

Check of α -clustering fragmentation with Sept. CNAO2025 data

INFN Milano

CNAO2025 September (No $\vec{B}$ configuration)

Selected runs: 7922 – 7924 – 7927 – 7928 – 7930 – 7931 – 7932 –
7933 – 7940 – 7941 – 7942 – 7943

2134224 events processed

Shoe **cnao2025datataking** branch

GenFit standard tracking

Comparison to MC: **CNAO25SEP_PS (*)**

Performed twice:
Before and after the new
decoding of M28

() for CNAO2025 there will be 2 separate MC campaigns (CNAO25SEP_MC and CNAO25NOV_MC), in order to better manage the distinction between the significant changes in the setup*

GenFit analysis. Event selection

- No Pile-up in Start Counter
- 1 BM track
- 1 VT vertex matched with BM track
- z coordinate of matched vertex in range $-0.3 - 0.3$ cm (within target)
- ≥ 2 Global Tracks with TW point

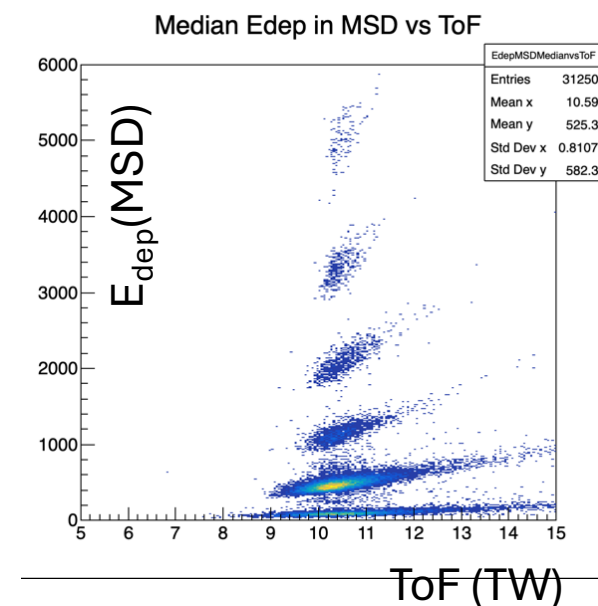
GenFit analysis. Track selection

- Cut 0: all tracks of selected events
- Cut 1: >2 VTX points in the track
- Cut 2: 1 TW point
- Cut 3: x-y coordinates of track proj in target in range -1 – 1 cm
- Cut 4: $\text{ToF} < \text{ToF}$ (50 MeV/u)

Only a very loose cut on χ^2

Additional selection:

$$Z_{\text{id}}(\text{MSD}) = Z_{\text{id}}(\text{TW})$$



GenFit analysis.

Reconstructed events and tracks

- **New decoding of M28 chip:**

Total Global Tracks: 1838966

Cut 0 (Total): 39118

Cut 1 ($N_{p_vtx} > 2$): 39118

Cut 2 ($N_{tpw} = 1$): 33087

Cut 3 (Tr_dist): 31346

Cut 4 ($ToF < ToF_{mx}$): 31250

Selected Global Tracks: **31250 (+28%)**

Selected Global Tracks with Z Match TW-MSD: **29867 (+29%)**

Selected Z=2 Tracks: **18566 (+23%)**

- **Old decoding of M28 chip:**

Total Global Tracks: 1827330

Cut 0 (Total): 28641

Cut 1 ($N_{p_vtx} > 2$): 28641

Cut 2 ($N_{tpw} = 1$): 25749

Cut 3 (Tr_dist): 24407

Cut 4 ($ToF < ToF_{mx}$): 24330

Selected Global Tracks: **24330**

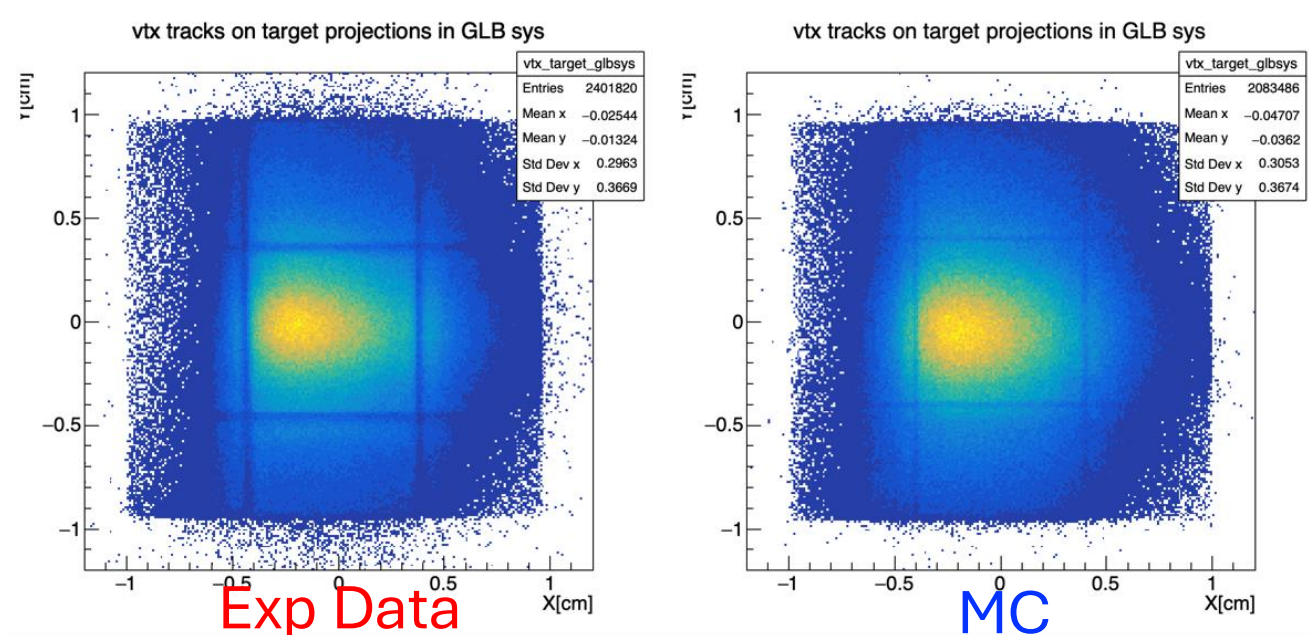
Selected Global Tracks with Ch Match TW-MSD: **23183**

