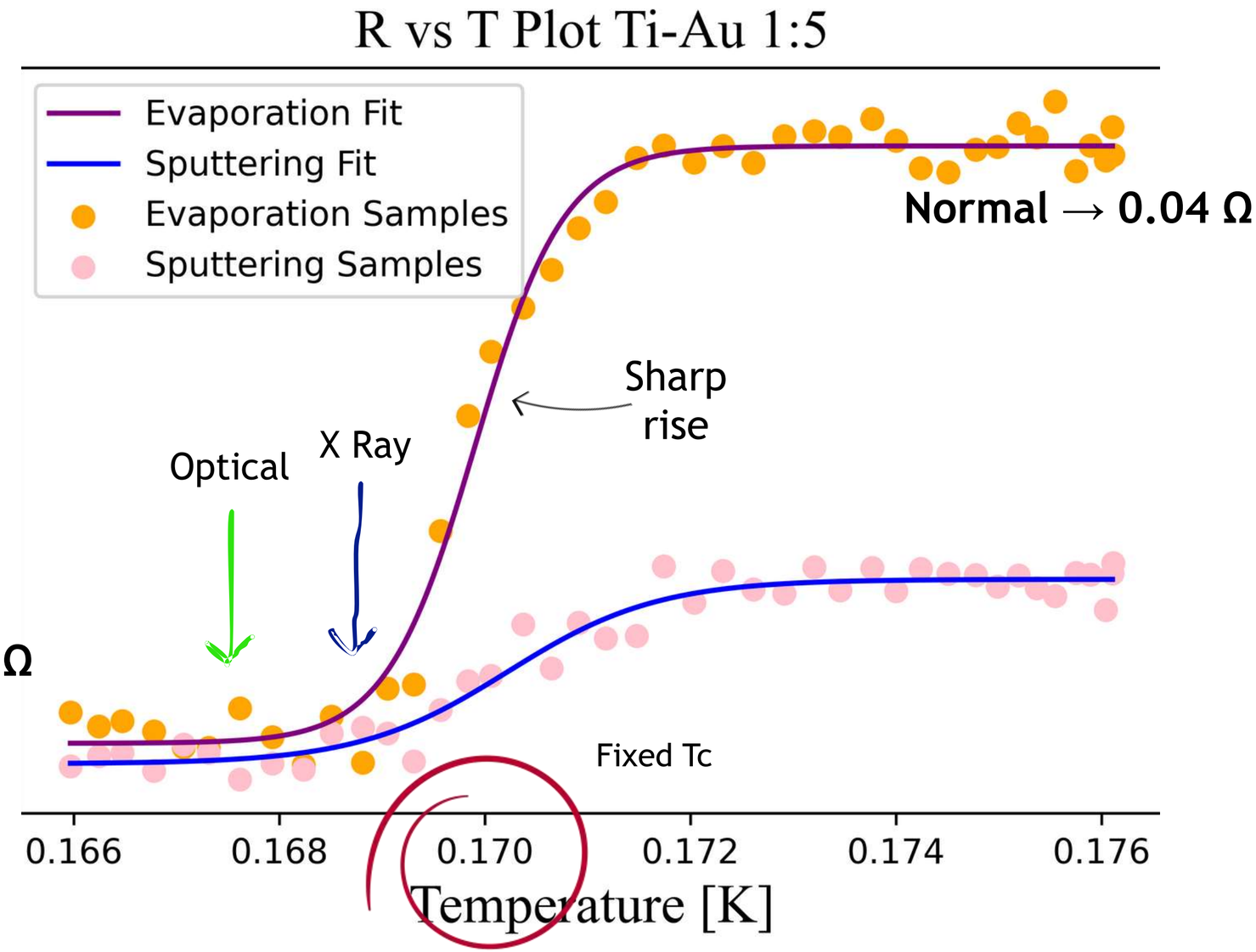


Fig: Transition Edge Sensor structure



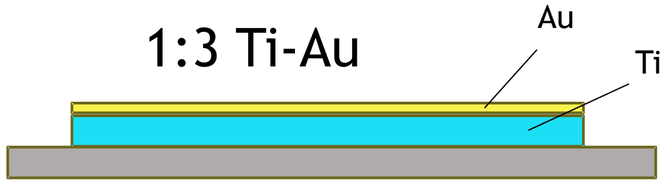
Superconductor → 0.001 Ω

- Can we tune natural Tc?

