

ANDROMeDa Status and Prospects

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12.09.25



ANDROMeDA

Aligned Nanotube Detector for Research On MeV Darkmatter



The ANDROMeDa Project

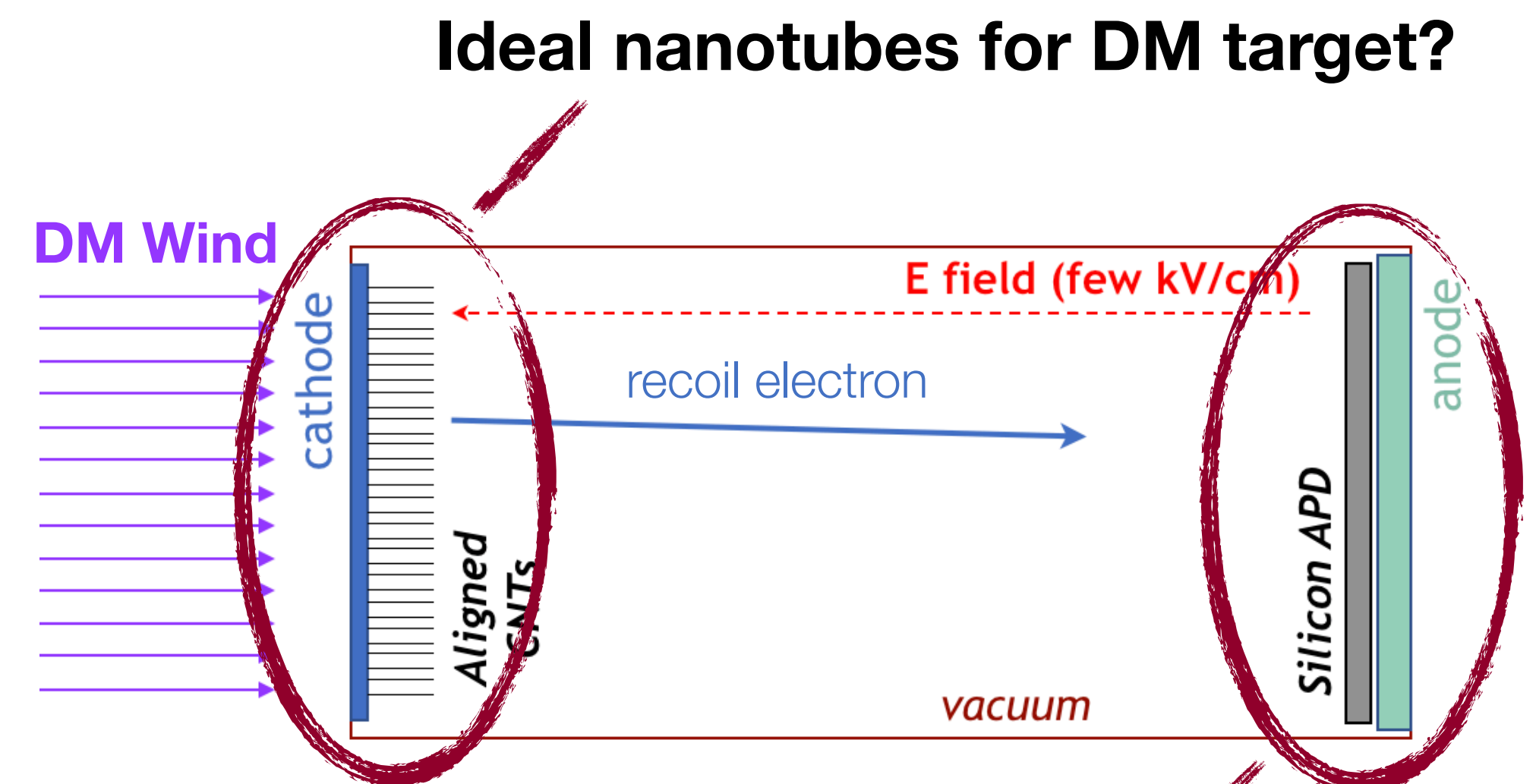


- ❖ Awarded PRIN2020 grant (1M€)
 - 3-year project, started in May 2022
 - 3 units: INFN (FP, P.I.)
Sapienza (G. Cavoto)
Roma Tre (A. Ruocco)
- ❖ **Main objective:** have a working dark-PMT prototype by end of project
 - Challenges on **both sides** of detector



ANDROMeDa

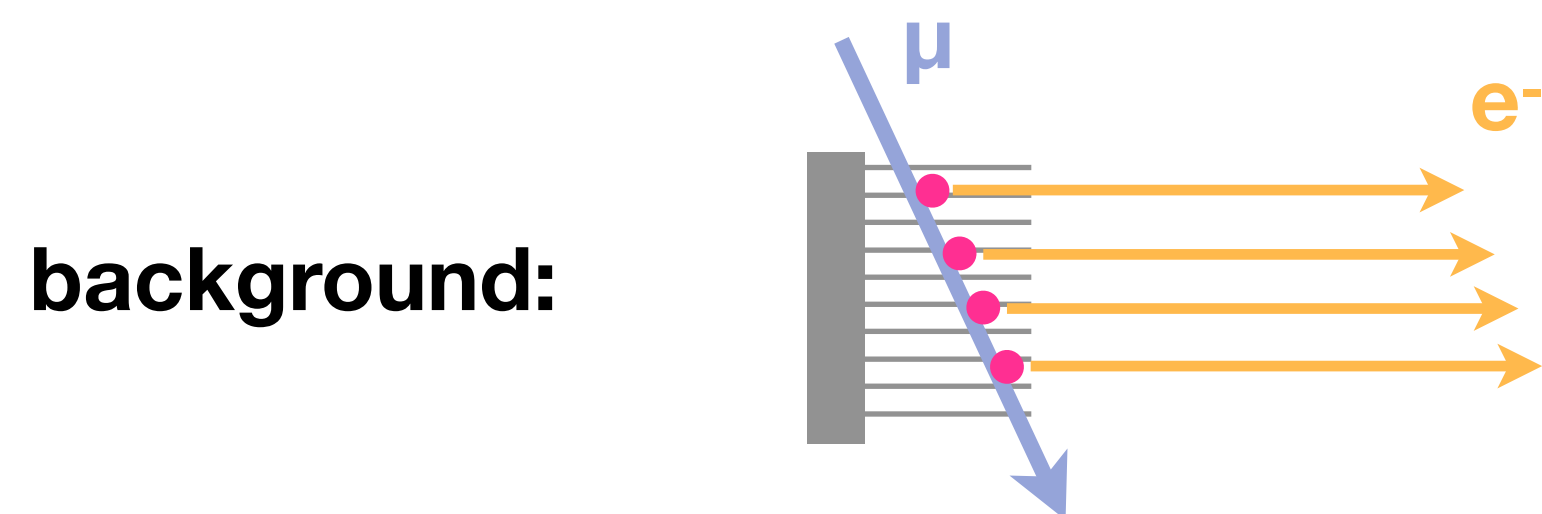
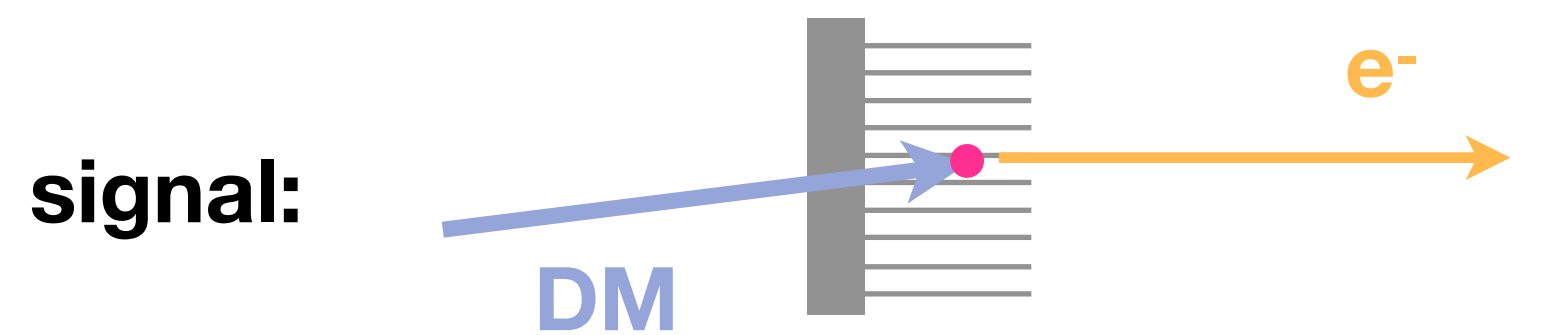
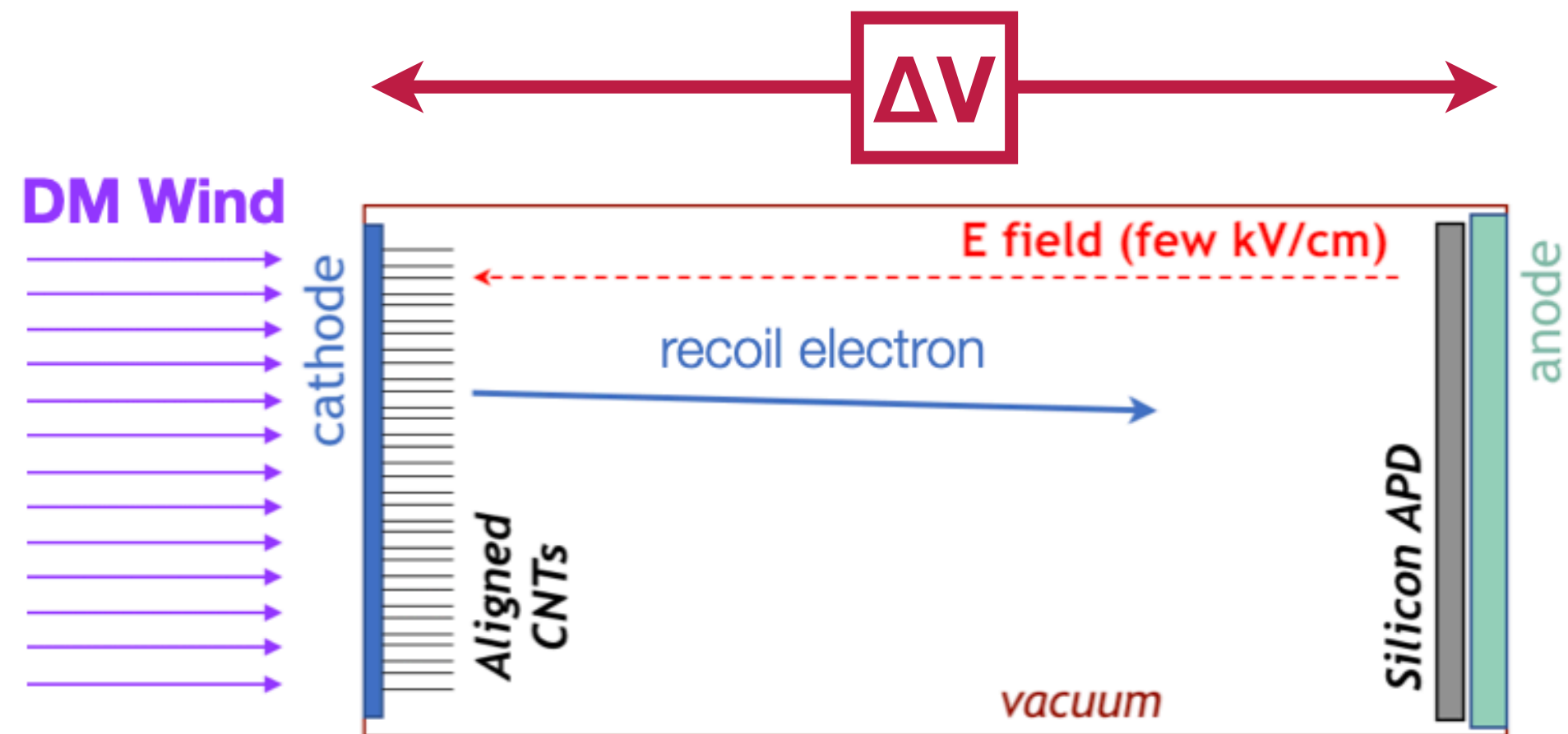
Aligned Nanotube Detector for Research On MeV Darkmatter