Selected Z=2 Tracks: **15087**

CNAO25SEP_MC simulation

(not yet copied in the shared area of tier1)

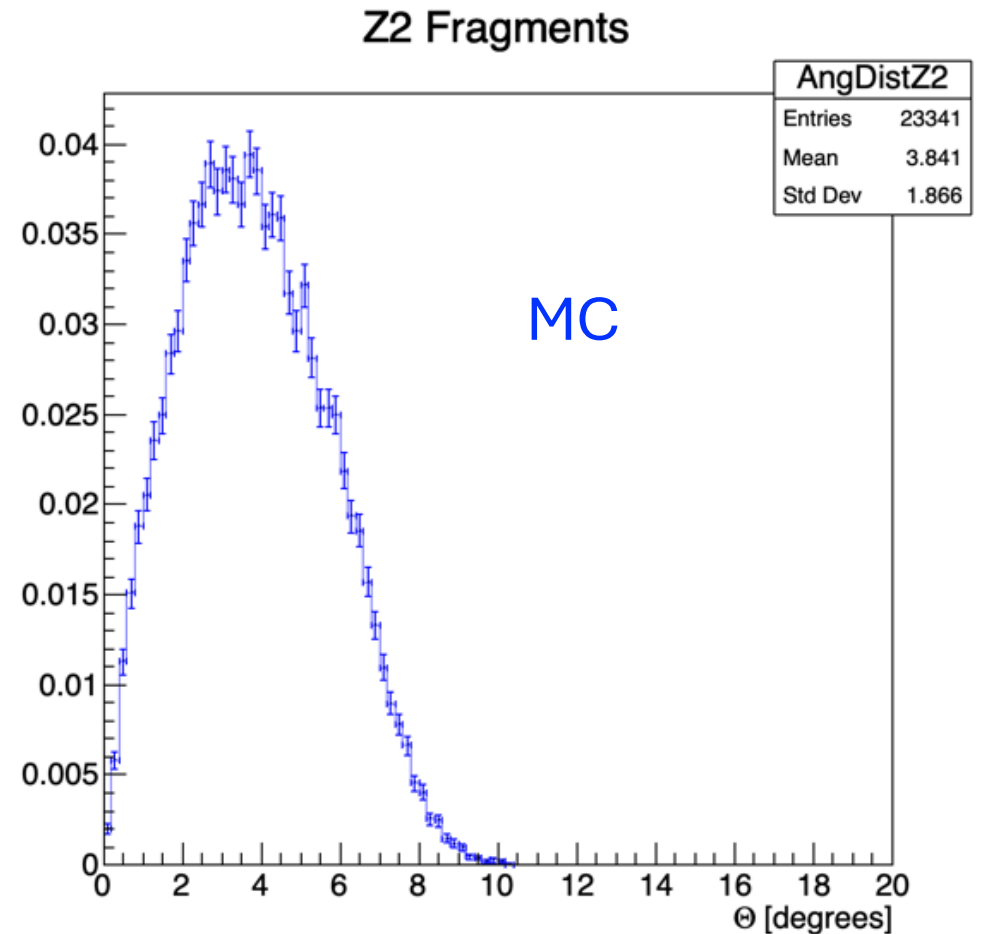
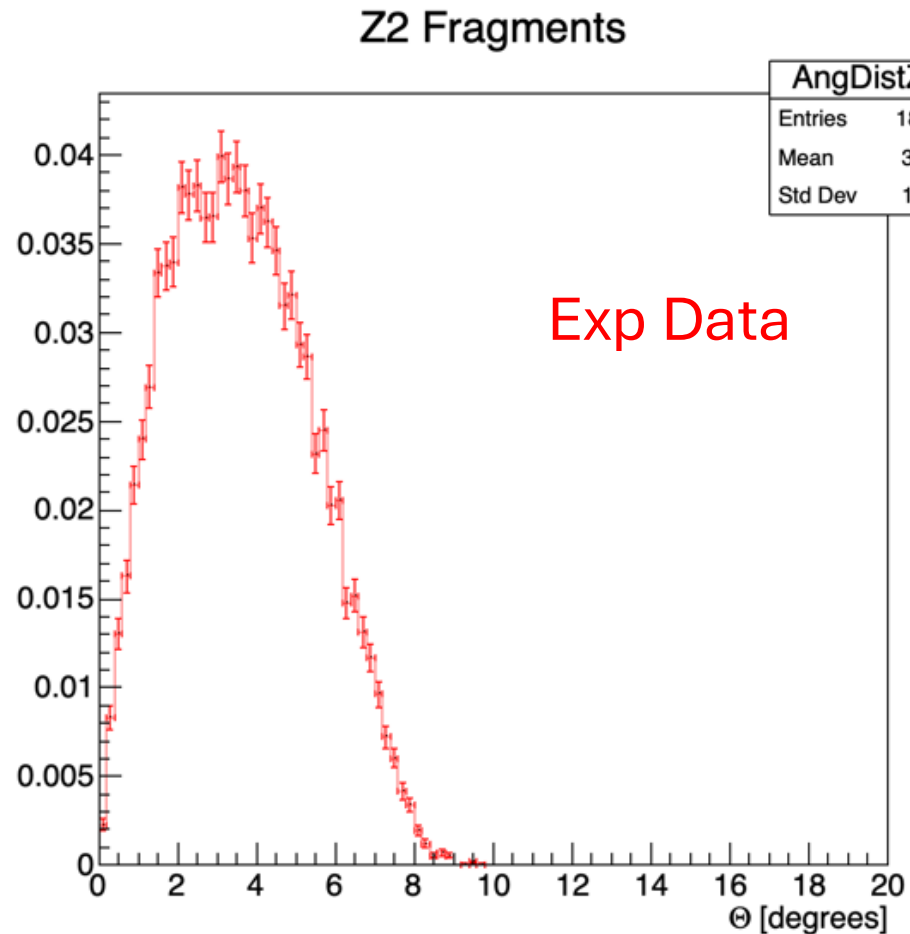
- $2 \cdot 10^6$ events
- Beam profile sampled from smoothed exp. data
- Same reconstruction and analysis as for exp. data



