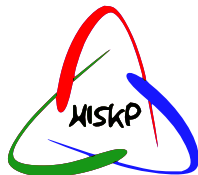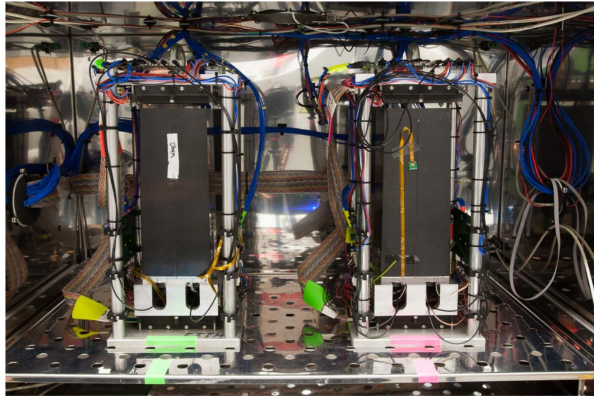# Status of the precalibration measurements using the Bonn detector module teststation
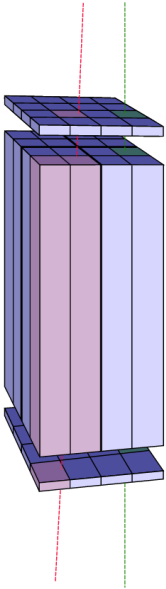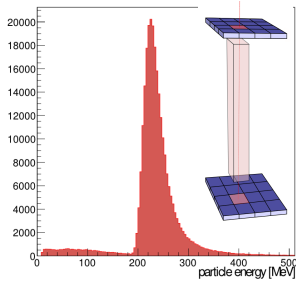
Tobias Seifen

01.06.2022

Measurements with cosmic radiation
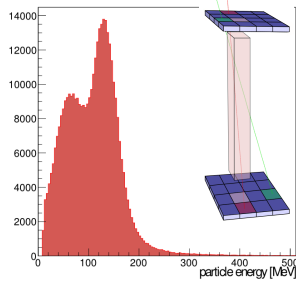

- $\geq 96\,\mathrm{h}$ measurement per submodule
- 4 identical Teststations (2 in 2 chambers)
- trigger modules with 16 channels $\rightarrow$ distinguish track types
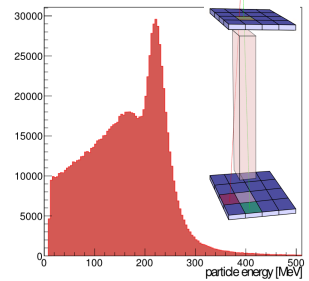
Examples of track types

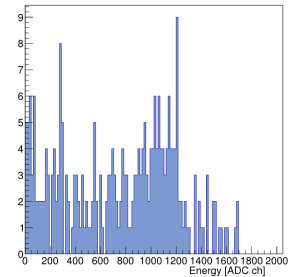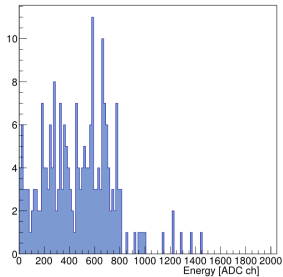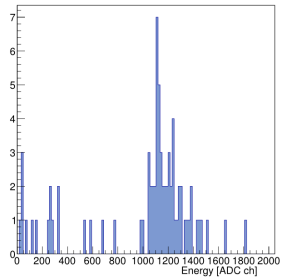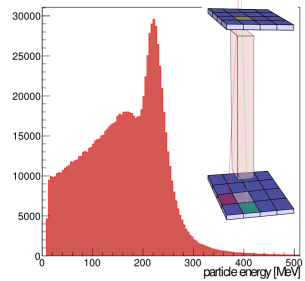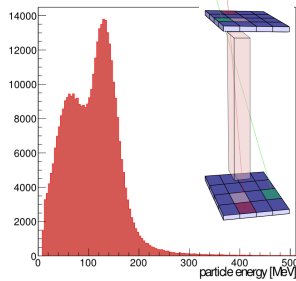track type 0   track type 4   track type 7

