

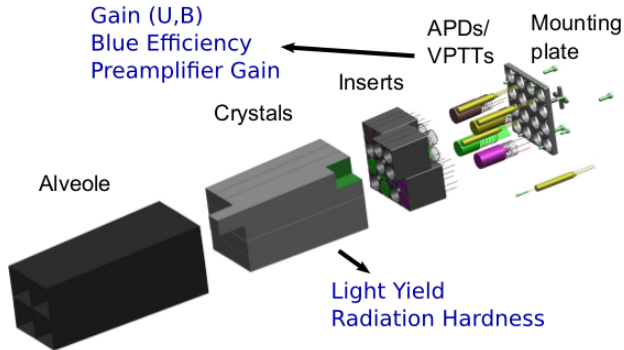
VPTT precalibration results from measurements using the Bonn detector module teststation

Tobias Seifen



26.06.2019

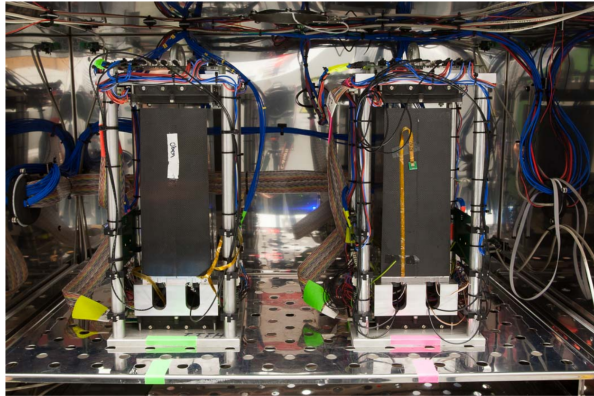
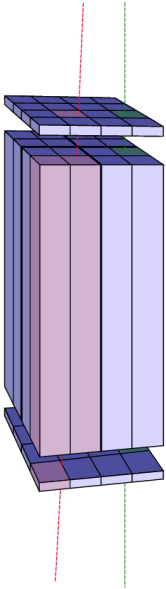
Submodule of the Forward Endcap



Expected quality factor Q_i from matching

$$Q_i = LY \cdot G_{VPTT}(1\text{ kV}) \cdot G(U, B) \cdot skb \cdot \frac{2.41}{100} \cdot G_{PreAmp}$$

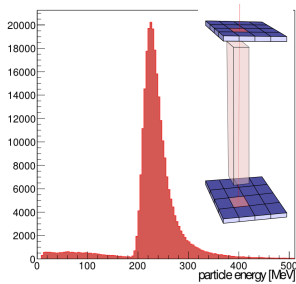
Measurements with cosmic radiation



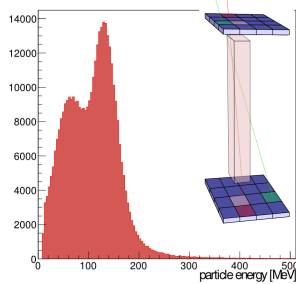
- ≥ 72 h measurement per submodule
- 4 identical Teststations (2 in 2 chambers)
- trigger modules with 16 channels \rightarrow distinguish track types

Examples of track types

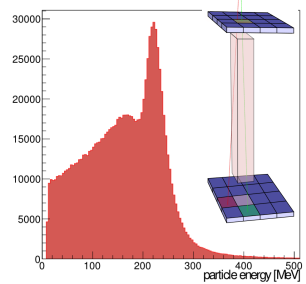
track type 0



track type 4



track type 7

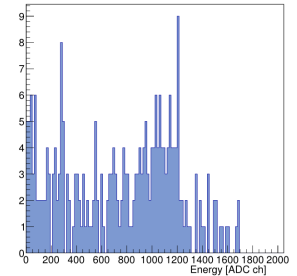
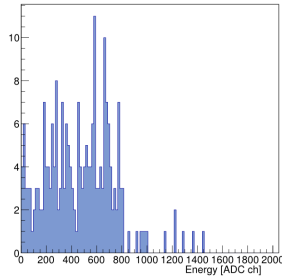
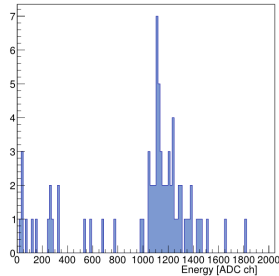
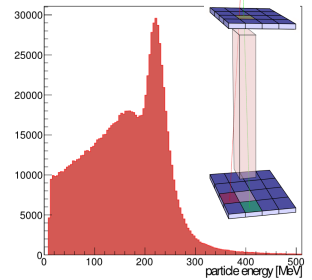
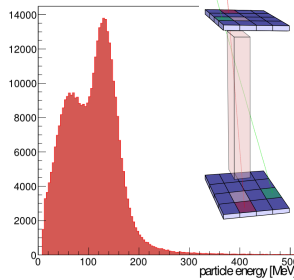
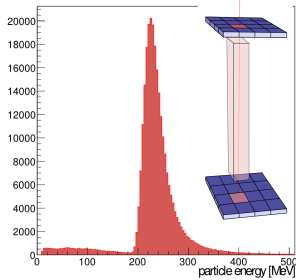