Small displacements in exp.
Data after the procedure of
software alignment

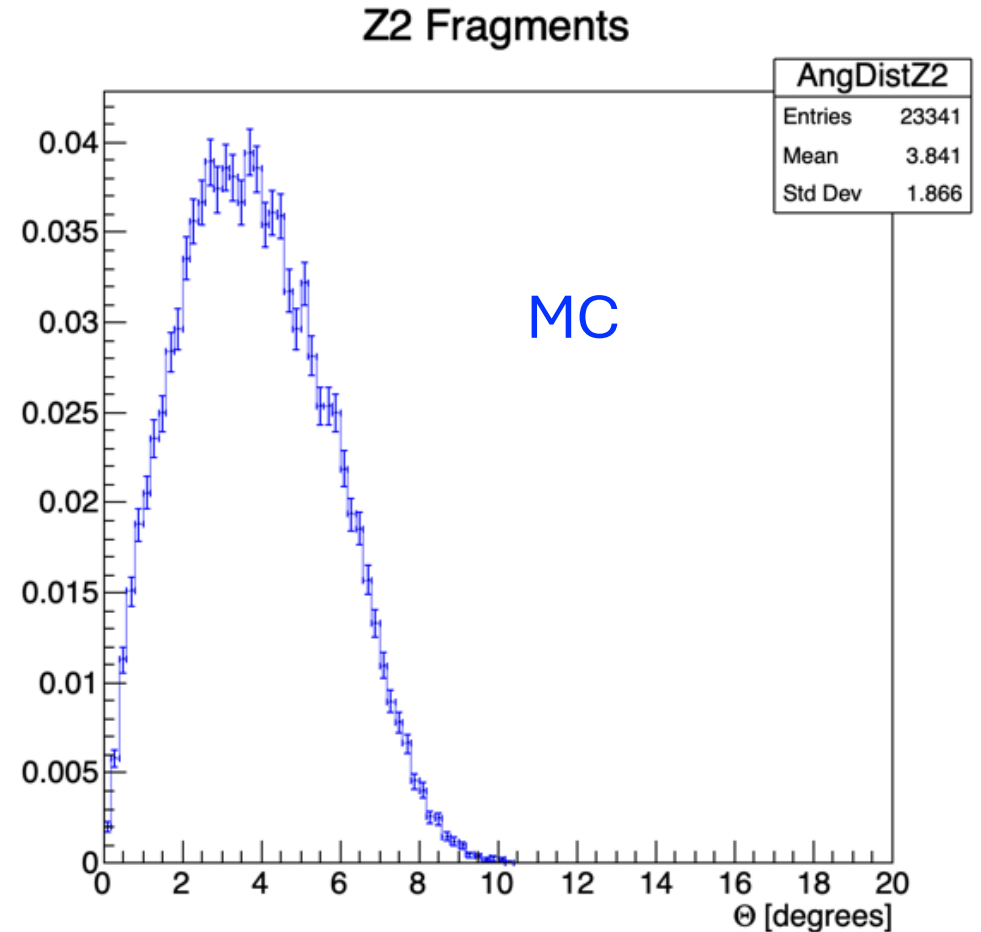
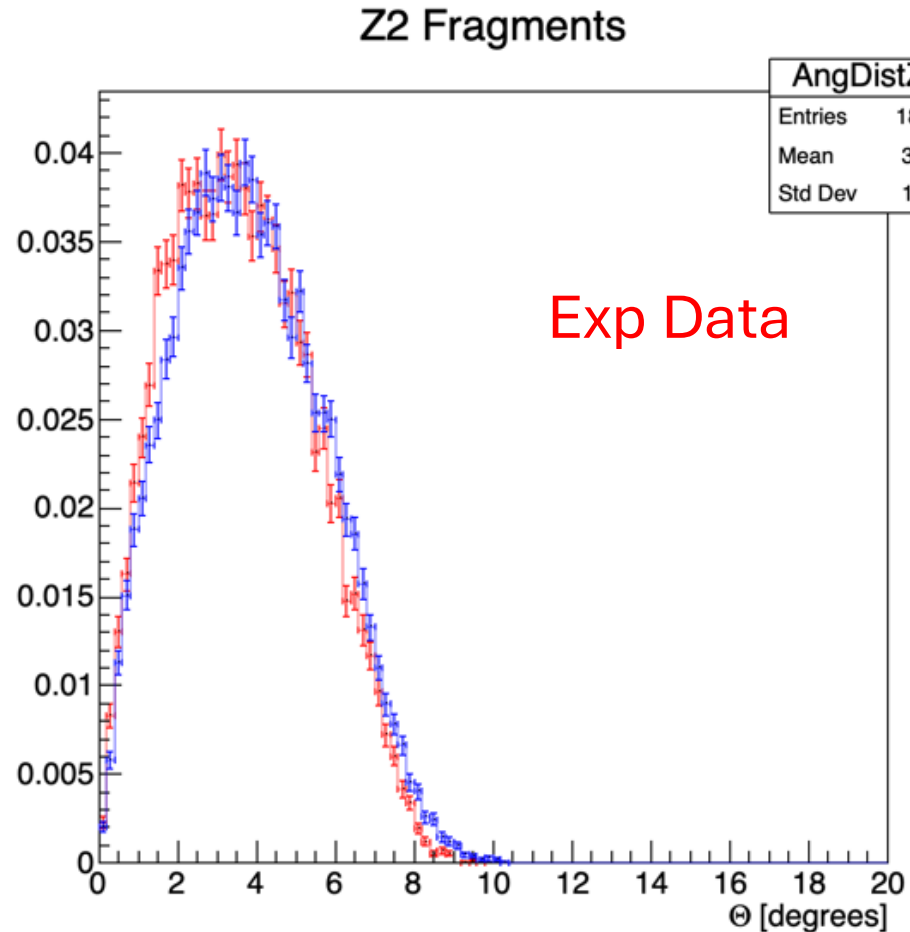
Z=2 pairs angular distribution

