FCC Napoli – TB analysis

WEEKLY REPORT – 11 APR. 2025

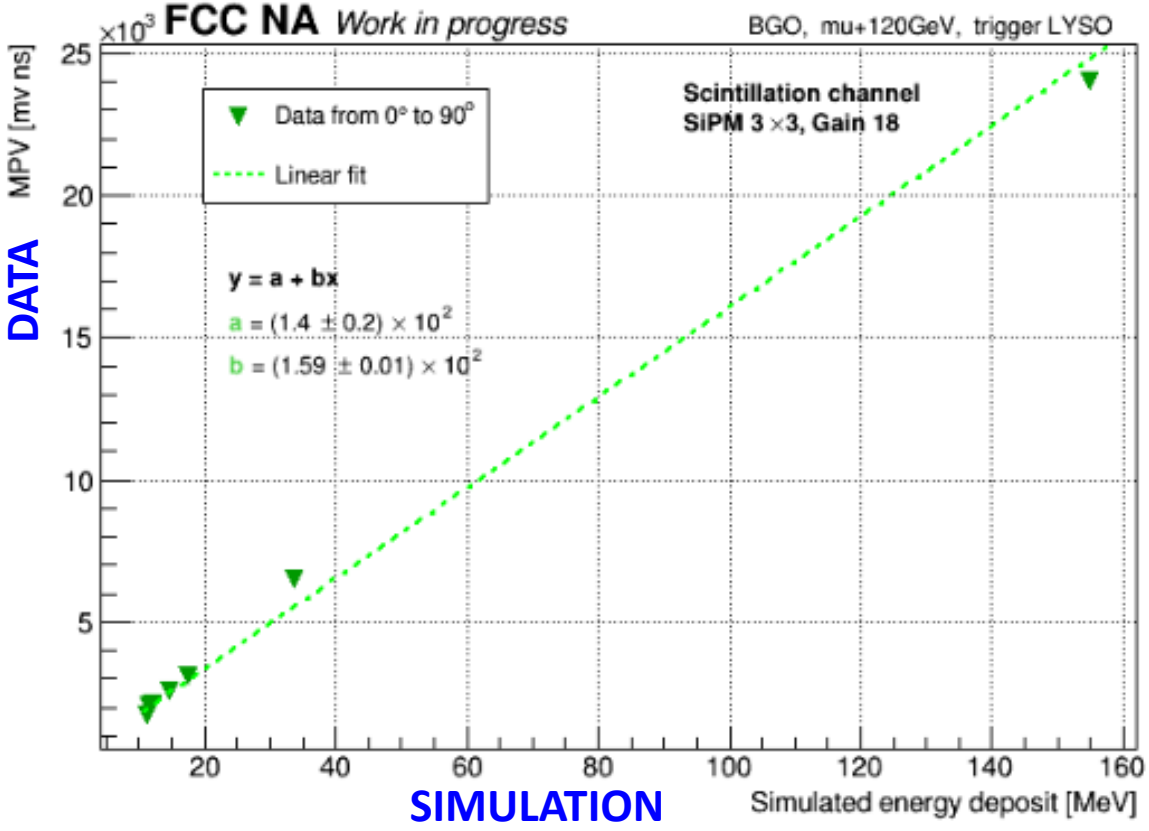
CARLO DI FRAIA

Last presentation – 21/03/24

BGO

- Energy calibration: compare the descending branch of U-plots, i.e. from **0° to 90°**, from data and simulation
- Points of a U-plot are MPVs from Landau fits to energy deposit distributions, for both data (integrals of waveforms) ad simulation

➢ **Verify how much slopes are sensitive to the last points, i.e. angles at maximum deposit**



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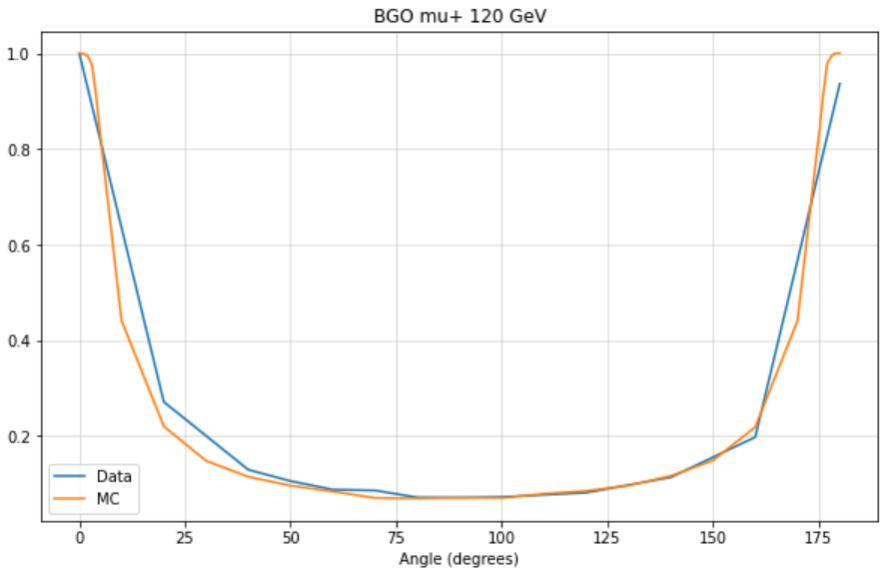

