

Proton range calibration for the R³B-CALIFA calorimeter

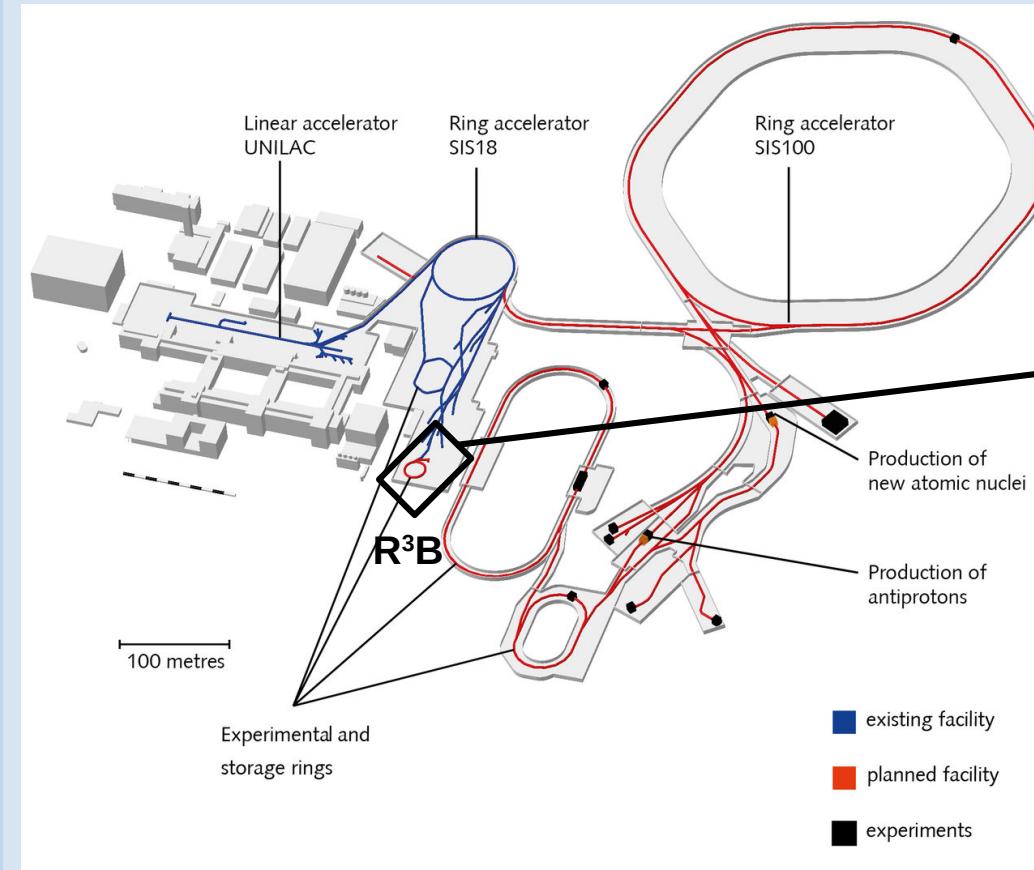


Mrunmoy Jena

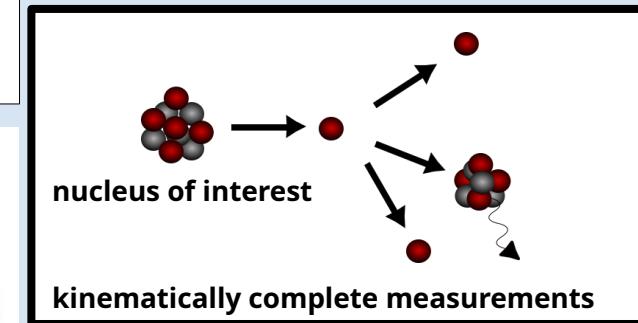
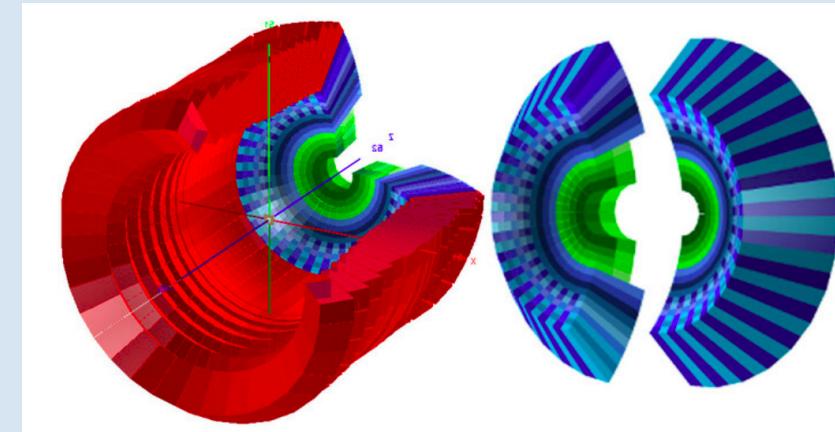
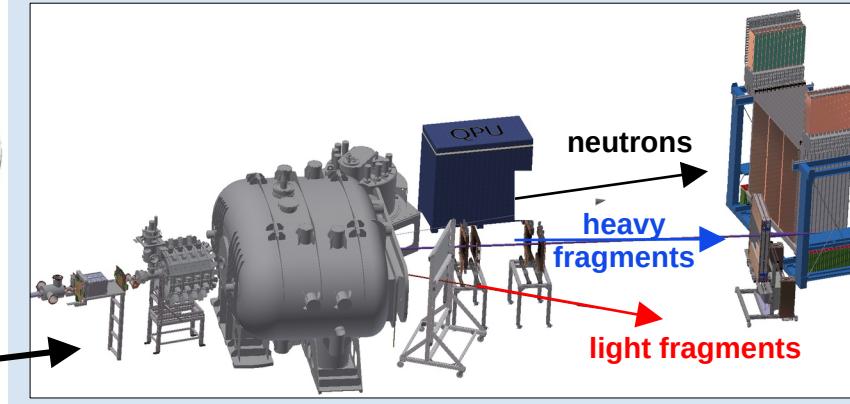
DPG Spring Meeting, Köln
HK 55.2
13.3.2025

Overview of R3B and CALIFA
Structure of calibration algorithm
Calibration in the gamma range
Extrapolation to proton range

Overview : R³B and CALIFA



R³B: Reactions with Radioactive Beams



Barrel: $43^\circ < \theta < 140^\circ$

iPhos: $19^\circ < \theta < 43^\circ$

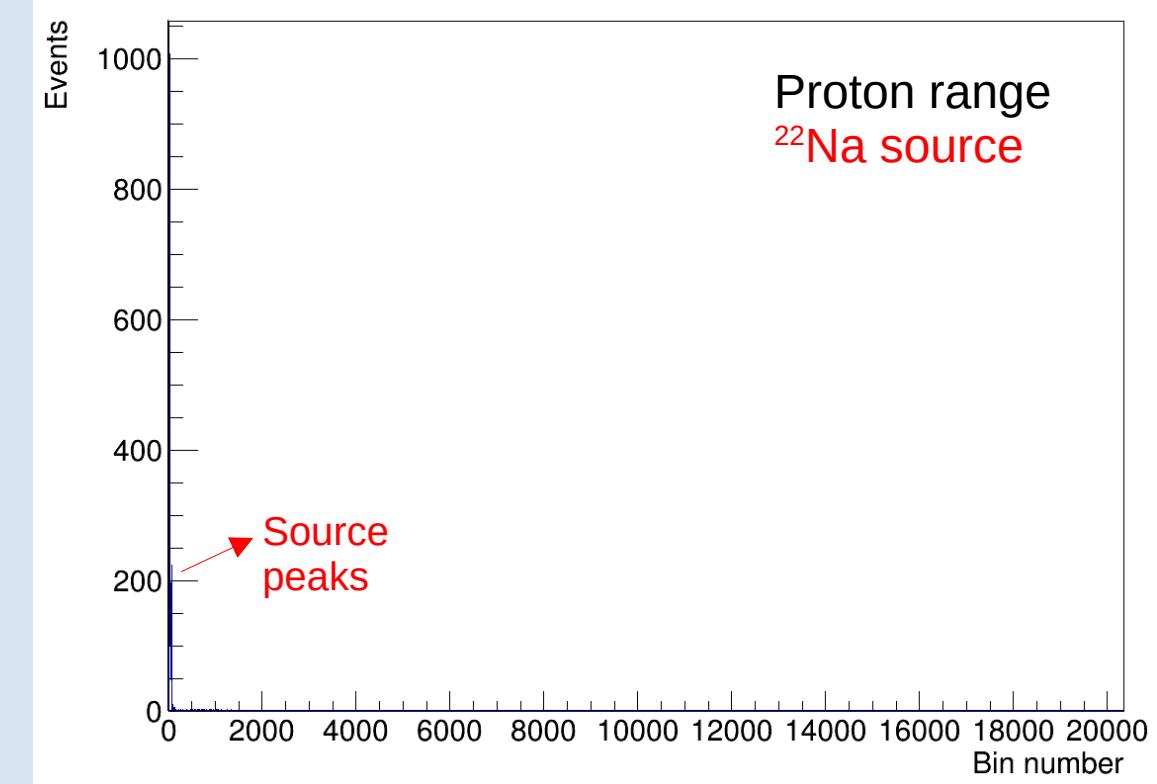
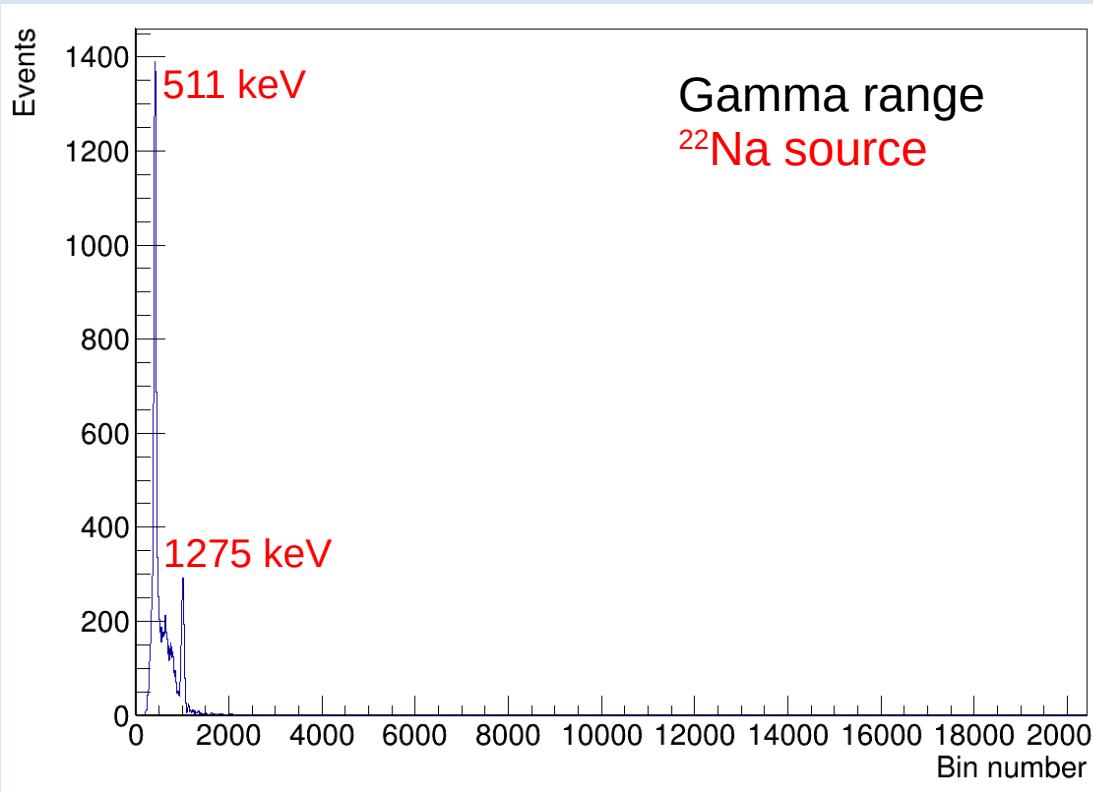
CEPA: $7^\circ < \theta < 19^\circ$