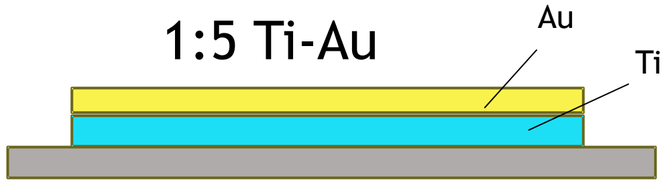
ADDING A LAYER OF GOLD!

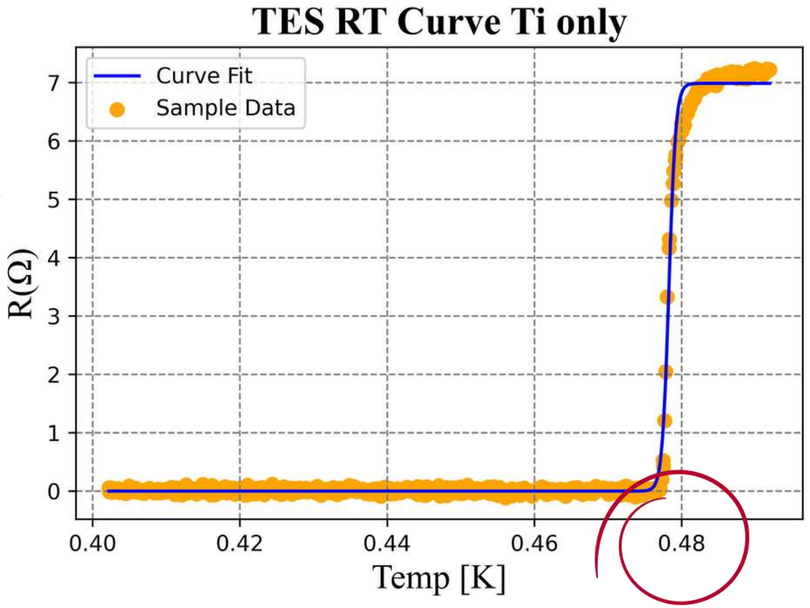
Ti only

1:3 Ti-Au

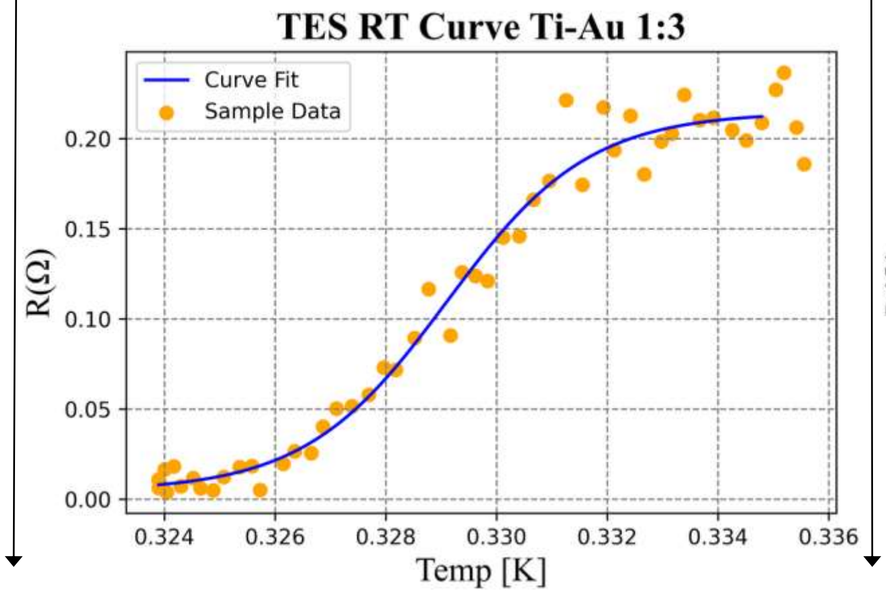


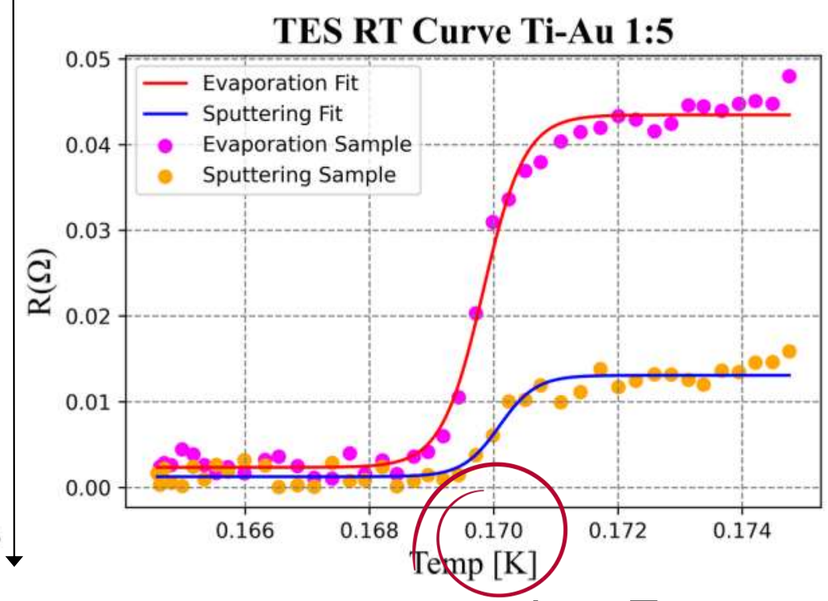
1:5 Ti-Au





High Tc



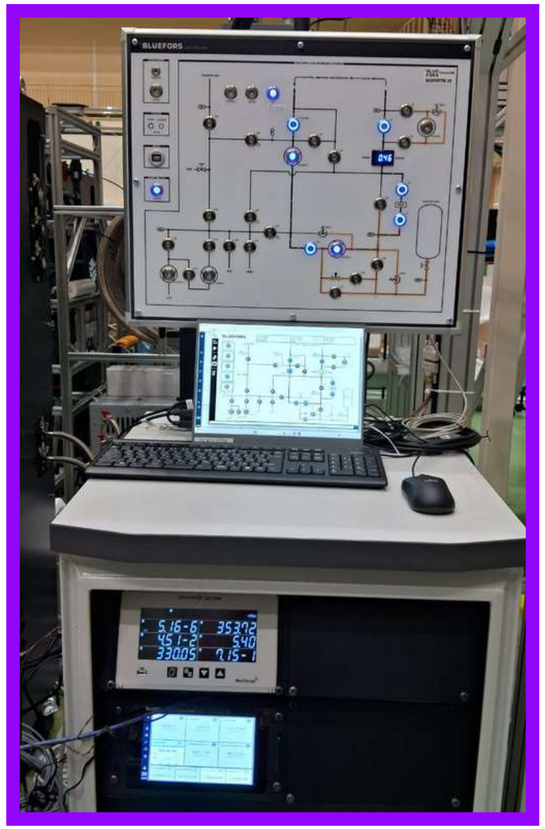


Low Tc

Cooper pairs leak into Au layer (Proximity Effect) → Fewer pairs → break easily at Lower Tc!