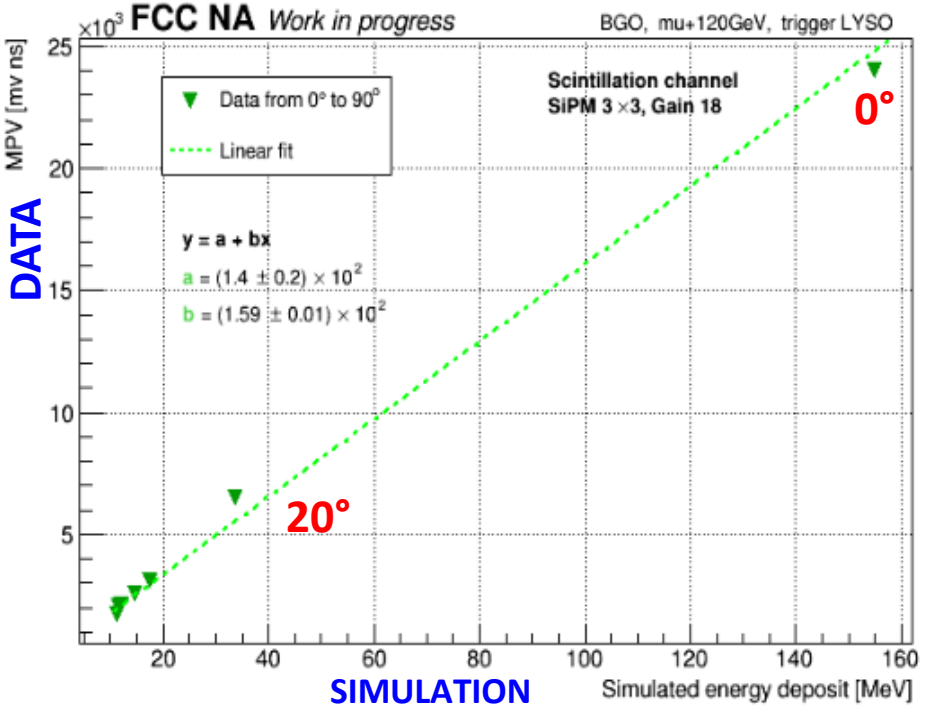

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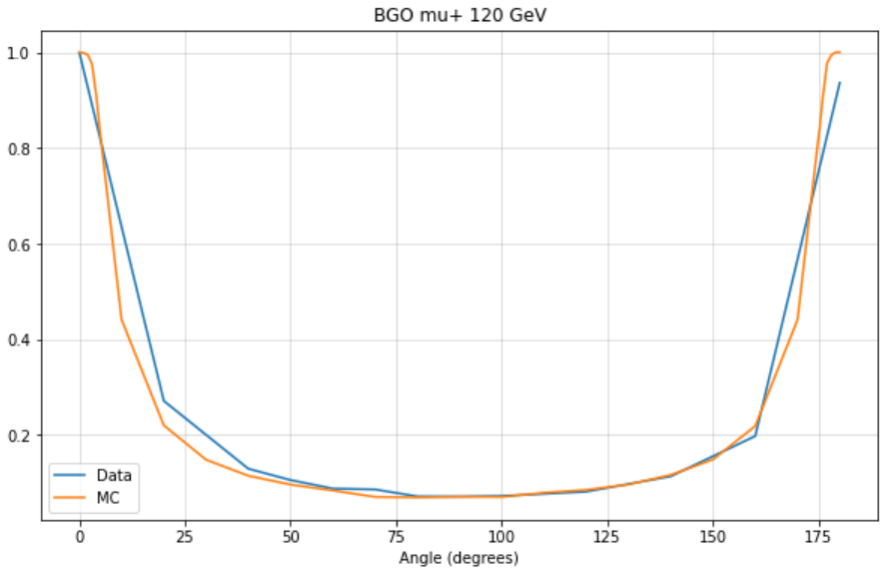
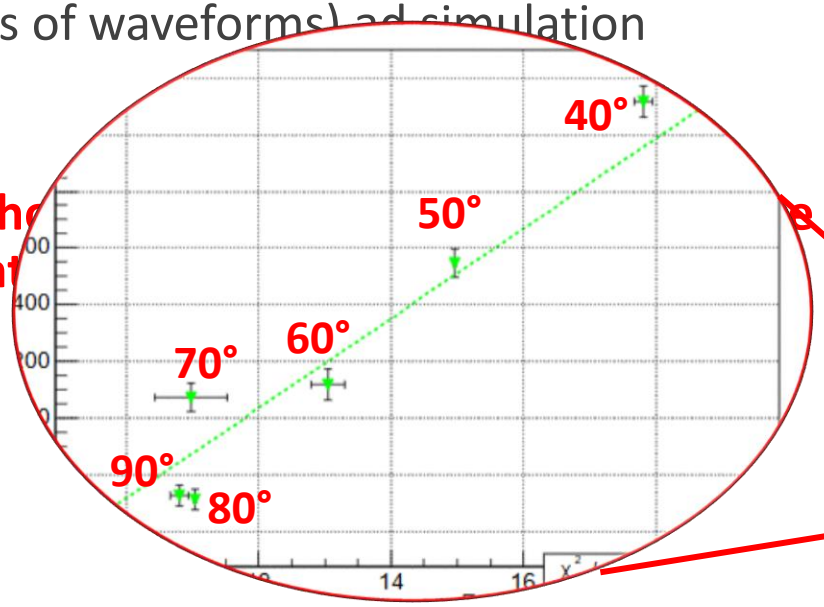
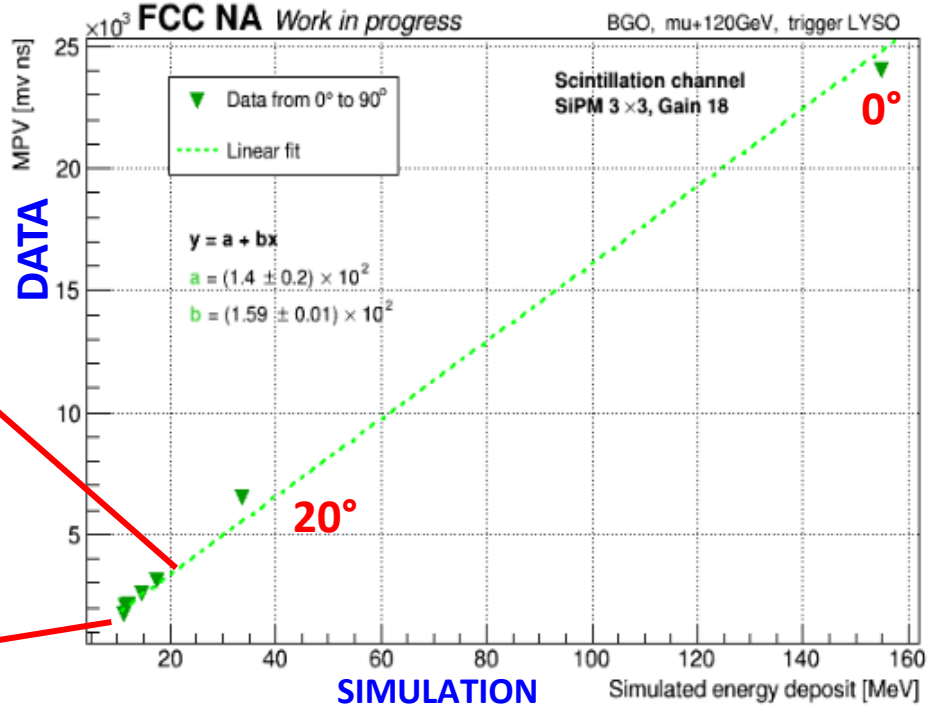


