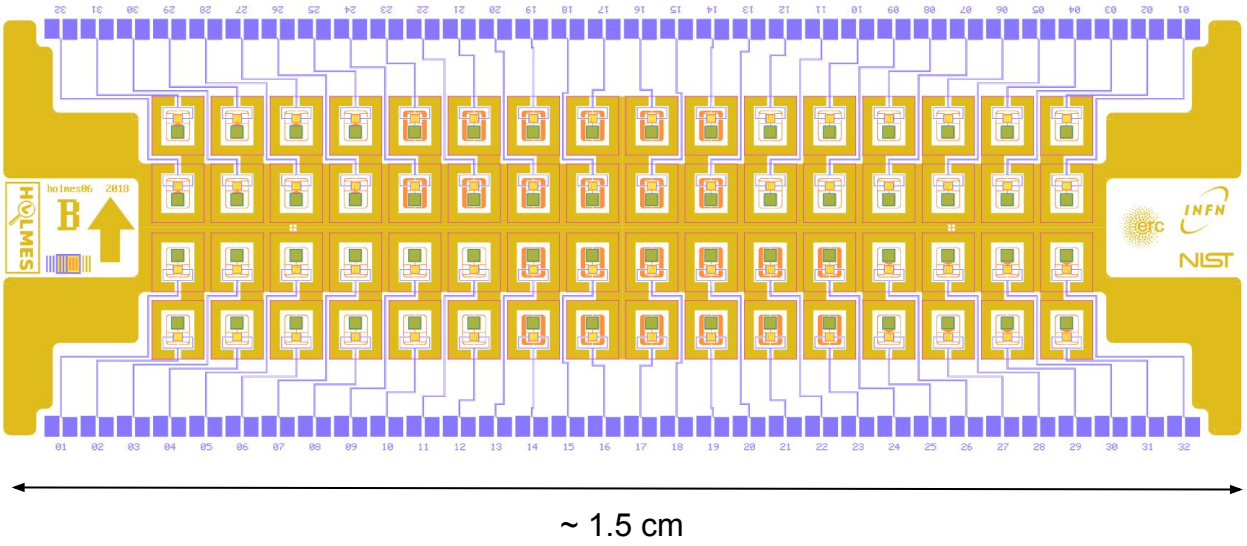
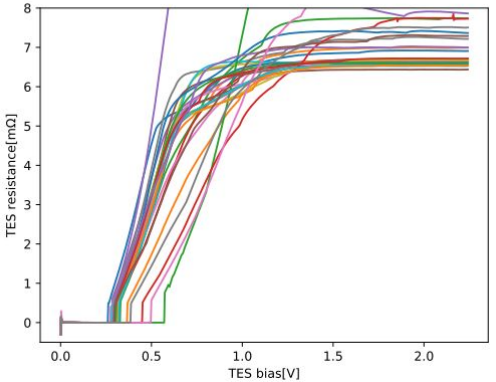
Detection of electrons @ 300 eV

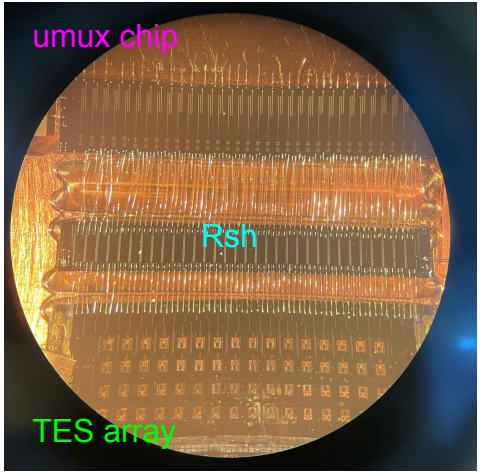
Matteo Borghesi, on behalf of Milano-Bicocca group

TES array

- Chip with 64 TES with **different geometries**. Only 32 (upper half) are connected to the readout chip.
- Microwave multiplexing readout.
- **Without collimator.**