Examples of track types

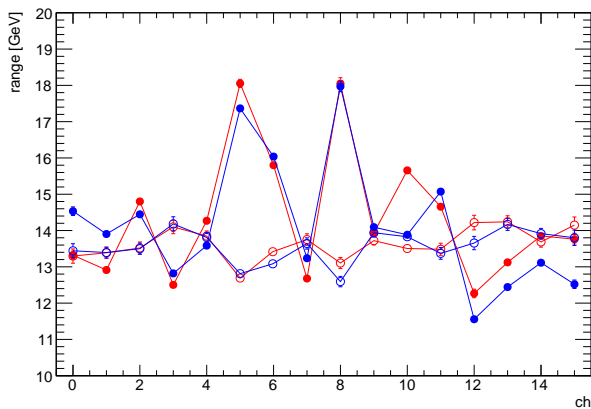track type 0　　　　　　　　track type 4　　　　　　　　track type 7
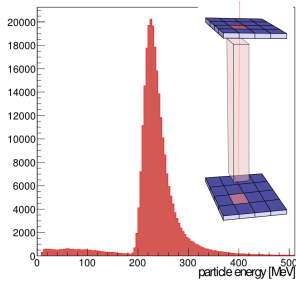
Stability of the measurement

two APDs per crystal,
ch0-15: APD A, ch16-31: APD B
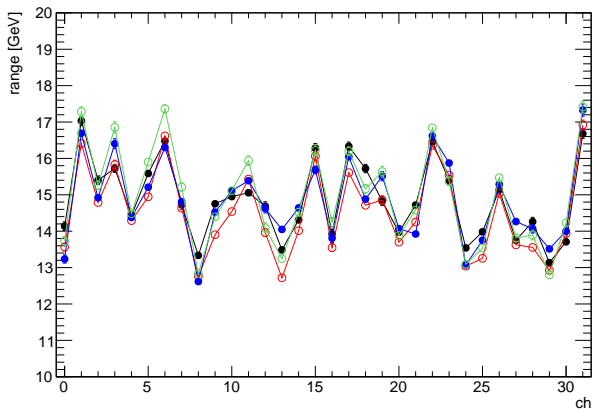
- submodule 1-X1Y6 measured on different positions
- consistent results
- systematic differences between stations between $0.4\,\%$ and $3.0\,\%$
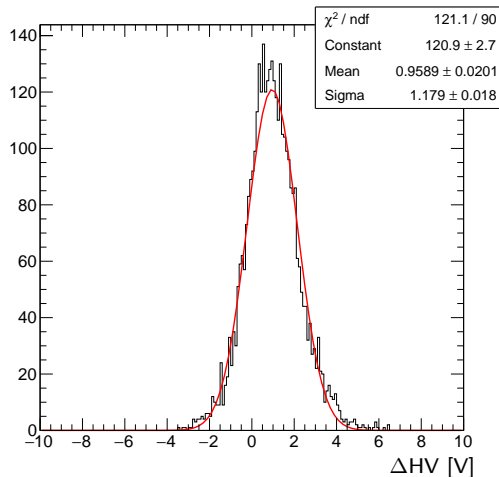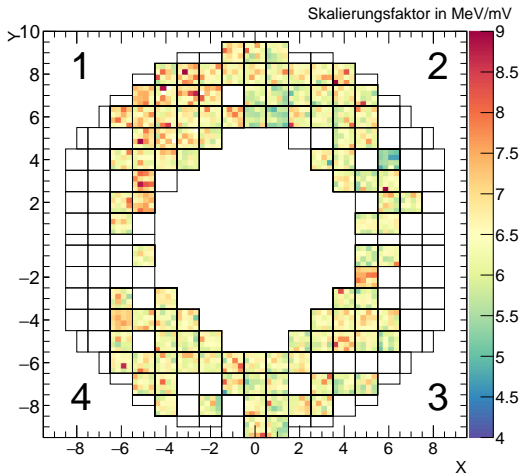
Maximally detectable energy

•/•: before HV adjustement
◦/◦: after HV adjustement

- measured scaling factor proportional to maximally detectable energy E_{max}
- adjustement possible through variation of HV
- $\Delta \mathsf{HV} = \dfrac{\ln\left(\dfrac{E_{\mathsf{max}}}{E_{\mathsf{max}}^{\mathsf{ideal}} \cdot 1.09^{\Delta T/\mathrm{K}}}\right)}{\ln(1 + \frac{\partial g}{\partial U})}$
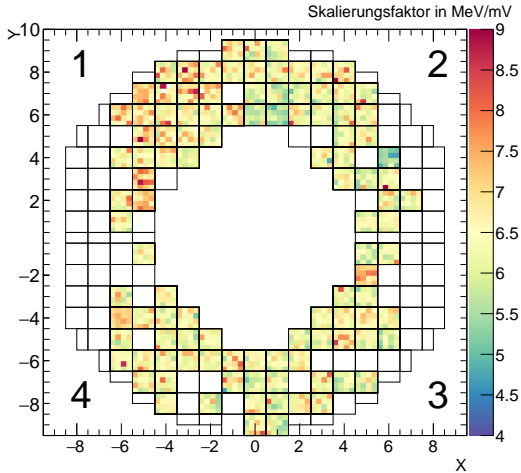
Maximally detectable energy