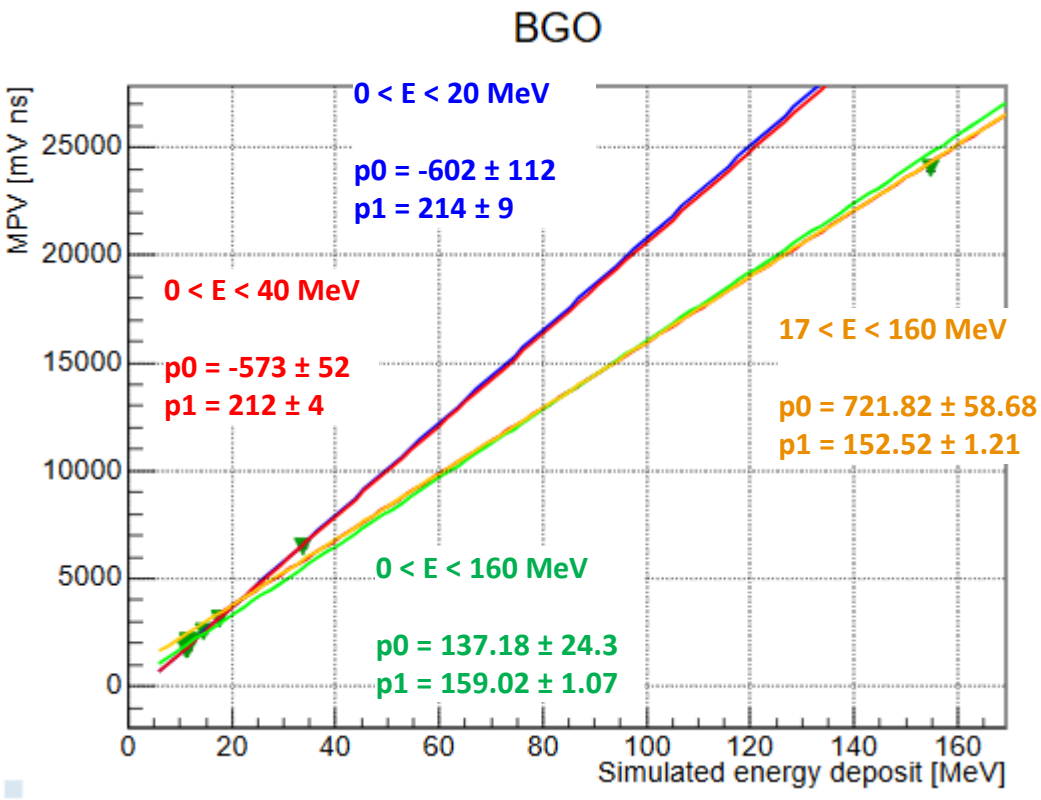
- **Verify ho… last point**





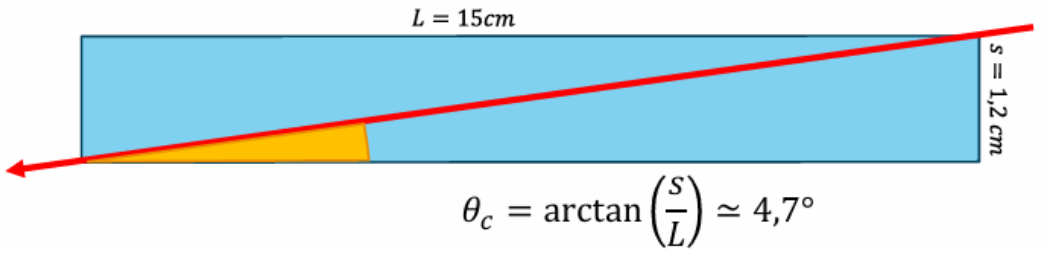
BGO

- The maximum deposit (0°) is quite out from the trend
- **Known phenomenology, due to the asymmetry of U-plots**
- Points from 20° up to 90° are comparable