Best detector for keV electrons?



Requirements on Detecting keV Electrons



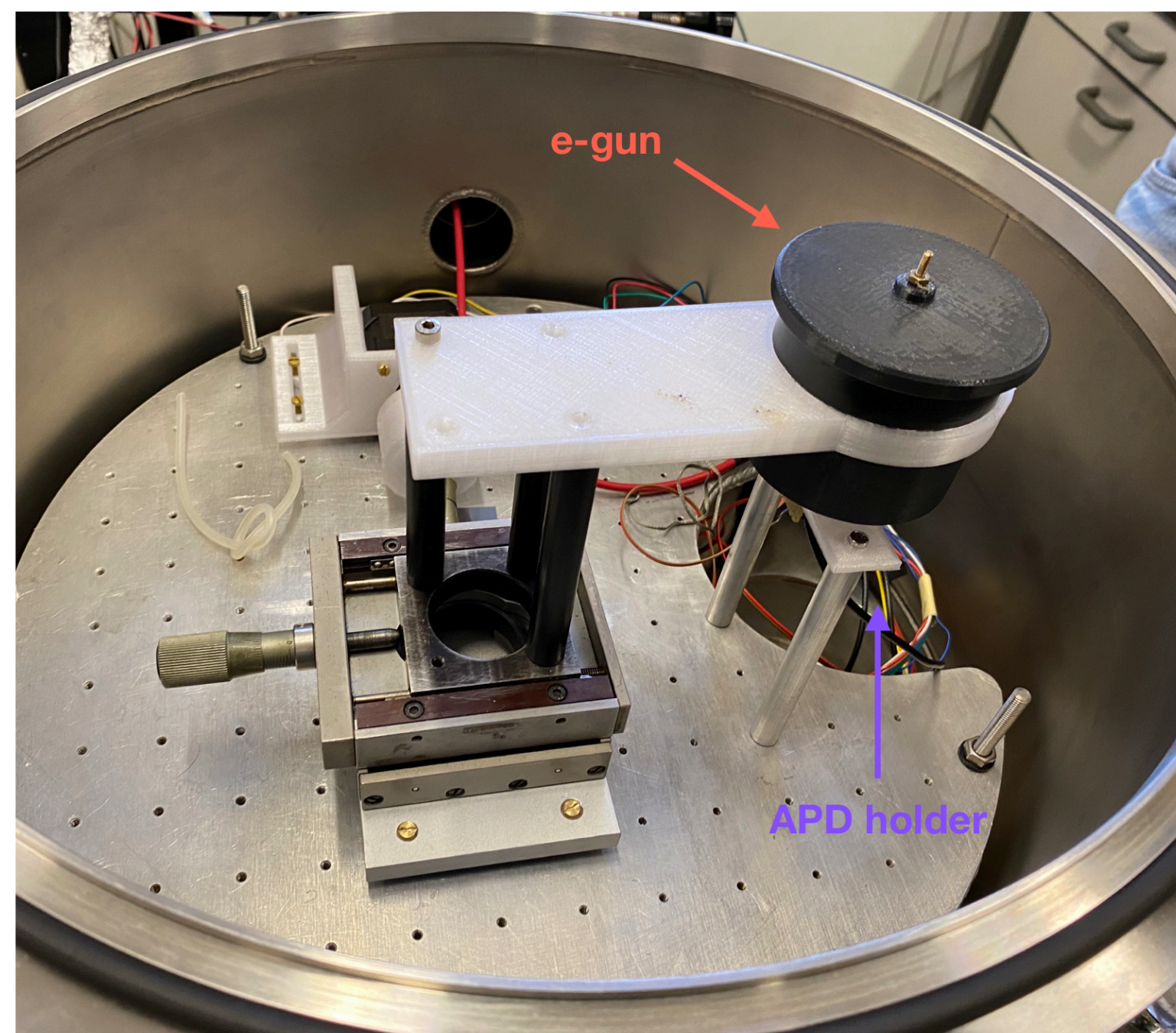
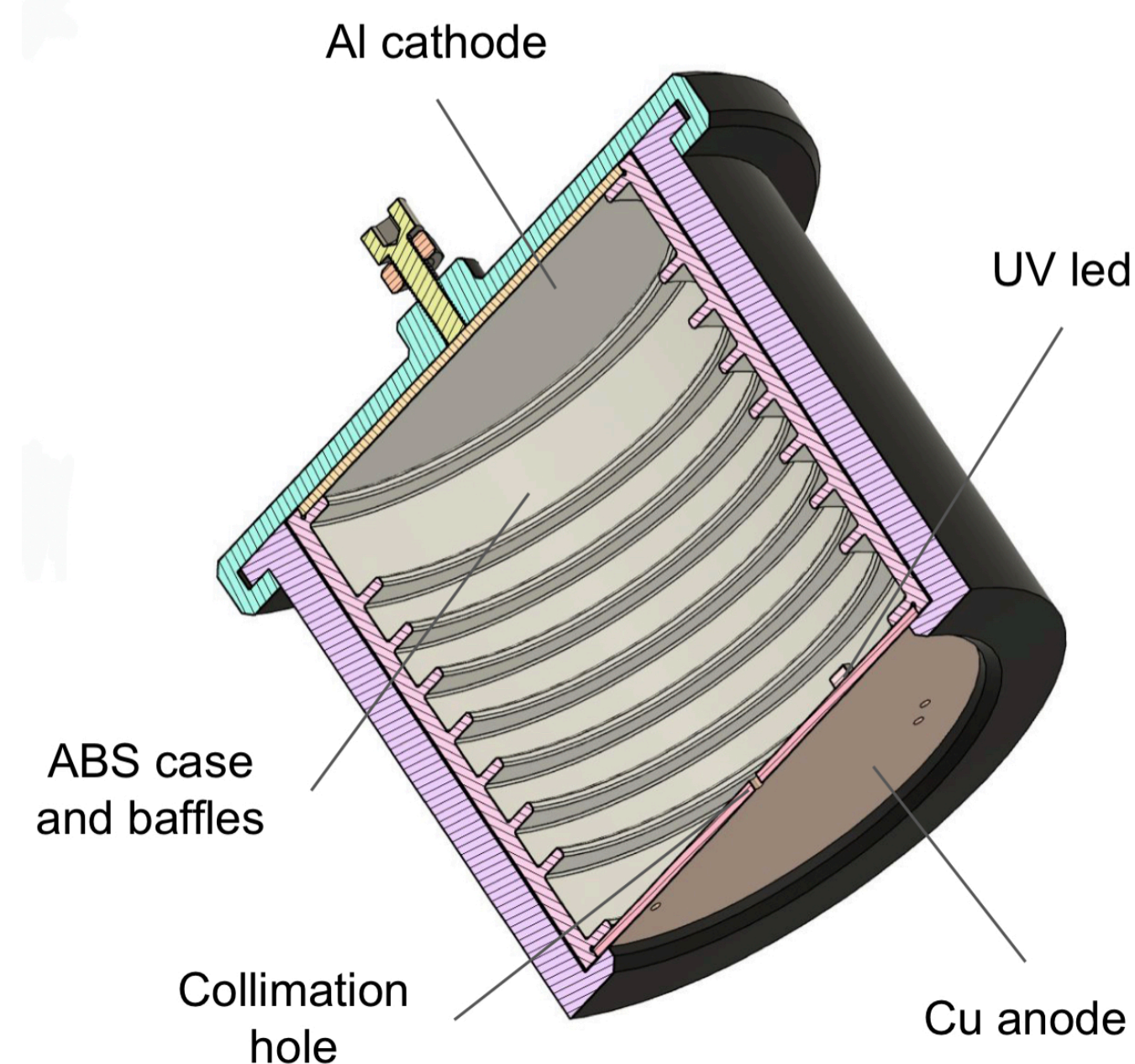
- ❖ Electron energy = $\Delta V e$ (initial energy negligible)
 - $\Delta V \sim 5 \text{ keV}$
- ❖ DM signal: **single** electron with $E = \Delta V e$
 - Ionizing backgrounds: **multiple** electrons
- ❖ Electron detector requirements:
 - High ($>95\%$) **efficiency**
 - Energy **resolution**: good enough to separate $1e^-$ vs $2e^-$ @ 5σ



