



# UPDATE ON THE ANALYSIS OF GSI1 $^{16}\text{O}$ (200 MEV ON $\text{C}_2\text{H}_4$ )

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# Outline

- Status of the analysis
  - Scanning/Alignment/Tracking Progresses
  - Tracks and vertices reconstruction in the whole brick

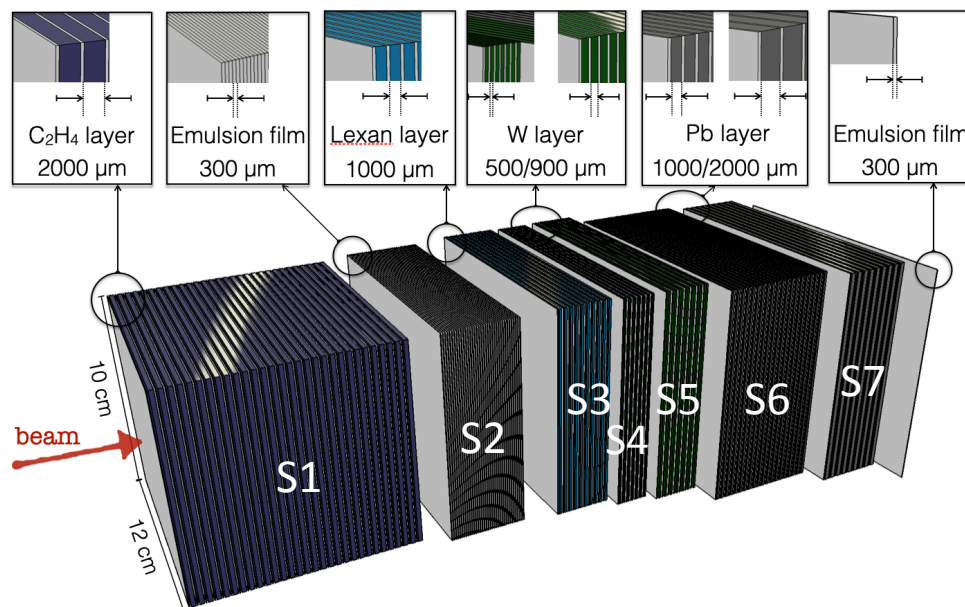




# SCANNING/ALIGNMENT/TRACKING PROGRESSES

# Status

TARGET	BEAM	2019		2020
		Oxygen 200 MeV/n	Oxygen 400 MeV/n	Carbon 700MeV/n
Carbon		GSI1	GSI3	GSI5
Polyethylene		GSI2	GSI4	GSI6



- 2019 (GSI1, GSI2, GSI3, GSI4):
  - **scanning:** 100%
  - **alignment:**
    - GSI1: 100%
      - S1+S2+S3: quality checks completed
    - GSI2: 100%
      - S1+S2+S3: quality checks completed
    - GSI3: 100%
      - S1+S2+S3: quality checks on-going
    - GSI4: 100%
  - **tracking:**
    - GSI1: S1-S7: completed
    - GSI2: S1-S7: completed
- 2020 (GSI5, GSI6):
  - **scanning:** 328/328 (100%)