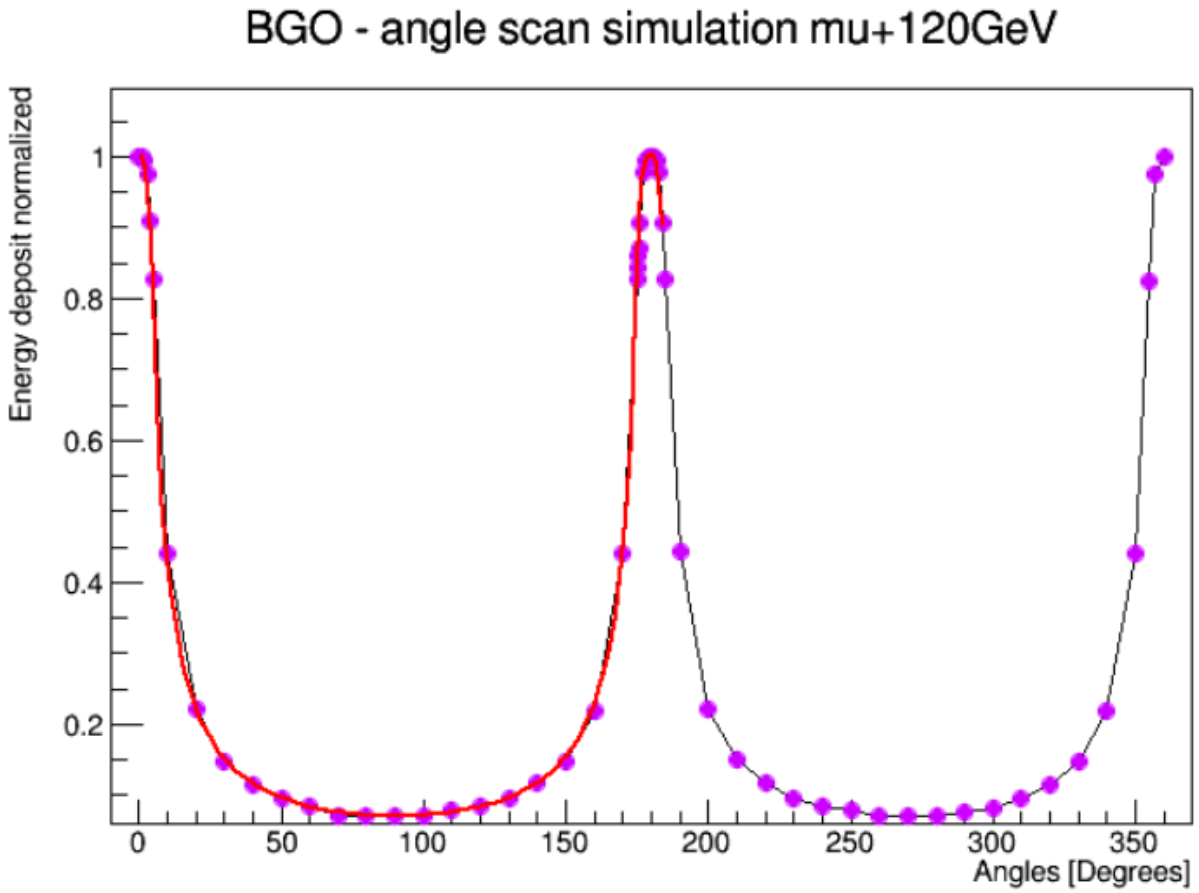
- Introduce the studies related to bias estimation

Improved fit model



- Piecewise function implemented in a single fit

$$E(\theta) = \begin{cases} \dfrac{[0]}{\cos([1] * \theta - [2])} + [3], & x \leq \theta_c \\ \dfrac{[4]}{\sin([5] * \theta - [6])} + [7], & \theta_c < x < 180° - \theta_c \\ \dfrac{[8]}{\cos([9] * \theta - [10])} + [11], & x \geq 180° - \theta_c \end{cases}$$



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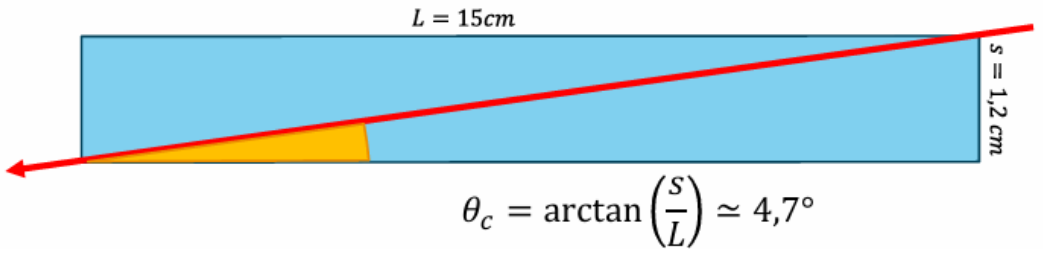