Examples of track types

track type 0

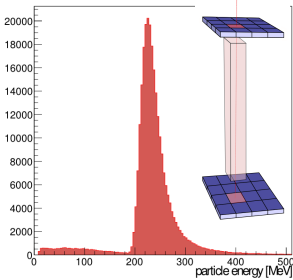
track type 4

track type 7

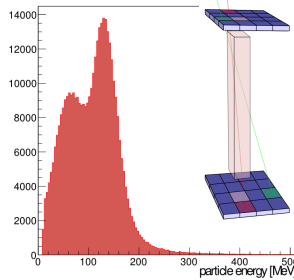


Examples of track types

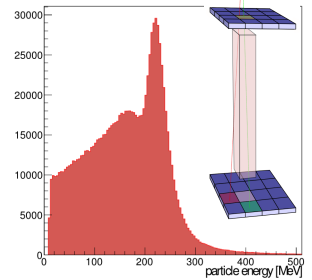
track type 0



track type 4

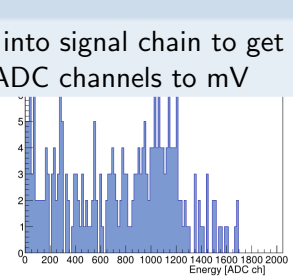
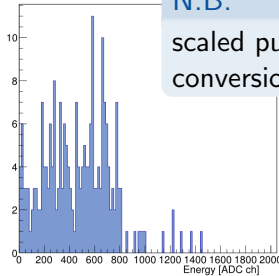
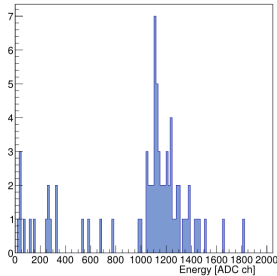


track type 7

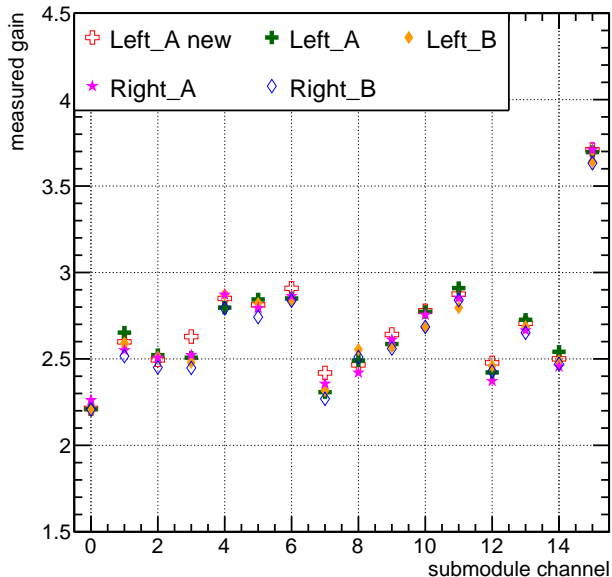


N.B.