# TRACKS AND VERTICES RECONSTRUCTION

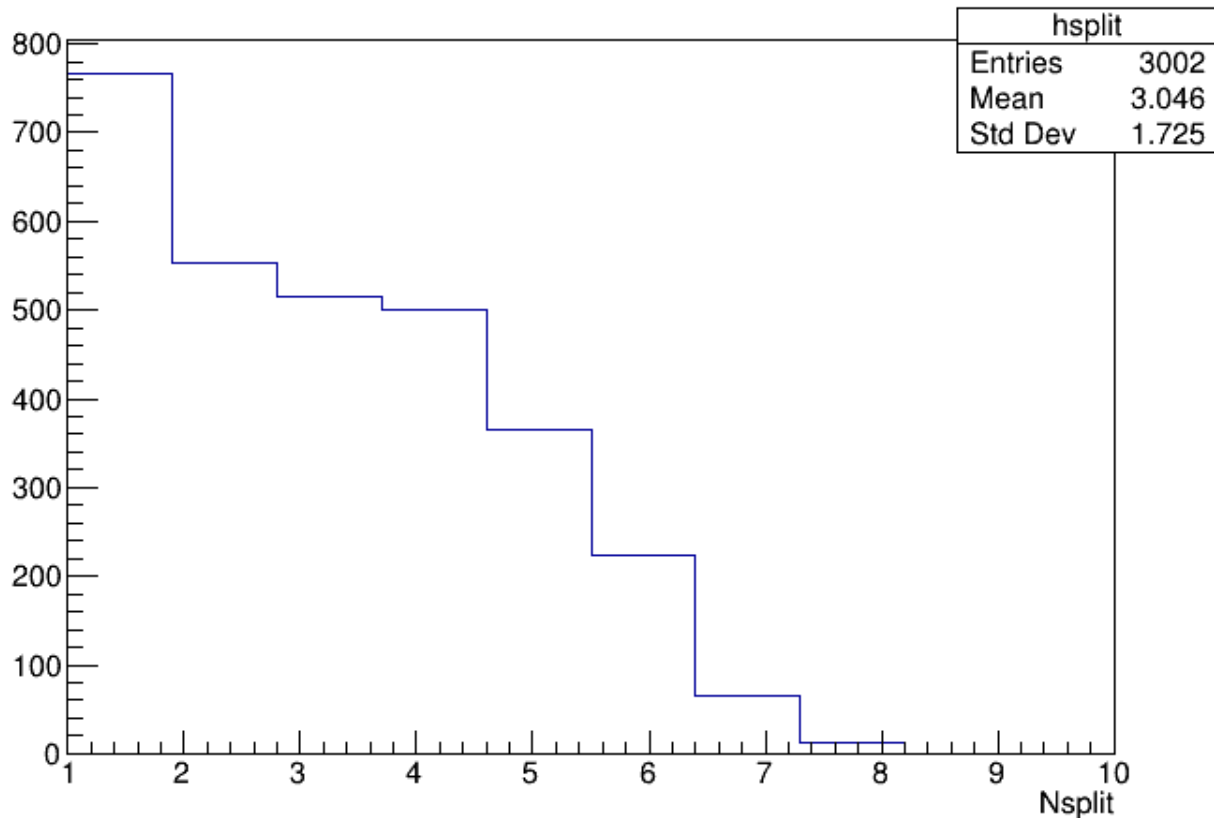
**GSI1 AND GSI2**

**(MC + DATA)**

# Tracking

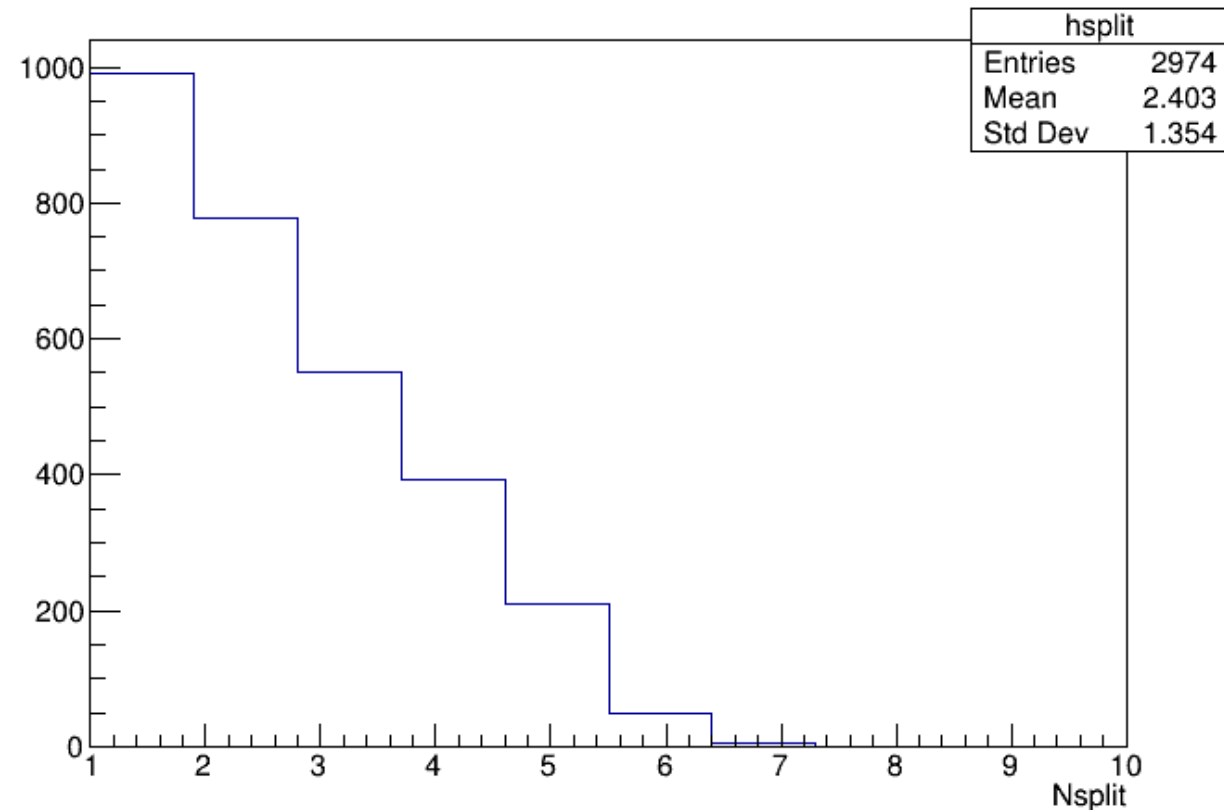
- Tracking for each section (S1 - S7) with appropriate tracking parameters from upstream plate to downstream plate
- Some tracks reaching their end are splitted because of large angle scattering

