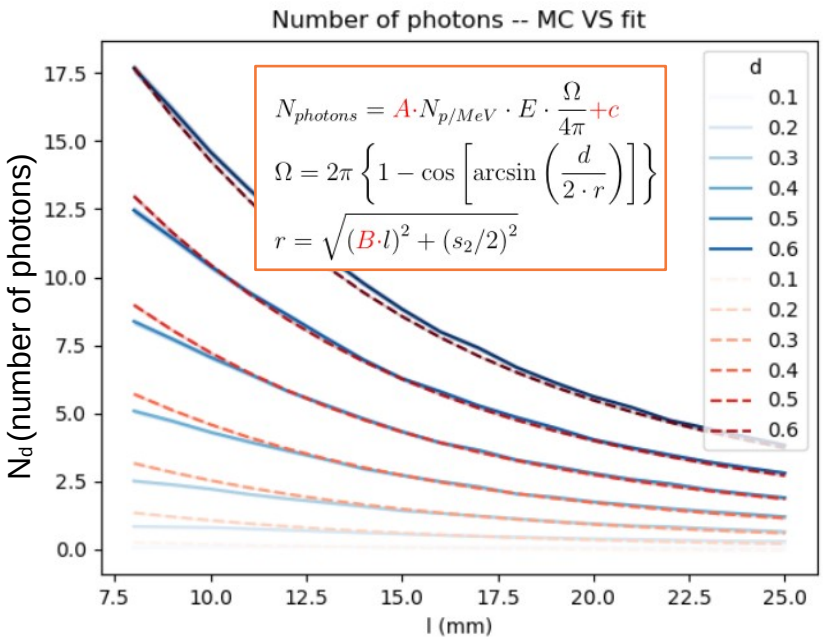
LAB report

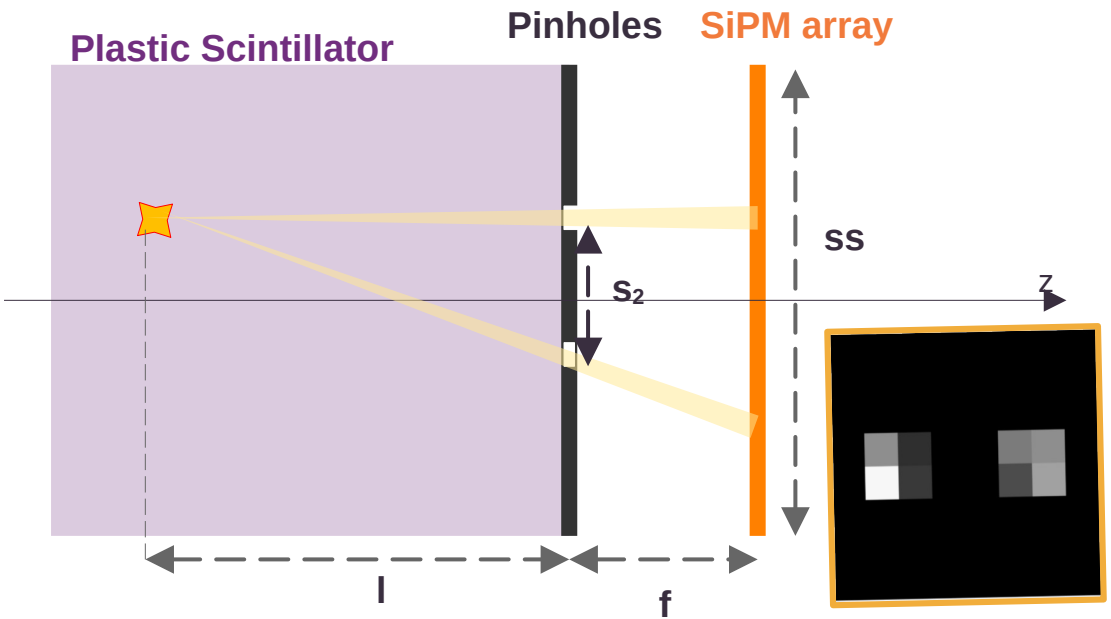
March 2025

Objectives

1) Check the scintillator performances

2) verify MC simulations results





ss = sensor side
s_2 = distance between pinholes
l = distance source-pinholes
f = distance pinholes-sensor

d = pinhole diameter
p = pixel pitch

Output image (8x8 pixel)