CALorimeter for the In Flight detection
of γ rays and light charged pArticles

Group report:

HK 33.1 Tobias Jenegger (Wed., 17:30)

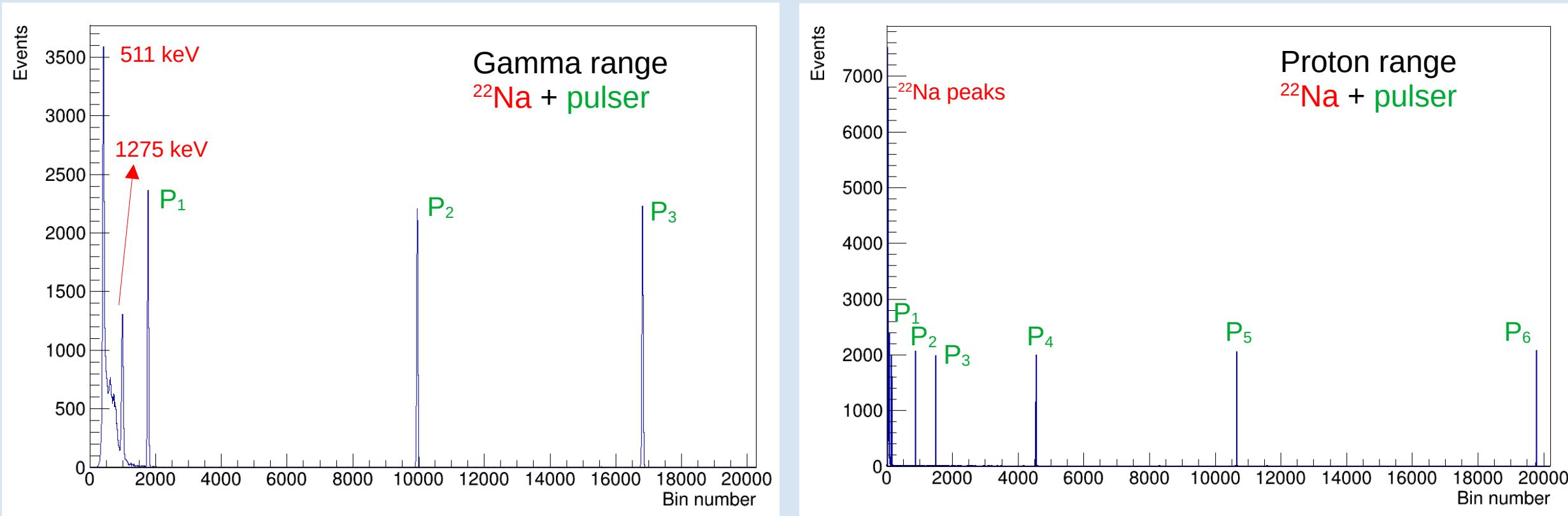
Introduction



^{22}Na source hardly useful for performing calibration in the proton range !



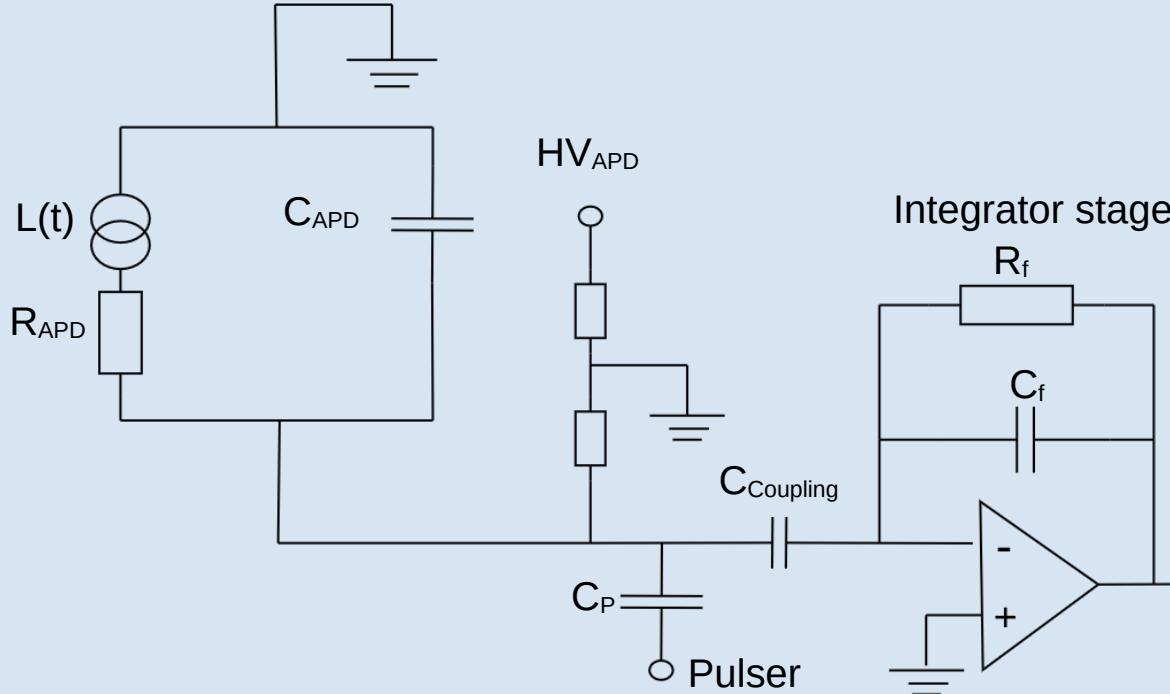
Introduction



Using **pulsers** is essential for calibration in proton range

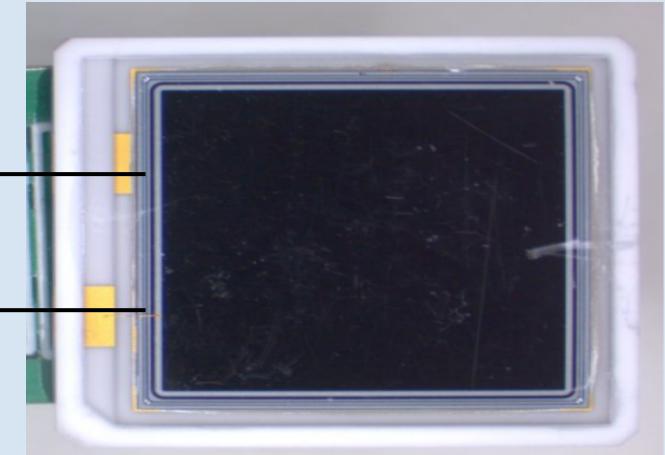
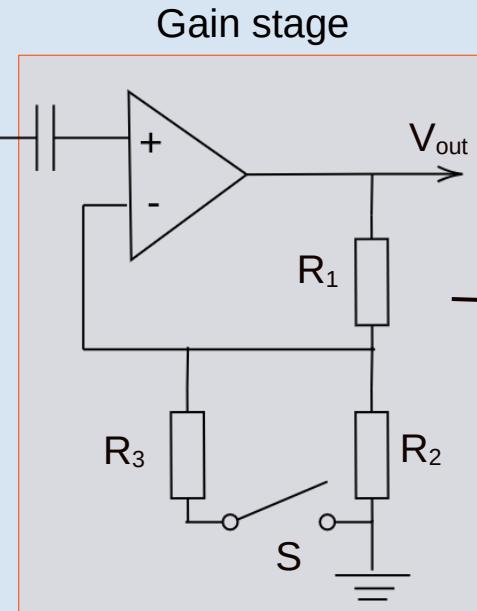