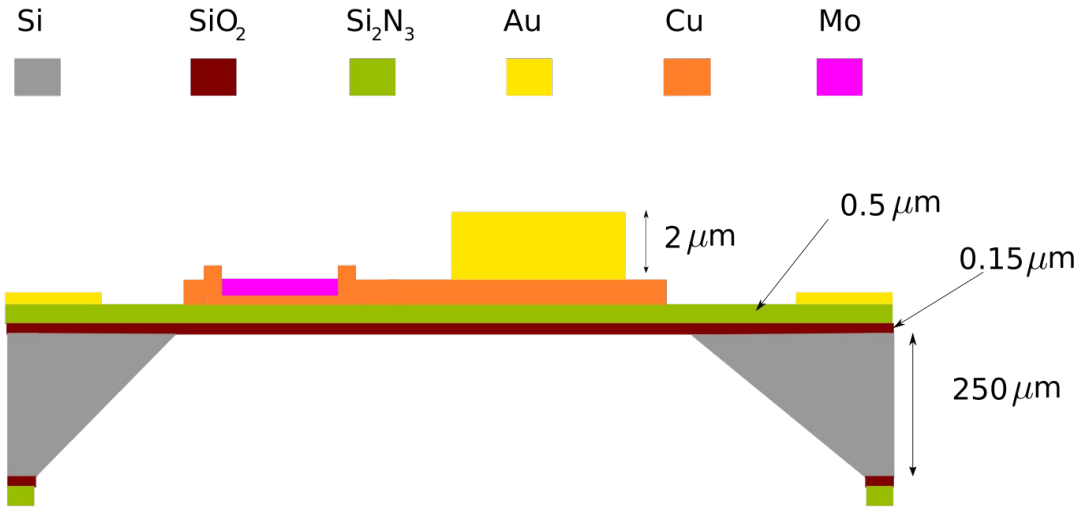


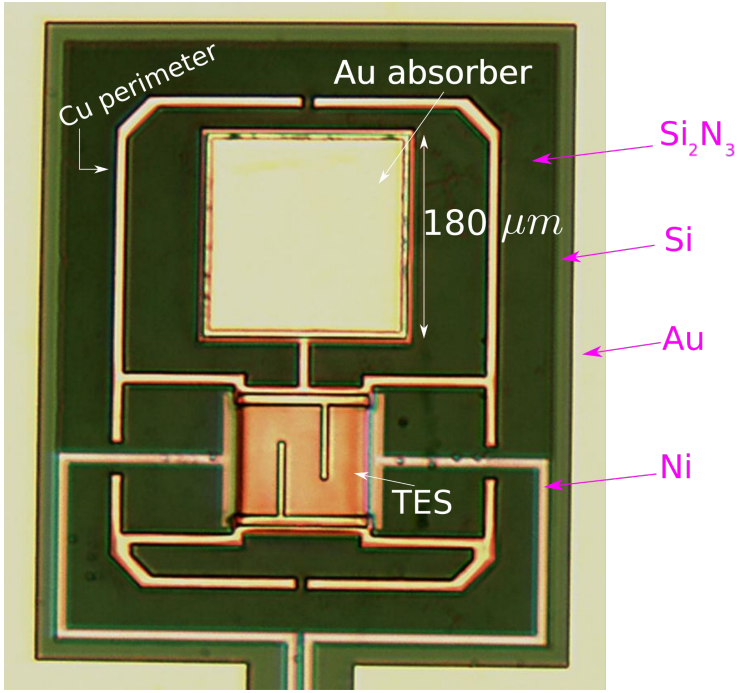




TES pixel

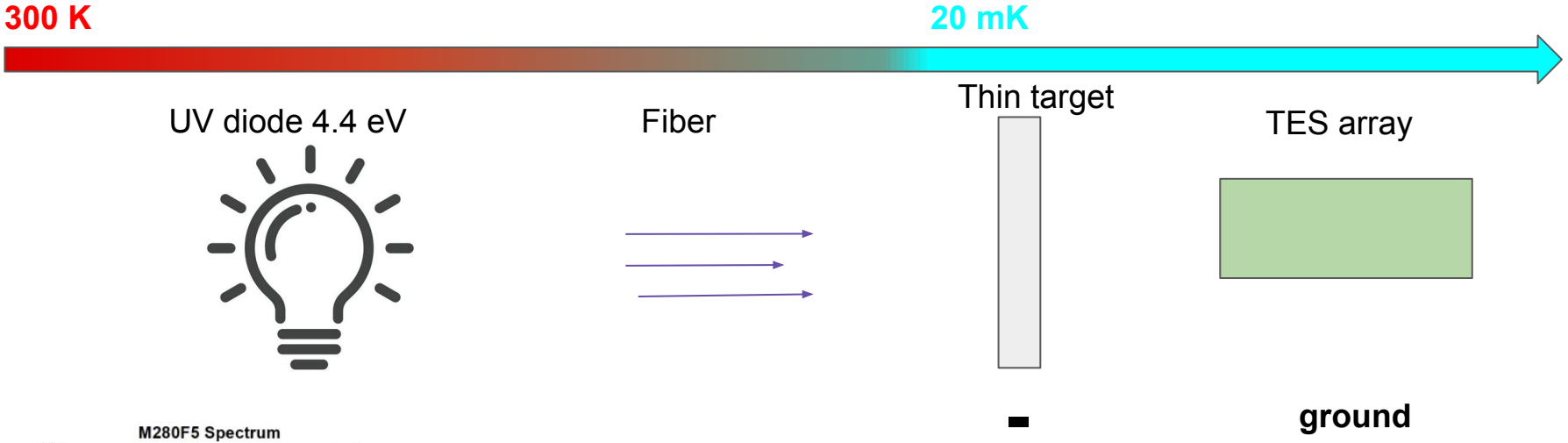
- TES designed for HOLMES.
- Dynamic range: soft X-ray (E<=10 keV)
- Energy resolution: 4-5 eV FWHM @6 keV

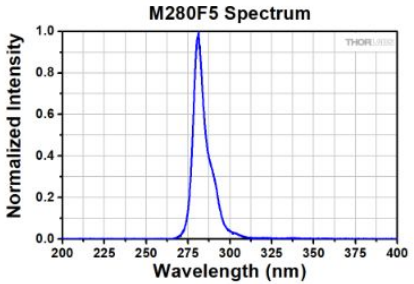




Egun concept

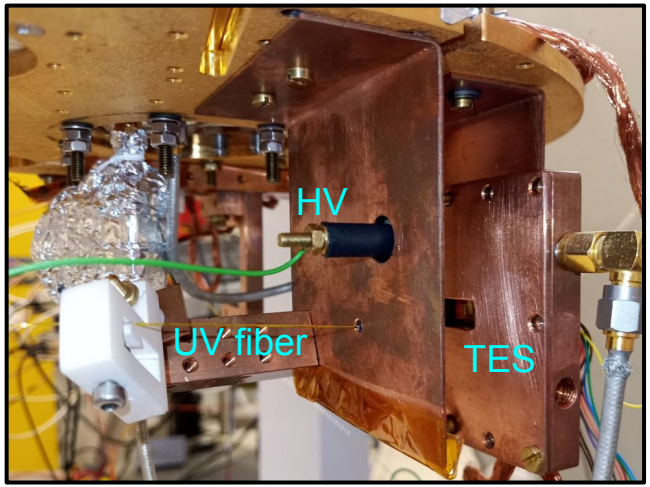
- Cryogenic, compact, switchable.
- Electron rate and electron energy not correlated.

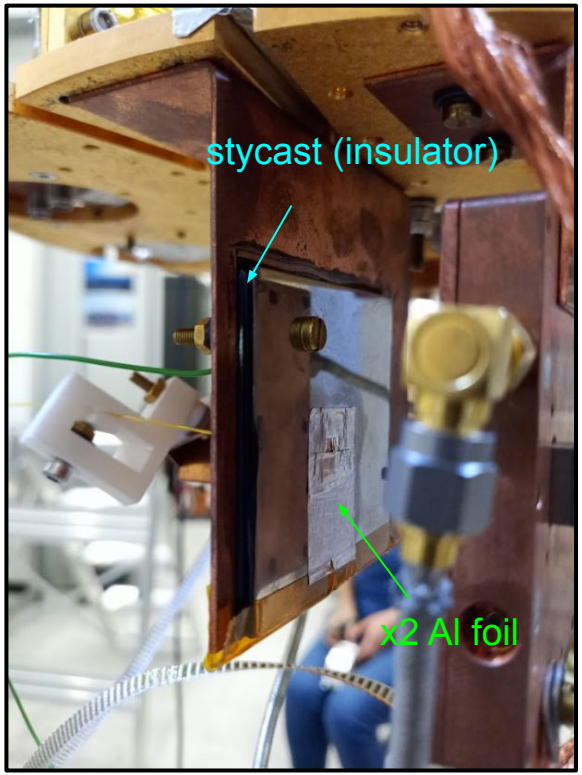


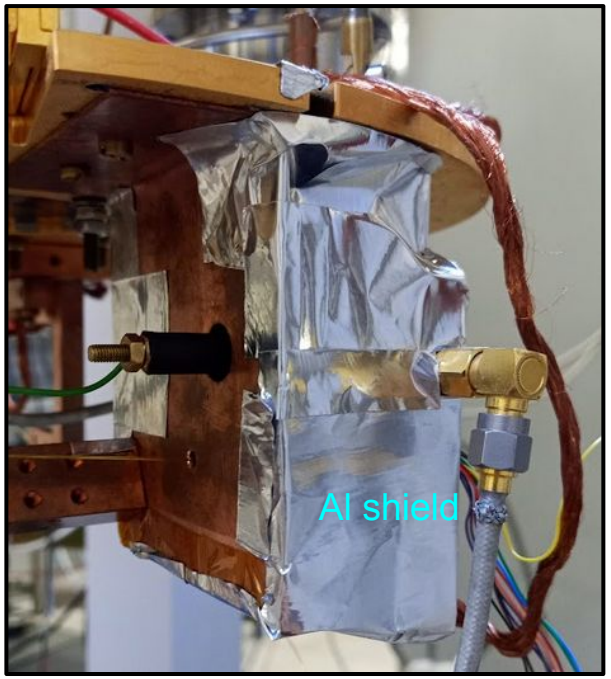


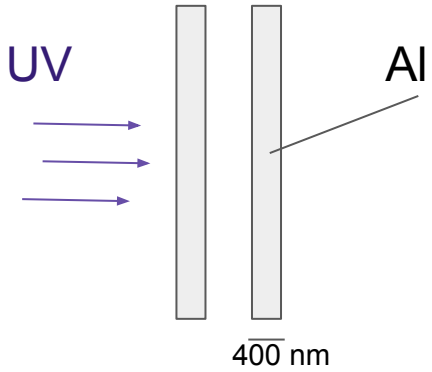
	Symbol	Min	Typical	Max
Peak Wavelength[a,b]	λ_p	275 nm	280 nm	285 nm
LED Output Power (Ø400 µm Fiber)[a,b,c]	P_{out}	0.5 mW	0.8 mW	-