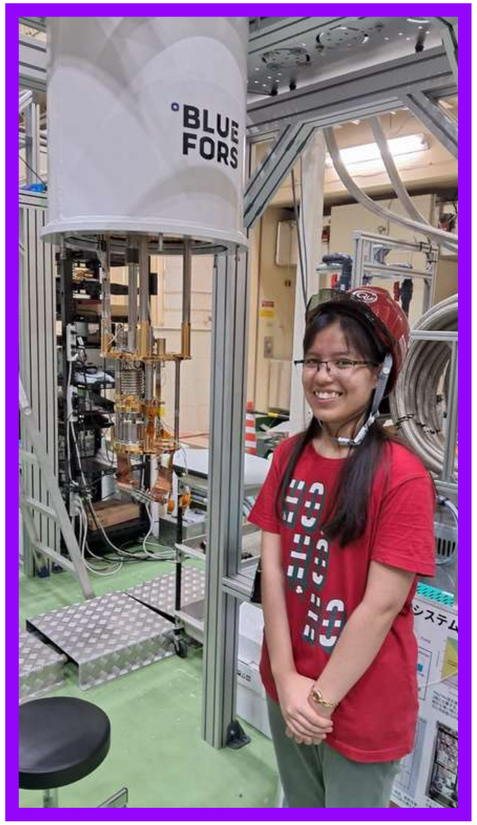
ENVIRONMENT – DILUTION REFRIGERATOR

"0.170 K" achieved by mixing He3 & He4 - endothermic



(a)

(b)



(c)

(d)

Fig: Experimental setup (a) Control Unit (b) Closed Cooler (c) Open Cooler (d) Mixing Chamber Flange (coldest) with RuOx Temperature Sensor