Introduction

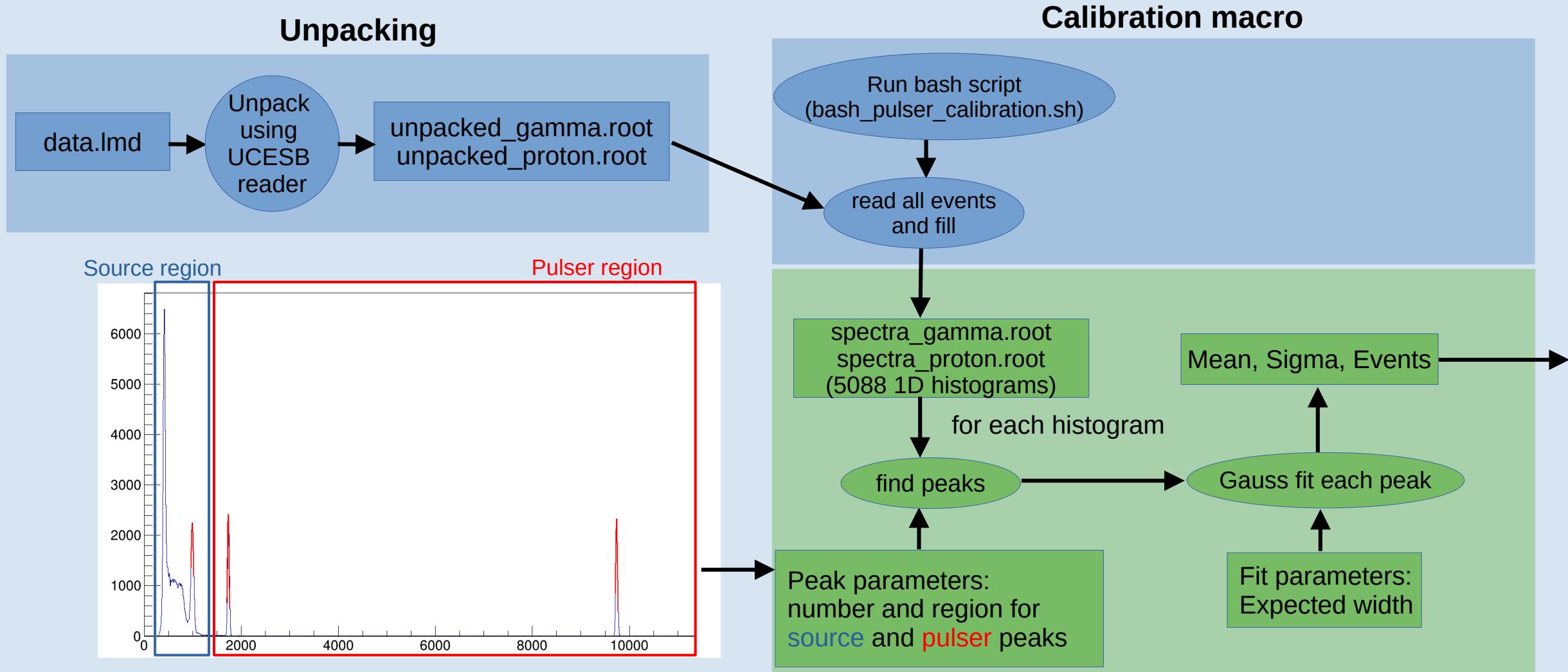


$$L(t) \equiv f(N_\gamma \cdot c_{Transp.} \cdot c_{Absorp.} \cdot \epsilon_{APD} \cdot g_{APD})$$

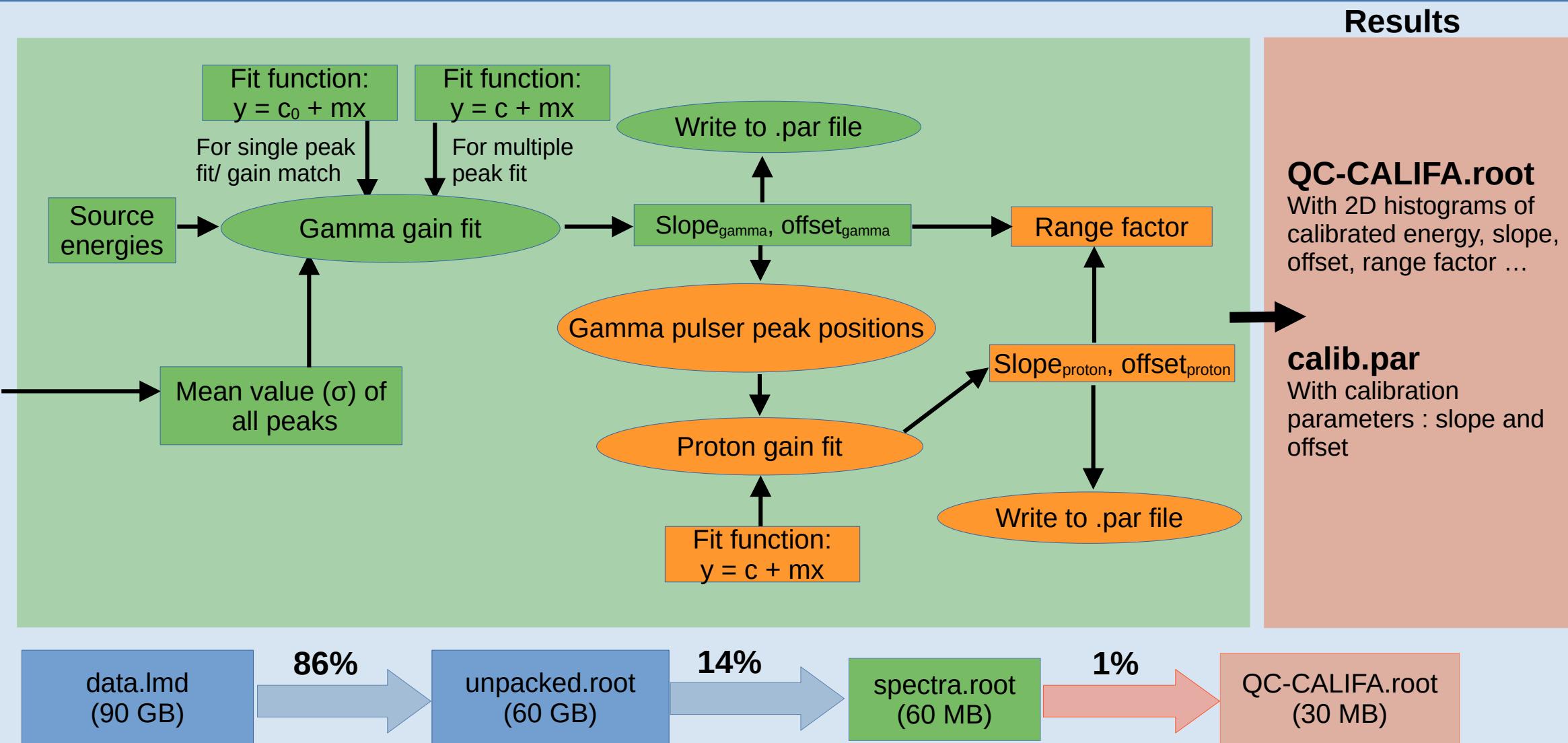
Need to calibrate: $\frac{\int L(t)dt}{V_{out}}$



Calibration algorithm

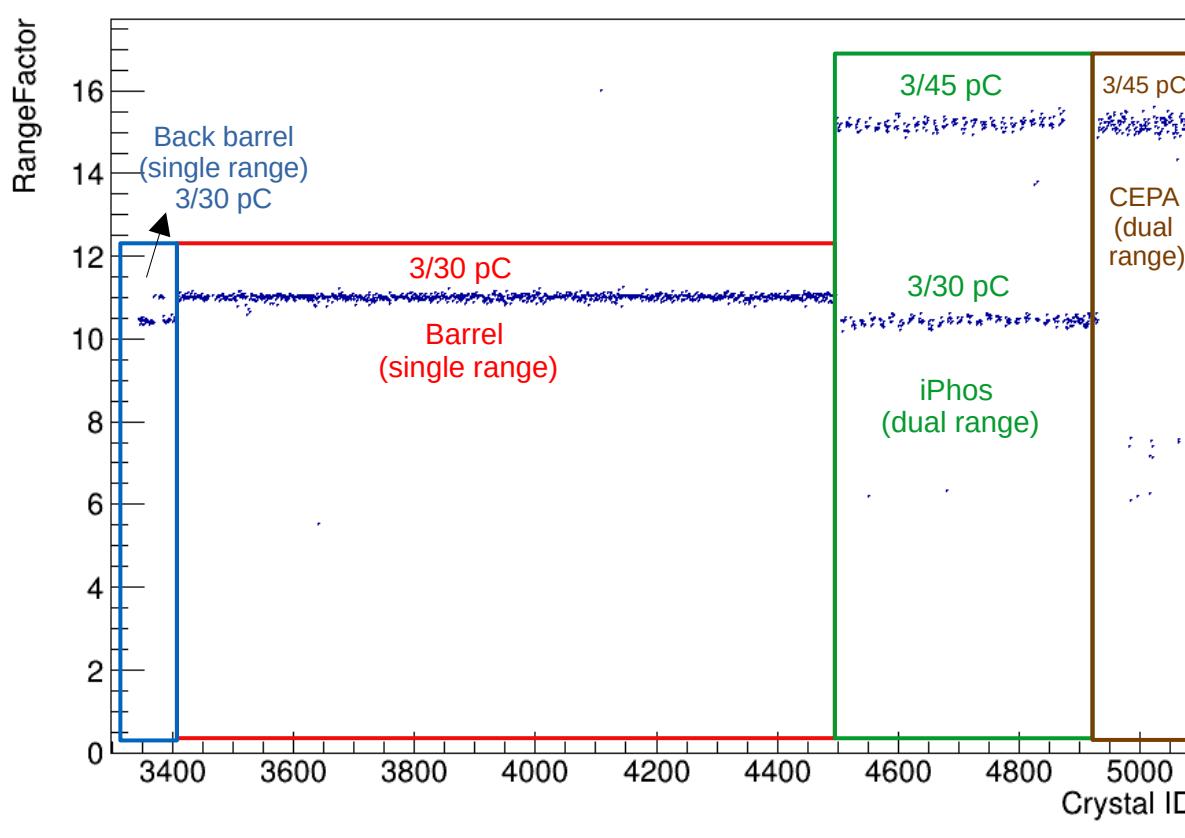


Calibration algorithm



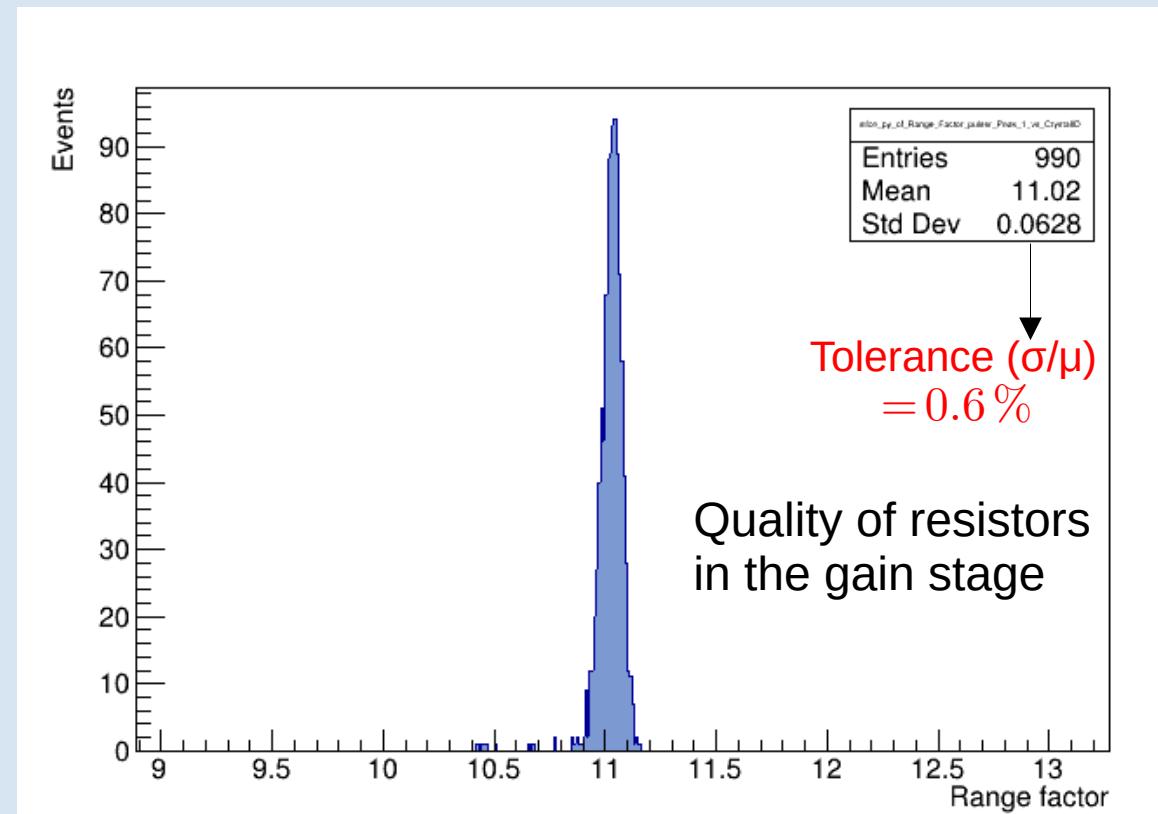
* % in terms of time taken on an 12th Gen Intel Core i5-12500, 12 cores