108 APD-equipped submodules measured (total: 172 full sized + 42 half sized)

necessary HV adjustement for 12.5 GeV

Maximally detectable energy

108 APD-equipped submodules measured (total: 172 full sized + 42 half sized)

issues encountered were:

- 13 submodules with interchanged signal $\leftrightarrow$ HV cable(s)
- 13 submodules with a dead channel, partly noticed before measurement, partly only visible when cold
- 6 submodules have a channel with very low signal yield
- $\Rightarrow$ to be repaired and (re-)measured

Summary

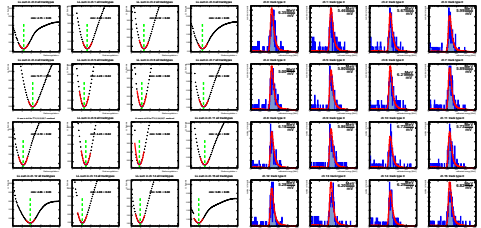Results of the precalibration measurements

- 108 APD-equipped submodules measured
- submodules with broken channels being repaired in Bochum
- temperature dependent voltage adjustement
- range of 12.5 GeV can be achieved with adjusted HV

every submodule equipped with summary of the measurements

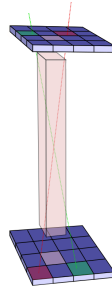# Definition of all Track Types
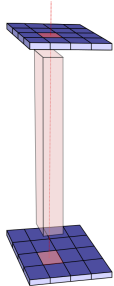
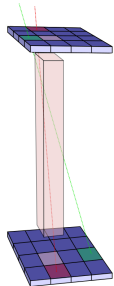Track Type 0   Track Type 1   Track Type 2   Track Type 3
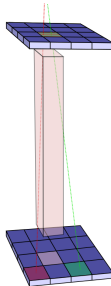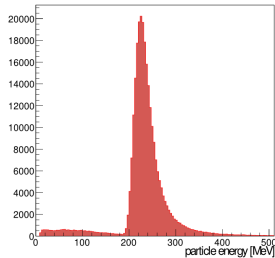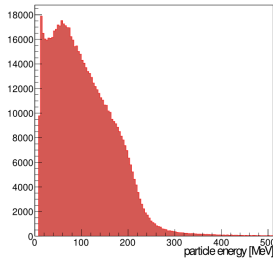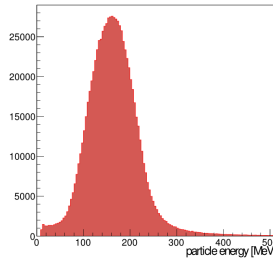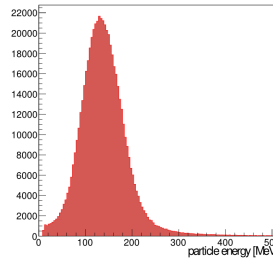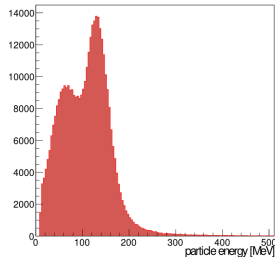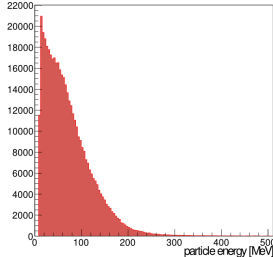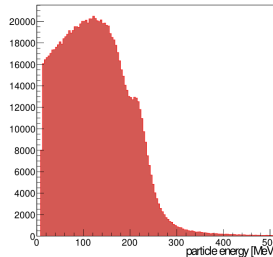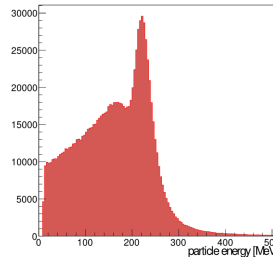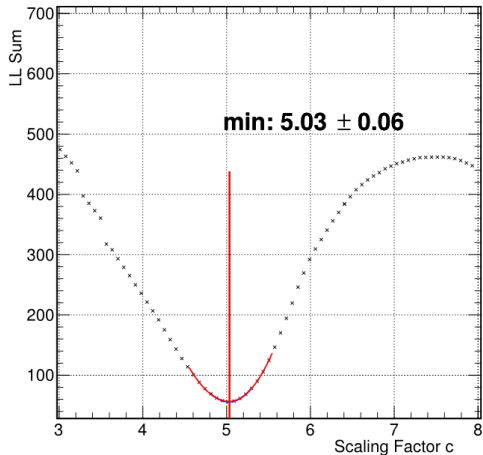
Track Type 4   Track Type 5   Track Type 6   Track Type 7