number of reconstructed tracks for each true track



Tracking in Downstream direction

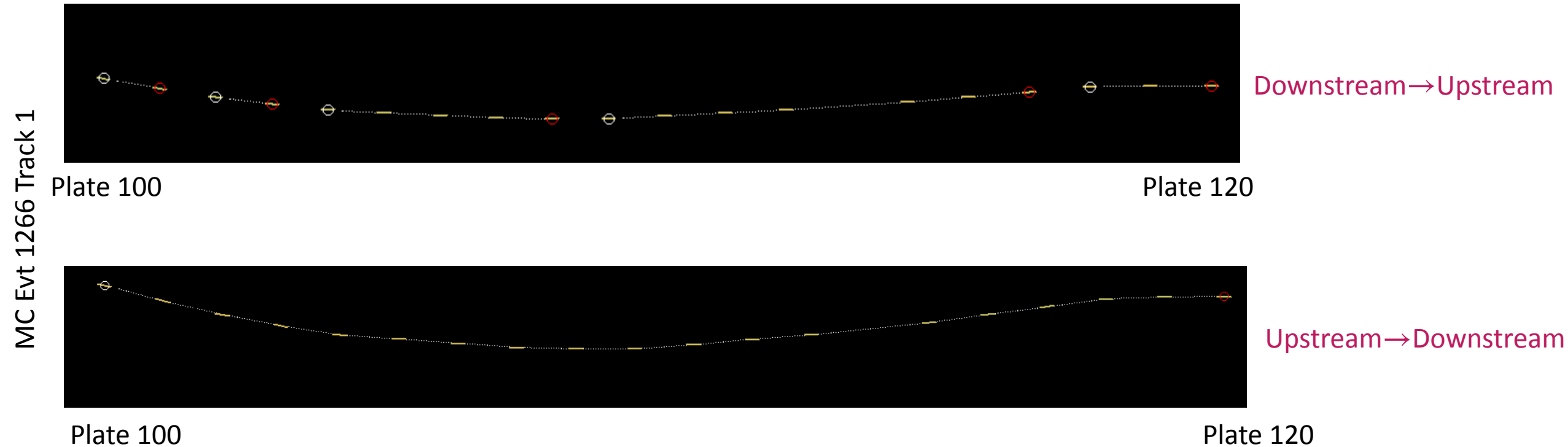
number of reconstructed tracks for each true track