Range factor

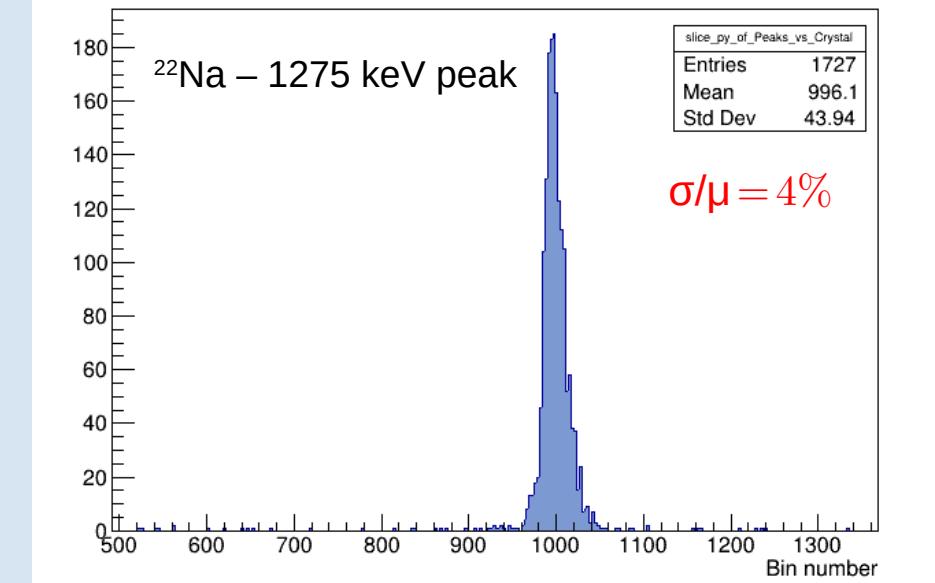
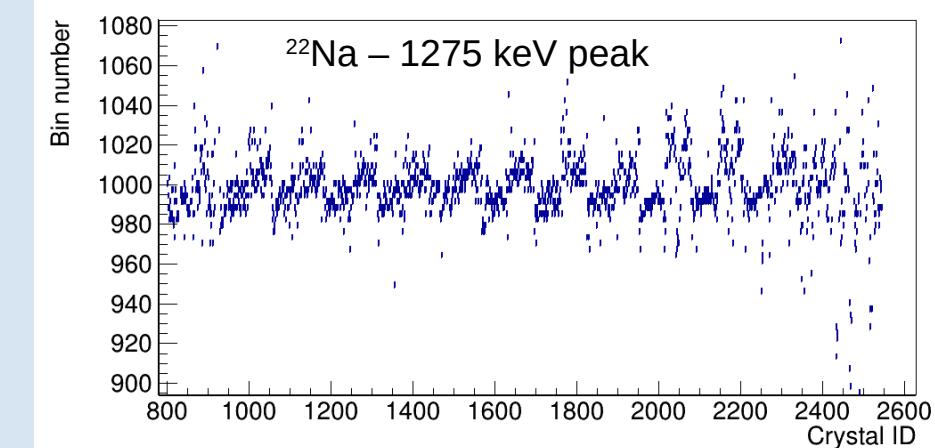
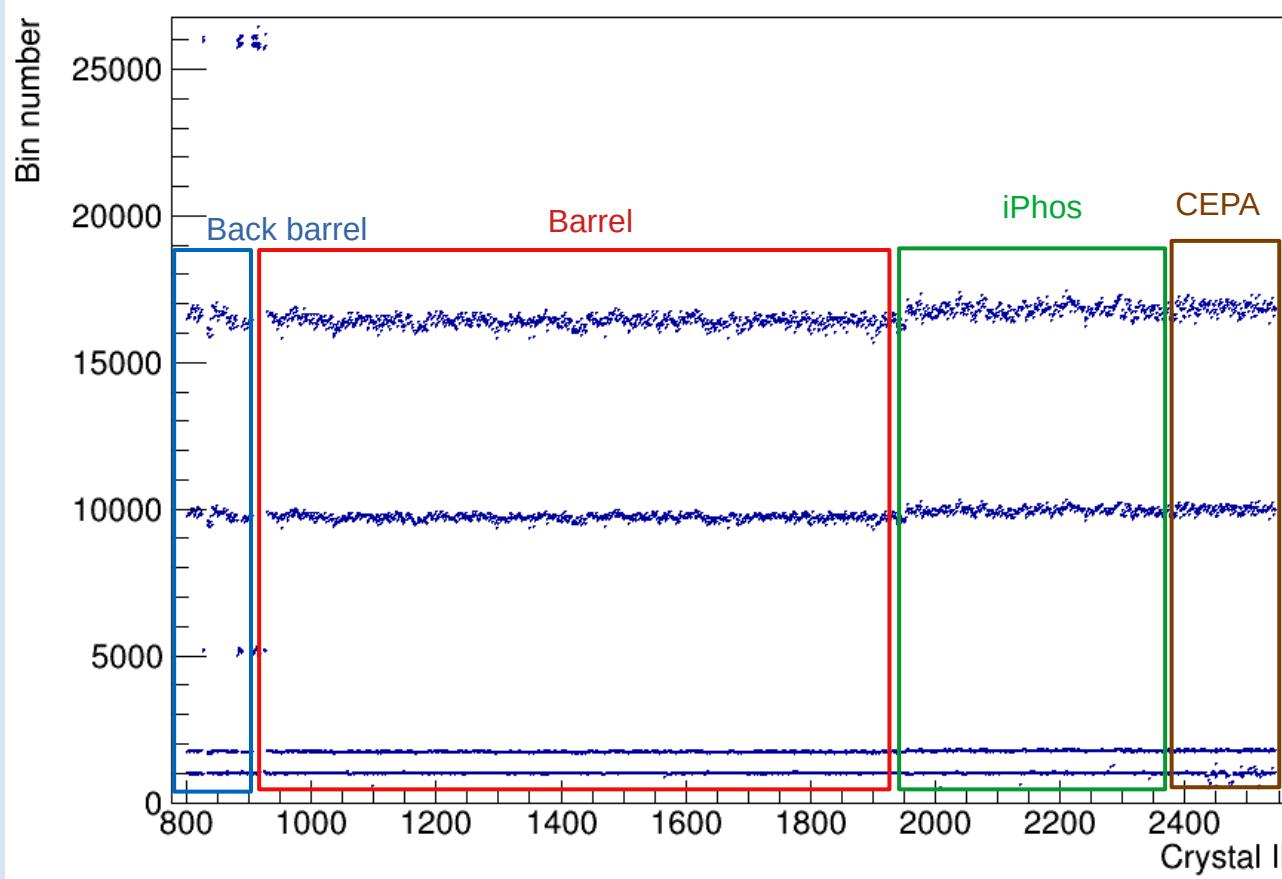