scaled pulsed fed into signal chain to get conversion from ADC channels to mV



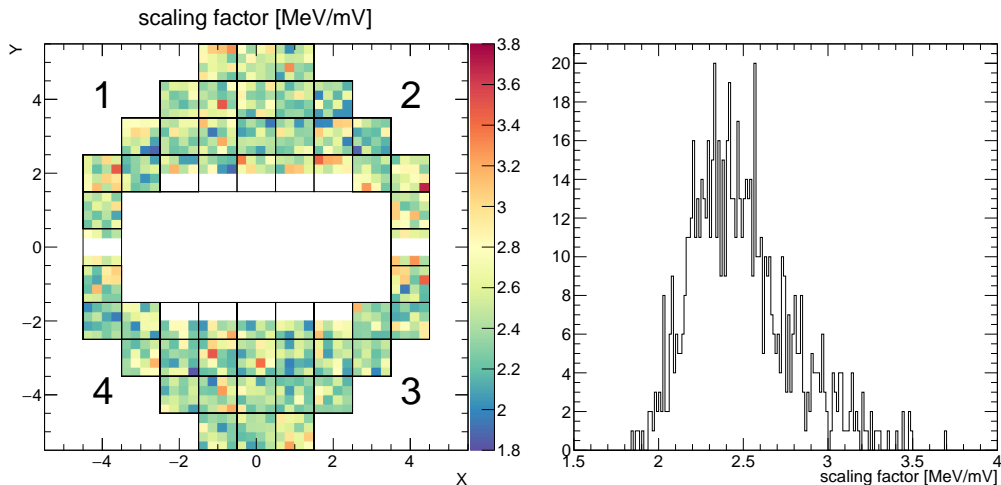
Stability of the measurement



- alveole 2-X4Y2 measured on different positions
- consistent results
- systematic differences between stations $\lesssim 2\%$

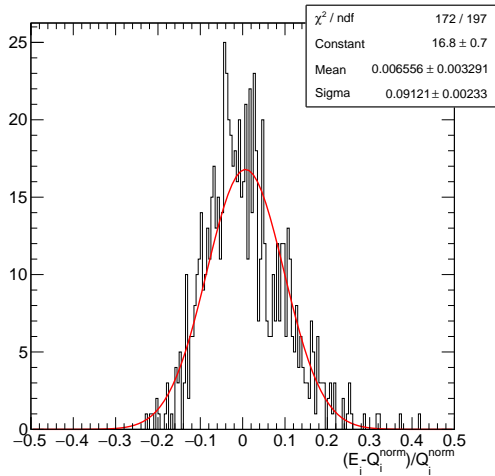
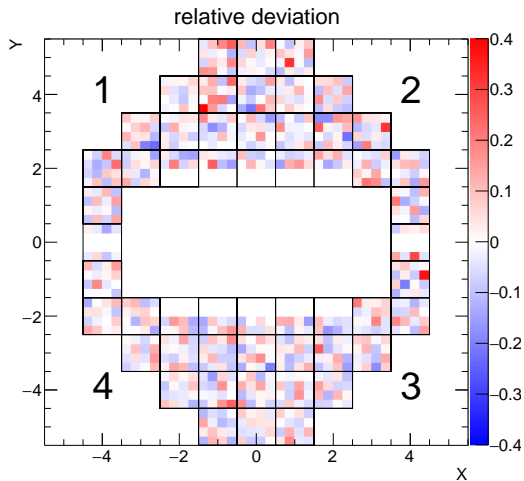
Results of the measurements