Tracking in Upstream direction

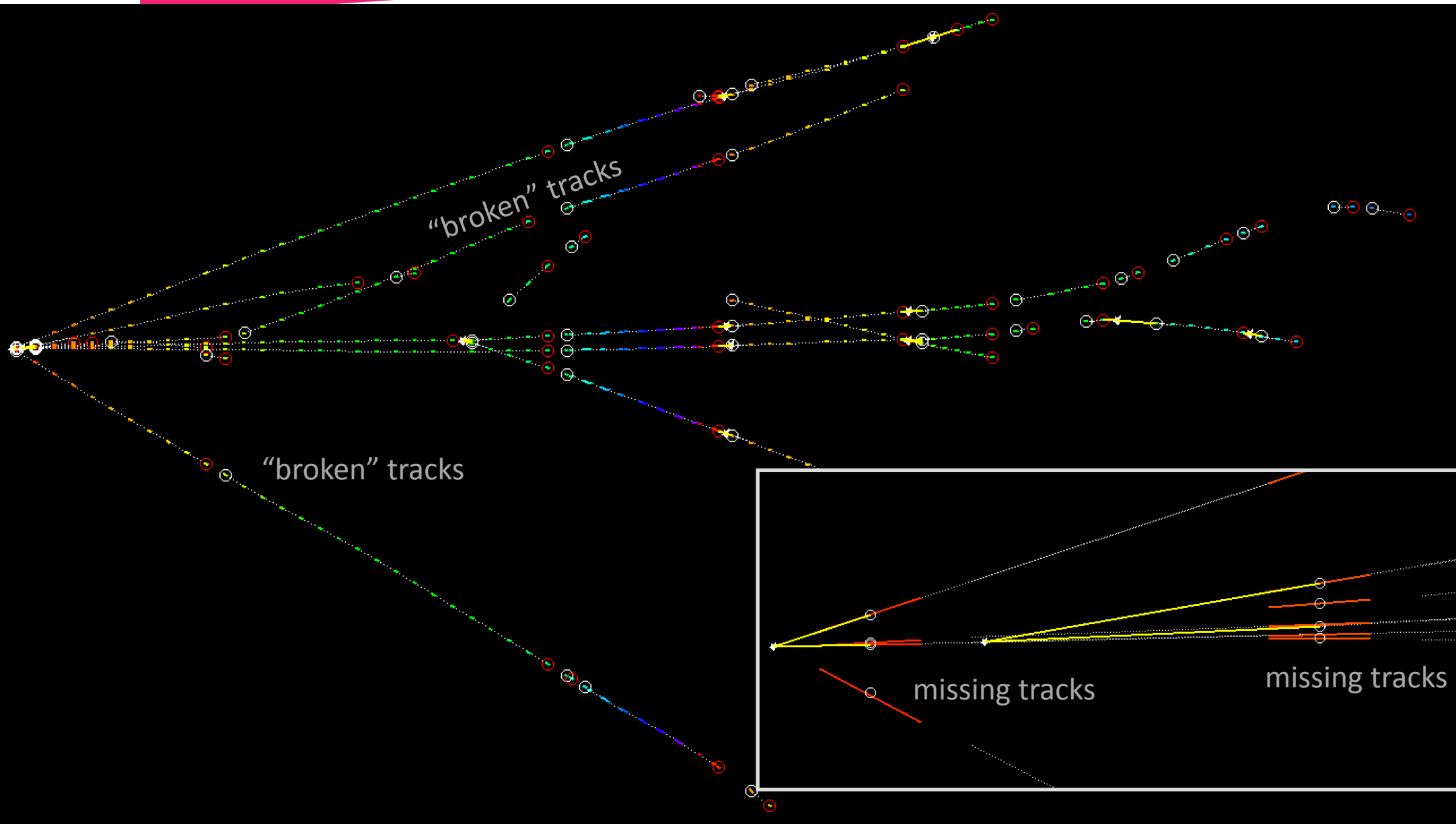
# Tracking

- Track reconstruction is based on Kalman algorithm: going in the upstream→downstream direction improves the reconstruction



- Tracks belonging to a vertex which are still splitted or go through more than one stack are merged later with a specific algorithm