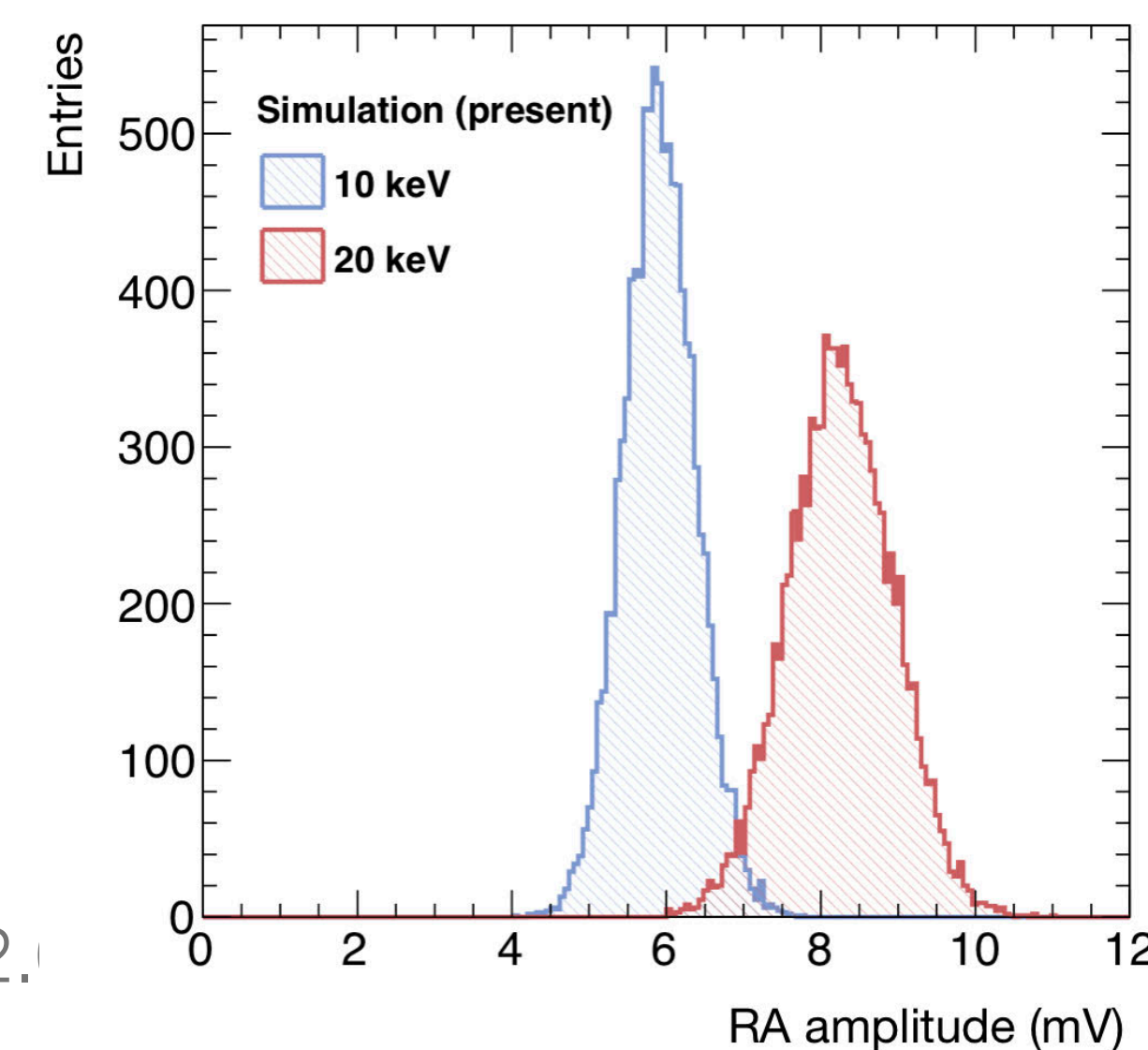
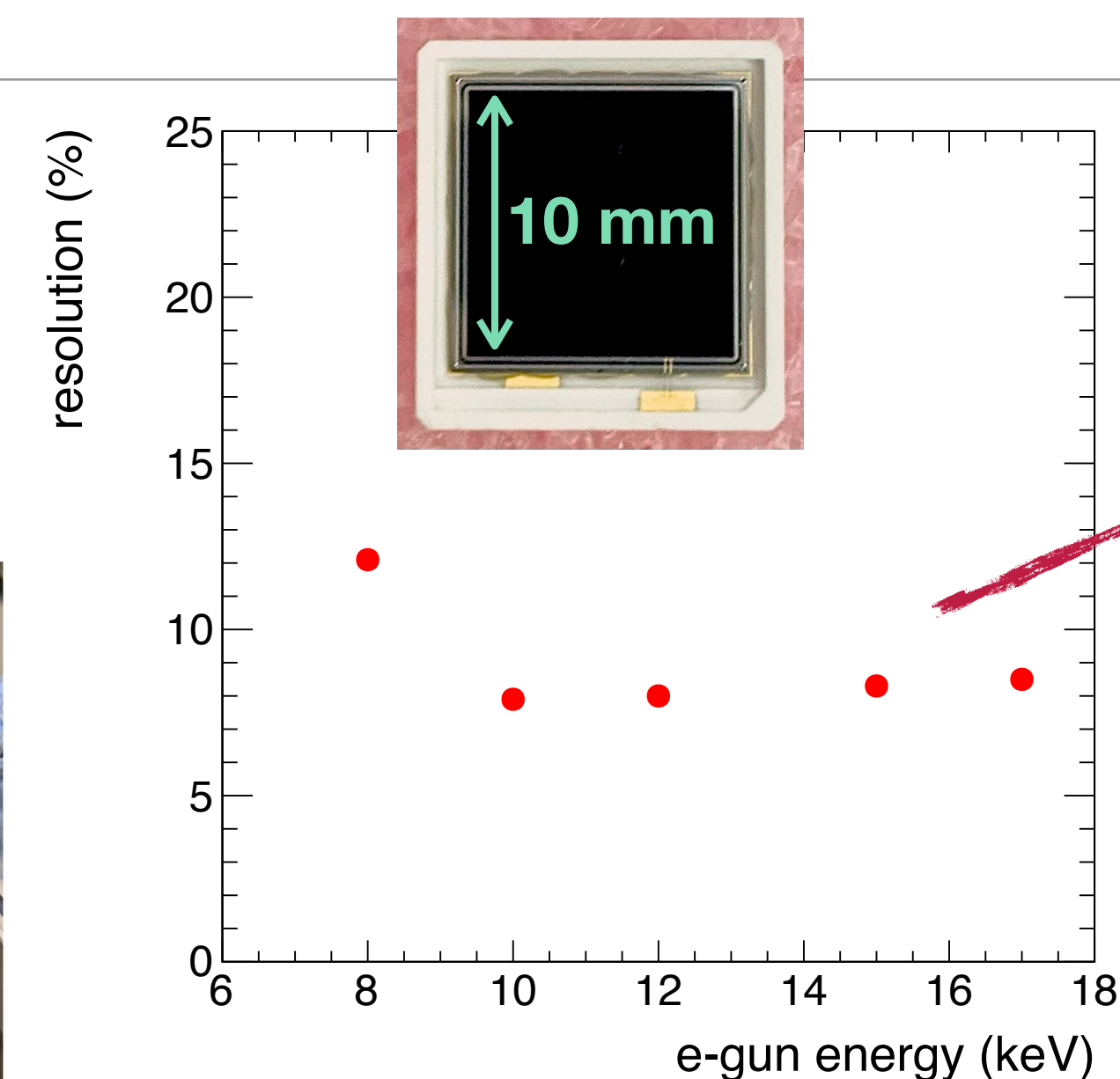
APDs: Not Enough Resolution

A. Apponi, et al., JINST 15 (2020) P11015

2023 Data Taking @ Milano Bicocca e-Gun (M. Biassoni)



Hamamatsu
windowless APD



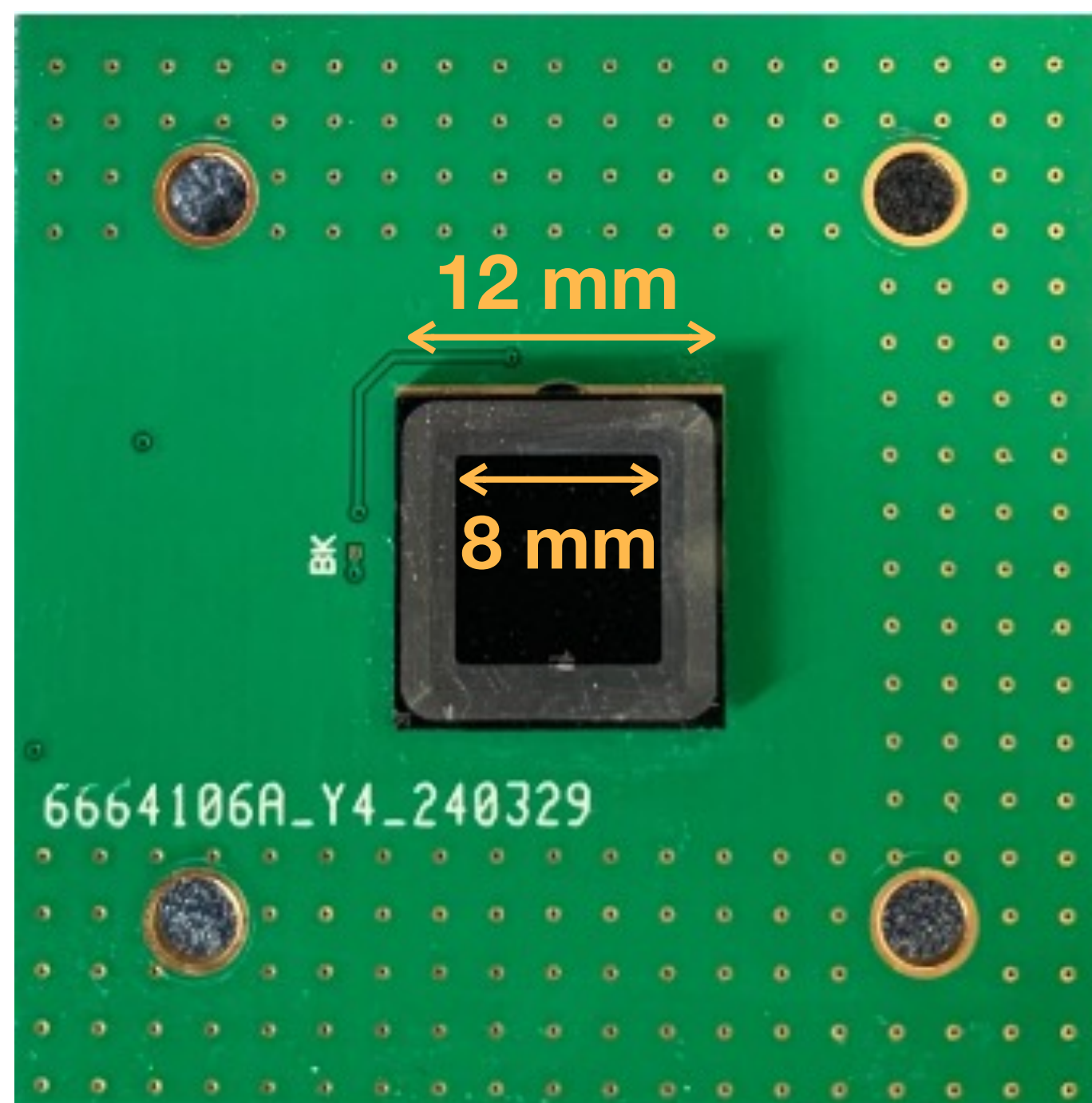
~3 σ separation
between
10 keV (data)
and 20 keV
(simulated)