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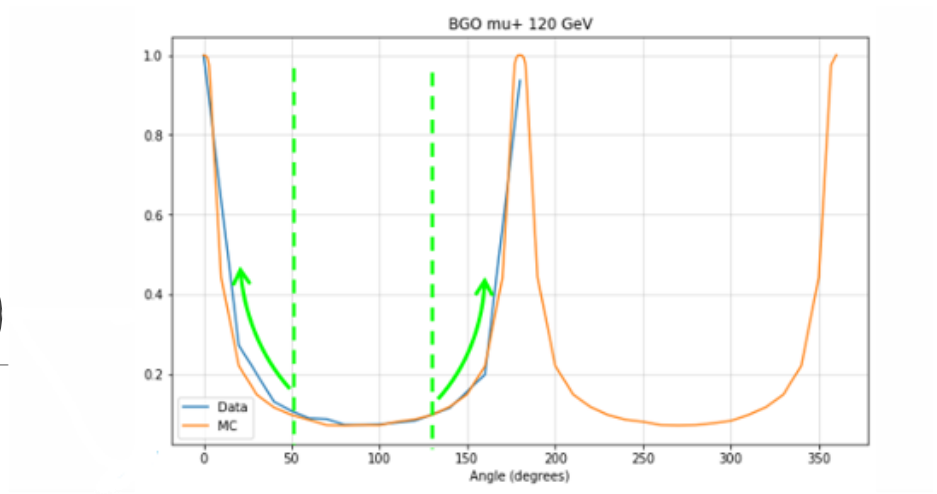
```
FCN=450649 FROM MINOS     STATUS=SUCCESSFUL   1146 CALLS       25257 TOTAL
                     EDM=0.000169705    STRATEGY= 1      ERR MATRIX NOT POS-DEF
 EXT PARAMETER                APPROXIMATE        STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  p0          -4.00555e-02   3.46546e-03  -1.47759e-06   4.58762e-01
  2  p1           3.60574e-01   1.03208e-02   1.08293e-08  -1.84027e-02
  3  p2           1.84796e-01   3.18103e-02   8.15584e-06   5.27590e-03
  4  p3           1.04052e+00   3.74650e-03   1.57829e-06   4.67722e-01
  5  p4          -8.47408e-02   1.30620e-04  -1.06042e-07   9.66422e-02
  6  p5           1.72820e-02   2.11915e-06  -1.84165e-09  -6.21645e+02
  7  p6           9.10916e+01   2.16999e-04  -1.81587e-07  -7.57549e-02
  8  p7          -1.41371e-02   1.88737e-04  -1.36237e-07   1.88372e-01
  9  p8           5.15382e-02   5.35799e-04   6.63104e-05  -1.70260e+00
 10  p9           2.97413e-01   8.34512e-05  -7.03293e-05   1.63367e+02
 11  p10          1.26792e+01   1.50142e-02  -1.26229e-02  -9.27731e-01
 12  p11          1.05505e+00   8.00387e-04   8.00387e-04  -2.14192e+00
```

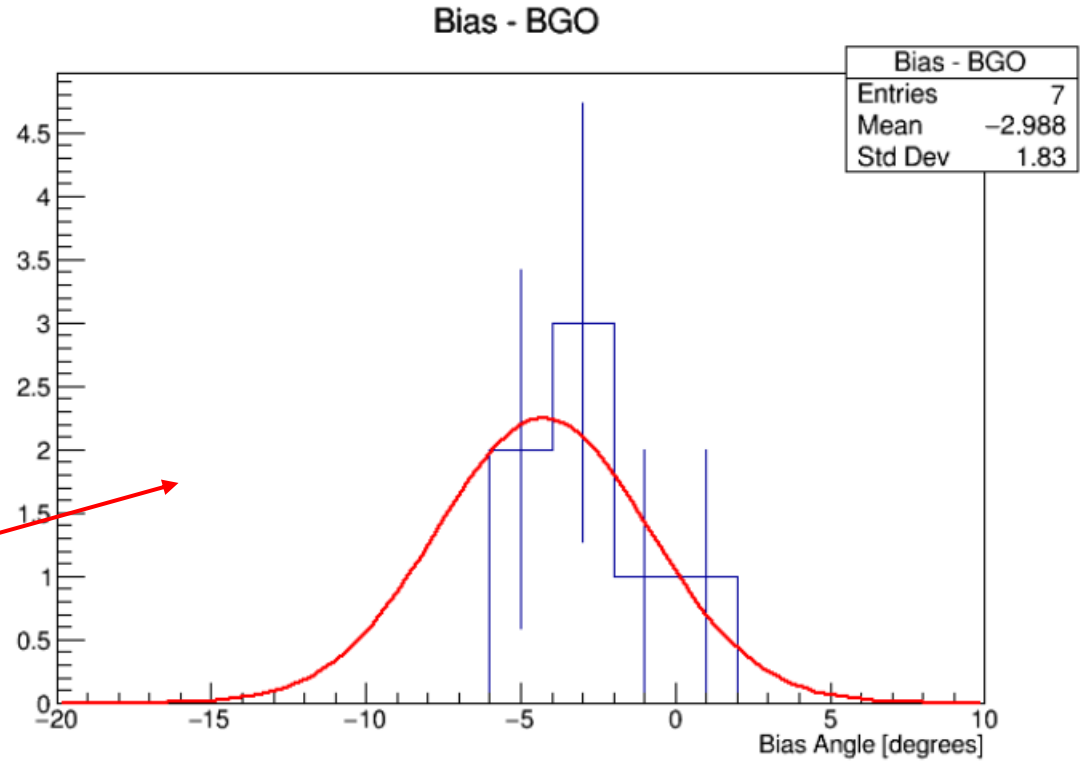
No particular pathologies emerged from the fit, **good convergence**