# Examples of vertices reconstruction (before improvements)

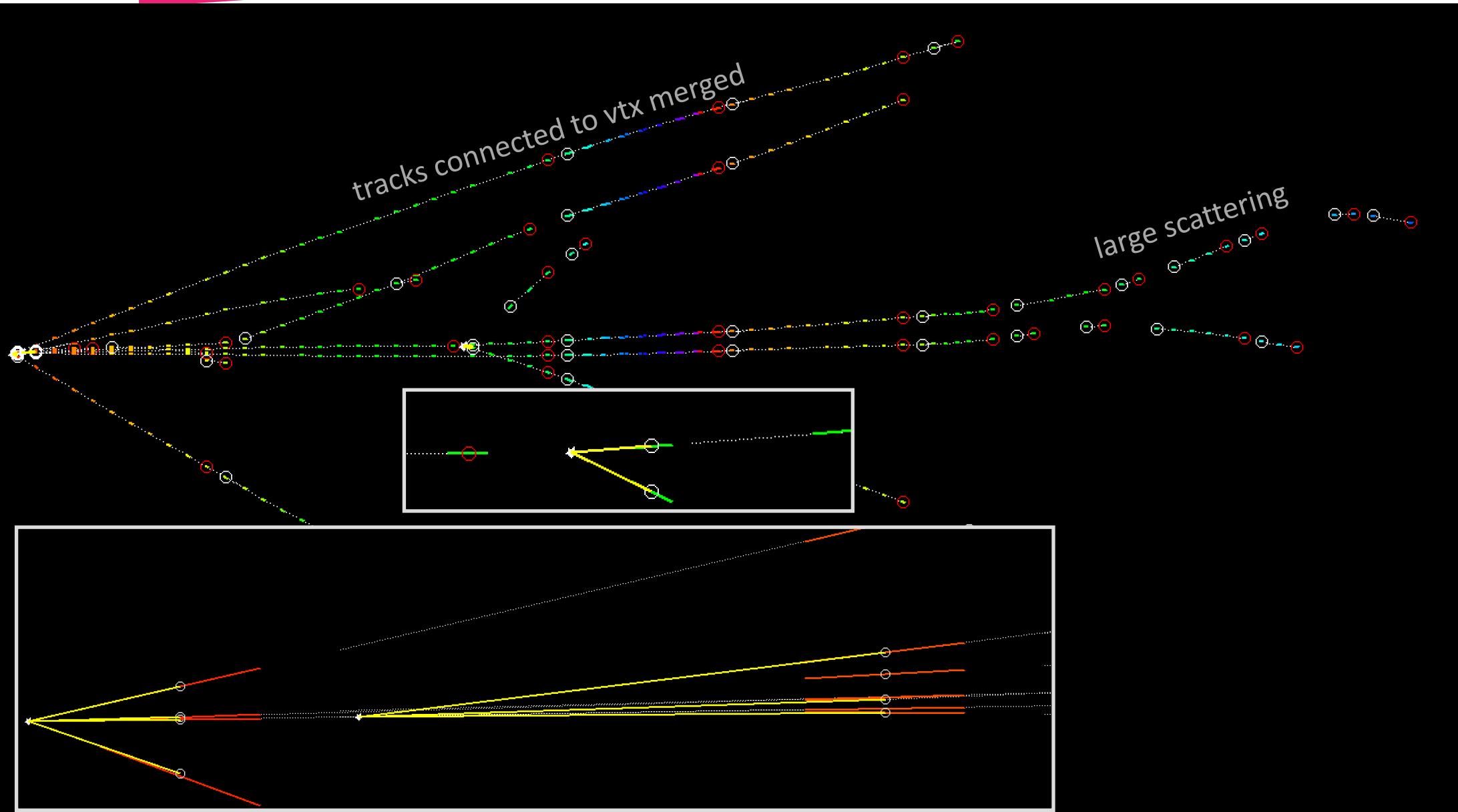


GSI1 MC  
RECO