Not enough

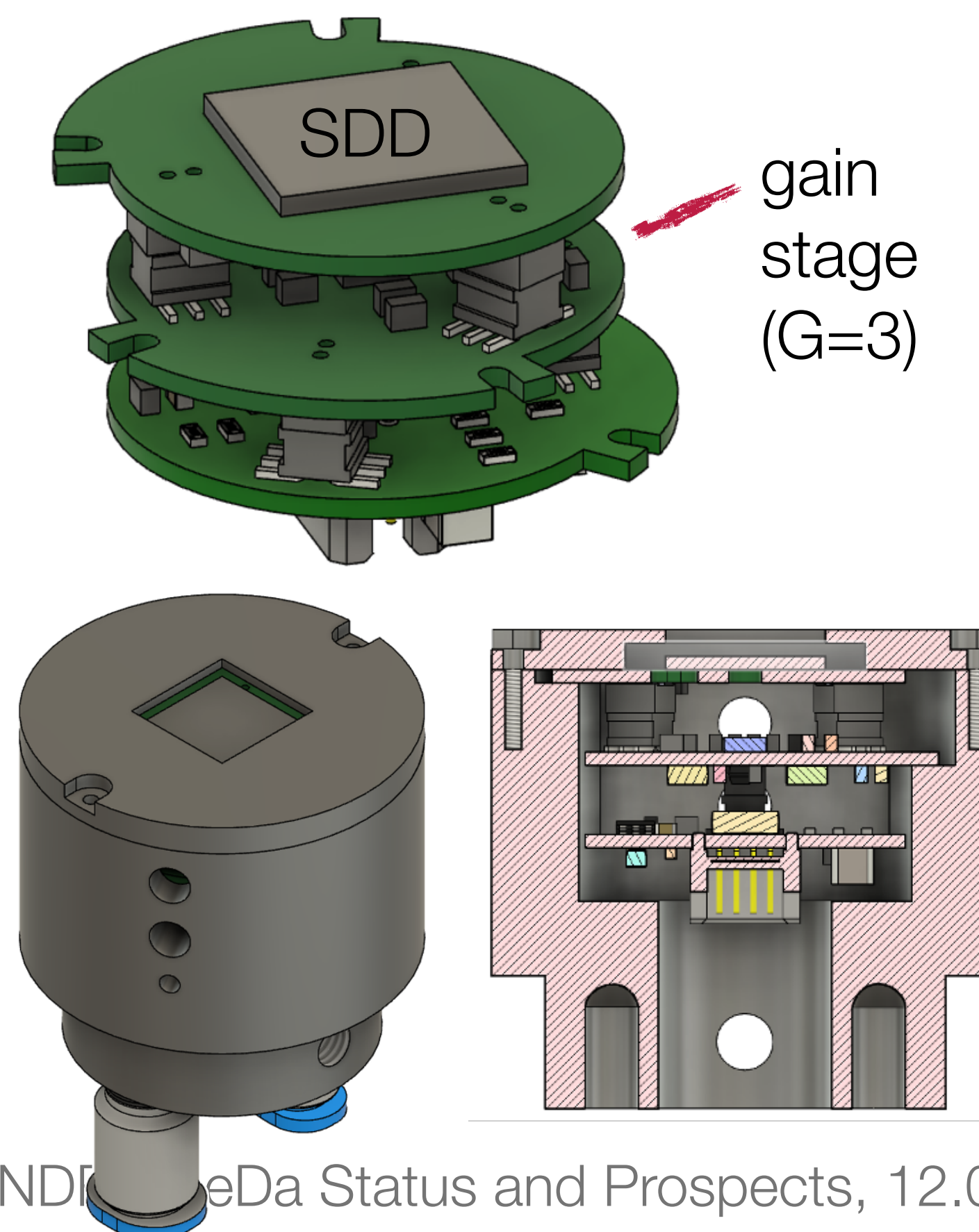


Chosen Technology: Silicon Drift Detectors

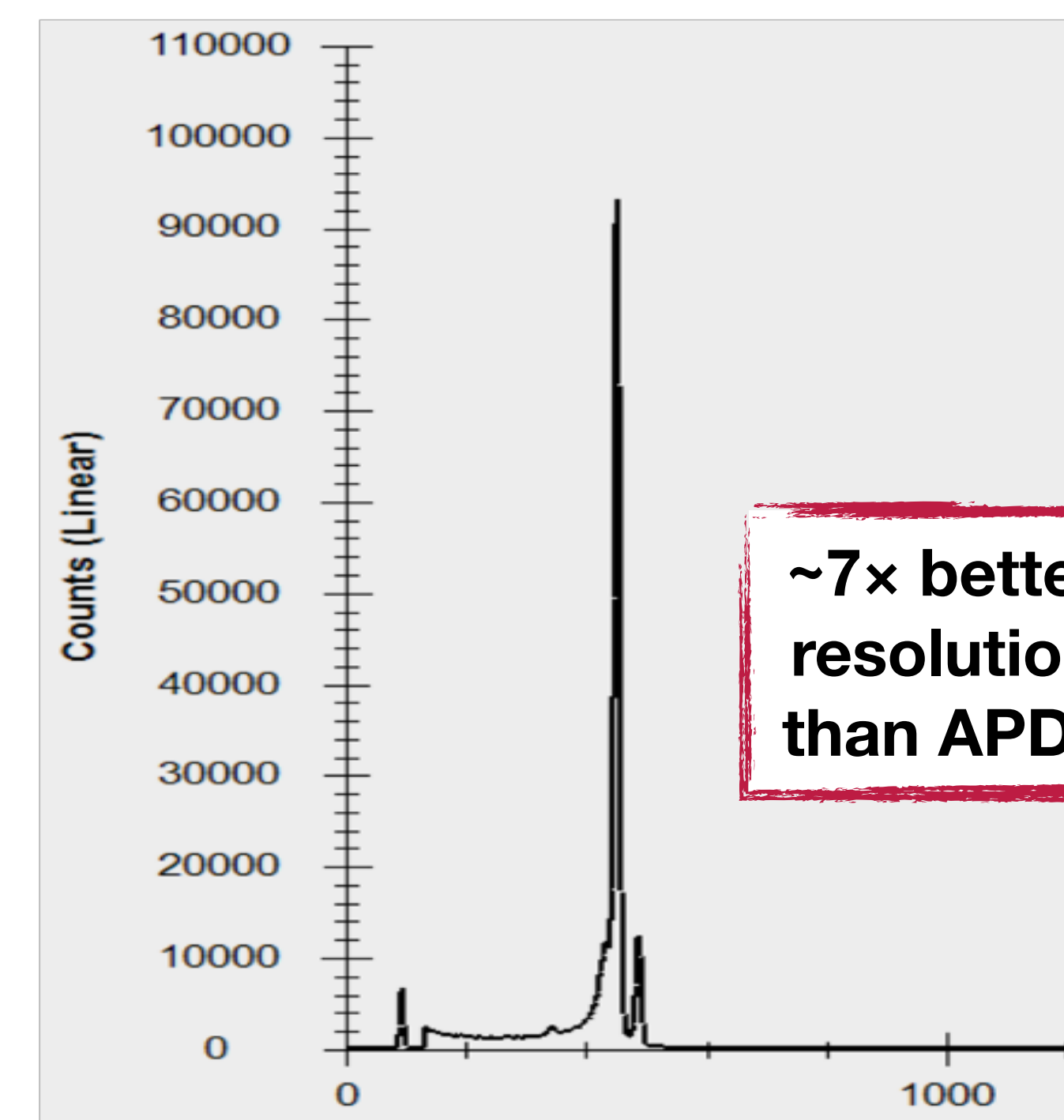
SDD produced by FBK



**Holder and electronics
by PoliMi**

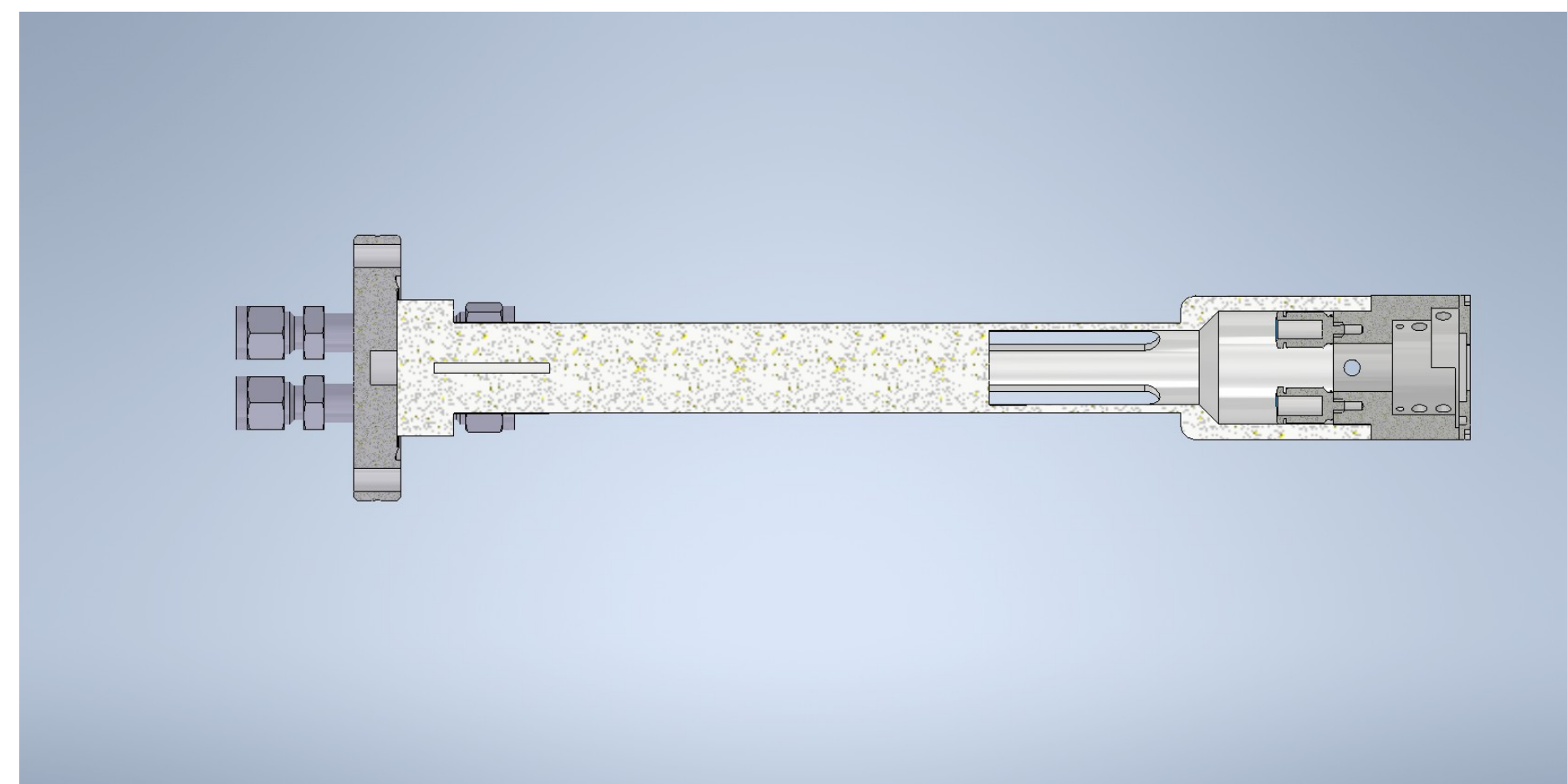
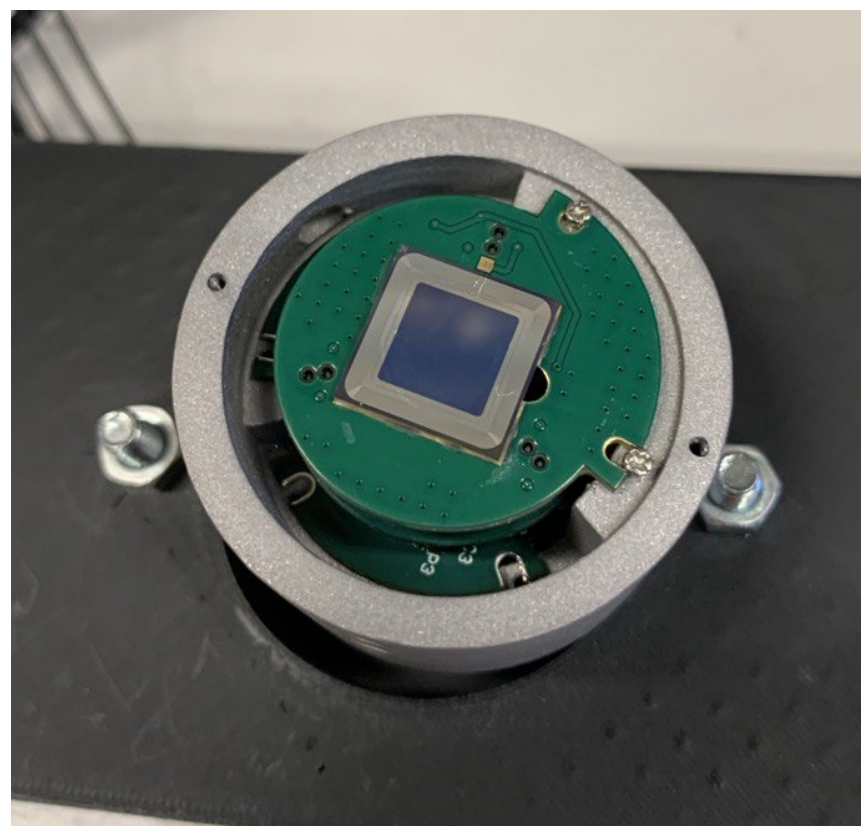