Simulated Spectra of all Track Types

Combining Measurement and Simulation
Example Track Type 0

LL sum in ch 5 for TT 0

Rescaling measured spectrum $\Rightarrow$ calculating $\sum_{TT} \ln \mathcal{L} \Rightarrow$ finding minimum in $\ln \mathcal{L}$
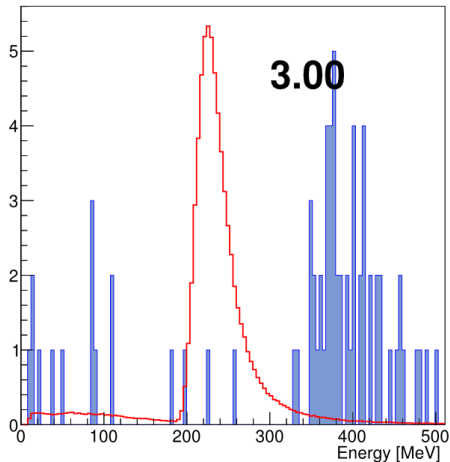
Combining Measurement and Simulation
Example Track Type 0

LL sum in ch 5 for TT 0

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

Combining Measurement and Simulation

Example Track Type 0

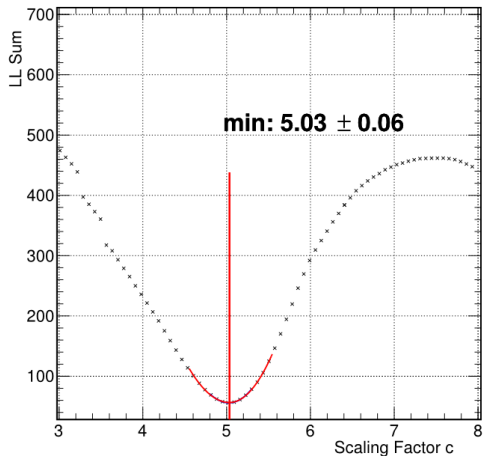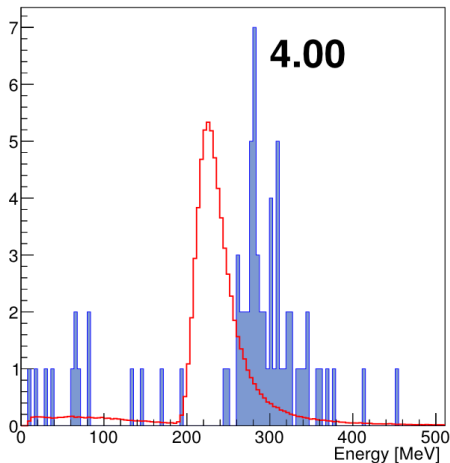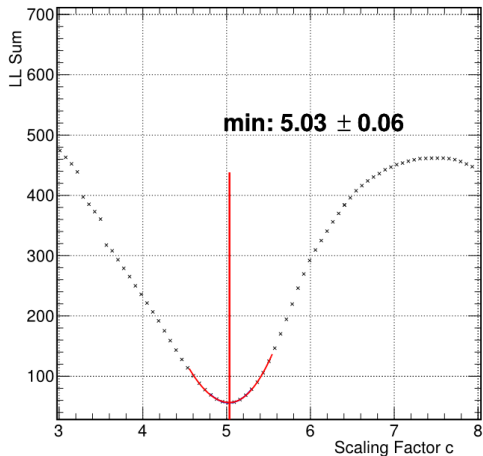