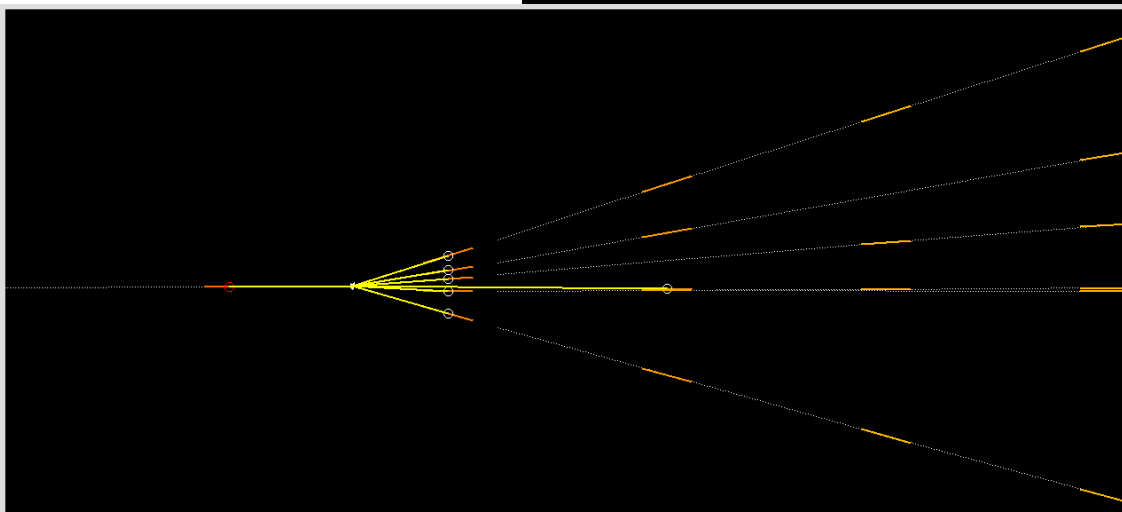
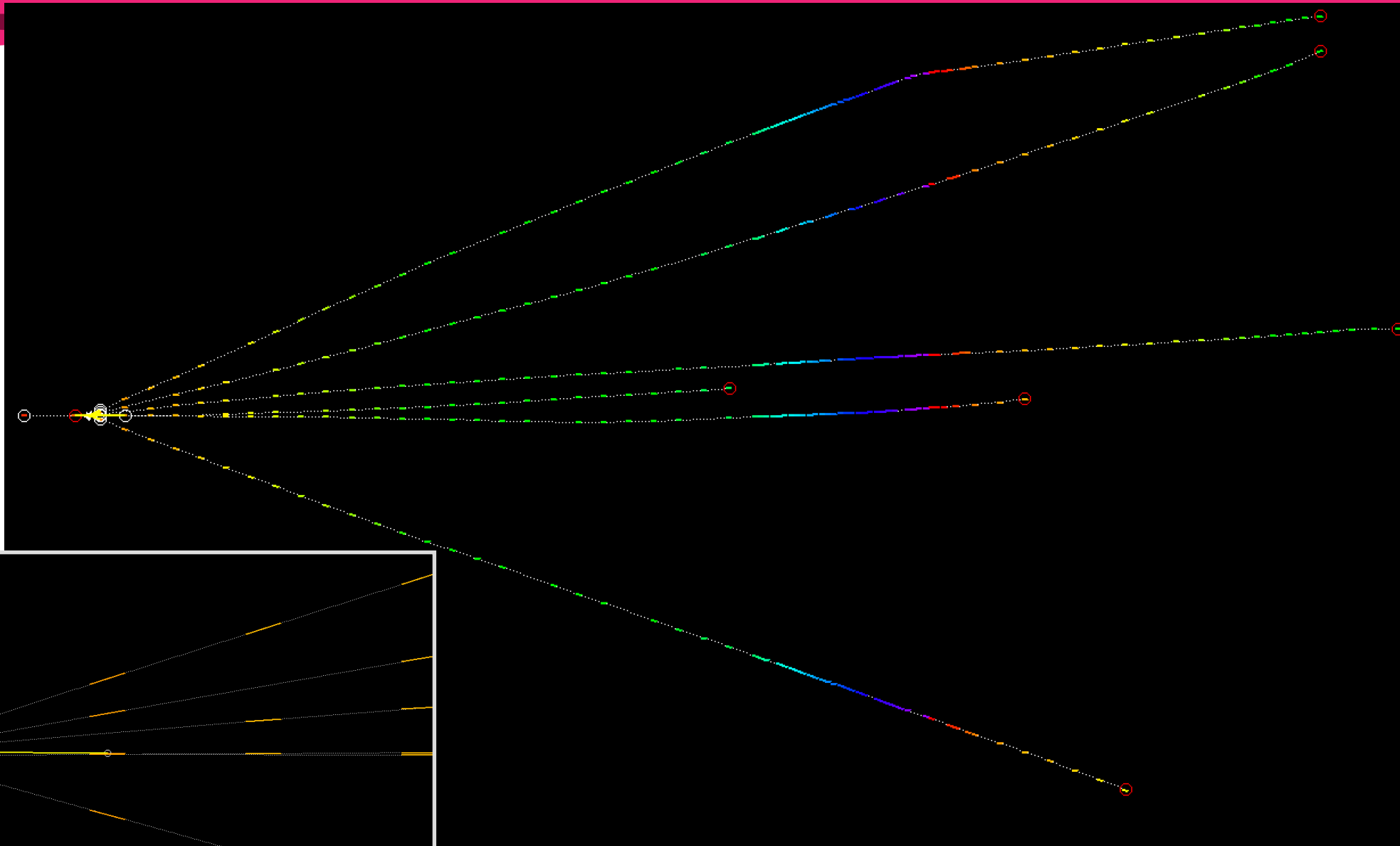
# Examples of vertices reconstruction (after improvements)