**Fe55 K α peak (5.9 keV)
FWHM \sim 170 eV**





Installation Planned for October 9th

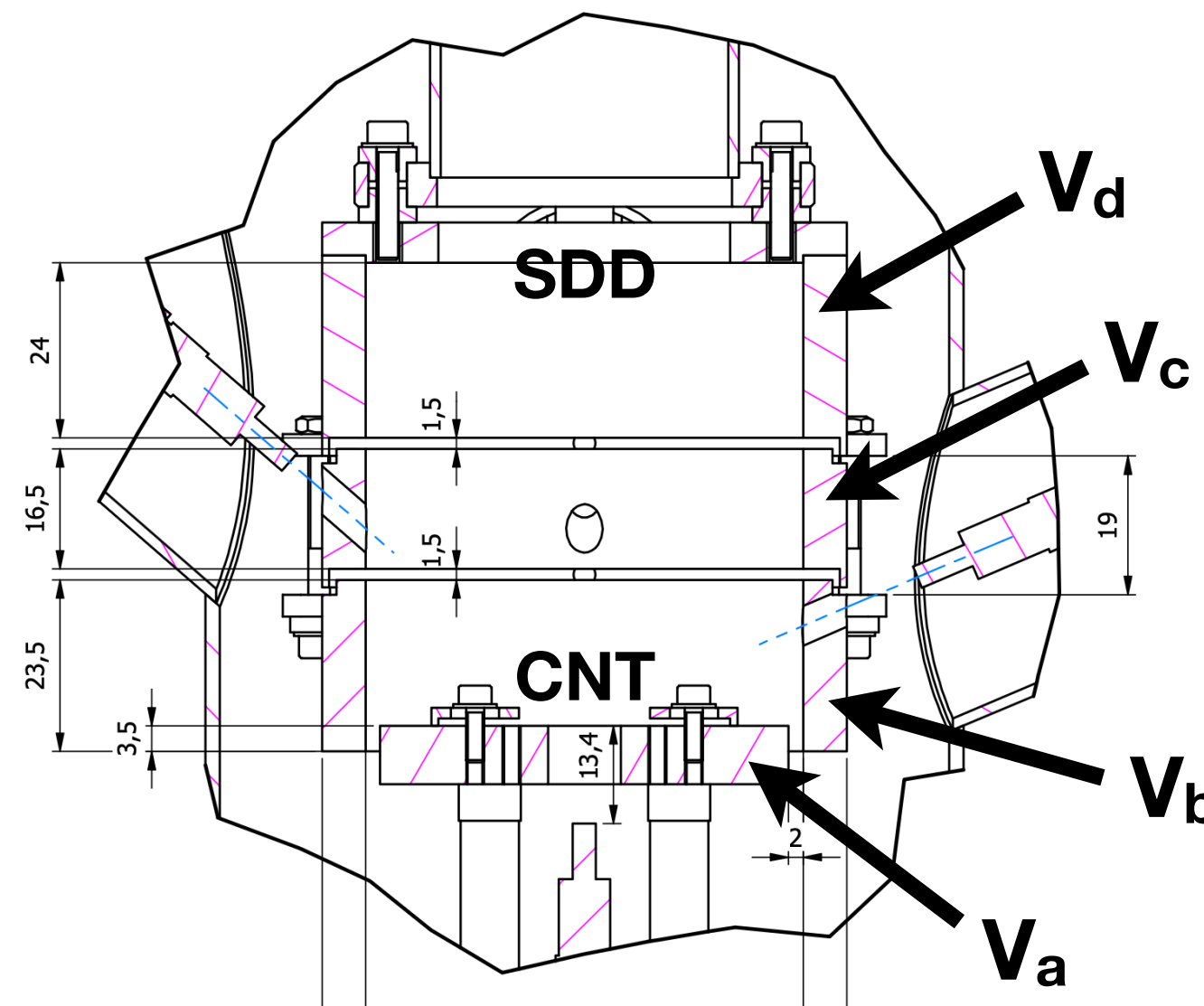
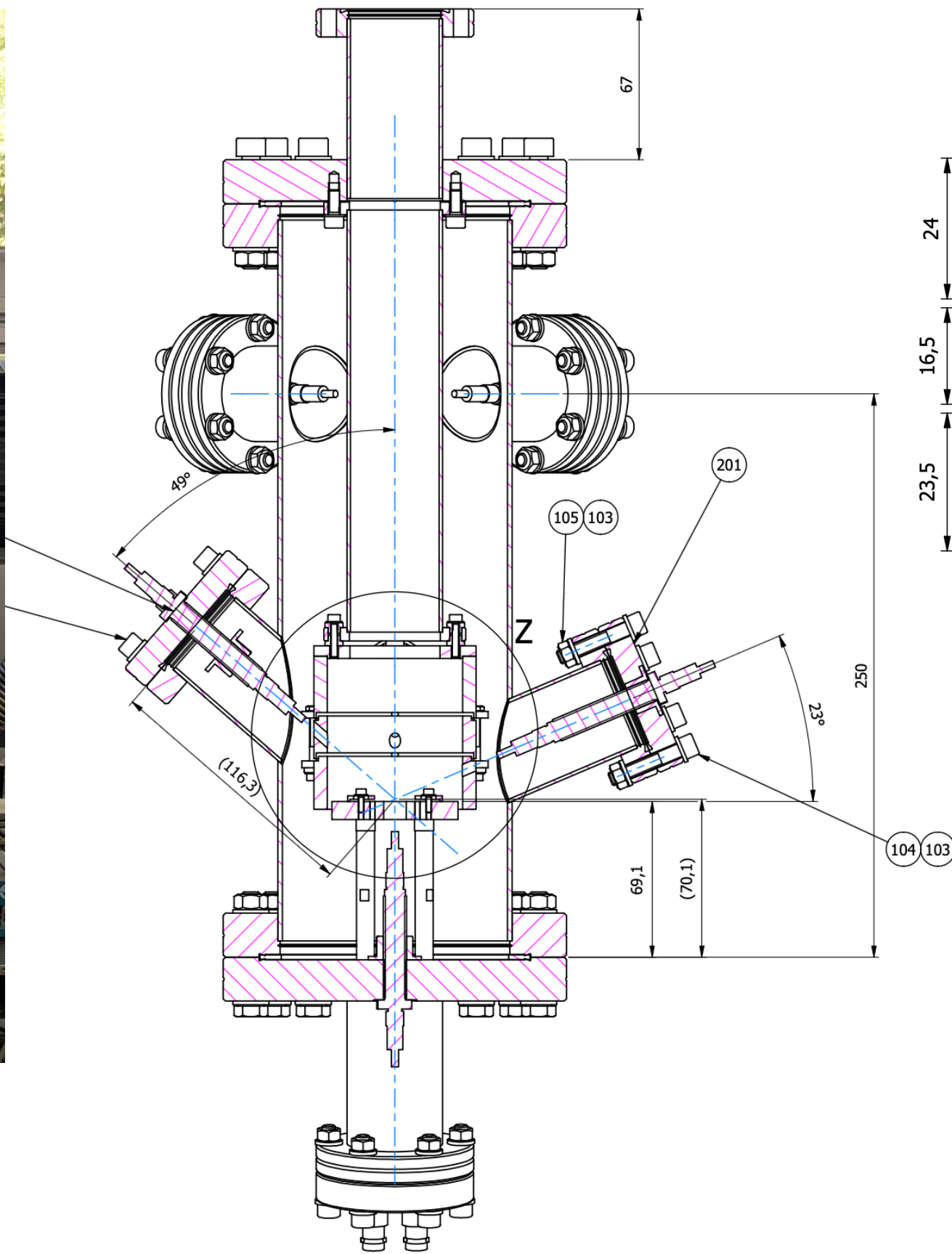
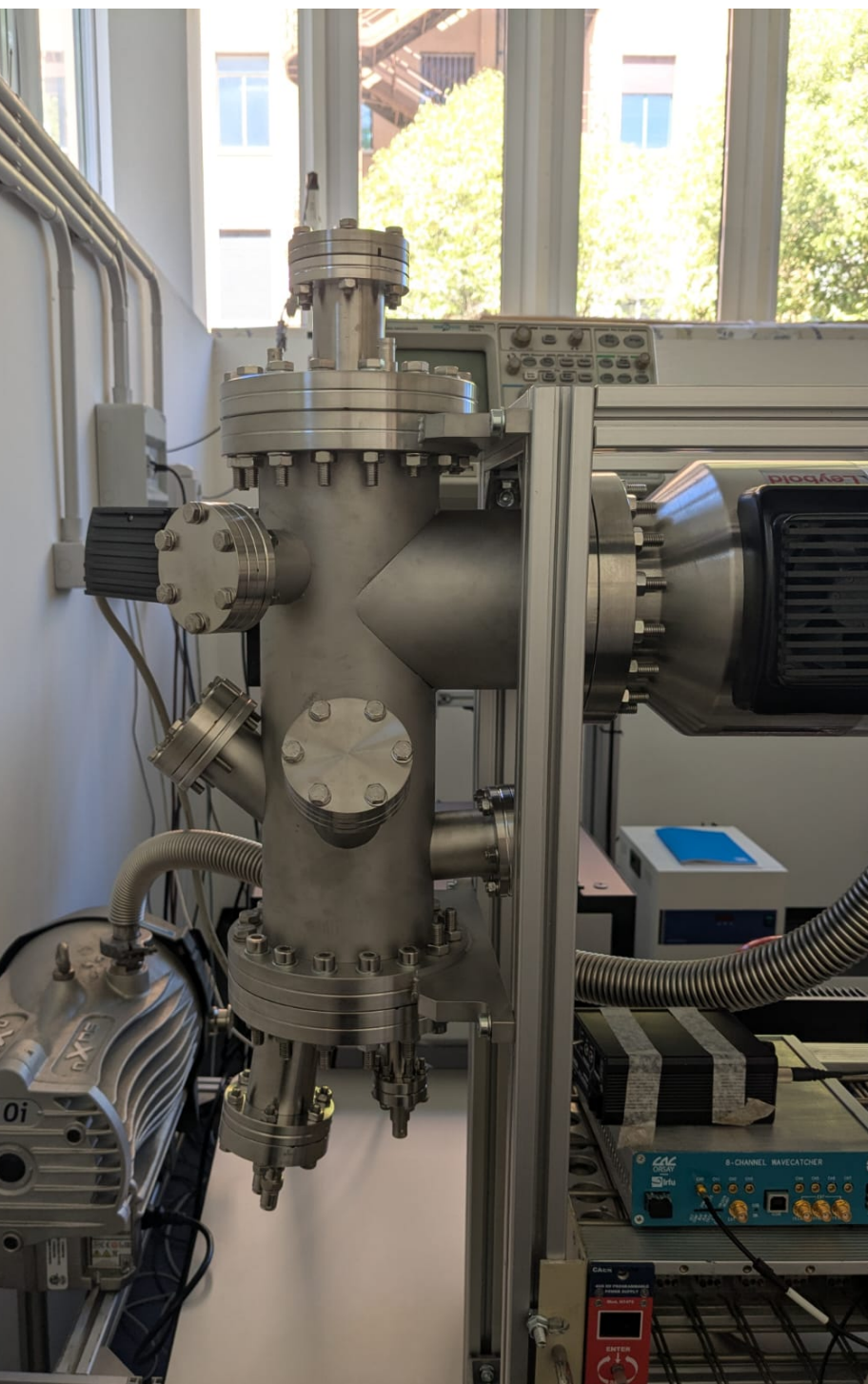