Setup



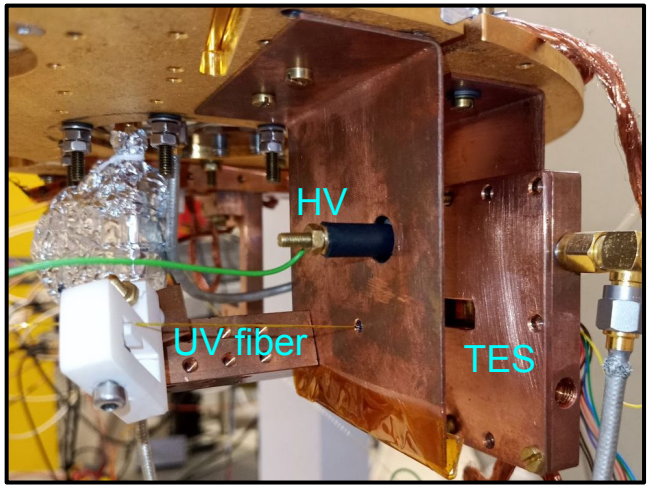


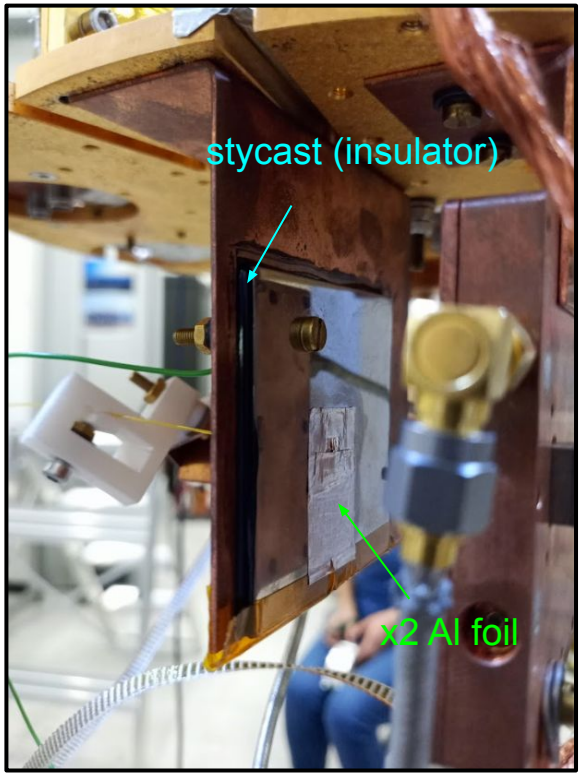


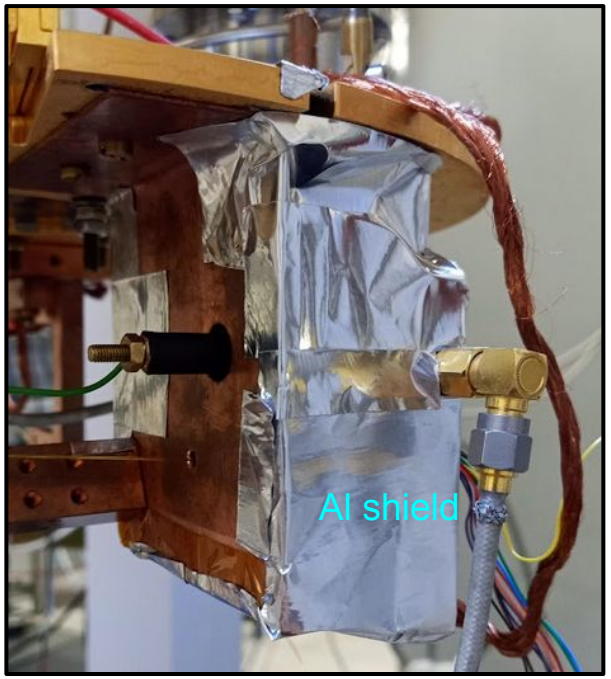


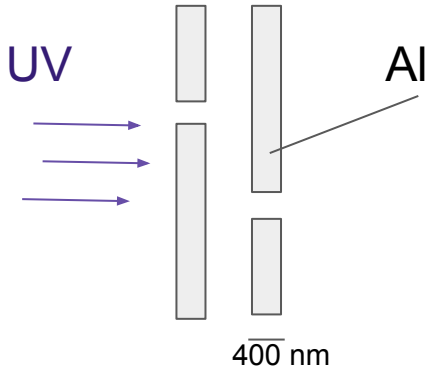
note: Inelastic Mean Free Path of Al for electrons @4 eV & @T<Tc = ?