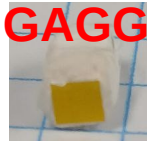
α-particle 5 MeV in [0,0,0]

Geometry of the detector

distance source-pinhole	**l**	[10,20] mm
distance pinhole-sensor	**f**	30 mm
sensor side	**ss**	50 mm
distance between pinholes	**s_2**	12.5 mm
pinhole diameter	**d**	0.6 mm
Magnification factor	**M**	3
pixel pitch	**p**	1 mm
Number of pixels		50 x 50 pixels

Field of View	**FoV**	[4,21] mm
Transversal uncertainty	**ε_{xy}**	[0.69, 0.82] mm
Longitudinal uncertainty	**ε_z**	[0.02, 0.2] mm
Number of photons	**N_d**	[10,20] photons
Dept of Field	**DoF**	10 mm

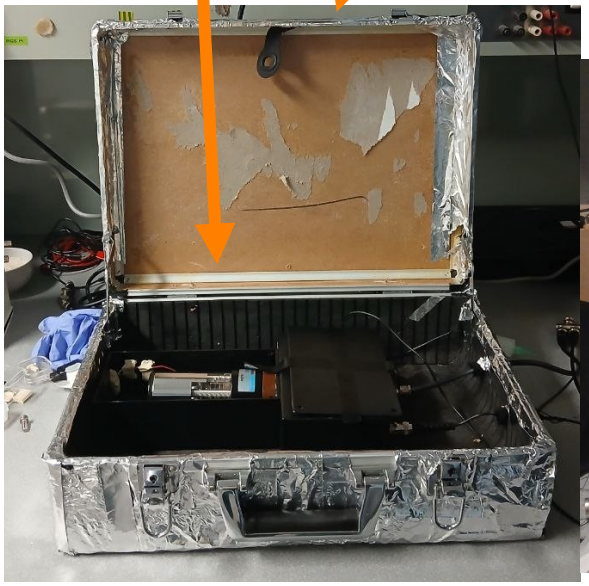
Materials



+

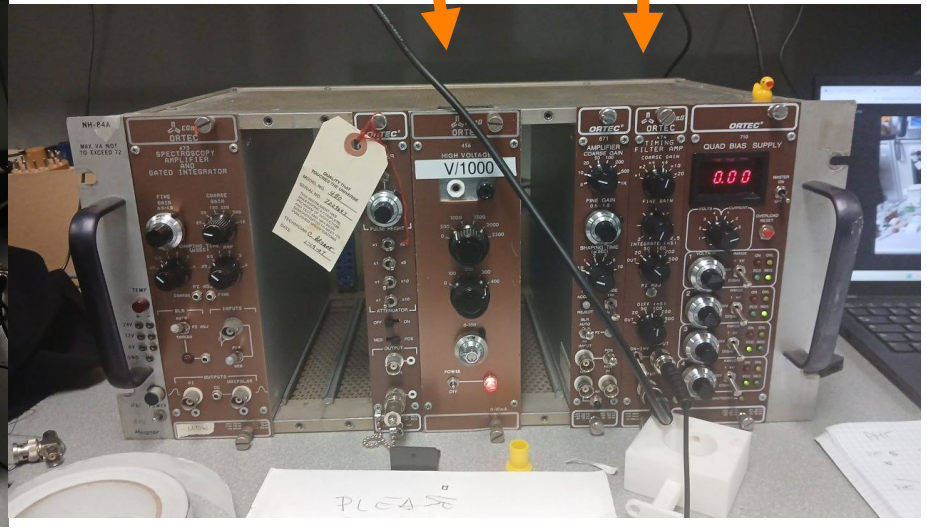
PMT

Isolated box

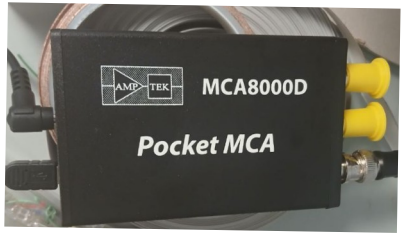


Time amplifier

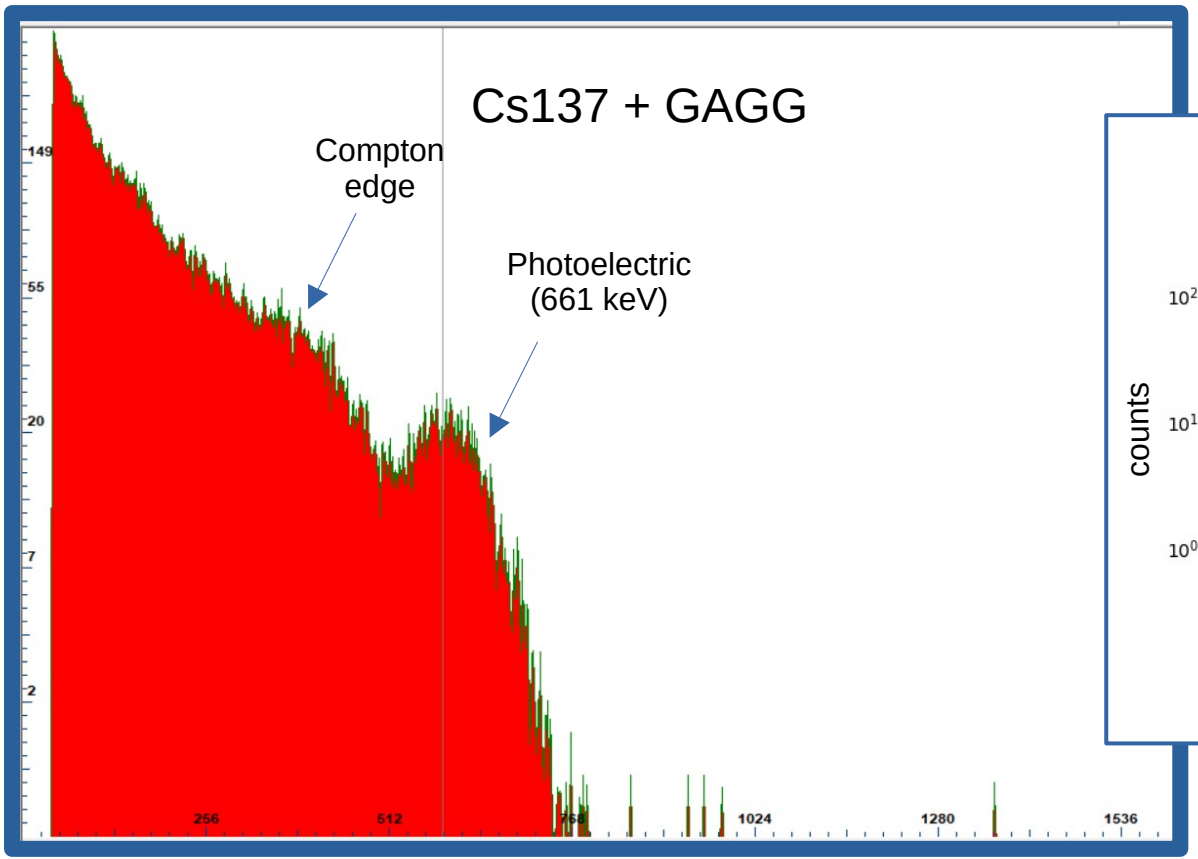
HV

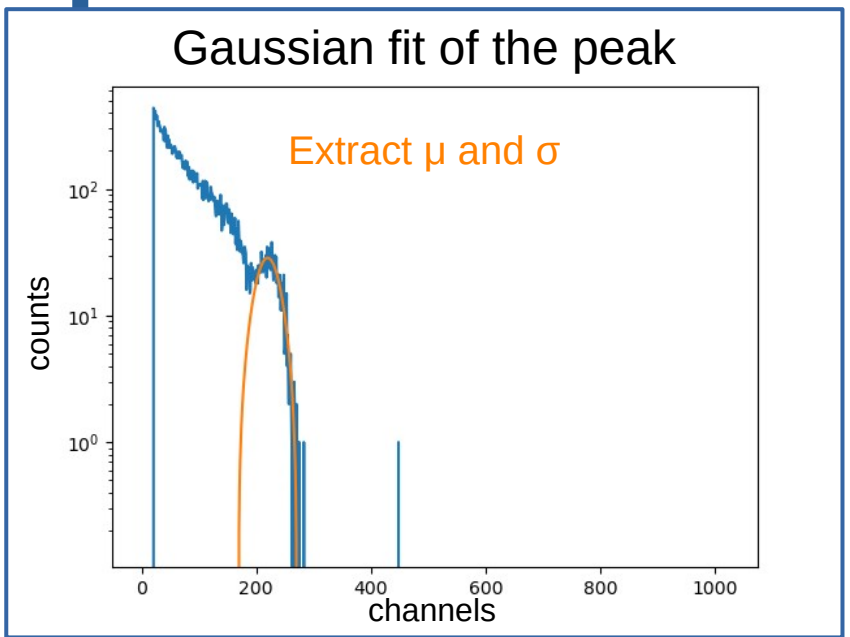


Multi channel analyzer



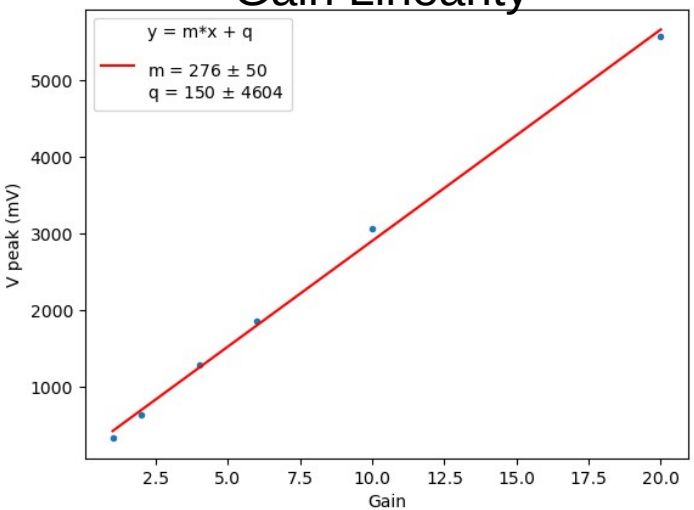
Preliminary



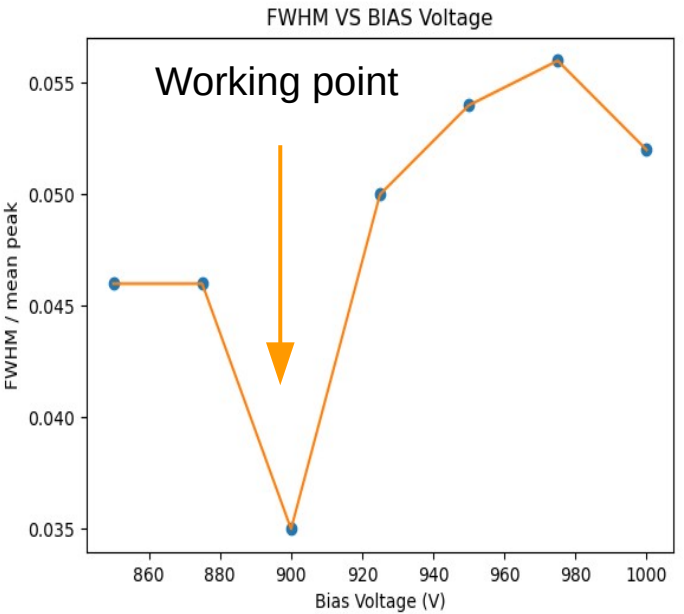


Preliminary

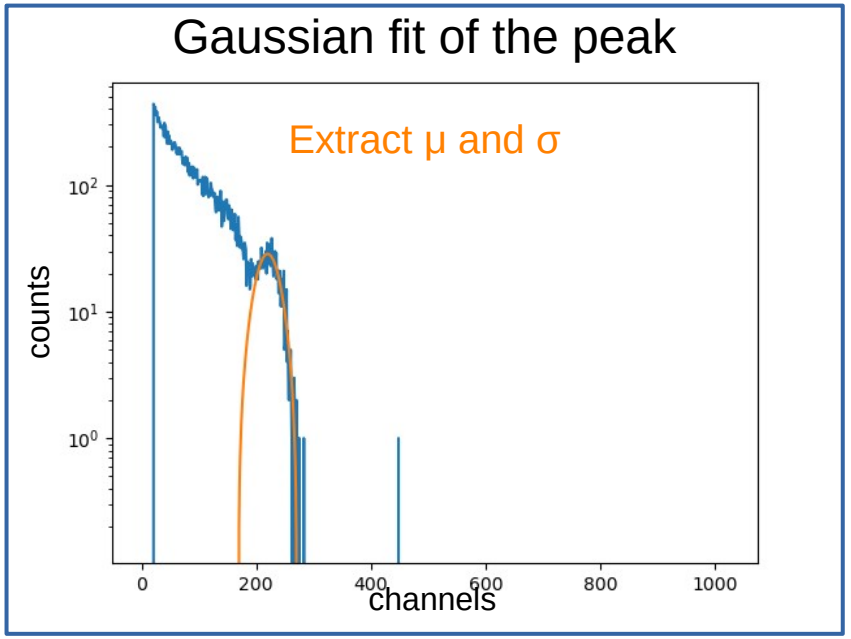
Tim Filter Amp
Gain Linearity