All 42 alveoles + 12 half-alveoles measured



⇒ values at optimal voltage (from matching) and without magnetic field

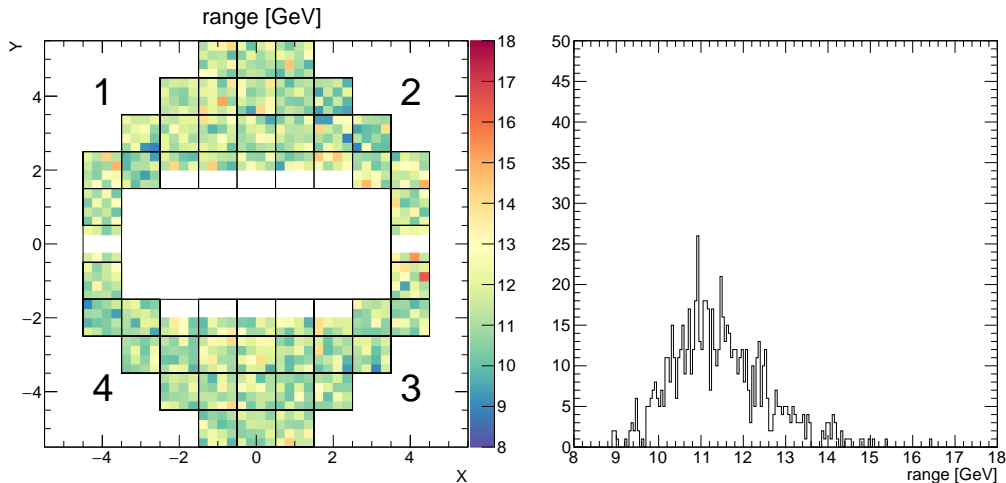
Comparison to expected value



\Rightarrow deviations in the order of $\sigma = 9\%$

Maximally detectable energy

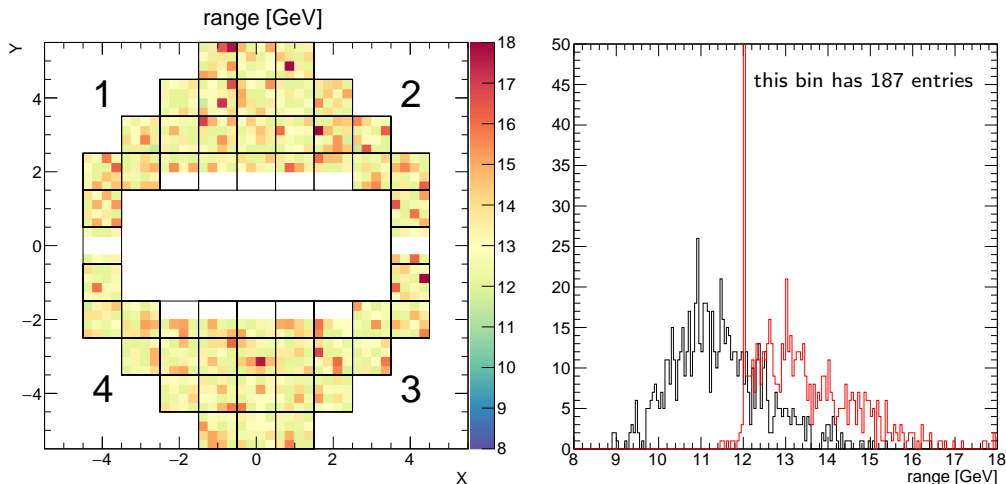
taking magnetic field into account and assuming max. 2.2 V at preamplifier



⇒ often 12 GeV not reached

Maximally detectable energy

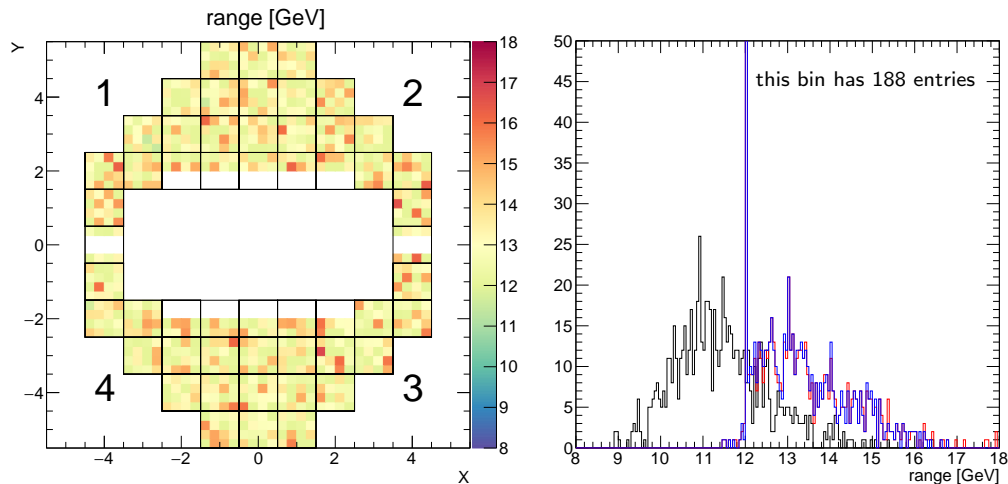
adjusting the voltage (750 V – 1000 V) to reach 12 GeV