Setup



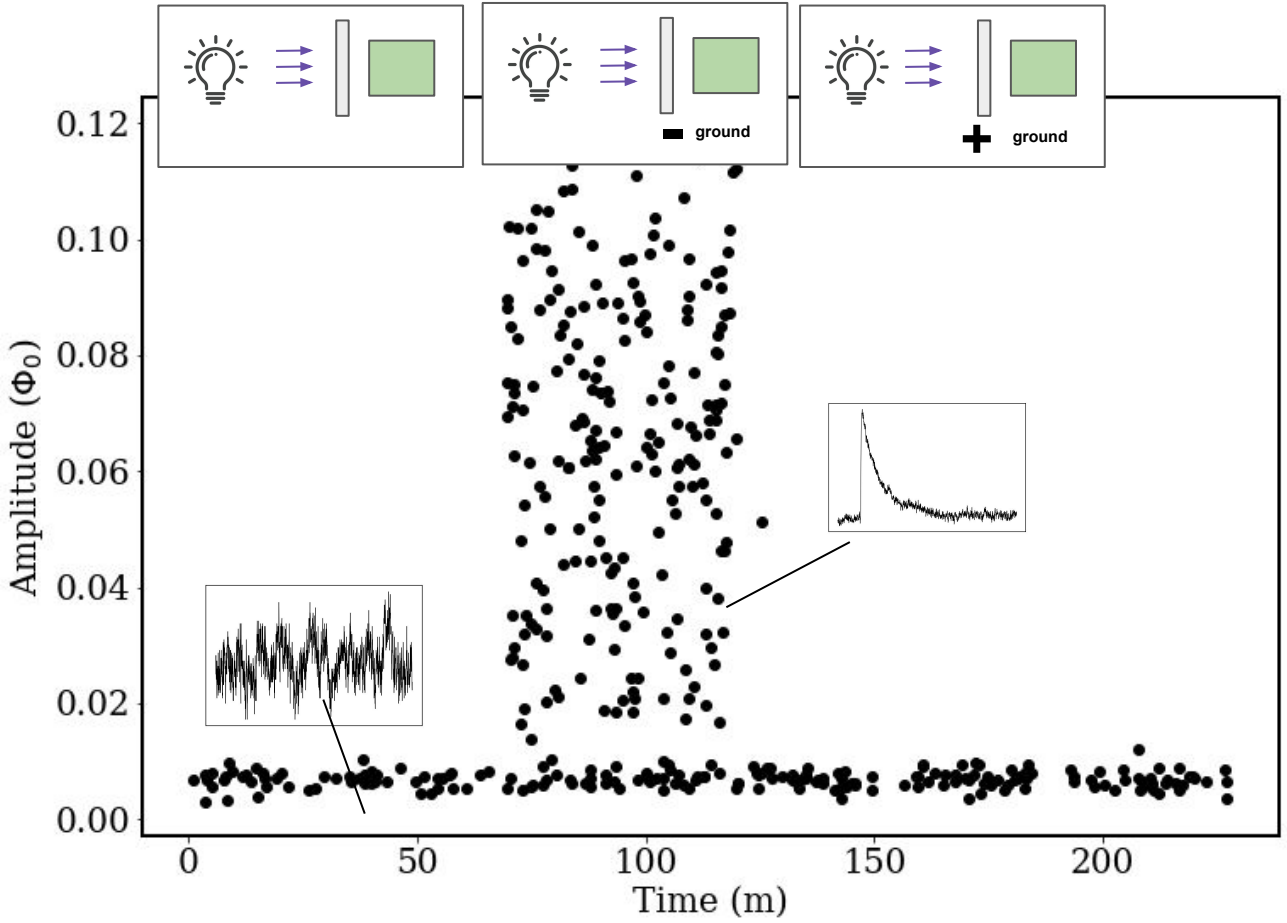






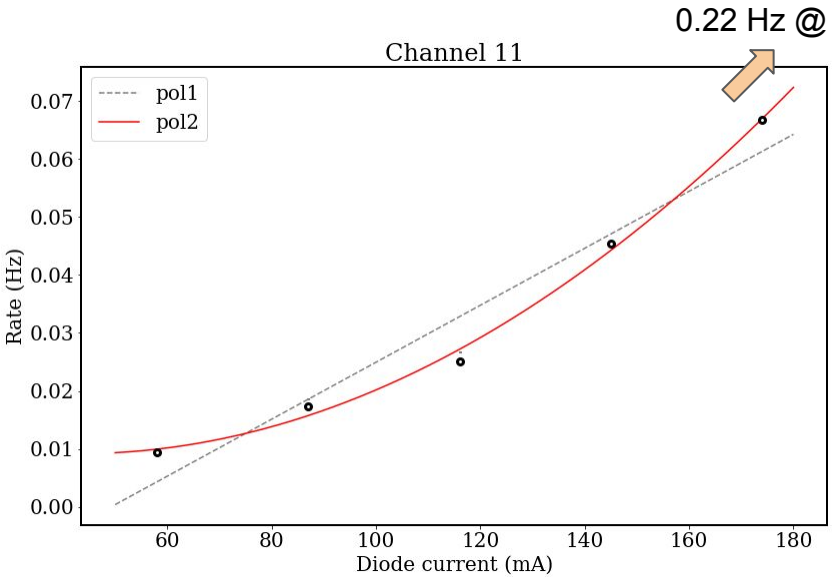
note: Inelastic Mean Free Path of Al for electrons @4 eV & @T<Tc = ?