RESULTS AND CONCLUSION

Table: Summary of Fabrication Methods and Performance

Method	Ratio of Ti/Au	Critical Temp (Tc) mK	Peak α
Evaporation	Ti only	$478.28 \pm 1.3 \times 10^{-5}$	873.2
Sputtering	1:3	$329.1 \pm 13 \times 10^{-5}$	190.8
Evaporation	1:5	$169.83 \pm 3.1 \times 10^{-5}$	314.0
Sputtering	1:5	$170.09 \pm 7.5 \times 10^{-5}$	303.9

- Sample Tc -> SRON and ISAS/JAXA
- Faint signals = Superconducting TES + Gold

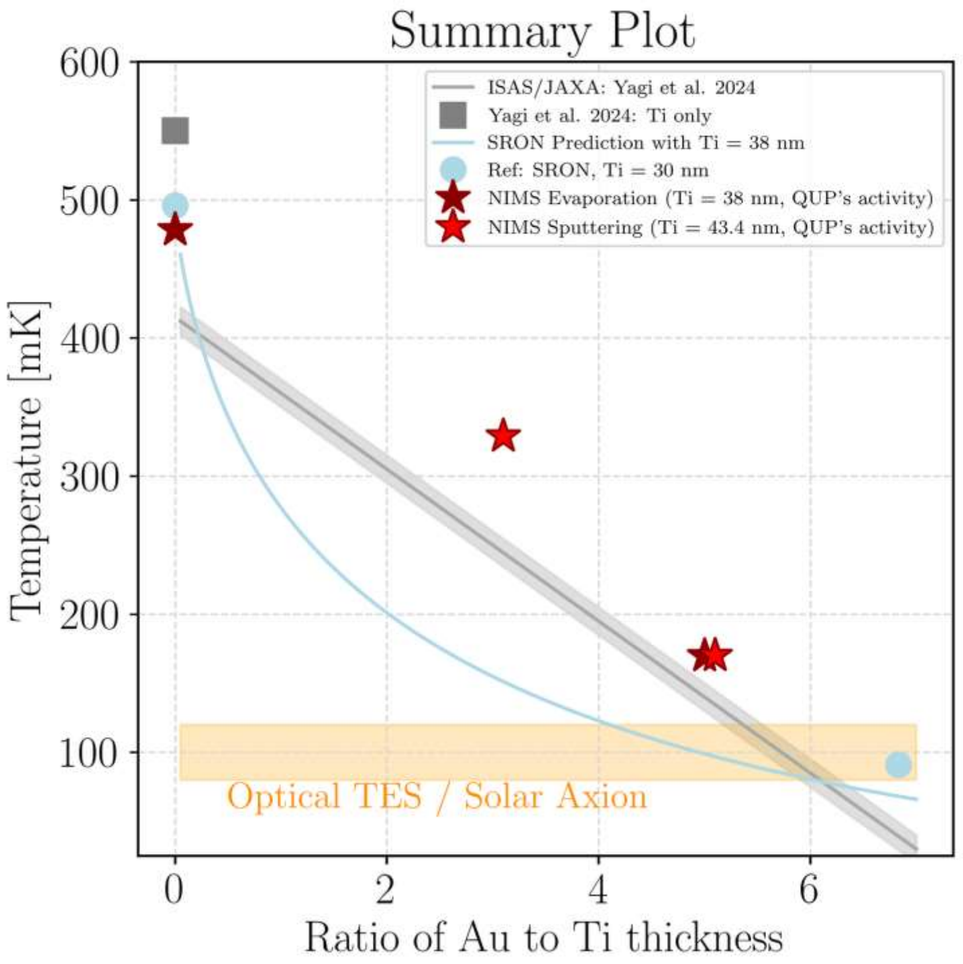


Fig: Summary plot comparing QUP's measurements with existing references

REFERENCES:

- Cabrera, B. (2008). Introduction to tes physics. *Journal of Low Temperature Physics*, *151*(1), 82-93.
- Yagi, Y., Hayashi, T., Tanaka, K., Miyagawa, R., Ota, R., Yamasaki, N. Y., ... & Homma, T. (2023). Fabrication of a 64-pixel tes microcalorimeter array.

ARIGATOGOZAIMASU for this amazing experience!

FOR FURTHER QUESTIONS : srijeeta.barua@stu.adamasuniversity.ac.in