⇒ only 11 crystals slightly below 12 GeV; highest range 18.3 GeV

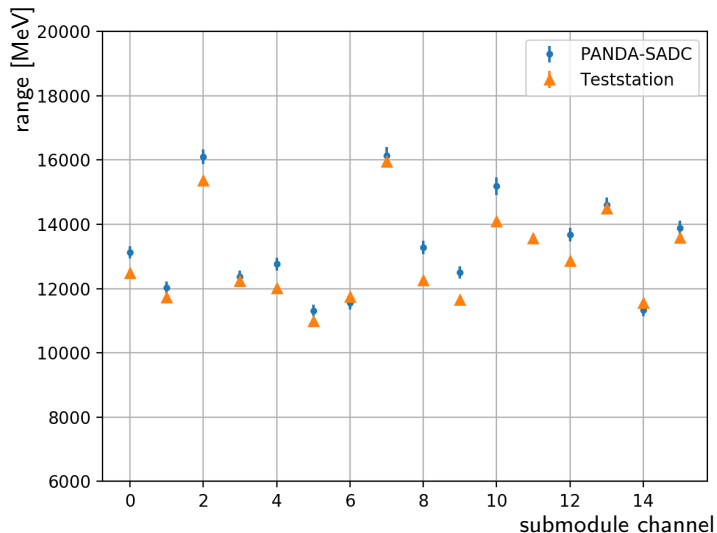
Maximally detectable energy

swapping 12 crystals in 8 alveoles



⇒ only 9 crystals slightly below 12 GeV; highest range 16.8 GeV

Measurement with PANDA-SADC read-out



bachelor thesis

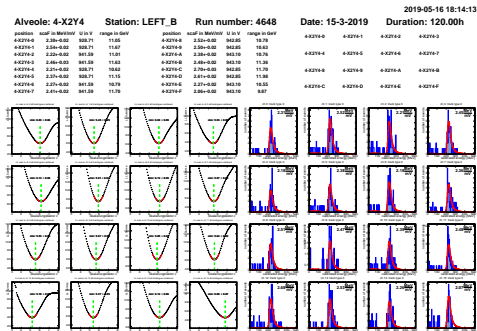
- alveole 1-X4Y2 measured with PANDA-SADC
- result \sim consistent with teststation measurements
- but systematically $\approx 3.5\%$ higher values

Summary

Results of the precalibration measurements

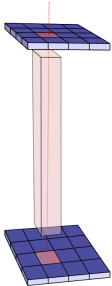
- all VPTT equipped alveoles measured
- measured values match expected with $\sigma = 9\%$
- range of 12 GeV reached (for nearly all crystals)
- swapping few crystals would improve range spread
- PANDA-SADC read-out \sim consistent with Teststation
- every alveole equipped with summary of the measurements