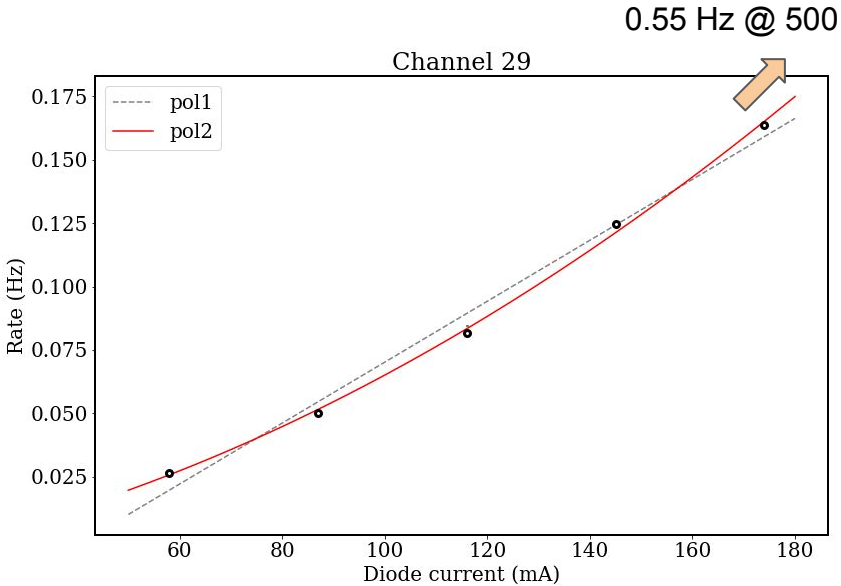
Are these electrons? I



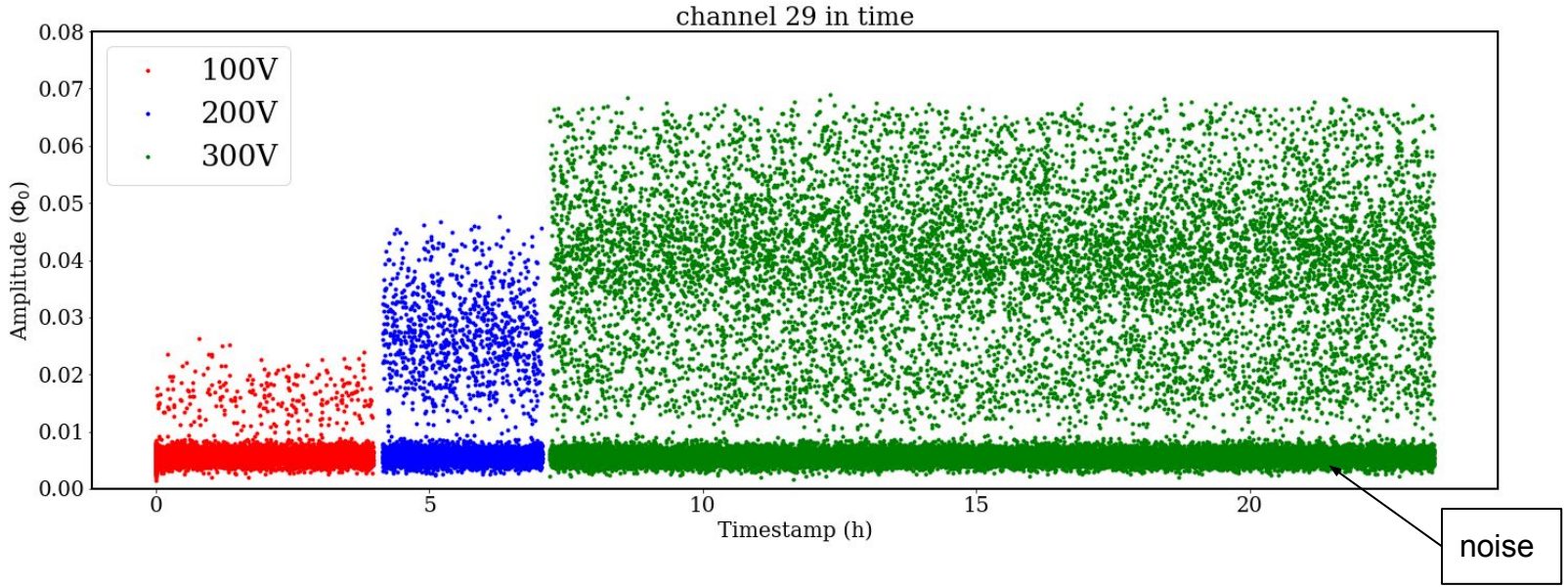
Are these electrons? II

- Note: diode Imax = 500 mA

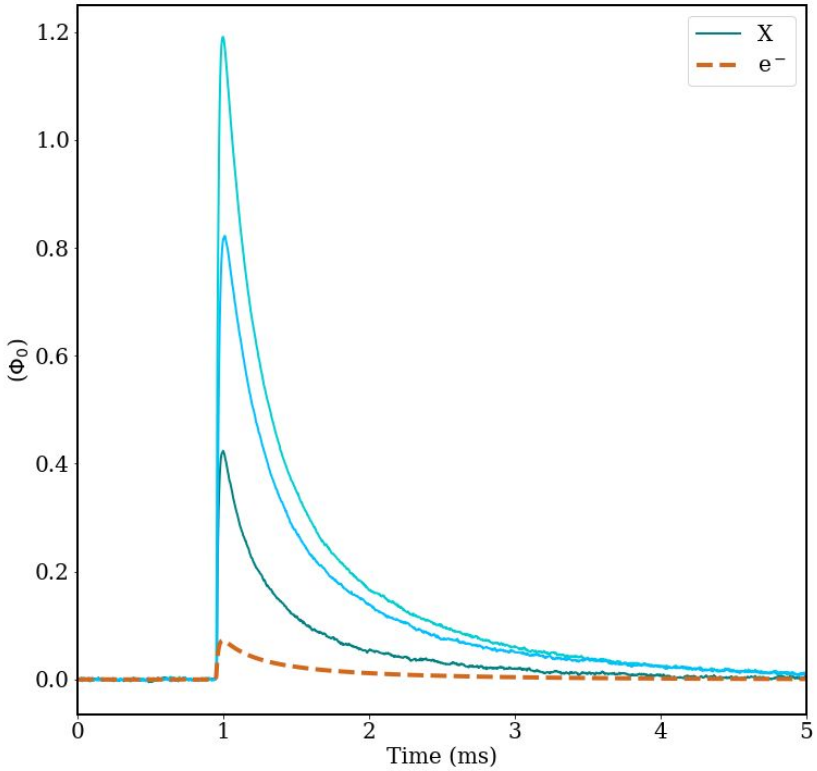


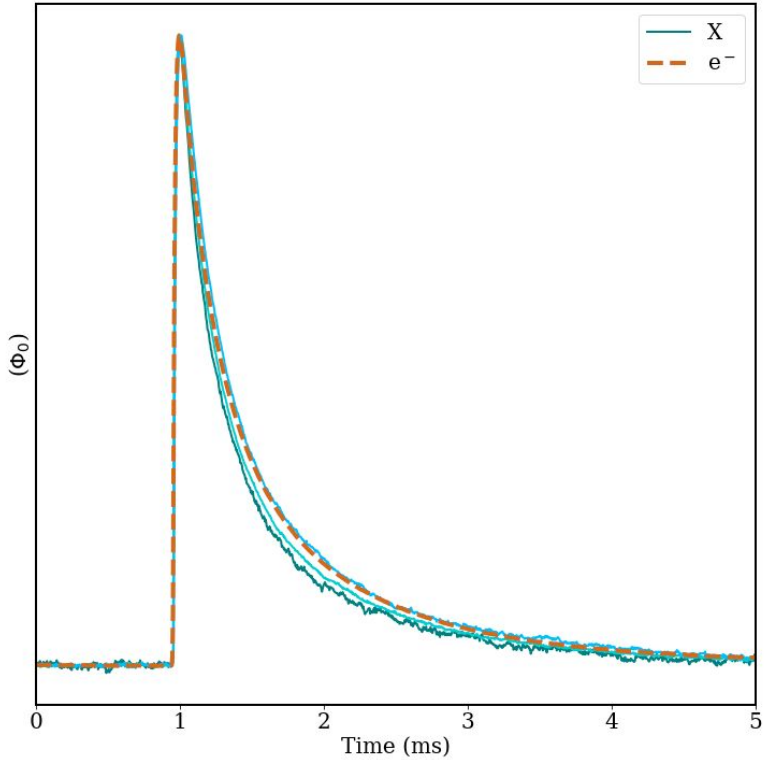


Are these electrons? III

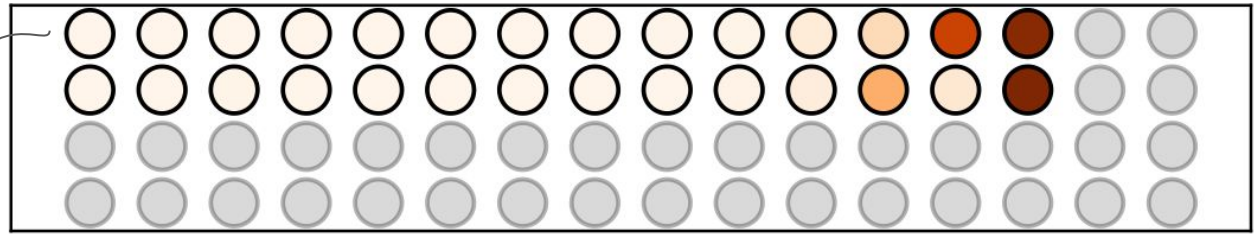


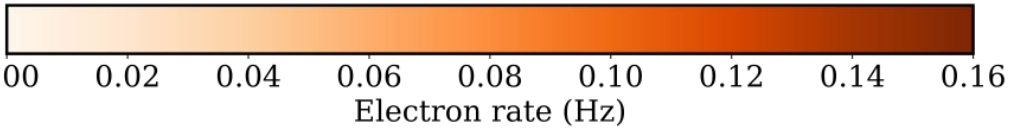
Are these electrons? IV

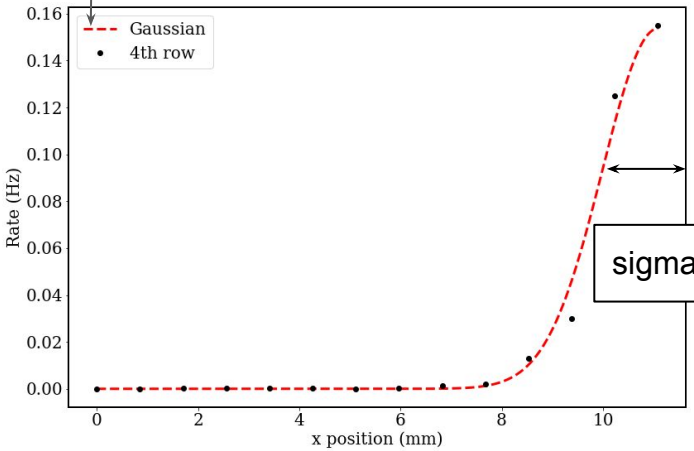




Activity map





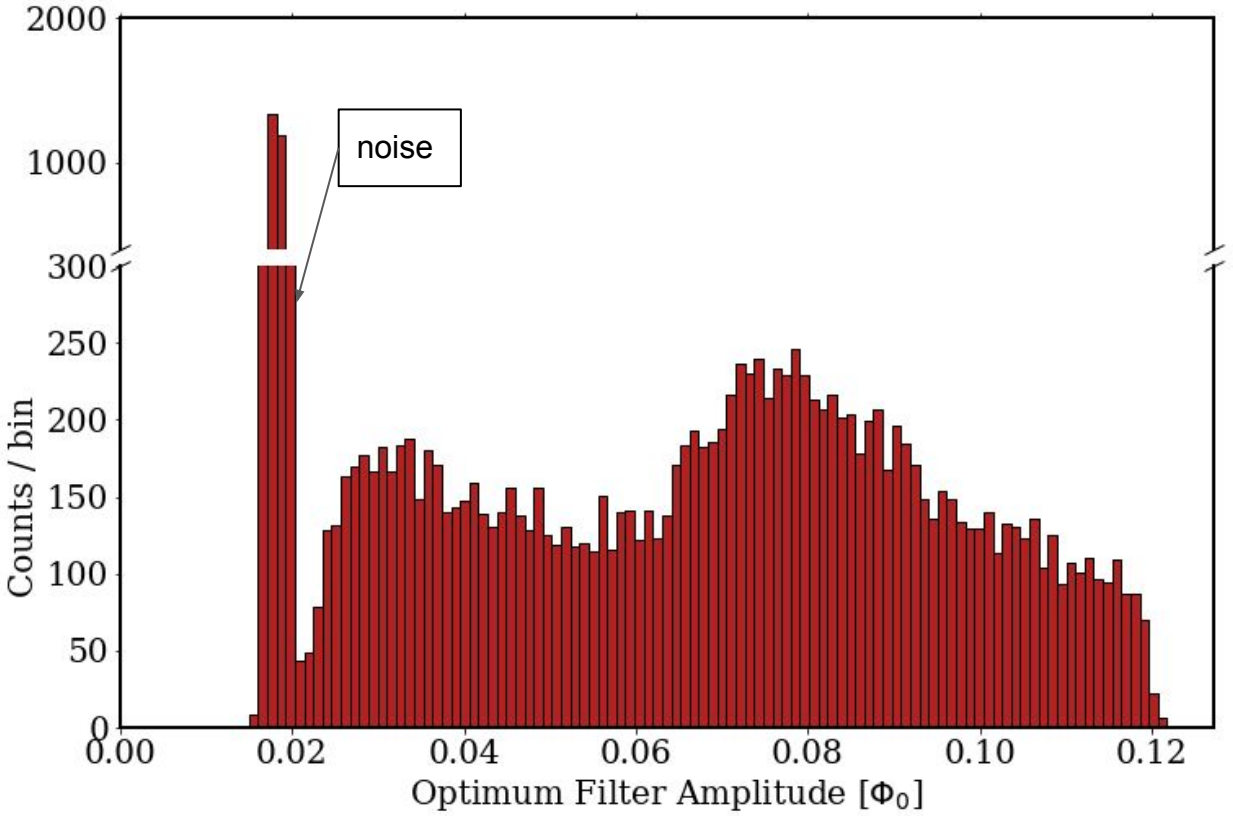