**CAEN Sci-Compiler SMART
FPGA**



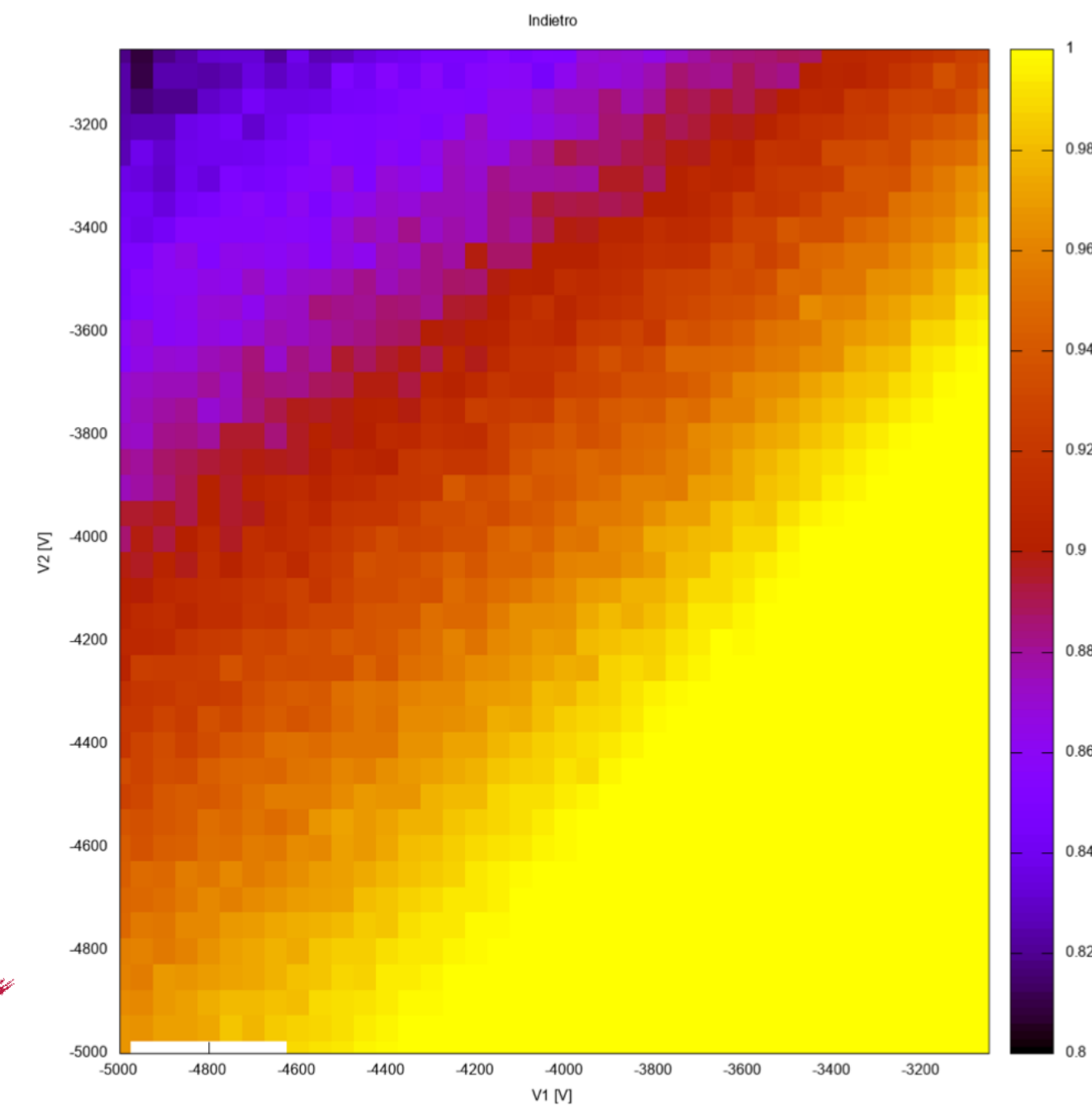


Hyperion III: UHV and Electrostatic Lensing



Simulation studies by D. Paoloni proved that simple **two-voltage configuration** achieves 100% ε