$$R = E_{\gamma(\text{uncalib.})} / E_{p(\text{uncalib.})} \approx 11$$

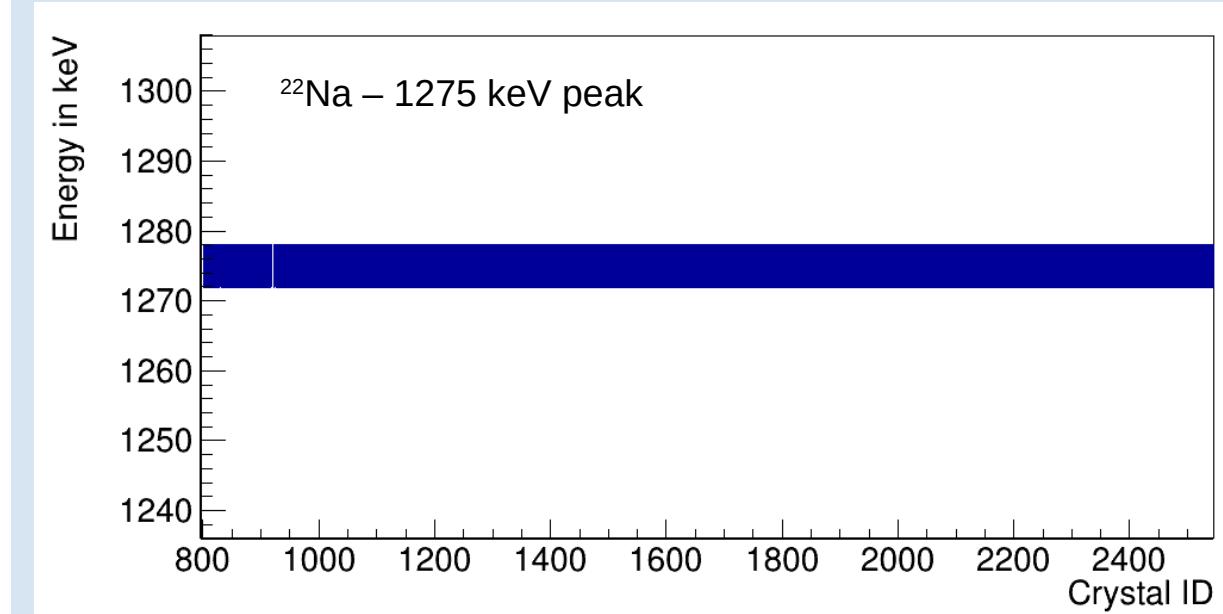
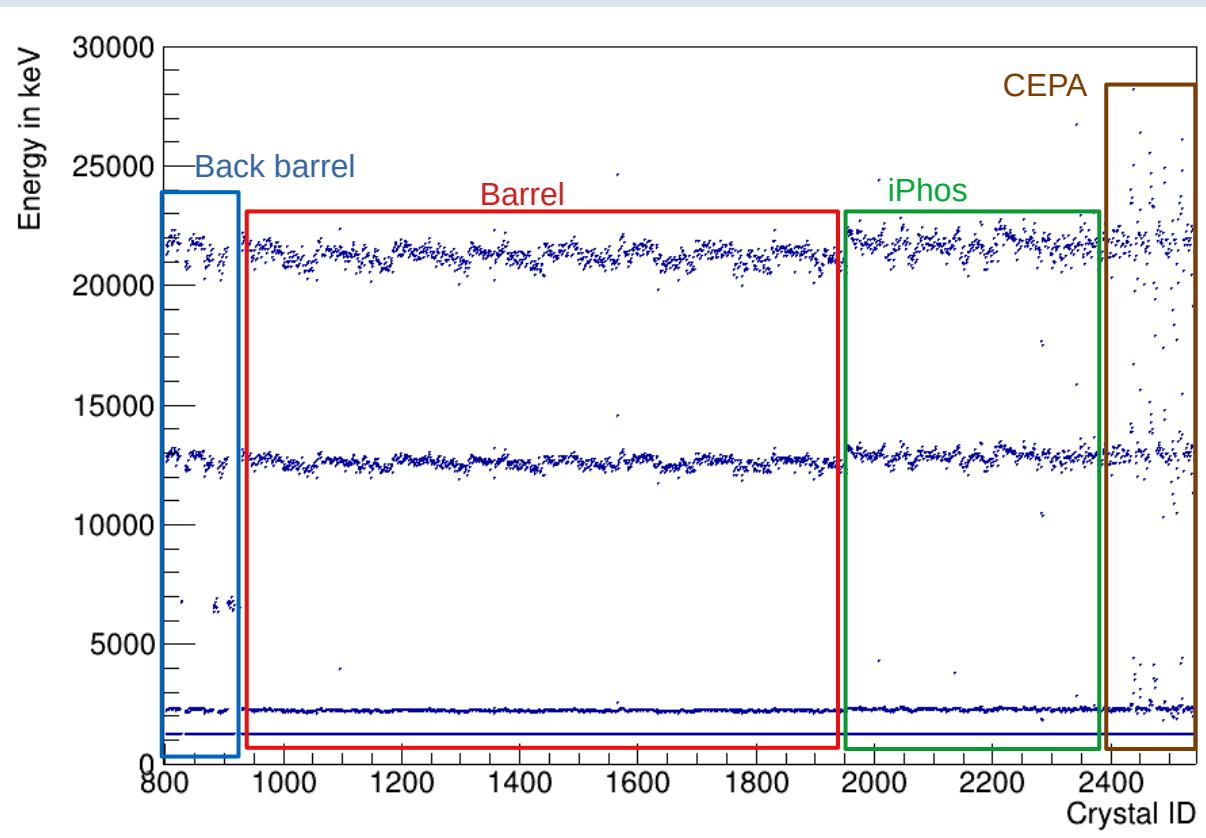
Serves as a translation factor between gamma range and proton range



Gamma range: uncalibrated spectra



Gamma range: calibrated spectra



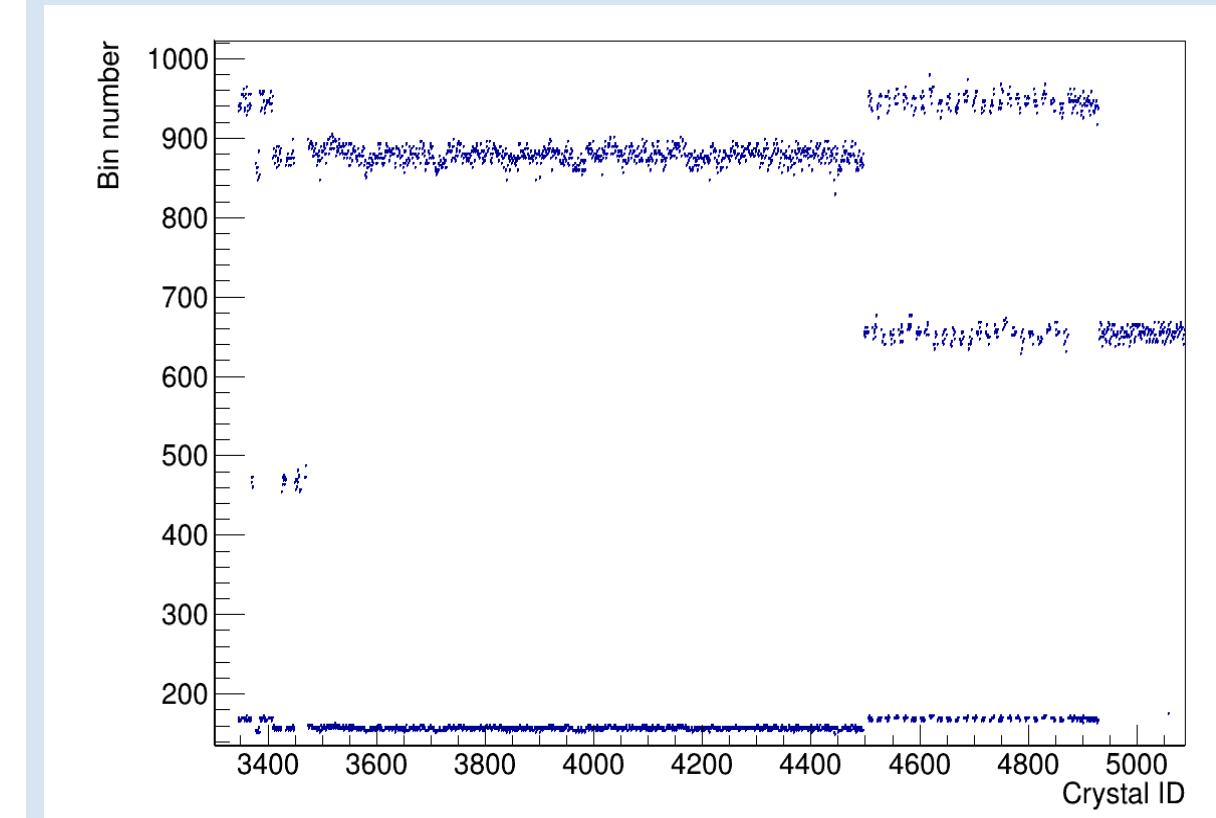
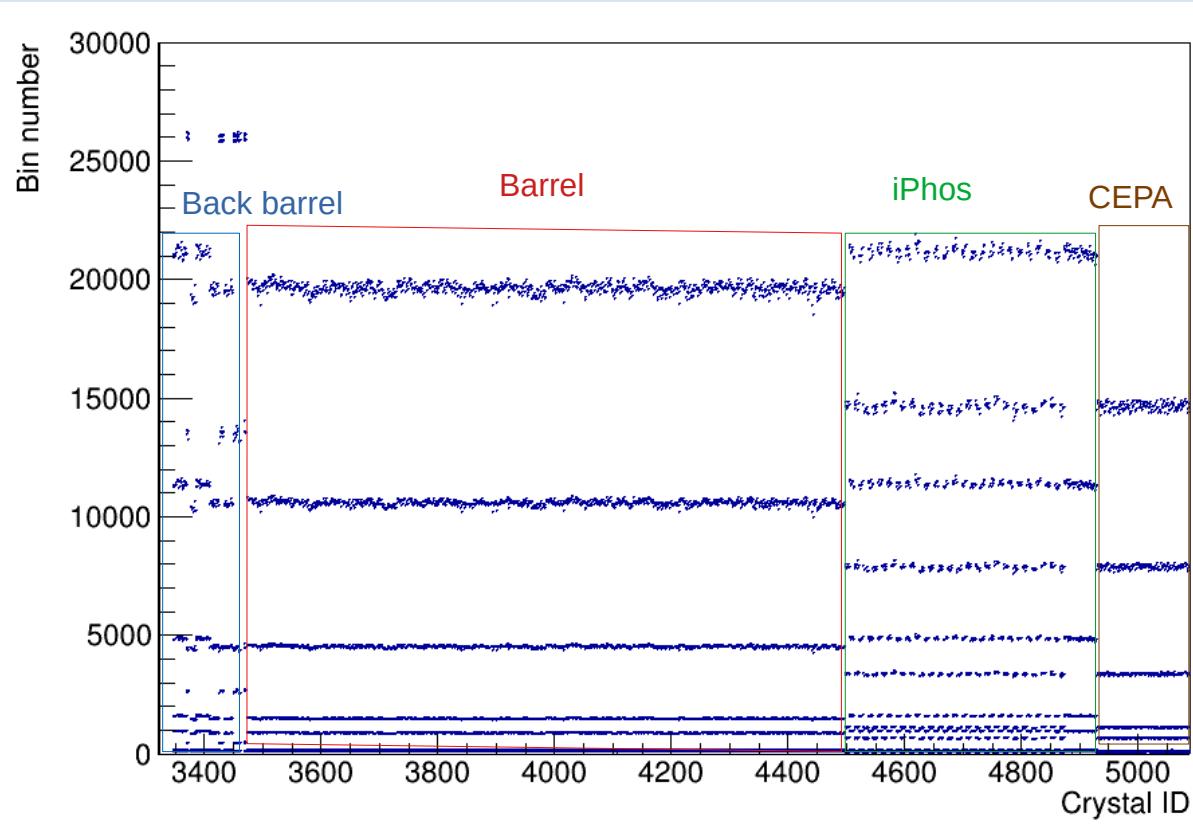
Applying a linear fit: $y = m_\gamma x + c_\gamma$

Software works !