GSI1 MC  
RECO  
(ID 859)

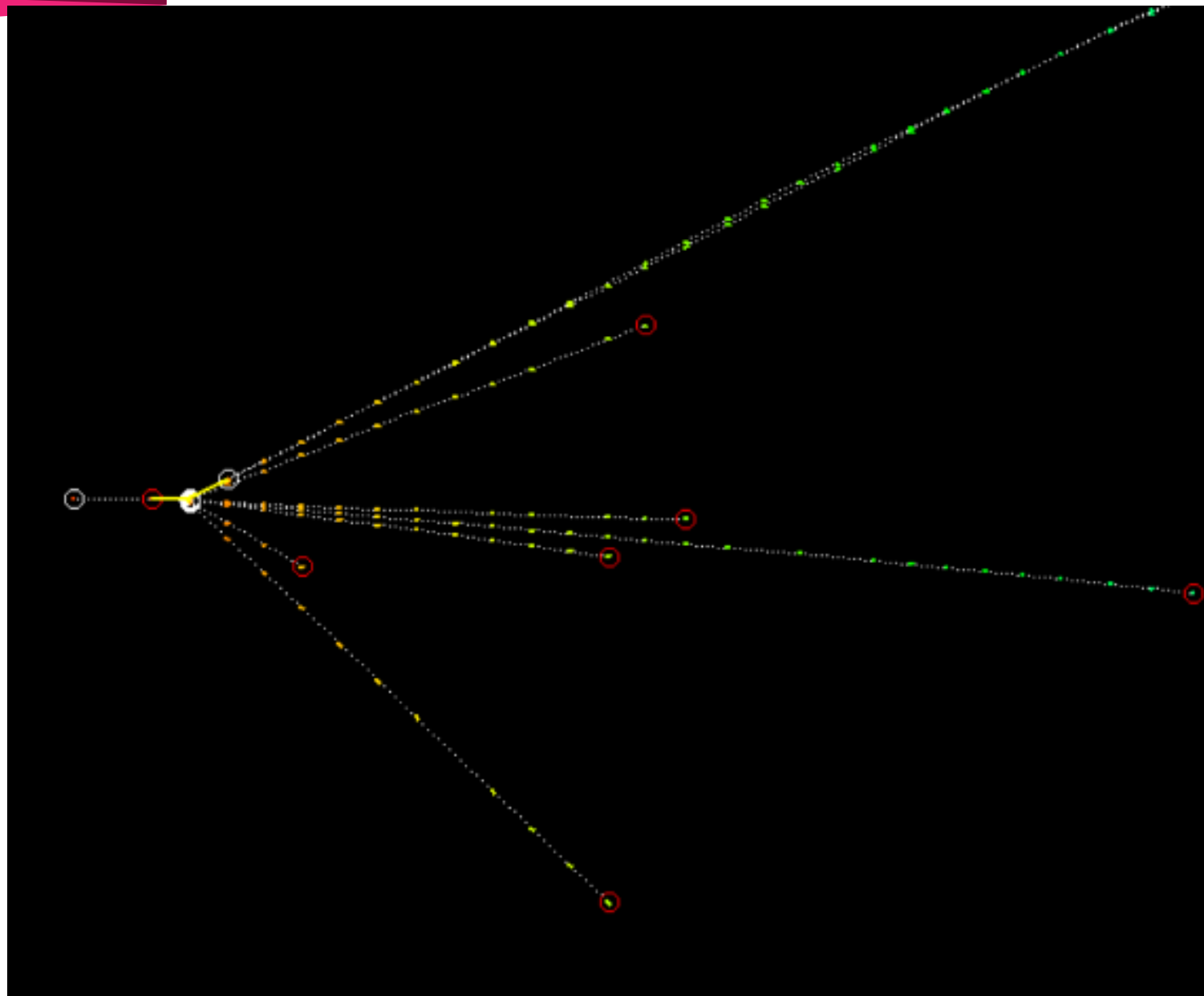


# Examples of vertices reconstruction

GSI1 MC  
RECO



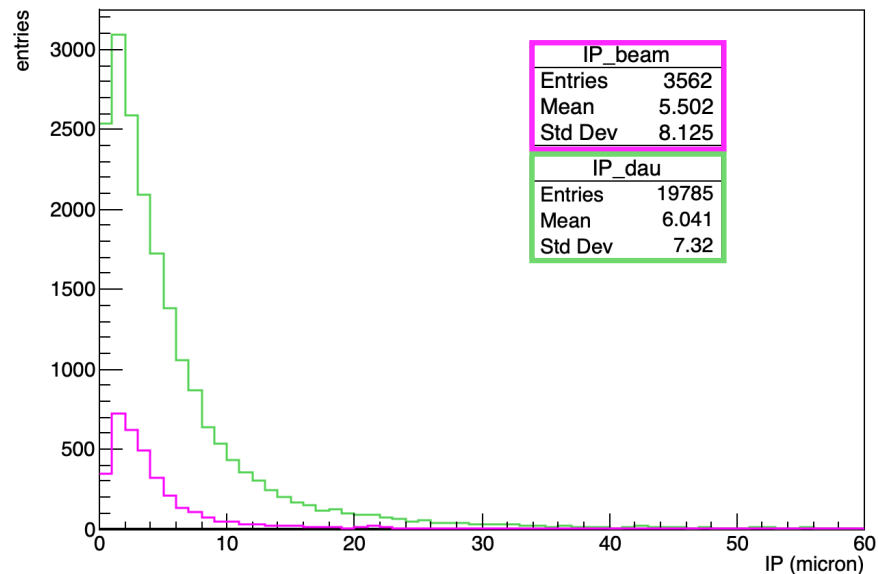
# Examples of vertices reconstruction



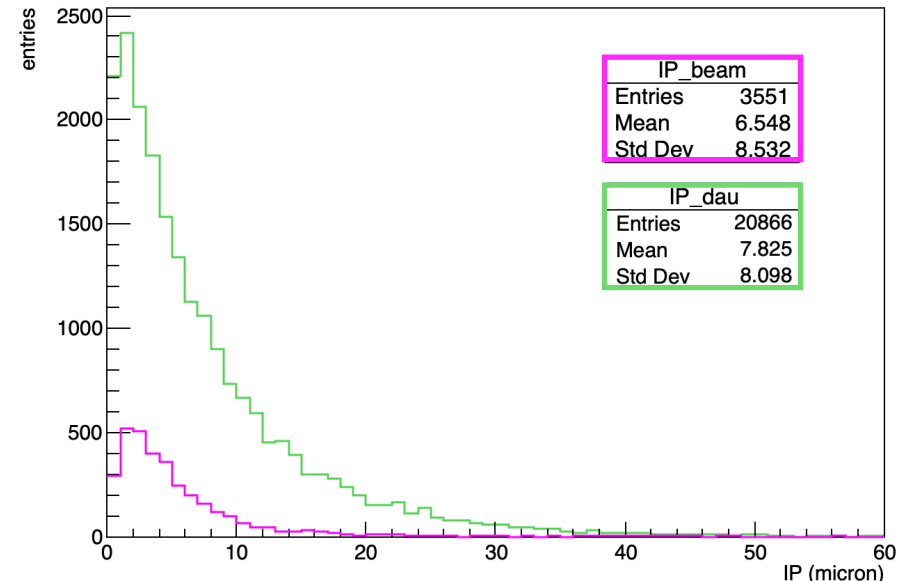
GSI2 MC  
DATA