FWHM-BAIS response



First test using Cs137



Ratio measured photons / estimatet photons = 0.61

i.e. I am underestimating of ~1/3 (due to optical coupling or other factors)

1) extract μ and σ (MCA channels).

2) convert channels in Voltage *(#channels = 2048 – range = 1 Volt)*

3) divide for the Timing Filter Amp gain *(Gain = x4)*

4) convert Voltage to Current *(I = V/R -- R = 100Ω Time filter input impedence)*

5) convert current into charge *(Charge = I * time integral – time integral = 20 ns)*

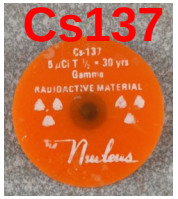
6) convert charge into number of electrons

7) divide photoelectron per PMT gain (1E5)

I HAVE THE NUMBER OF PHOTOELECTRONS DETECTED BY THE PMT

8) Compare this value to he number of photons produced by the γ of Cs137 (661 keV) multiplied bu the QE of PMT (11.5%), coupling (50%) and scintillator (70%)

$$(\text{Photoelectrons} = E_{\gamma} * \text{Yield}_{GAGG} * QE_{scintillator} * QE_{coupling} * QE_{pmt})$$

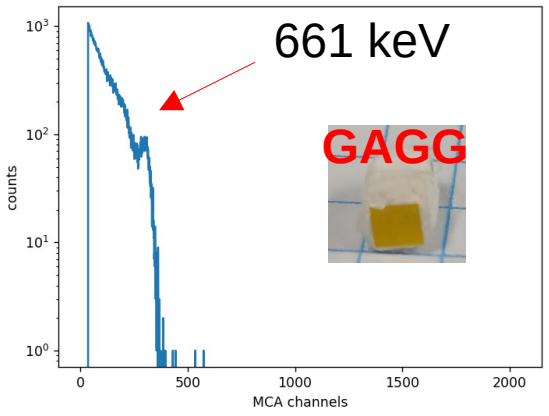


Cs137 spectrum

(peak at 661 keV)