Now we also have pulser peaks in keV



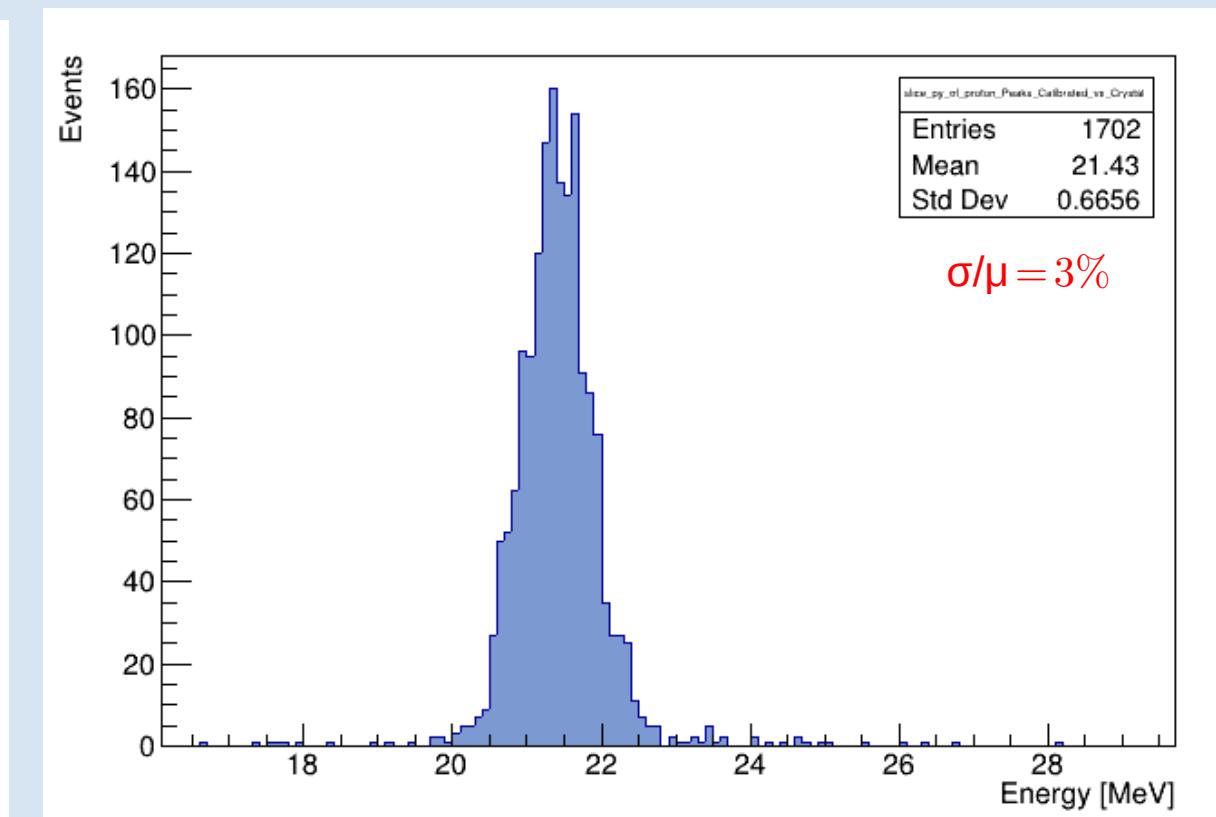
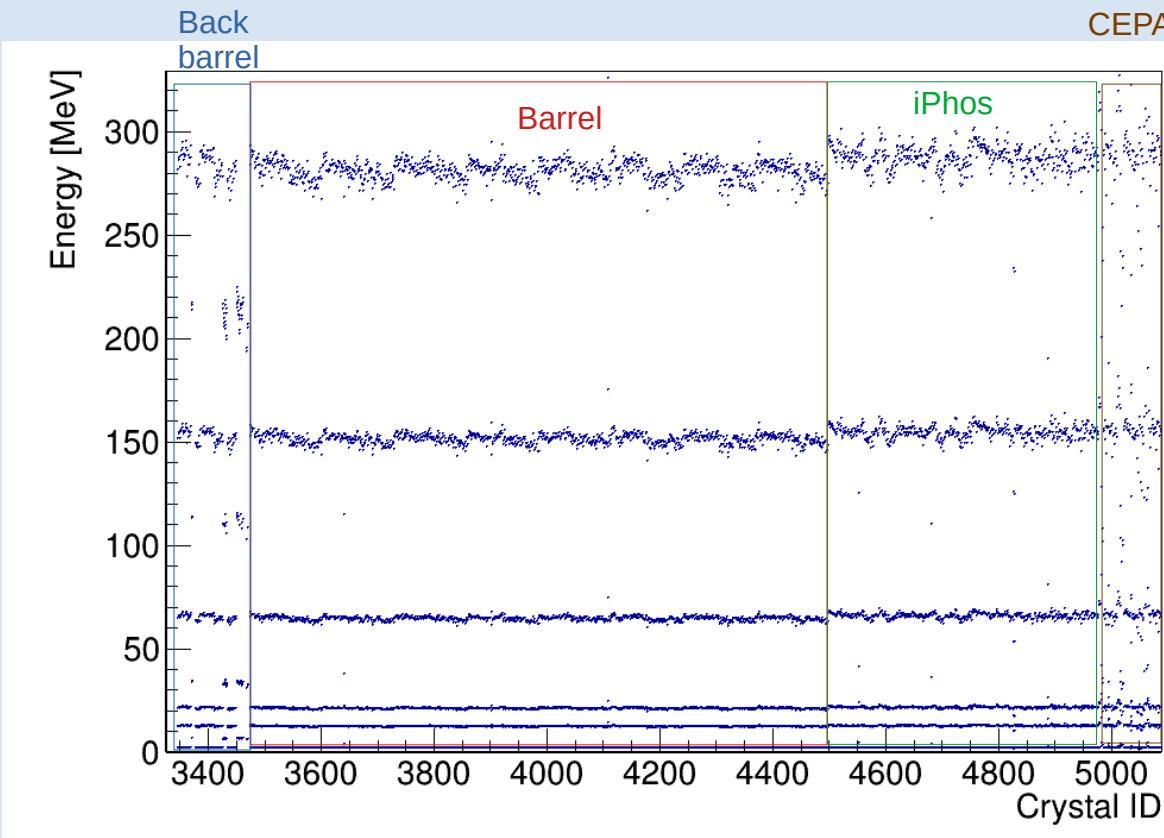
Proton range: uncalibrated spectra



There are (channel to channel) variations in the electronics



Calibration in proton range

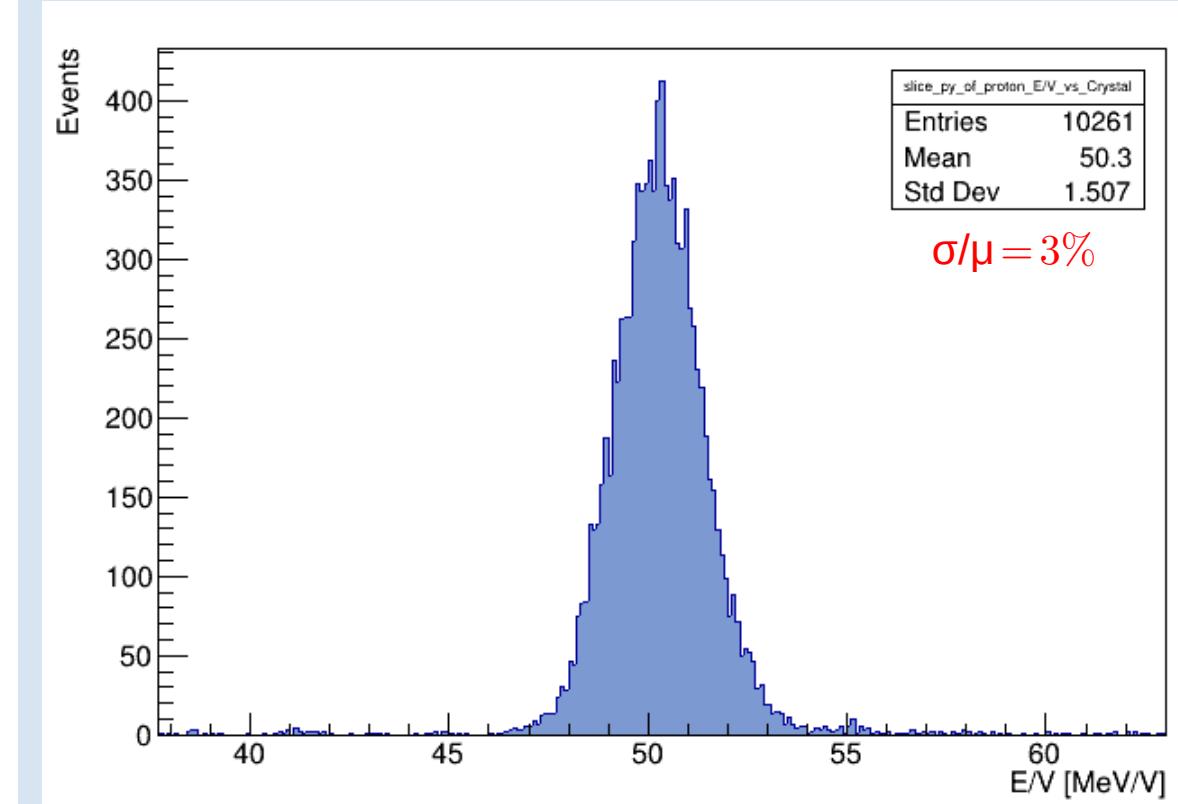
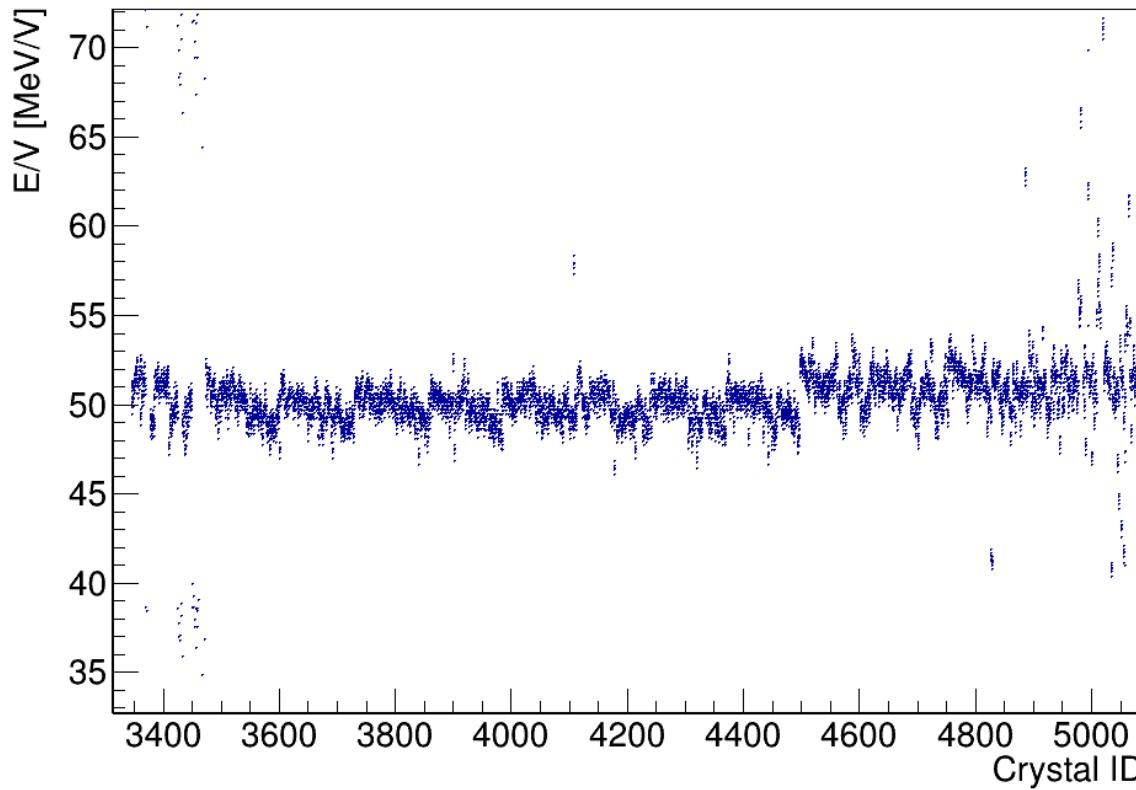