⇒ ready to include the values into RUB database



Definition of all Track Types

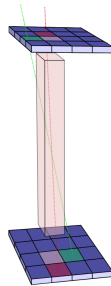
Track Type 0



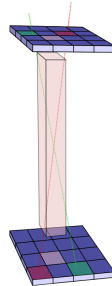
Track Type 1



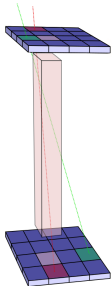
Track Type 2



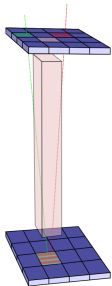
Track Type 3



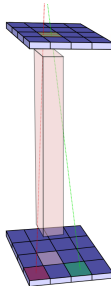
Track Type 4



Track Type 5



Track Type 6

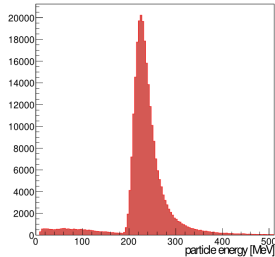


Track Type 7

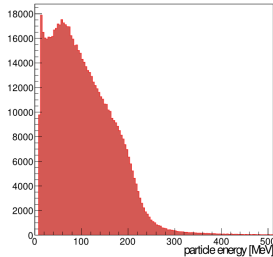


Simulated Spectra of all Track Types

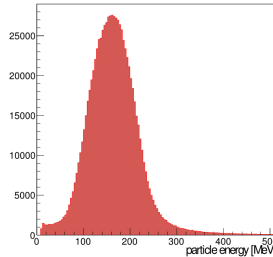
Track Type 0



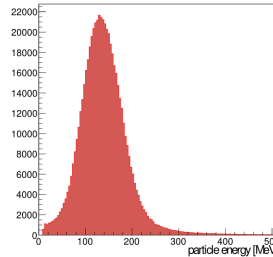
Track Type 1



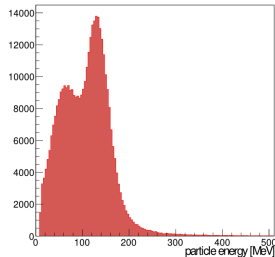
Track Type 2



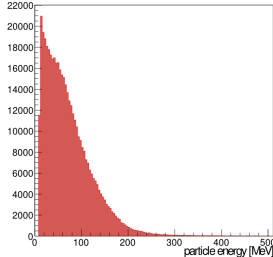
Track Type 3



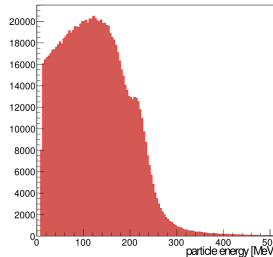
Track Type 4



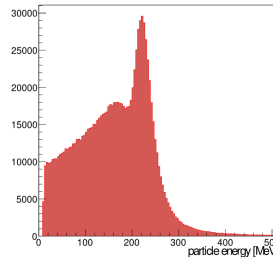
Track Type 5



Track Type 6



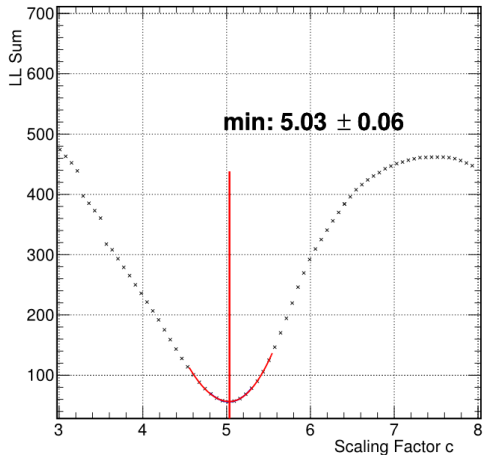
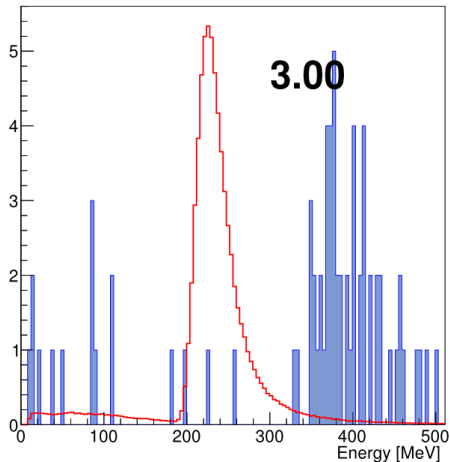
Track Type 7



Combining Measurement and Simulation

Example Track Type 0

LL sum in ch 5 for TT 0

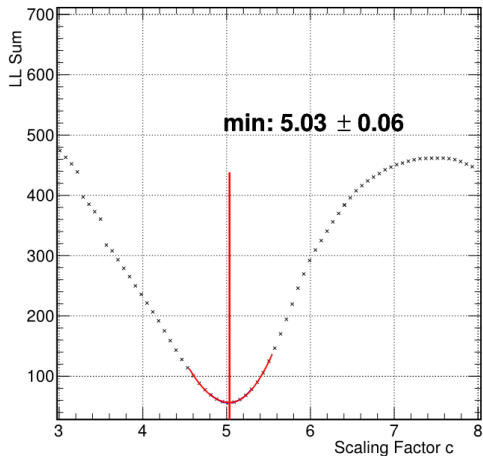
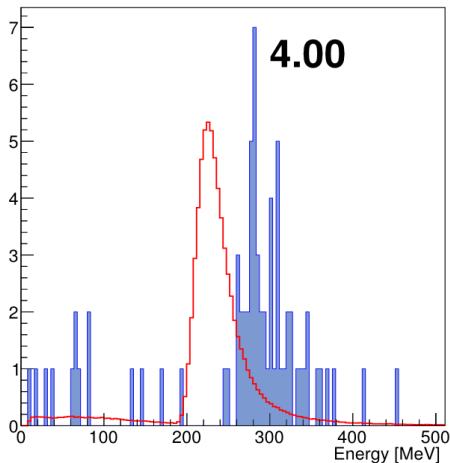


Rescaling measured spectrum \Rightarrow calculating $\sum_{\text{TT}} \ln \mathcal{L} \Rightarrow$ finding minimum in $\ln \mathcal{L}$