sigma ~ 1.1 mm

Assuming multivariate normal distribution

Electrons rate@source >= 1 Hz
(170mA UV diode current)

Energy spectrum (dV = 300 V)

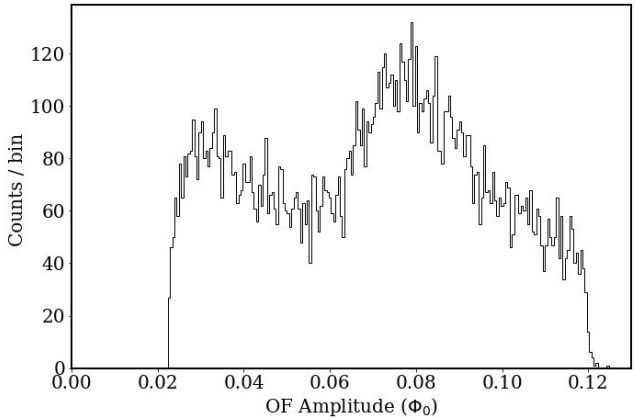


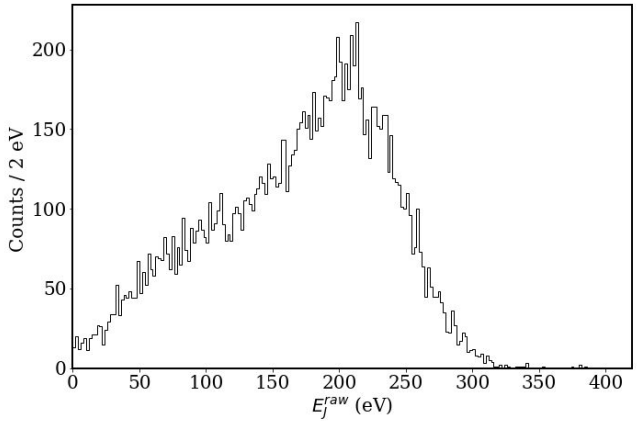
- w/o data reduction.
- We can calibrate the data using the “Joule energy” *Ej*

$$E = \int P^*_{bath} + \int P^*_J$$

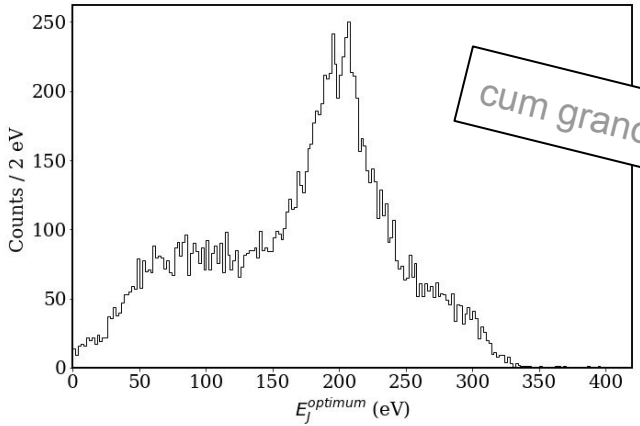
$$E_J = R_{sh}(I_b - 2I_0)\int dt\, s(t) + R_{sh}\int dt\, s^2(t)$$

Energy spectrum (dV = 300 V)