Normalized to same area



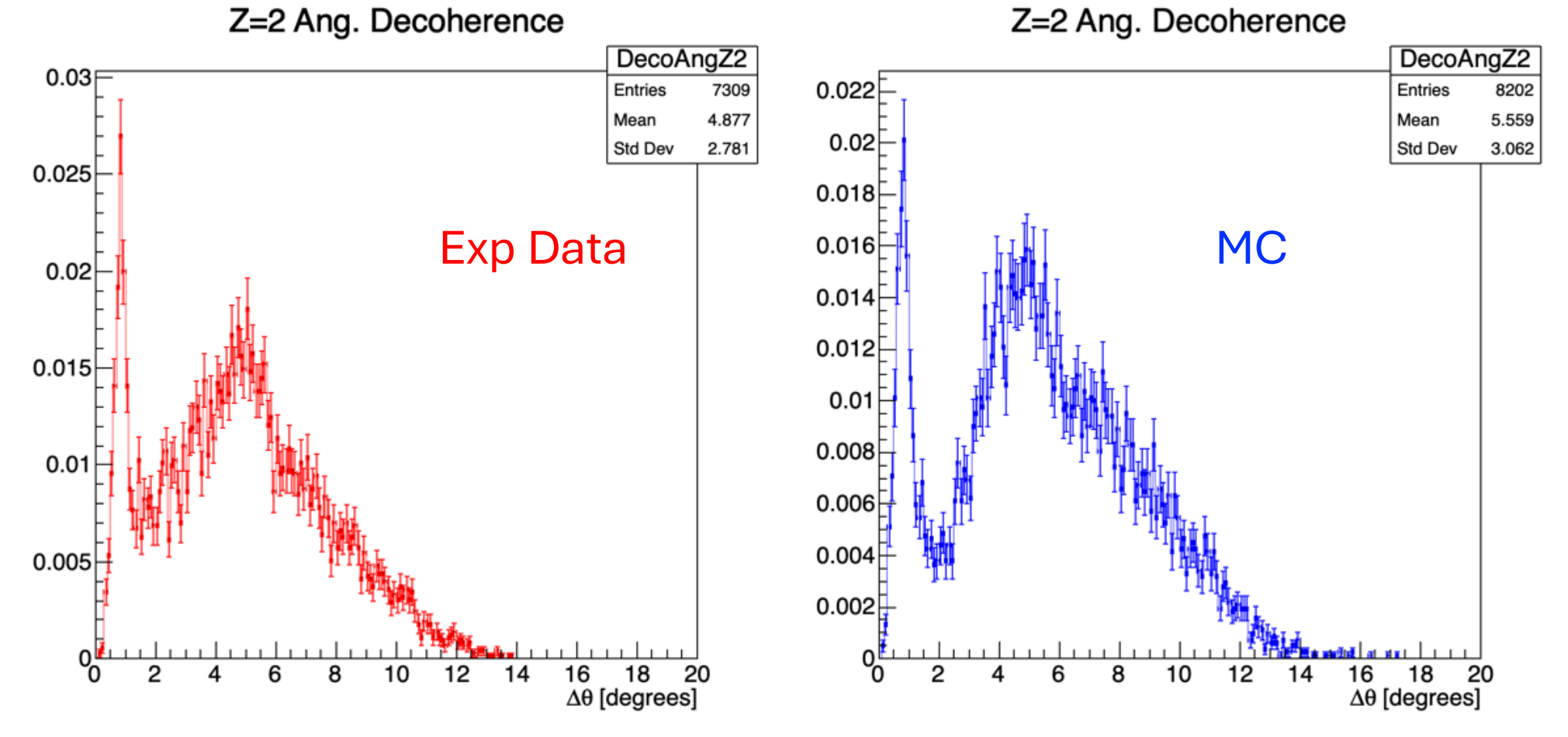
Z=2 pairs angular distribution

Normalized to same area