$$V_2 = V_d$$

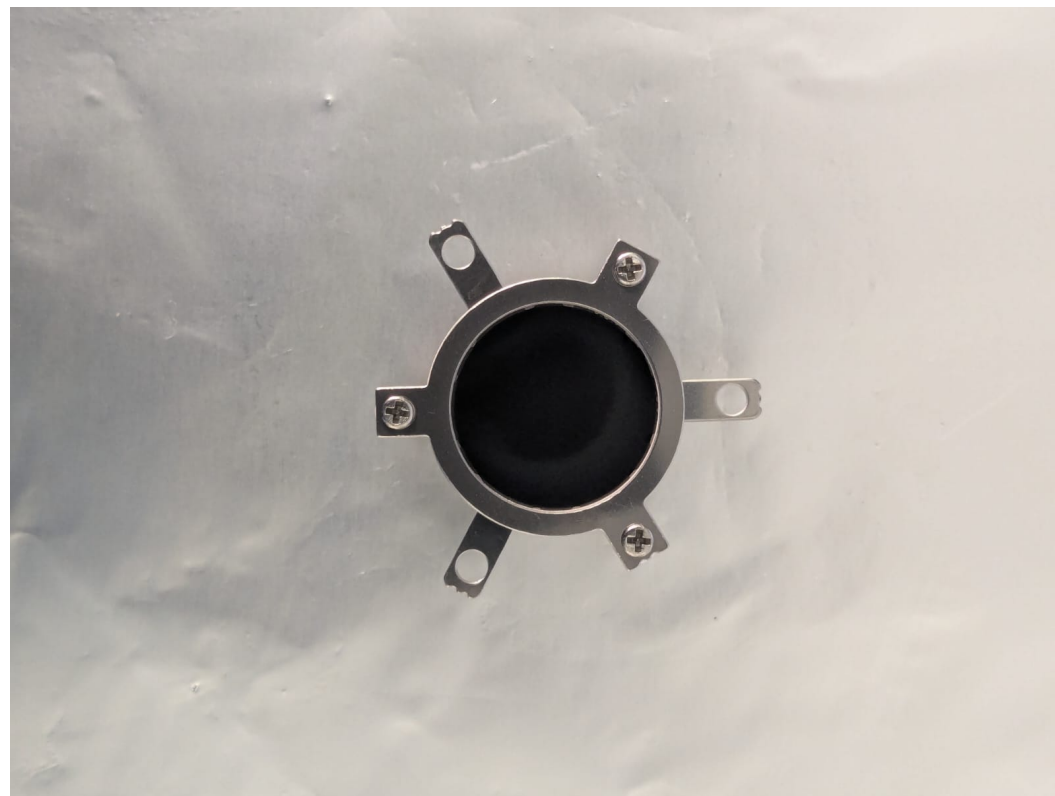


$$V_1 = V_a = V_b = V_c$$

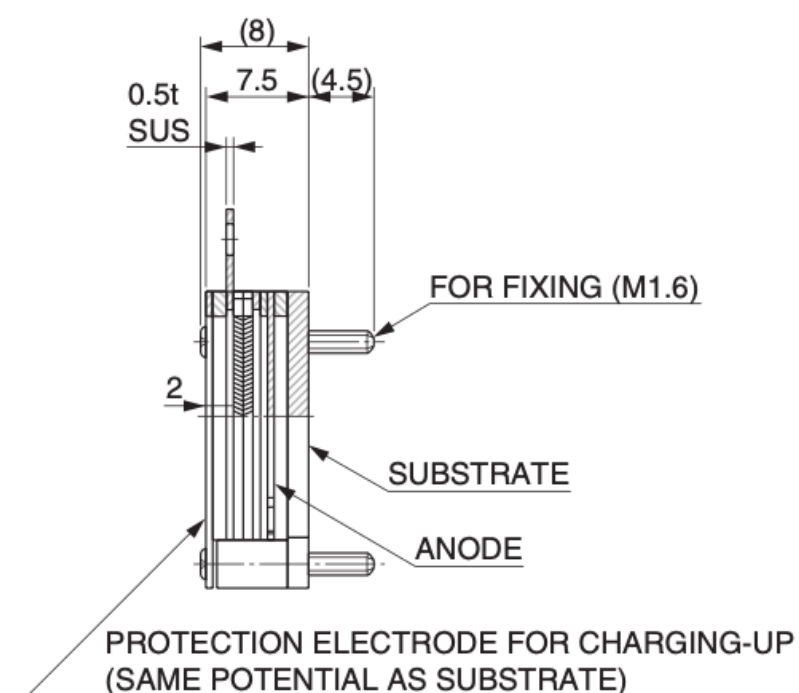
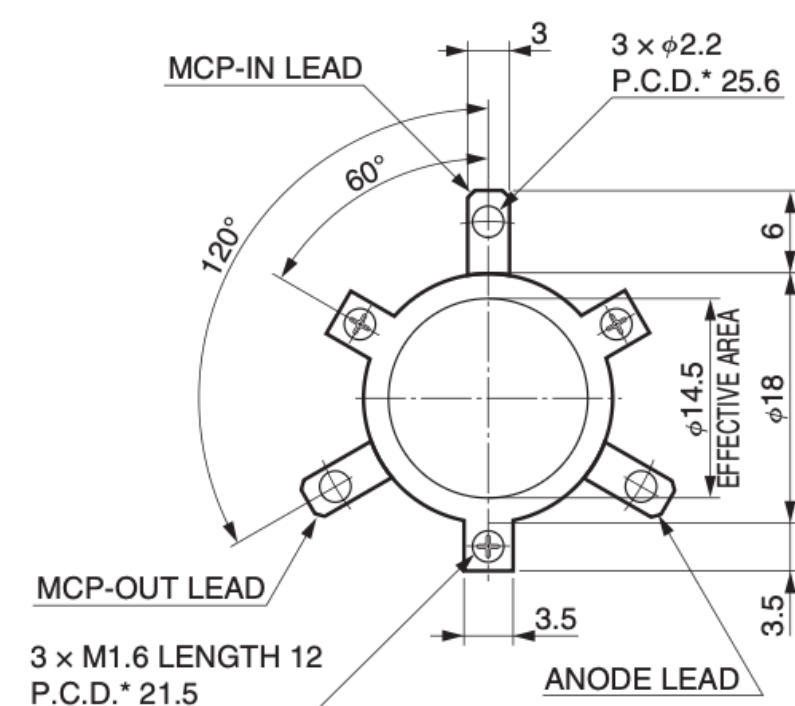
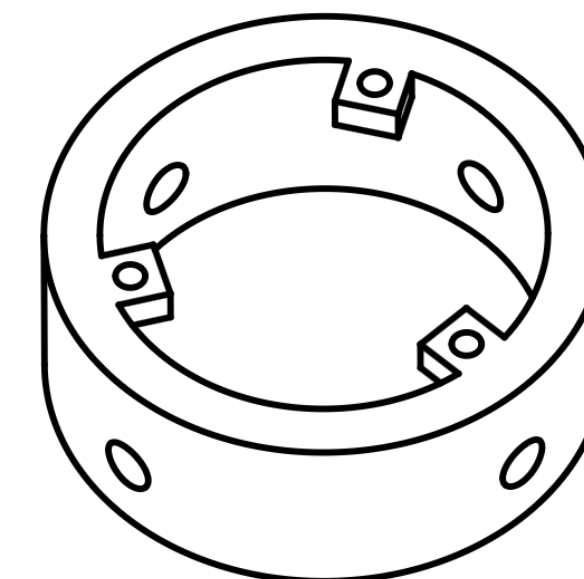
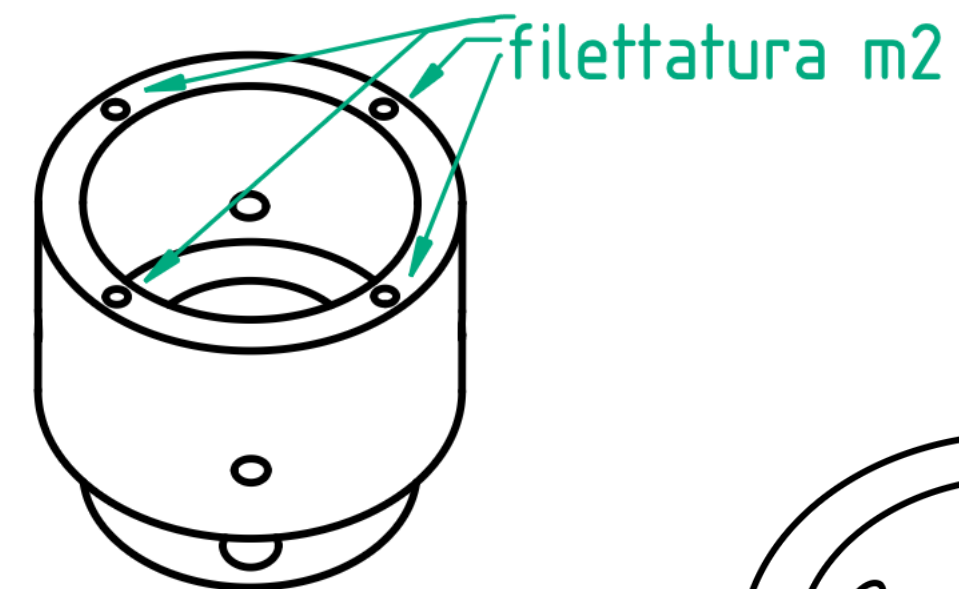
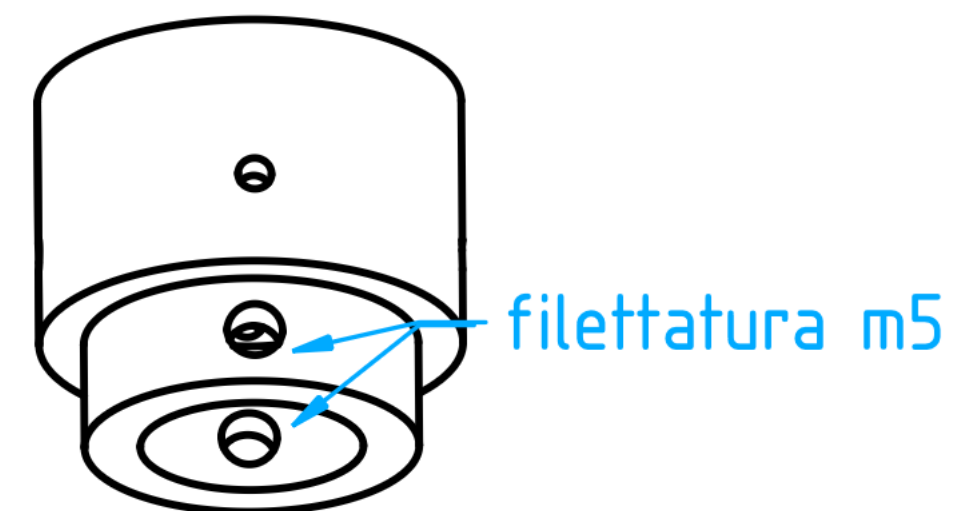