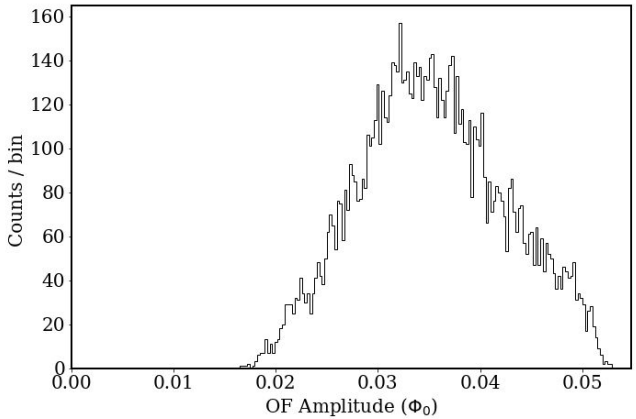


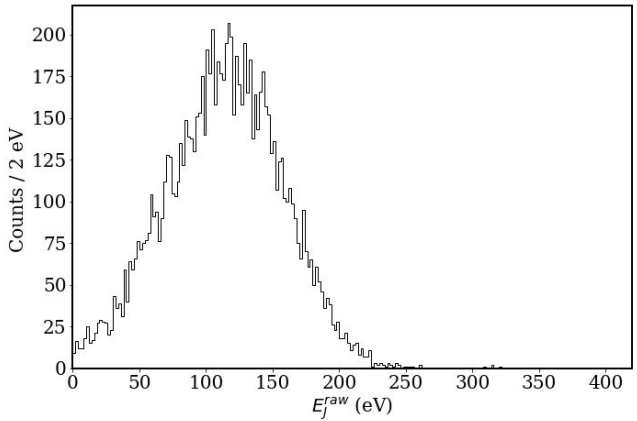
- w/o data reduction.
- preliminary!



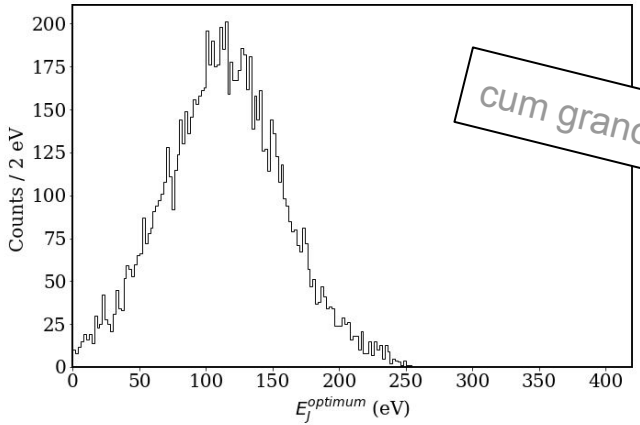
cum grano salis

Energy spectrum (dV = 200 V)



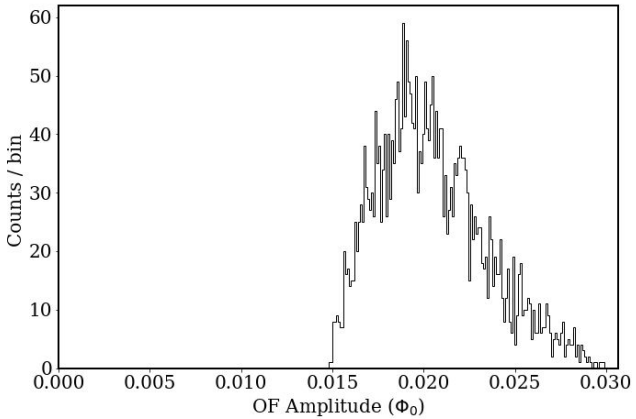


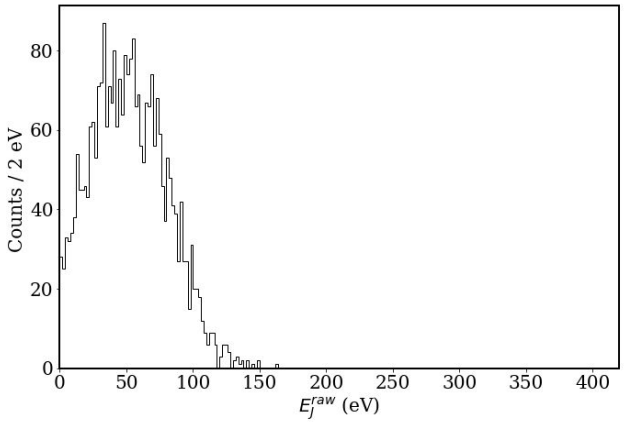
- w/o data reduction.
- preliminary!

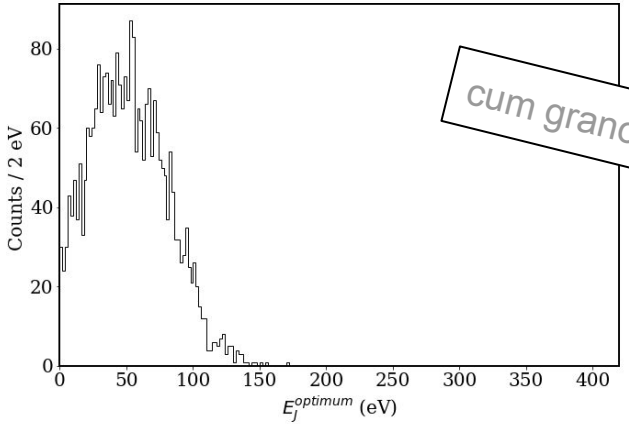


cum grano salis

Energy spectrum (dV = 100 V)