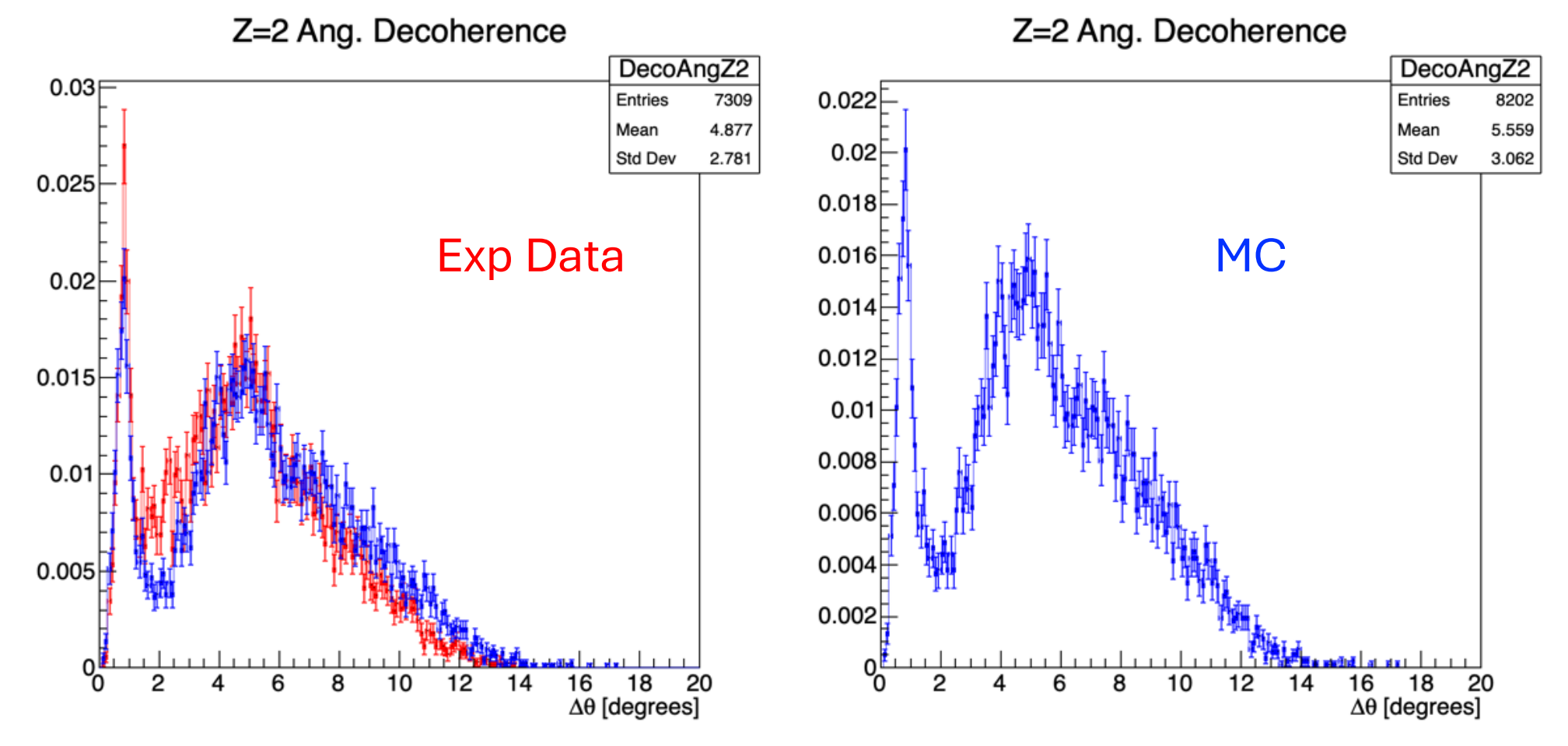
Z=2 pairs angular separation

Normalized to same area



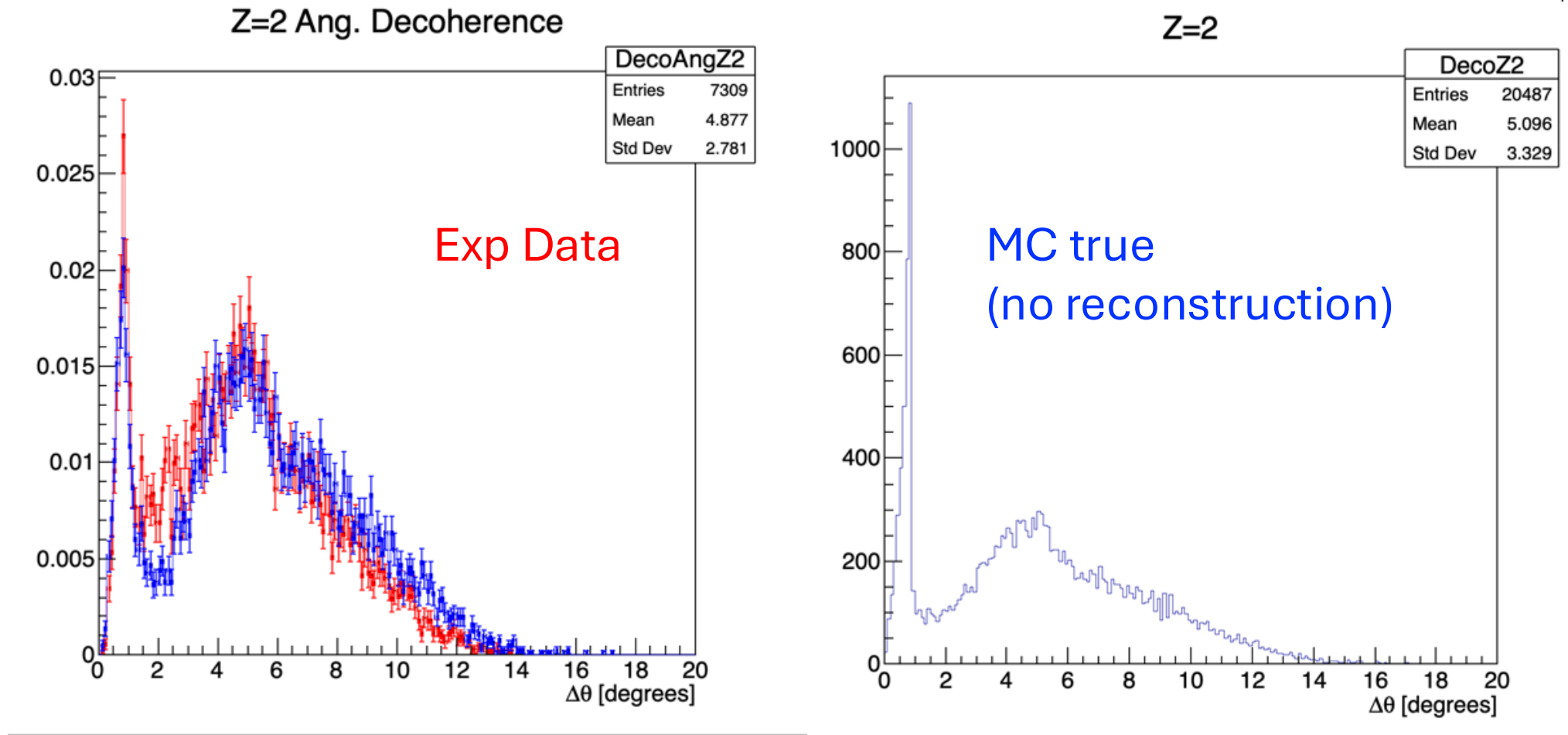
Z=2 pairs angular separation