Combining Measurement and Simulation

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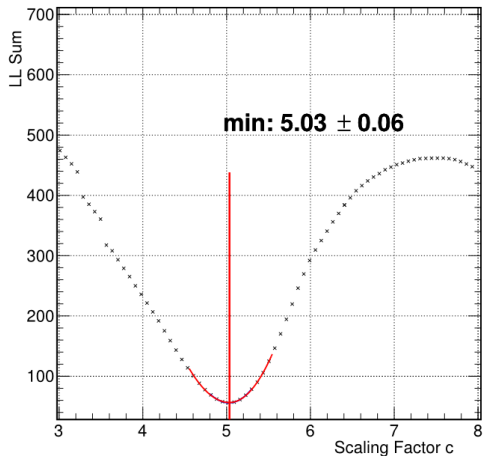
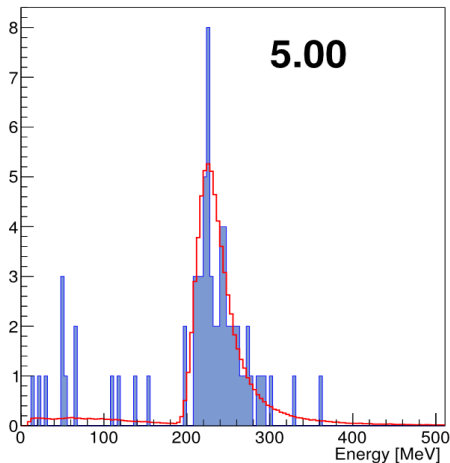


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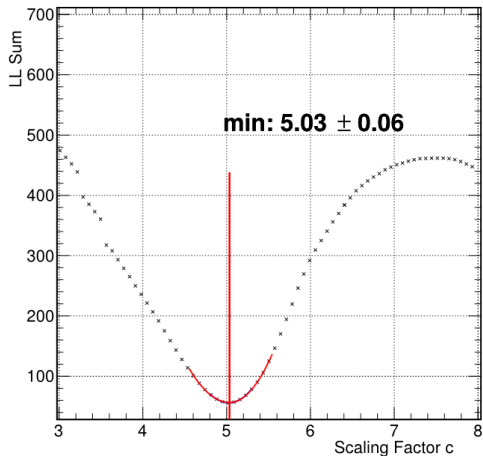
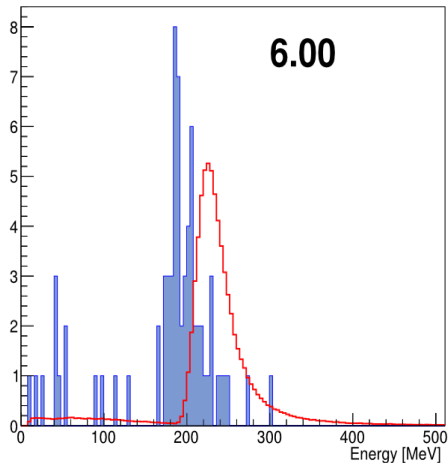


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Combining Measurement and Simulation

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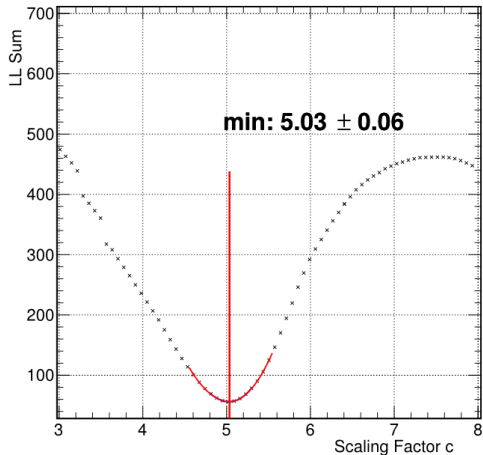
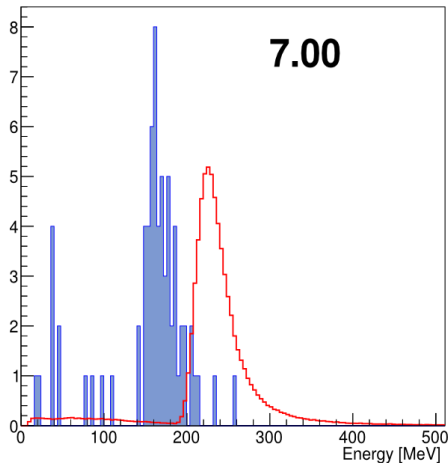


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Combining Measurement and Simulation