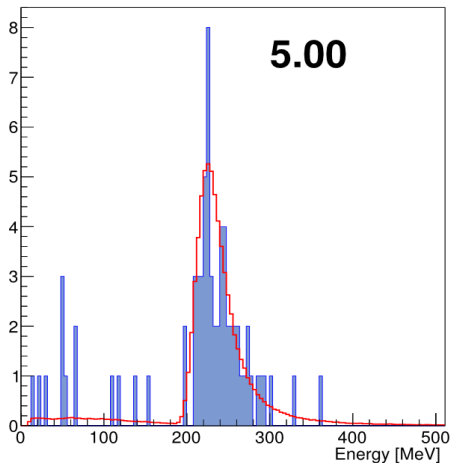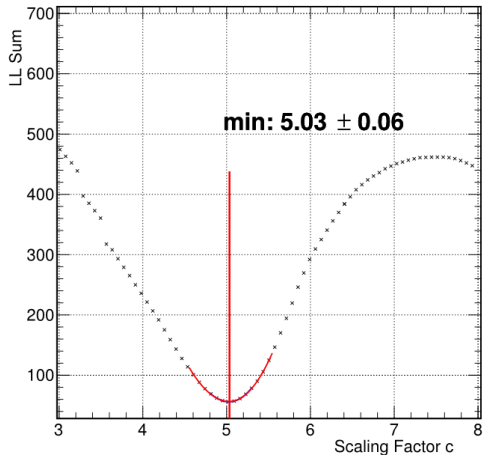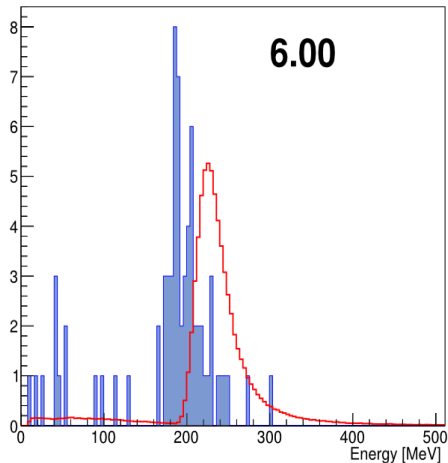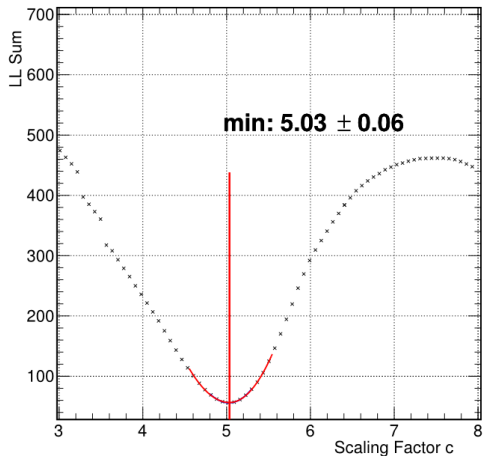Rescaling measured spectrum $\Rightarrow$ calculating $\sum_{TT} \ln \mathcal{L} \Rightarrow$ finding minimum in $\ln \mathcal{L}$

Combining Measurement and Simulation

Example Track Type 0
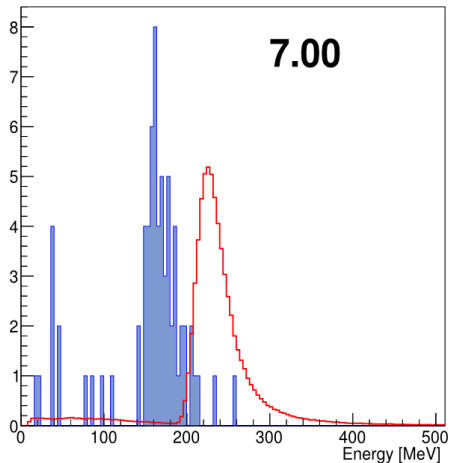

Rescaling measured spectrum $\Rightarrow$ calculating $\sum_{TT} \ln \mathcal{L} \Rightarrow$ finding minimum in $\ln \mathcal{L}$
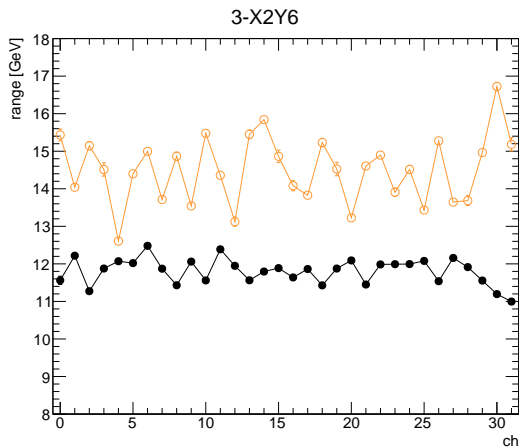
Combining Measurement and Simulation