Normalized to same area



Z=2 pairs angular separation

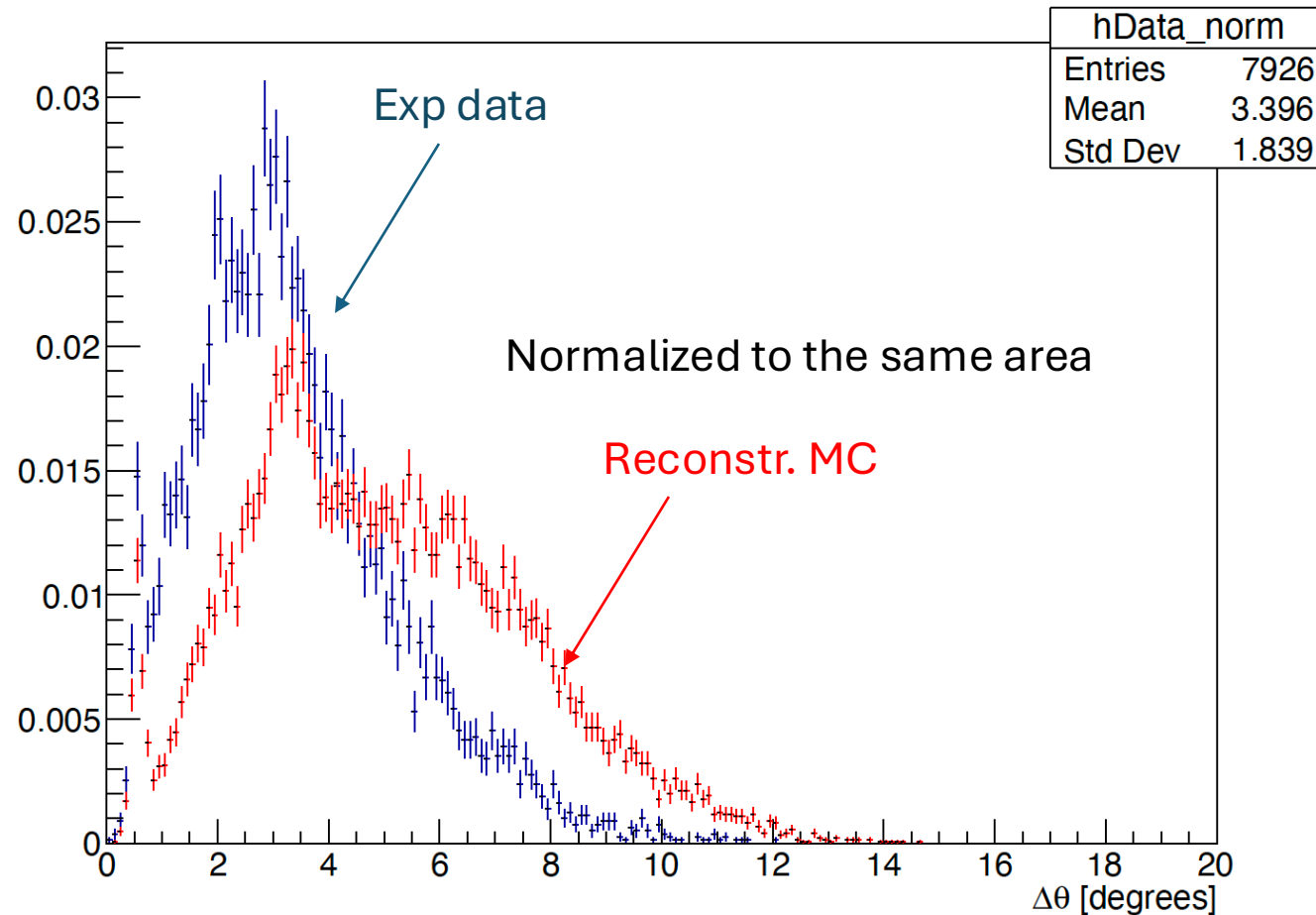
Normalized to same area