Bias from the new model- BGO

$$\theta_{true} = f_{MC}^{-1}(y_{obs}) \quad \rightarrow \quad \hat{b}_\theta = \theta_{true} - \theta_{obs}$$



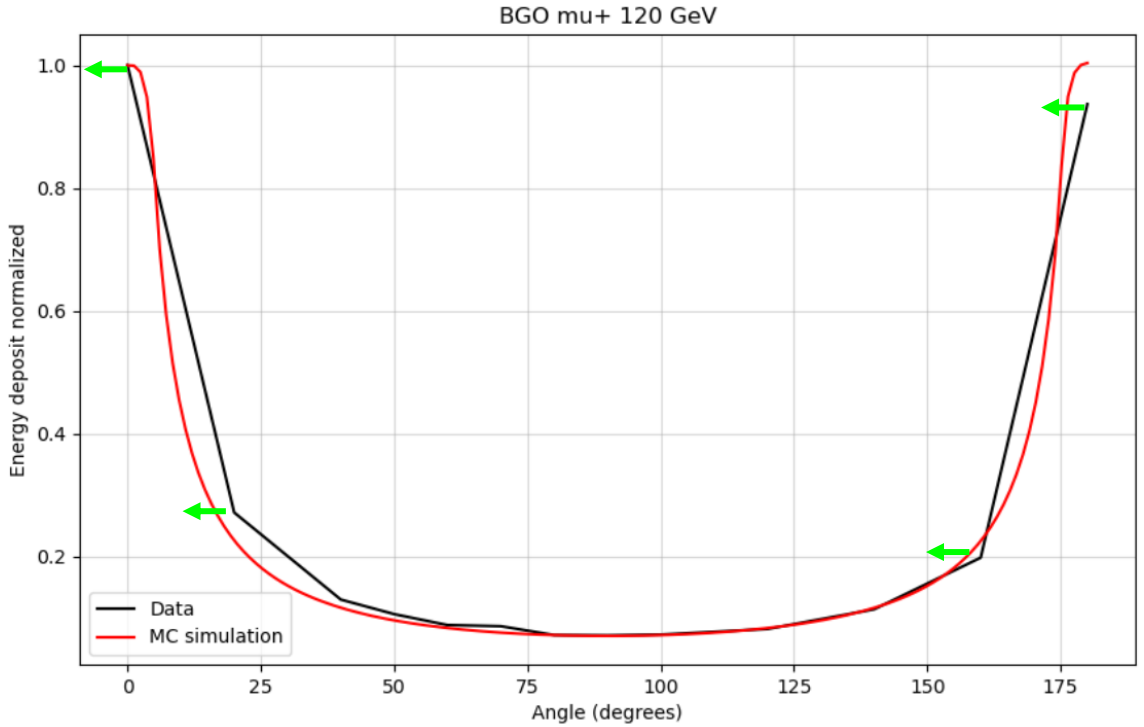
- Nominal angles of the data inverted on the MC function to obtain the one corresponding to their actual deposition
- Used angles on branches of U-plot: more sensitivity
- Bias estimation from distribution of residuals
- New estimation from model in previous slide