Energies for first 3 pulsers obtained from gamma calibration

Then doing a linear fit : $y=m_p x + c_p \Rightarrow$ All pulser energies in keV

Variation in pulsers include all uncertainties (depending on L(t), R and C_{pulser})

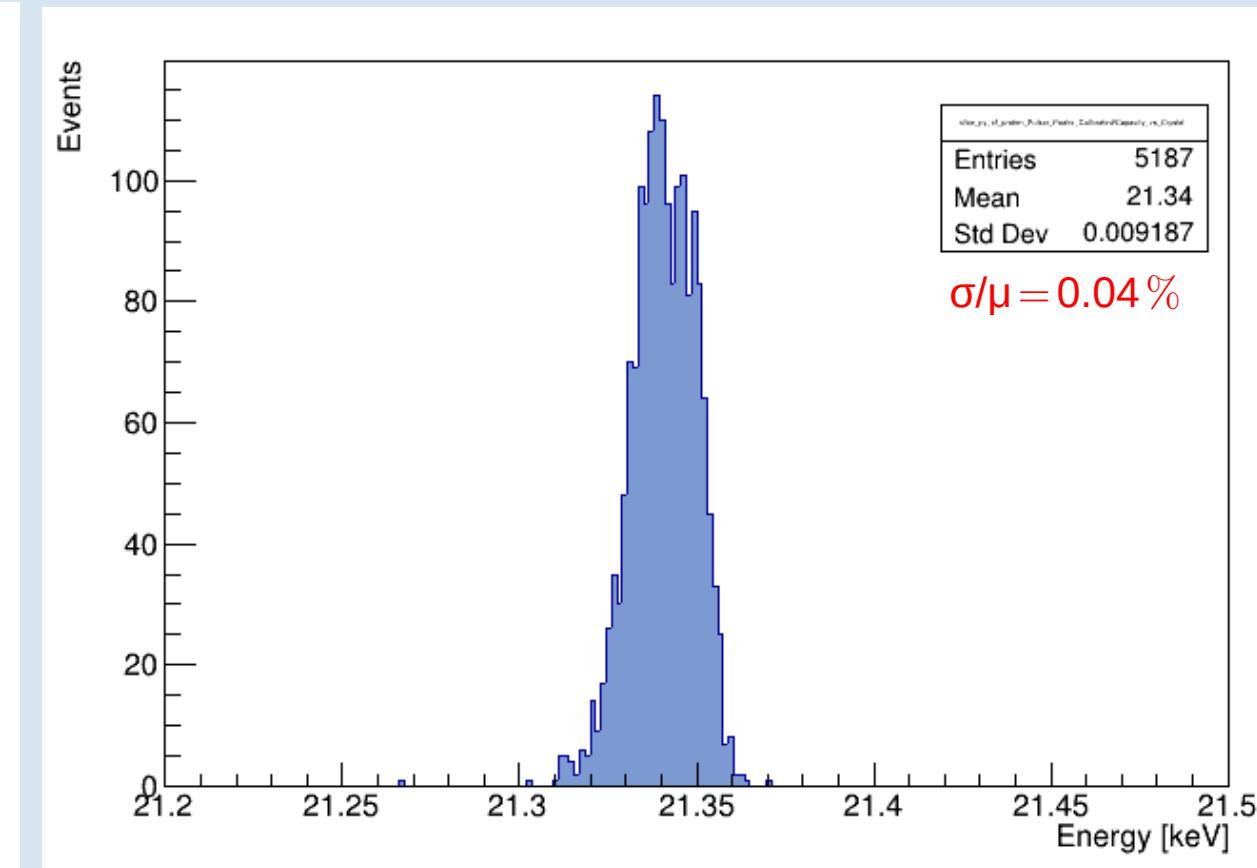
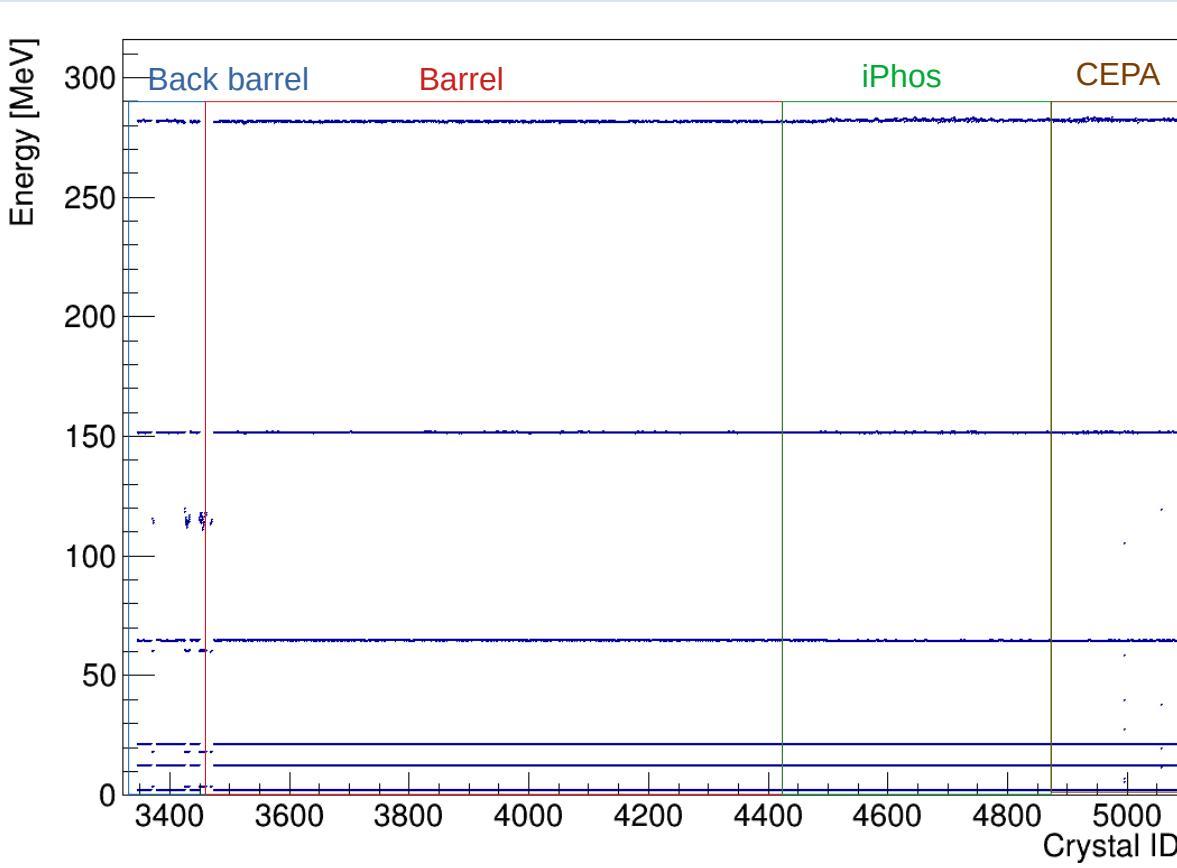
Pulser capacitance



Variation in E/V for the pulsers again include all uncertainties ($L(t)$, R and C_{pulser})