Let us remind the data-MC comparison of GSI2021 data (^{16}O @ 400 MeV/u)

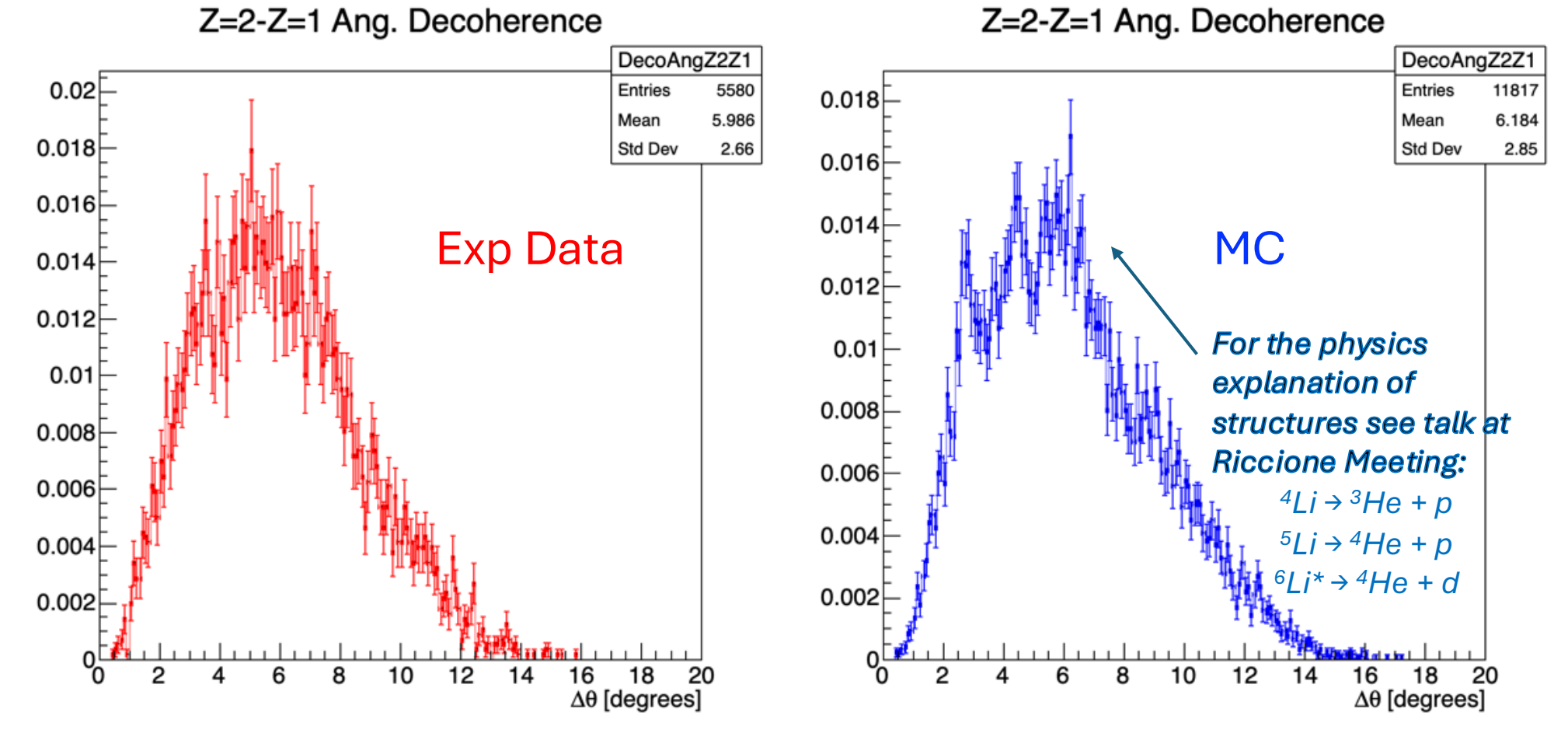
(from the talk at Riccione meeting)