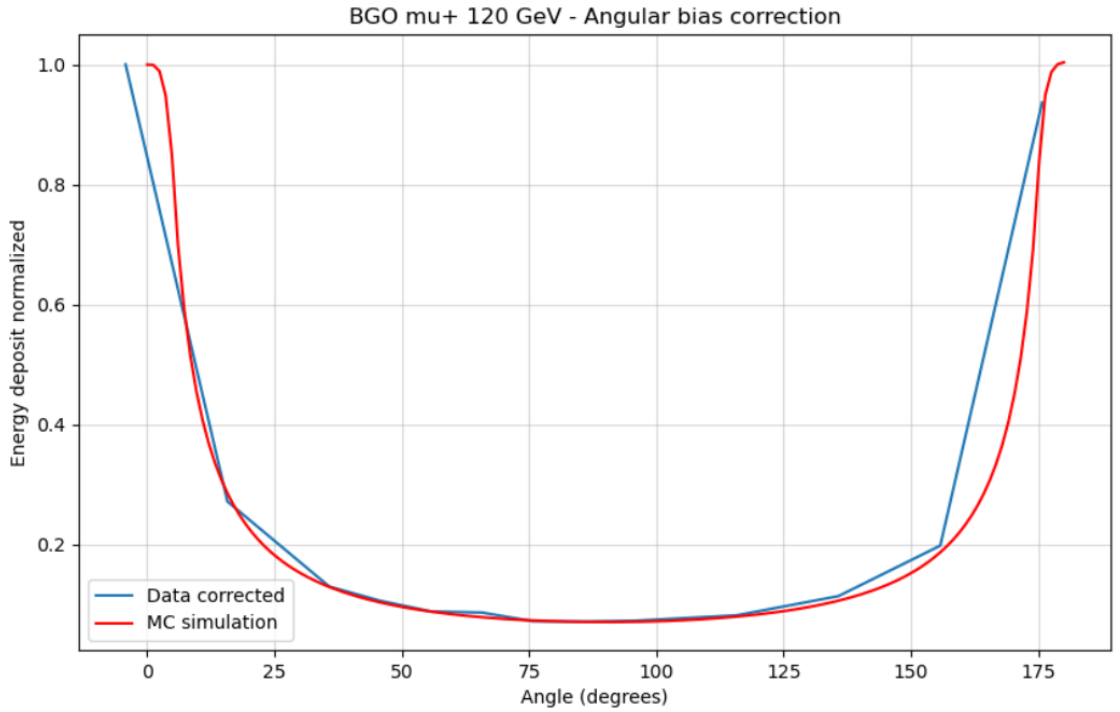


Bias correction

- Bias correction would symmetrize the U-plot

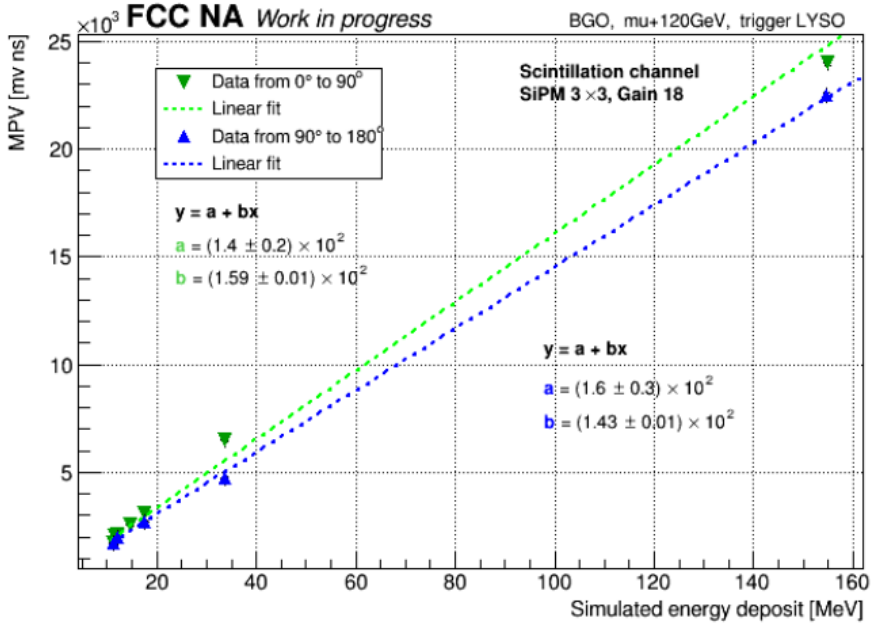
BIAS CORRECTION





Bias correction → Energy calibration

- Bias correction would symmetrize the U-plot
- Adjust the energy-calibration lines



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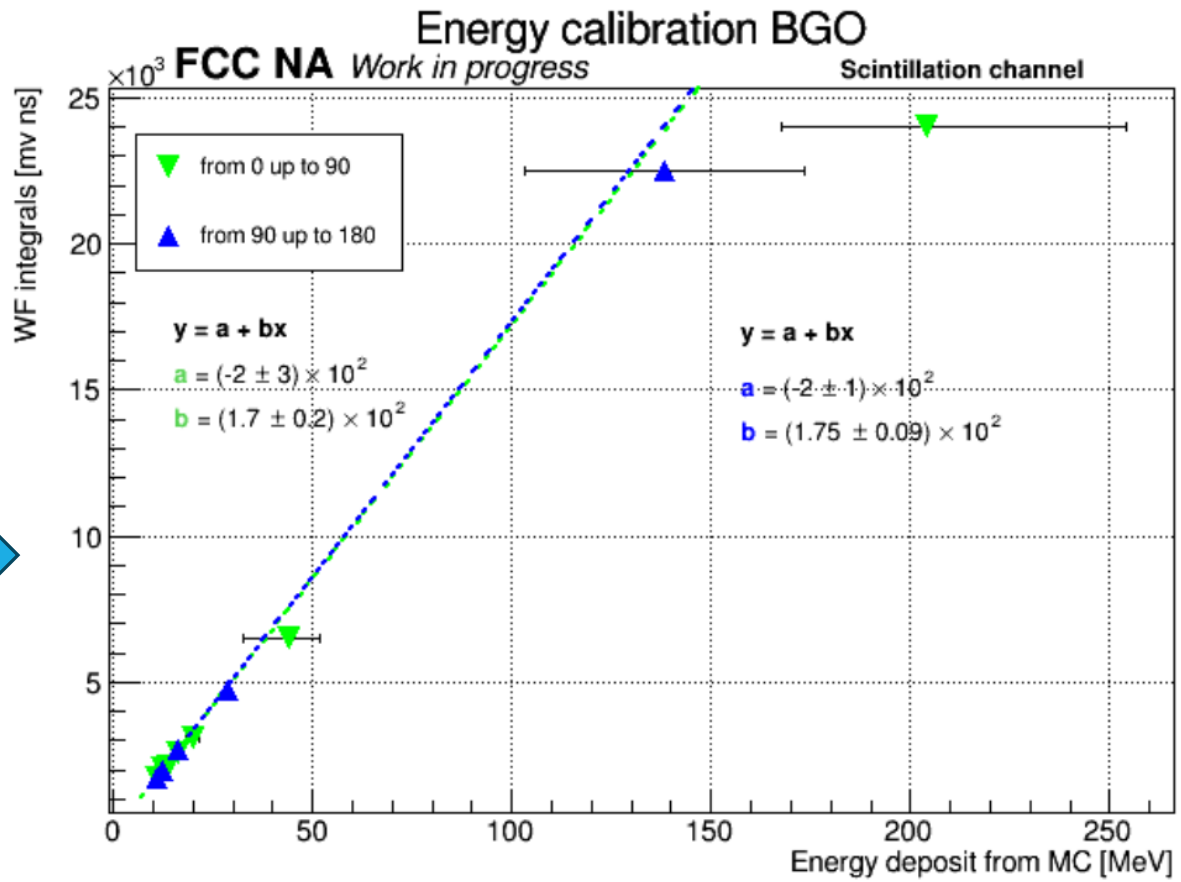