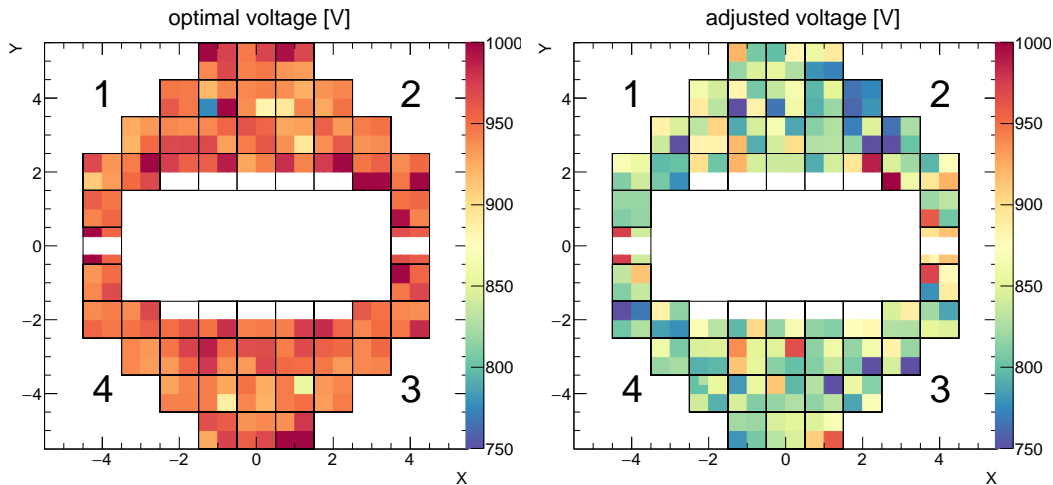
Example Track Type 0

LL sum in ch 5 for TT 0



Rescaling measured spectrum \Rightarrow calculating $\sum_{\text{TT}} \ln \mathcal{L} \Rightarrow$ finding minimum in $\ln \mathcal{L}$

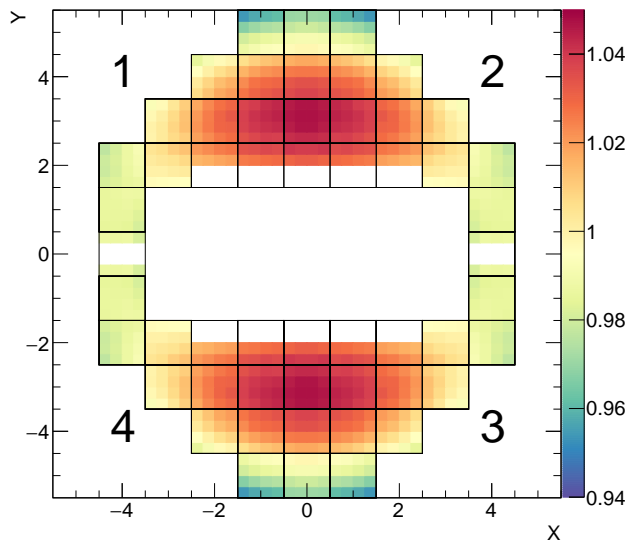
Voltages



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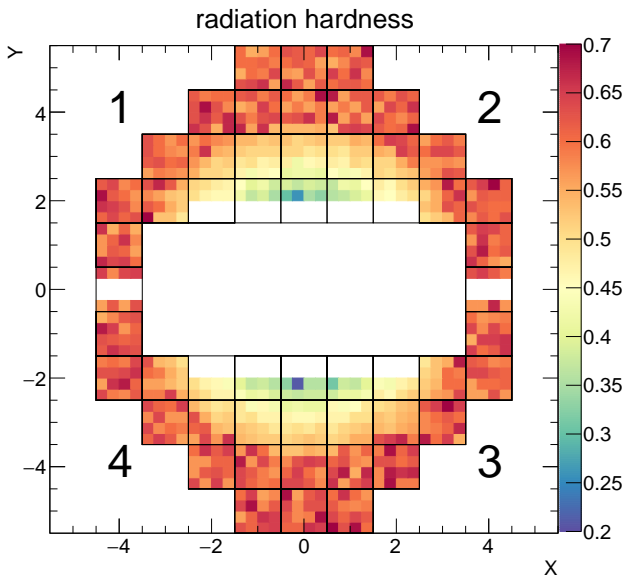
Magnetic field

magnetic field [T]



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Radiation Hardness



lower value
means higher
radiation hardness

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