There are strong differences between MC and data!



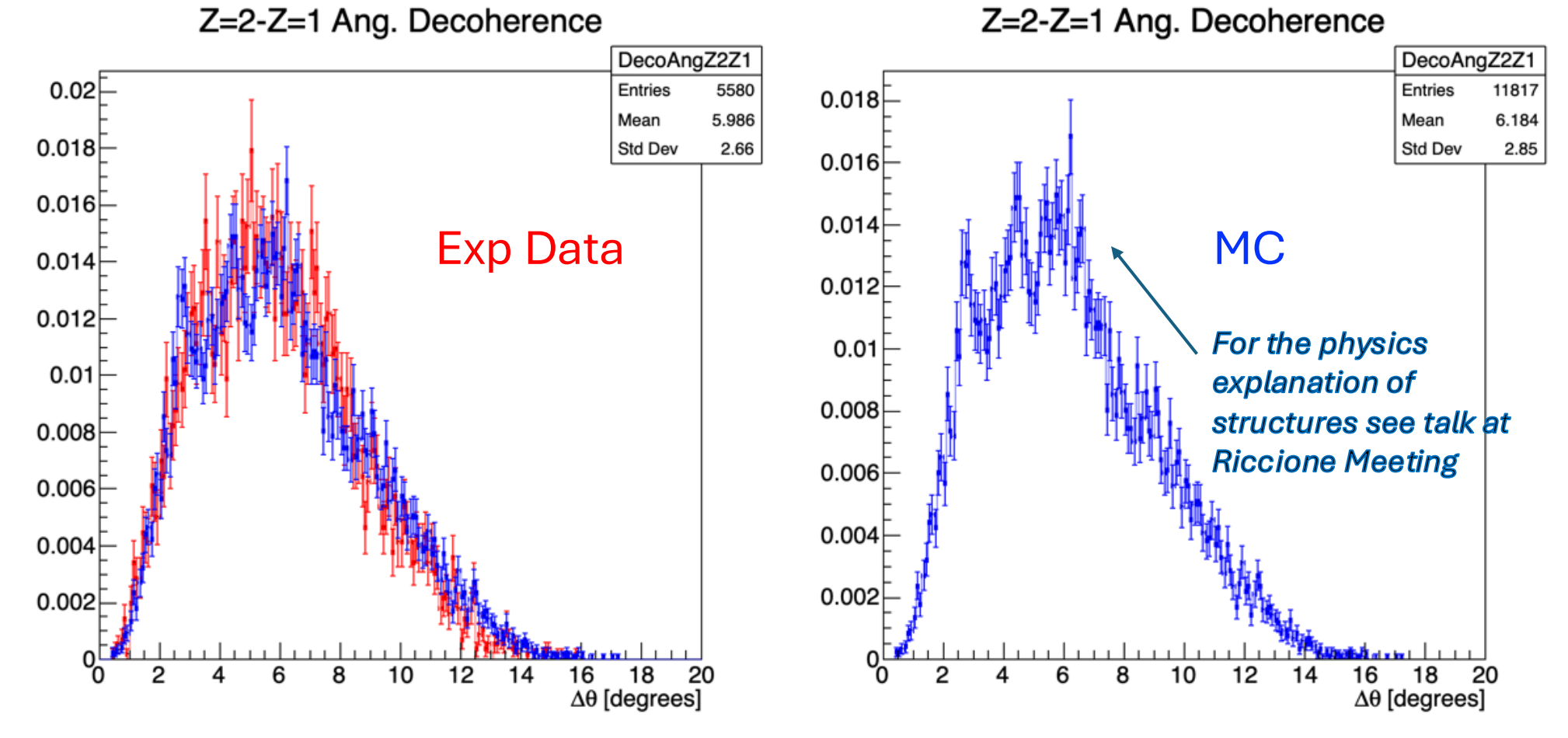
Z=2 vs Z=1 angular separation

Normalized to same area



Z=2 – Z=1 angular separation

Normalized to same area



Conclusions

- For comparison, CNAO2022 data should be re-processed. Not yet possible in the same conditions (new M28 decoding): waiting for some fixes in Shoe
- Some checks on GenFit performance have also to be completed by experts
- At present, data-MC comparison for this run (^{12}C @ 200 MeV/u) is much better than for the case of GSI2021 (^{16}O @ 400 MeV/u presented in Riccione). GSI2021 data also should be re-processed
- Too early to draw any conclusion on physics models, at this time