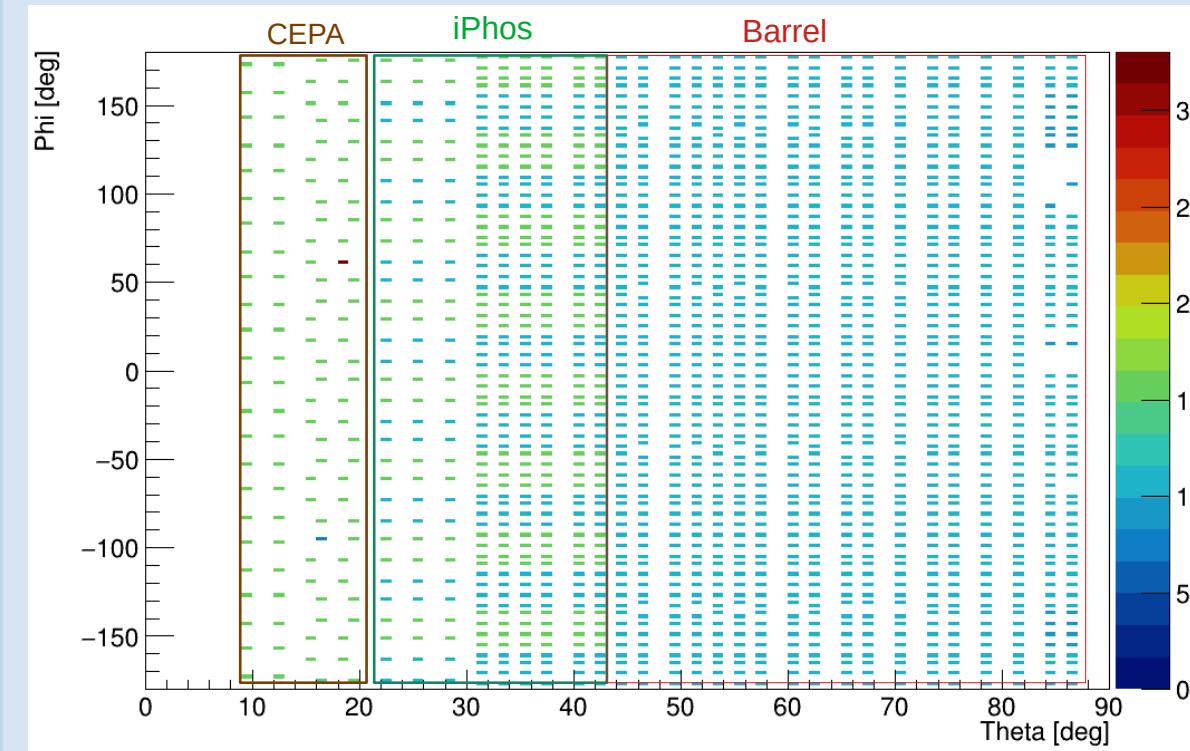
Proton range: calibrated spectra



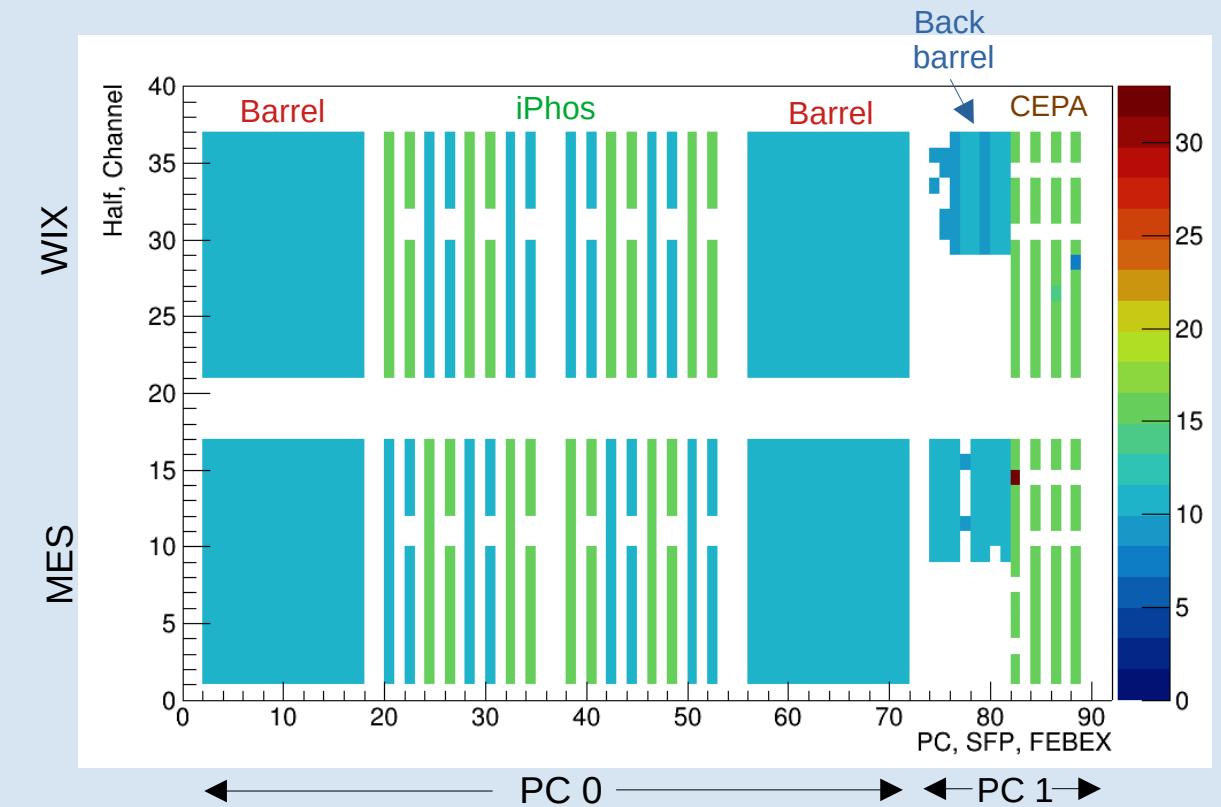
Software works !



QC Plots

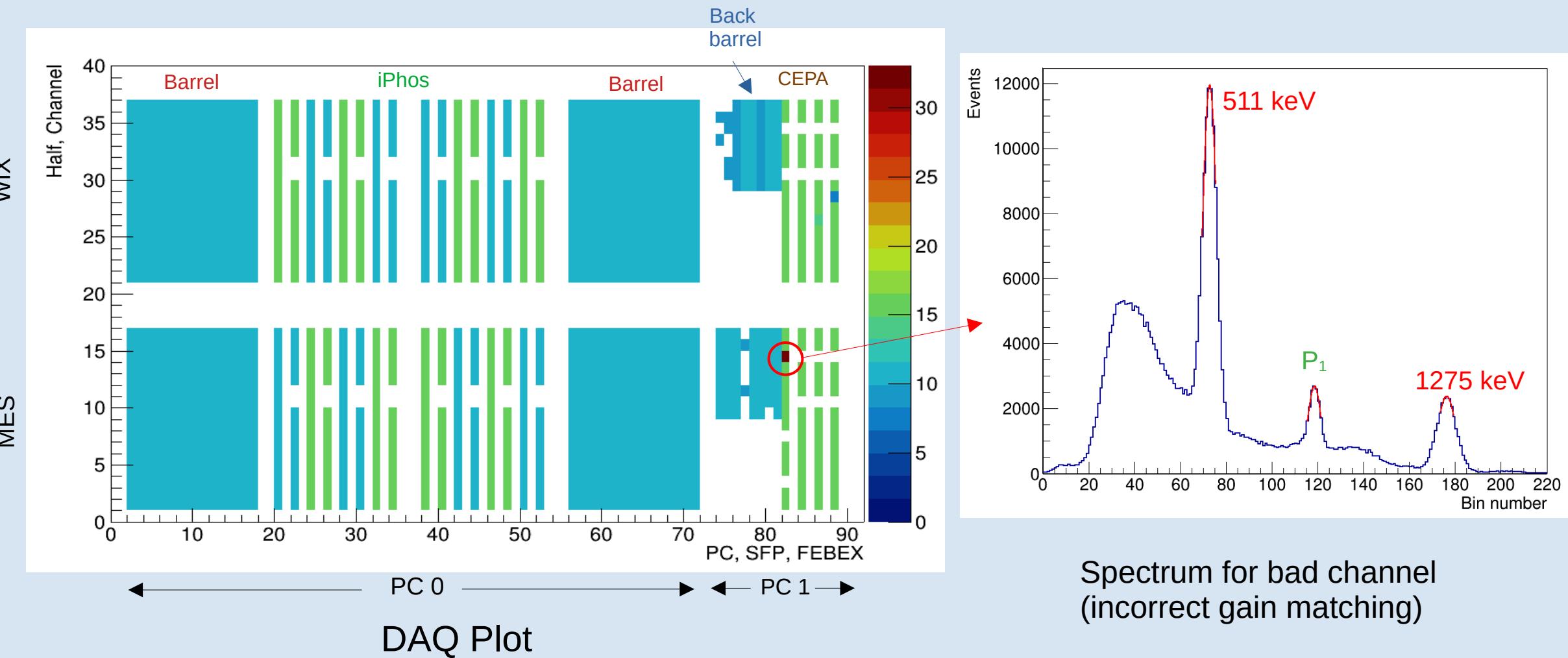


Quality Assessment Plot



DAQ Plot (Hardware level)

QC Plots



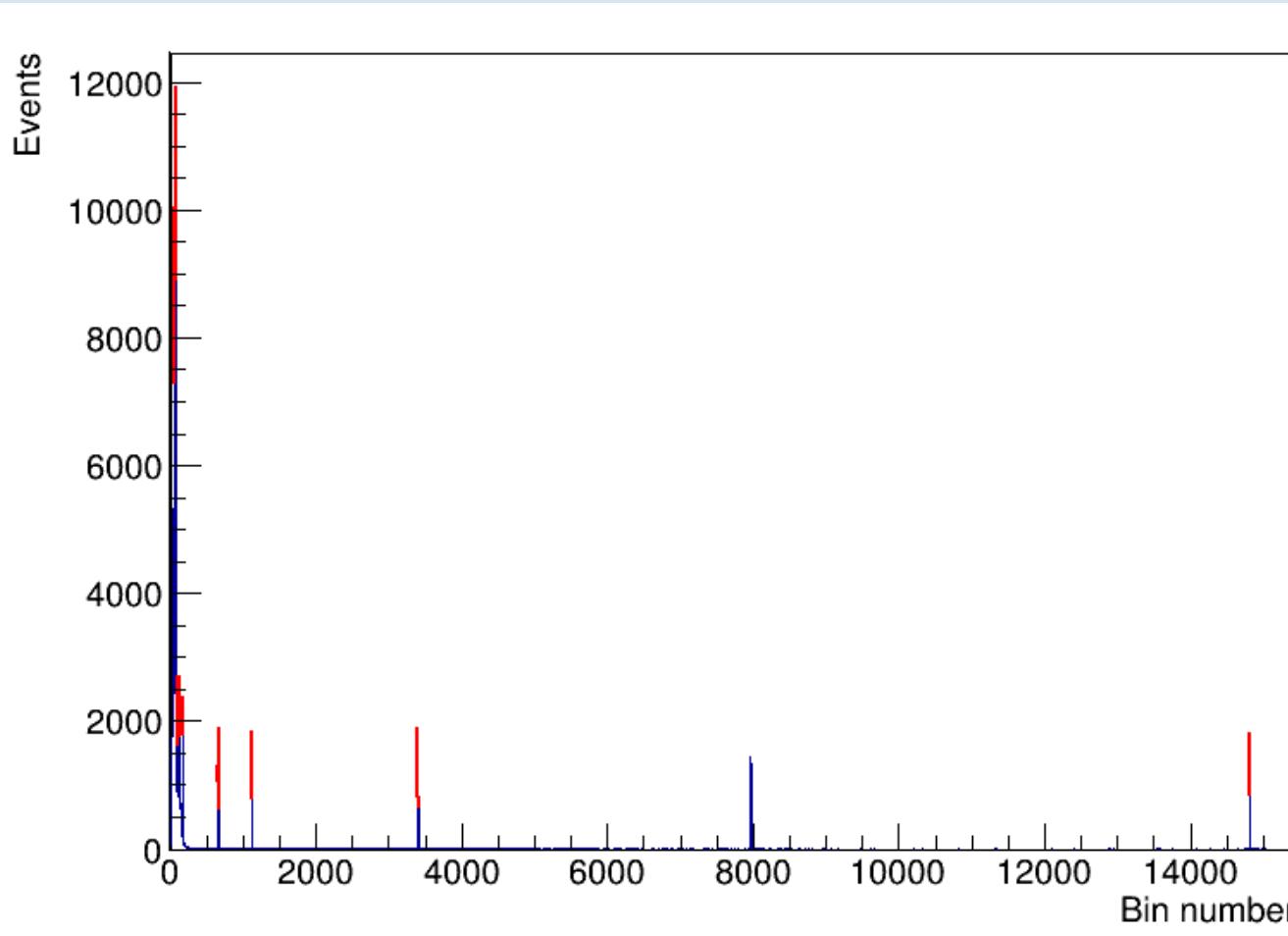


Thank You !

CALIFA @ Technical University of Munich
Roman Gernhäuser, Tobias Jenegger, Mrunmoy Jena



Extras: Bad channel



Crystal ID: 5057, in CEPA

Crystal 5057

Source Peak 1, Bin number: 72.8852
Pulser Peak 1, Bin number: 118.622
Pulser Peak 2, Bin number: 176.335
Pulser Peak 3, Bin number: 664.026
Pulser Peak 4, Bin number: 1121.33
Pulser Peak 5, Bin number: 3402.16
Pulser Peak 6, Bin number: 14819.5
Range factor Pulser Peak 1: 15.2875
Range factor Pulser Peak 2: 57.8574
Range factor Pulser Peak 3: 25.9151
Range factor: 33.02
Pulser Offset: -2053.82
Pulser Slope: 36.794