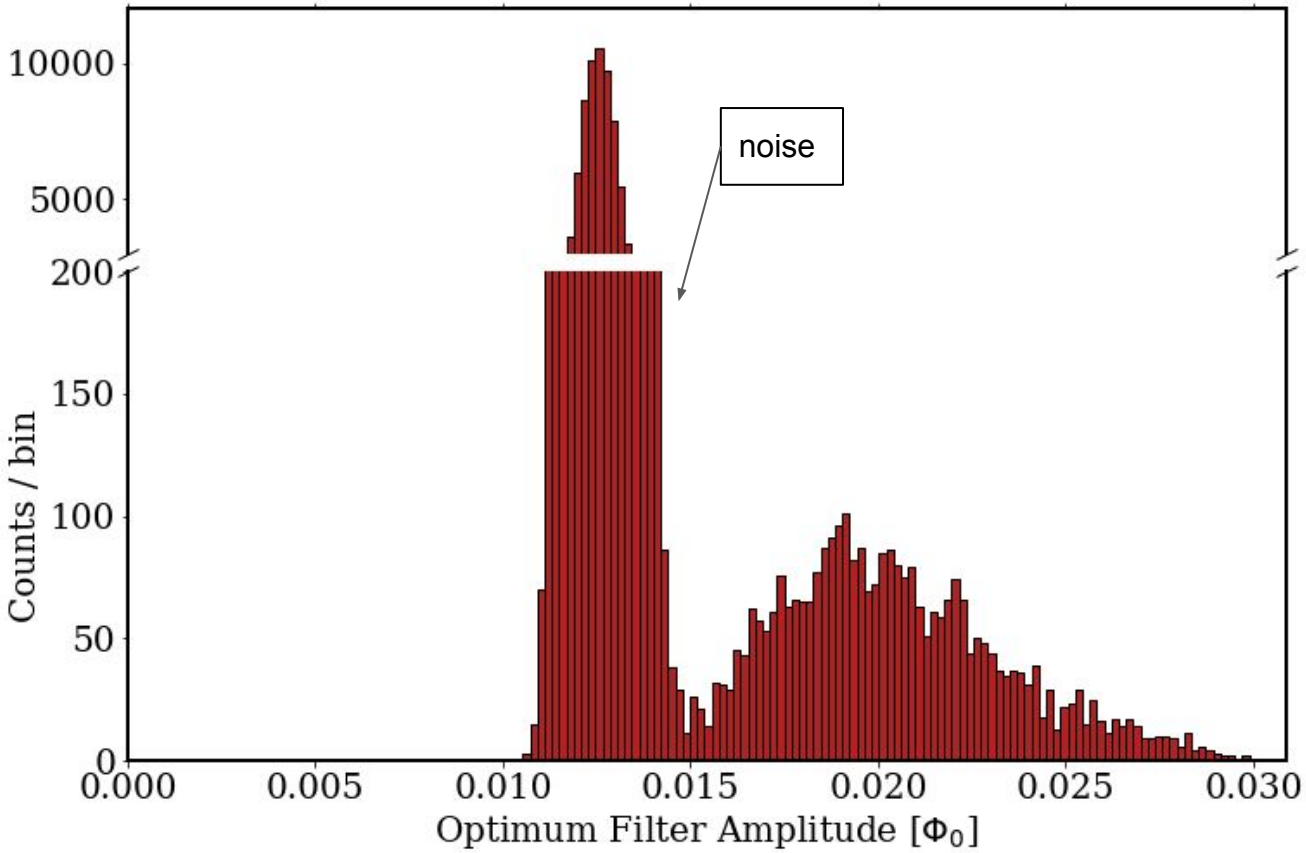




- w/o data reduction.
- preliminary!
- data taking in progress

cum grano salis

Energy spectrum (dV = 100 V)



Conclusions

- **It works!**
  - Why are there “so many” electrons?

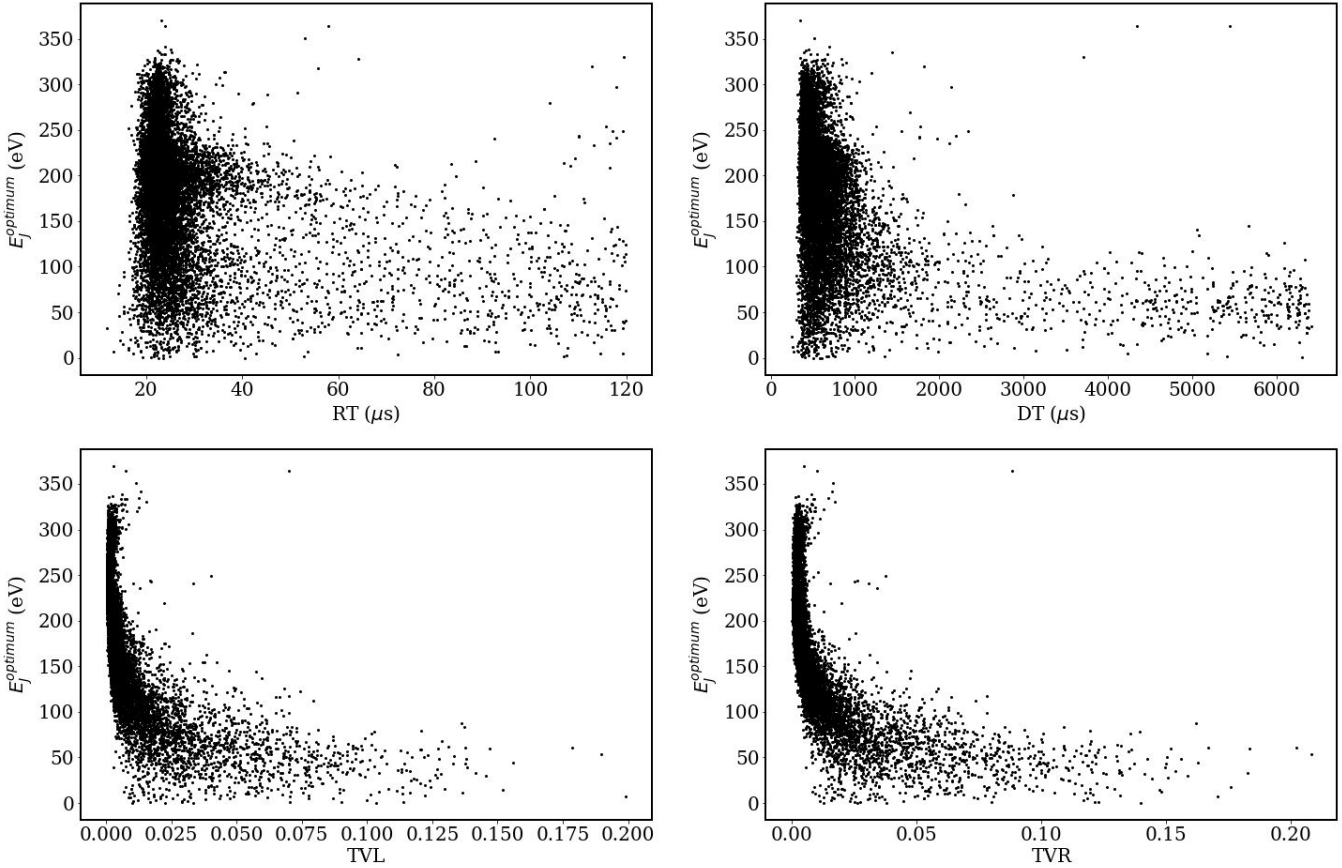
- Many space for improvements in the setup.
  - Use just one Al foil
  - Add collimator
  - Improve thermalization
  - Improve online trigger
  - ….

- Spectral shape has to be understood.

  https://doi.org/10.5281/zenodo.4129807

- 100V measurement ongoing.

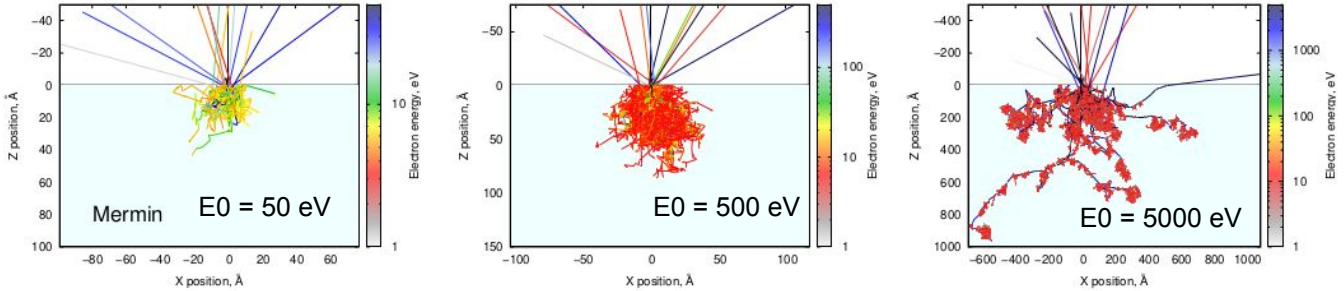
bkup: data reduction?



Theory (yet to be fully understood)

Monochromatic electron beam (E0) hitting Au

@ TES



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