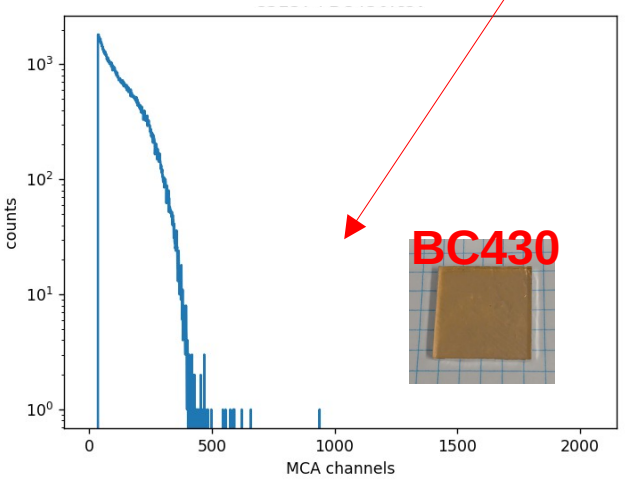
Cs137 peak is not visible

GAGG



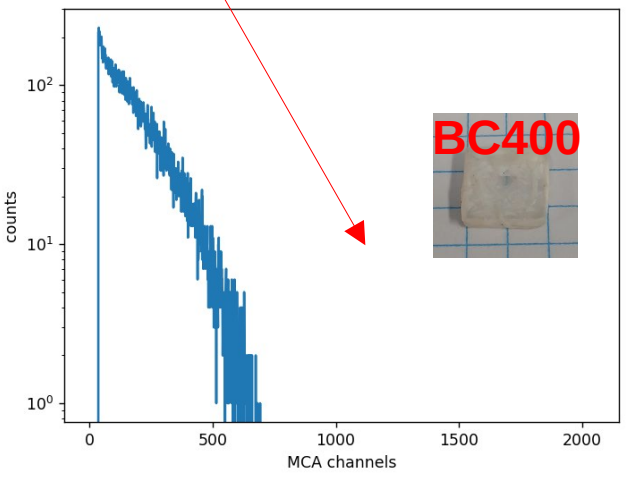
30000 photons/MeV

BC430



9045 photons/MeV

BC400

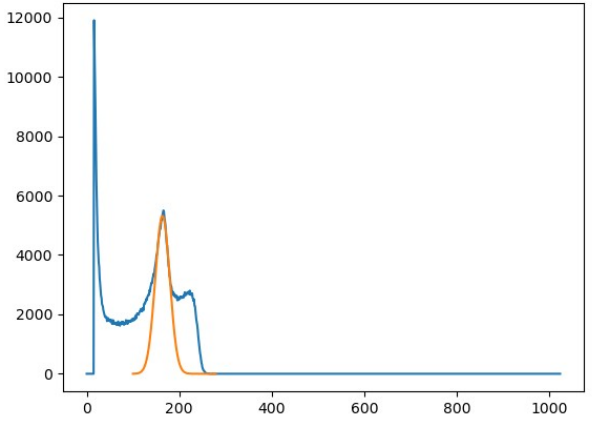


13065 photons/MeV

Am241 spectrum – in air

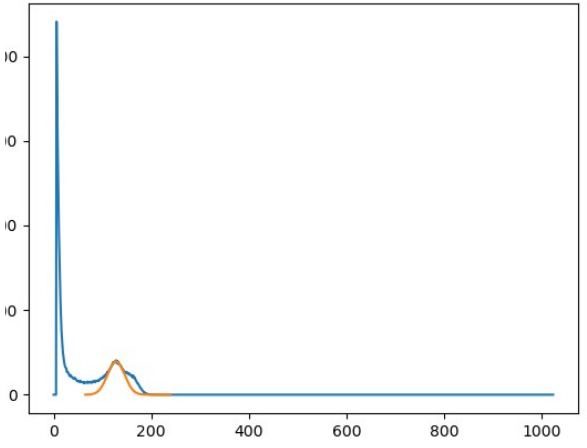
(α a 5.5 MeV)

BC400



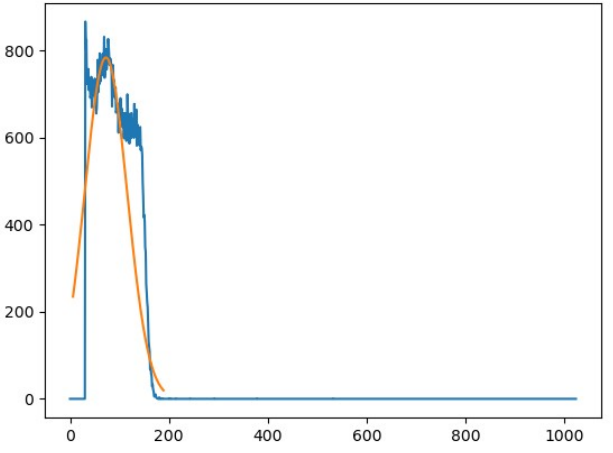
Yield = 13 065 ph/MeV

BC430



Yield = 9 045 ph/MeV

GAGG



Yield = 30 000 ph/MeV