Same Setup Will Host Also MCP

Hamamatsu F4655-14 dual-stage MCP



Holder design by B. Corcione





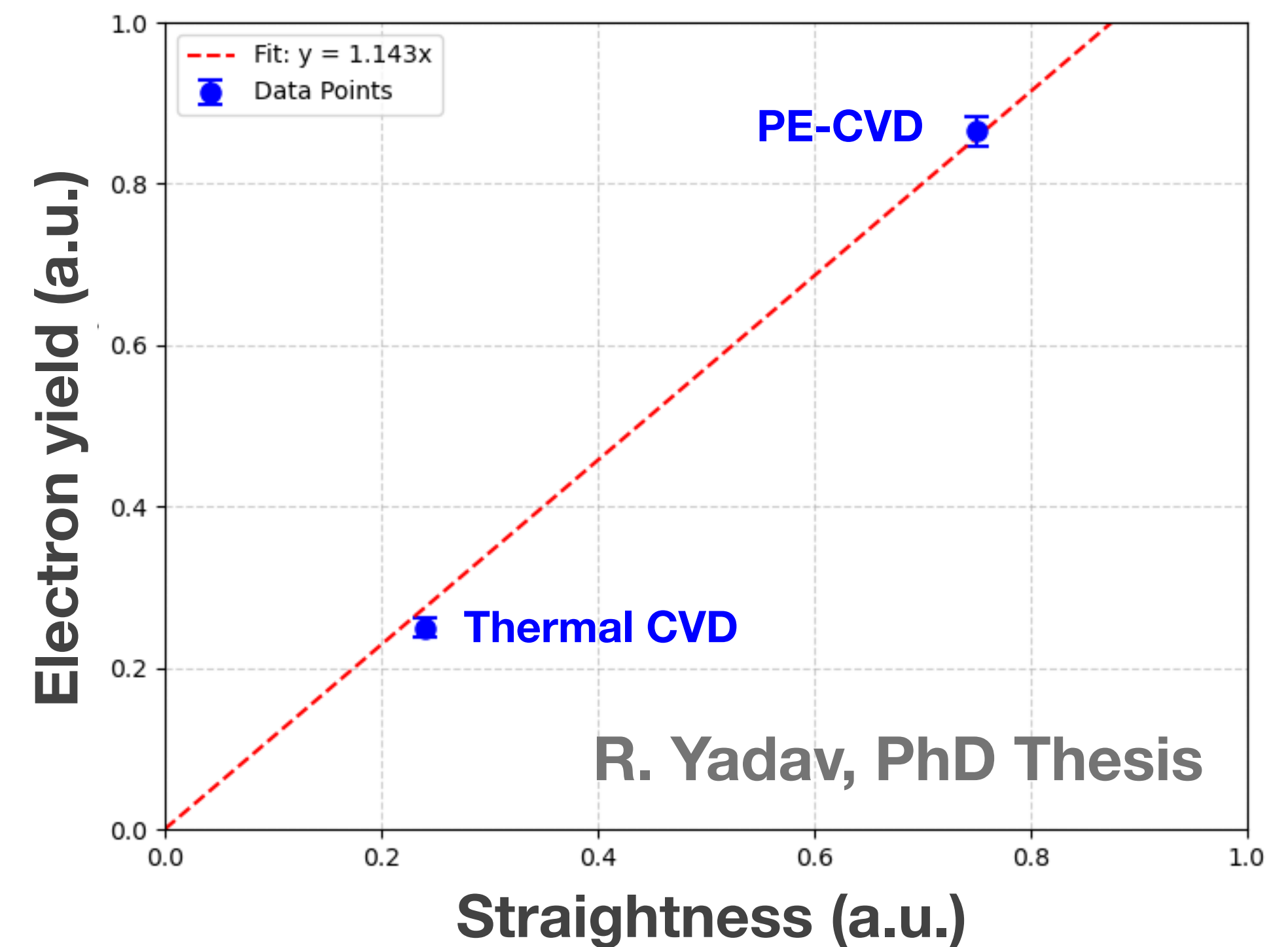
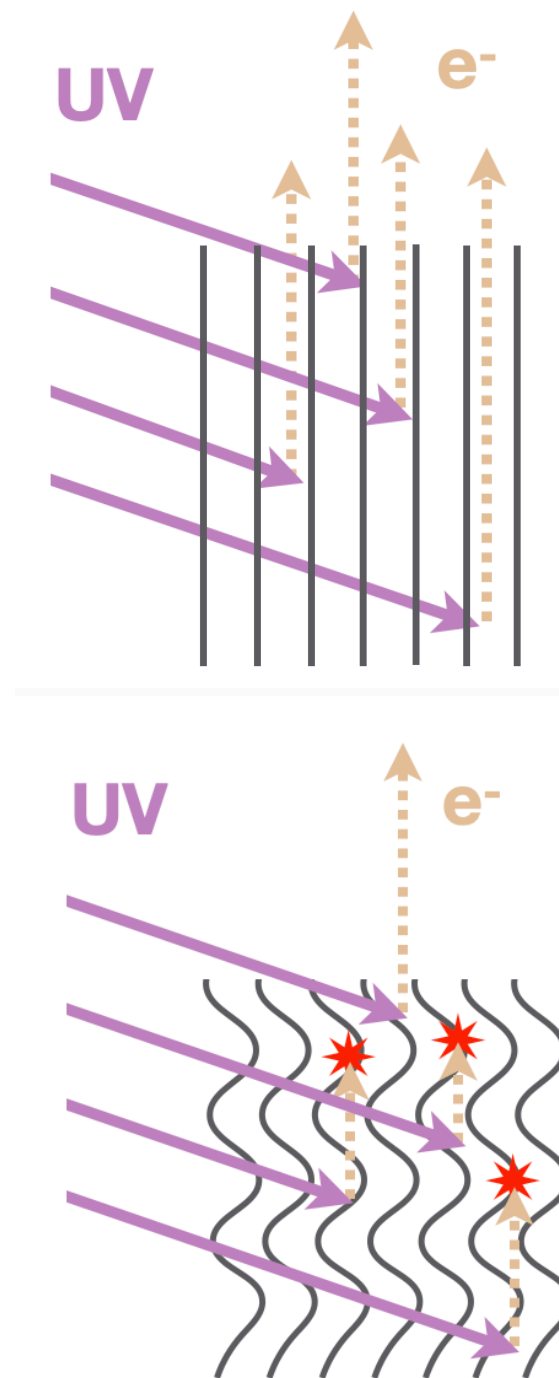
What About Nanotubes?

❖ Main result from UPS

- $E_{\gamma} = 5 \text{ eV} > \phi_{\text{cnt}} = 4.7 \text{ eV}$
- **Straighter** nanotubes eject **more electrons**

❖ Better to move away from UPS

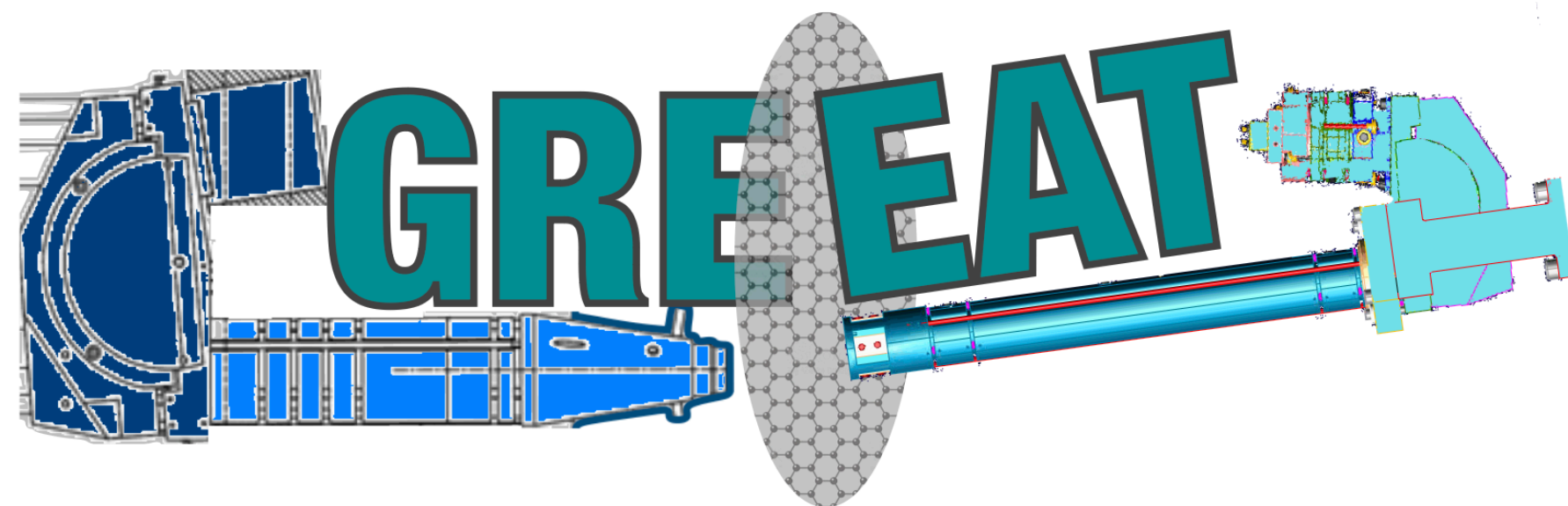
- Test e^{-} transmission **directly**





Plans for Testing Transmission Through Nanotubes

Electrons



GRaphene to Electrons:
Energy and Angular resolved Transmission

INFN Roma Tre, A. Apponi

Protons

SWEATERS

INFN Pisa, F. Pilo