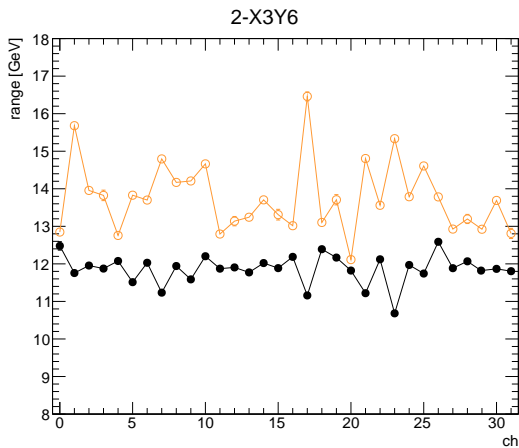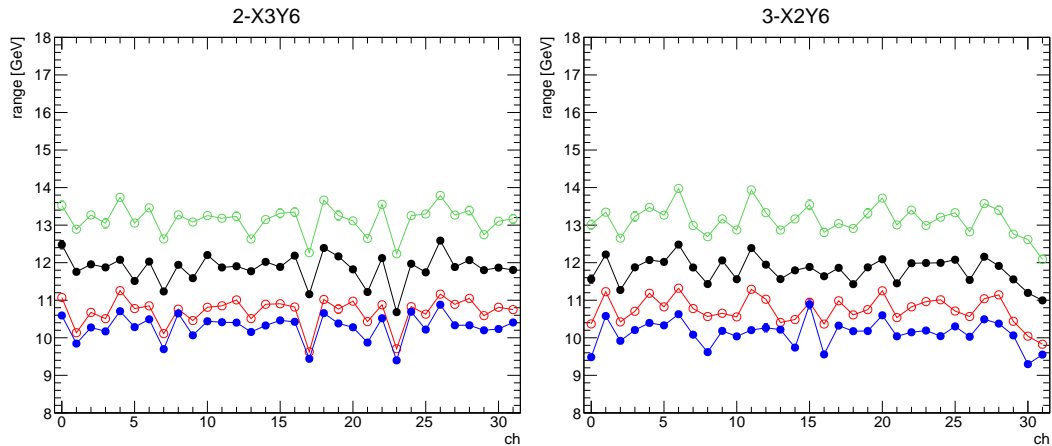## Example Track Type 0

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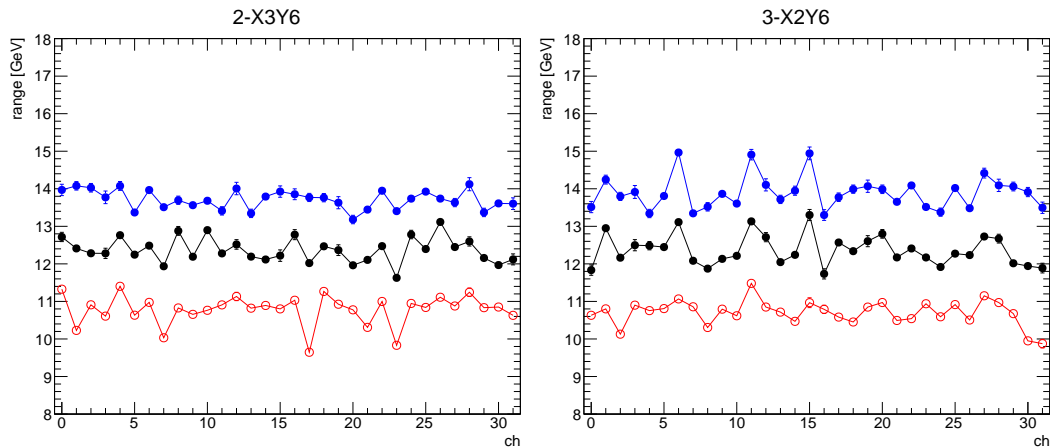
Maximally detectable energy

use gain slope to adjust HV to reach 12 GeV

Maximally detectable energy

measurements at different T: -23 °C, -24 °C, -25 °C, -25.5 °C

Maximally detectable energy

measurements at different voltages: such that range is at 10.8 GeV, 12.5 GeV, 14 GeV