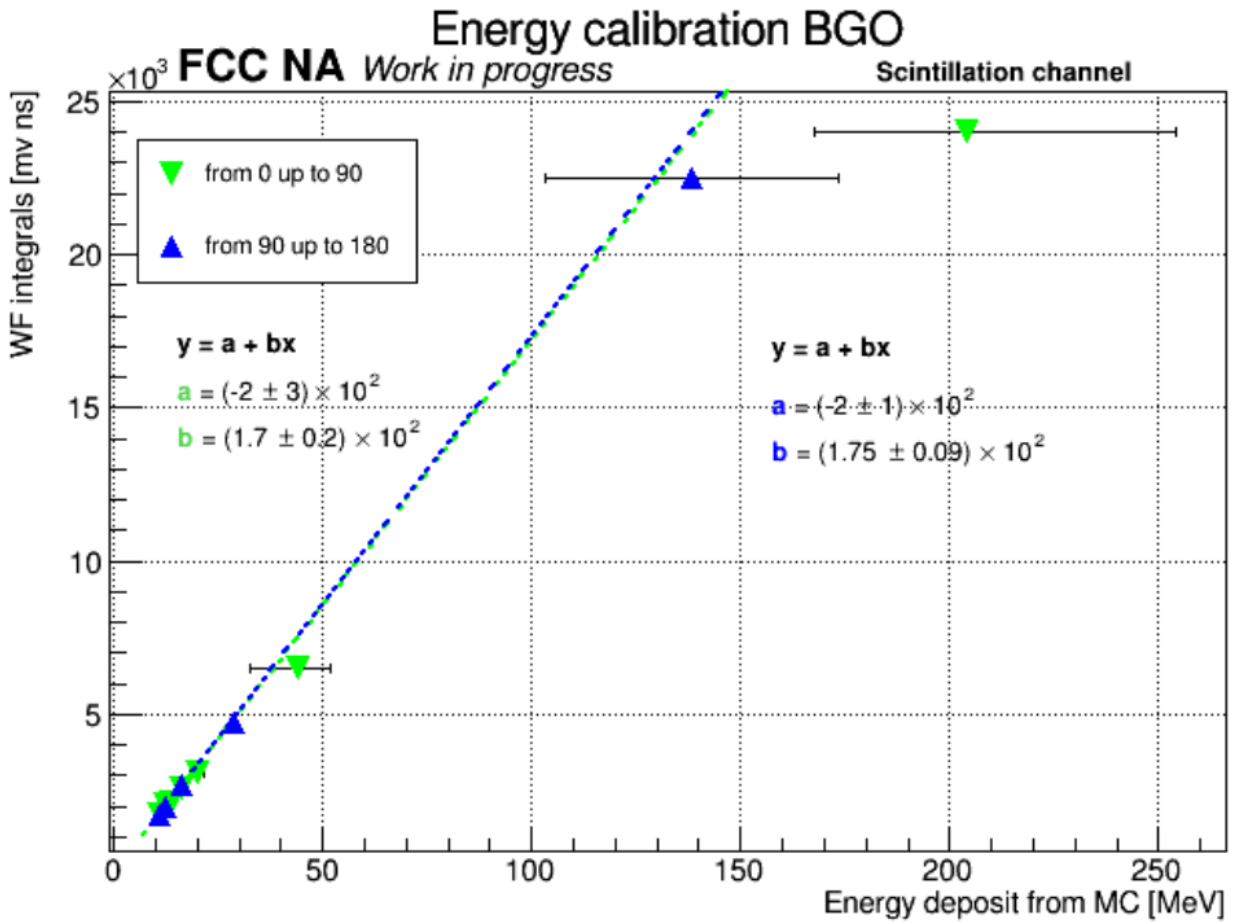
New energy calibration

1. Fixed the asymmetry of the U-plot → *Calibration lines are comparable for each branch*
2. New error estimation → *Points near the deposition peaks (0° and 180°, most sensitivity) are "reweighted" better in the fit*

$$E' = E(\theta_{true}) = E(\theta + \hat{b})$$

$$\sigma_{up}(E') = |MC(E' + \hat{\sigma}_{bias}) - MC(E')|$$

$$\sigma_{down}(E') = |MC(E') - MC(E' - \hat{\sigma}_{bias})|$$



Conclusion

- New fit model for energy calibration
- Angular Bias correction applied to calibration procedure
- More reliable error estimation
- It seems a more robust procedure → **Next step: validation also for BSO crystal**

- **Coming soon:** new *phe/MeV* estimation