# Vertices Impact Parameters

## GS11 MC RECO

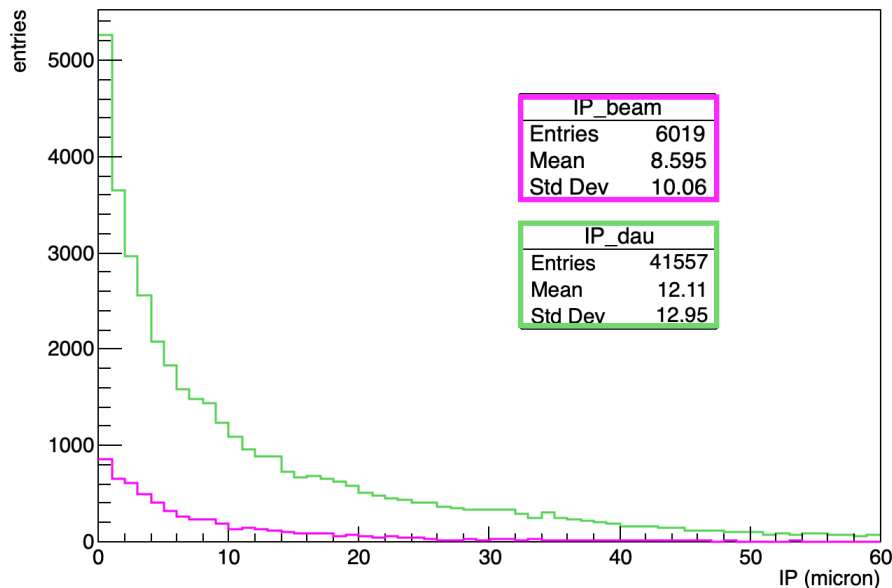


## GS12 MC RECO

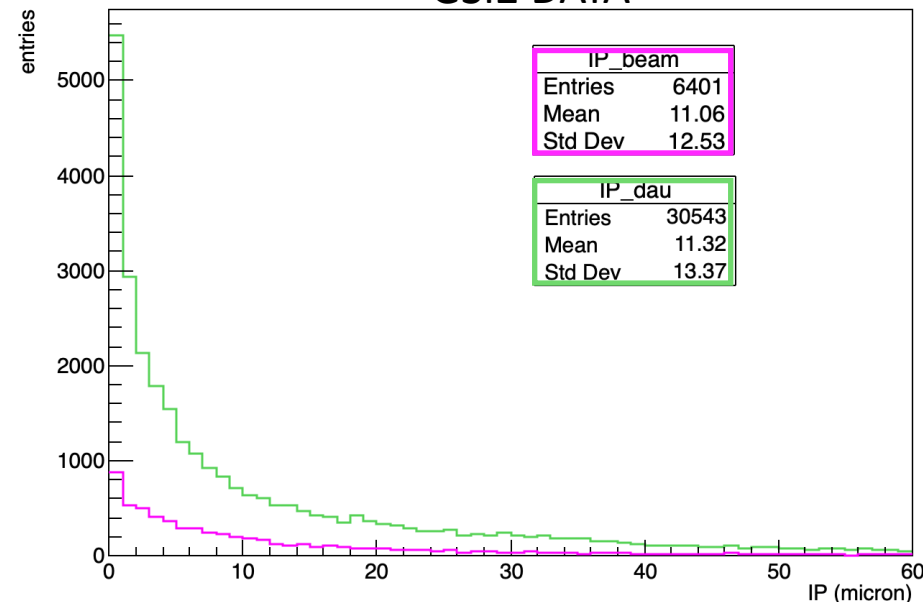


IP beam  
IP daughters

## GS11 DATA



## GS12 DATA



# Some results on “improved” reconstructed vertices

PRELIMINARY

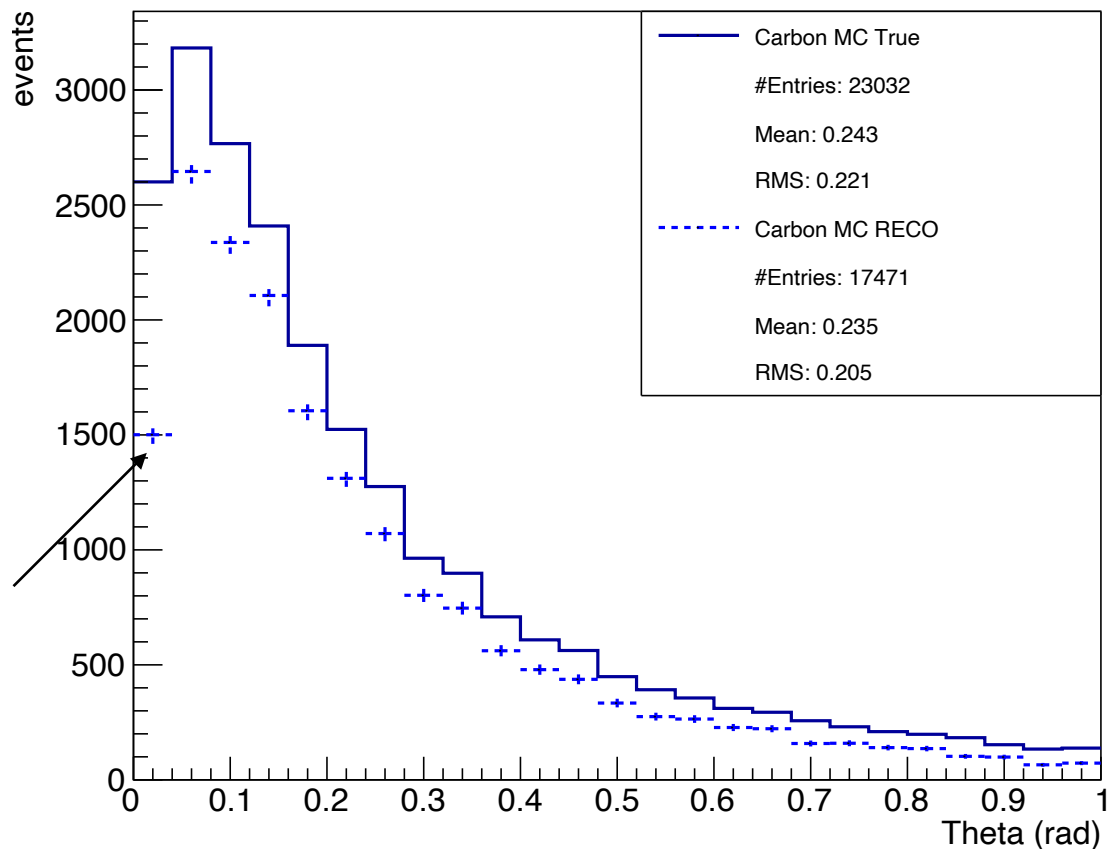
	GSI1 MC	GSI2 MC	GSI1 DATA	GSI2 DATA
Beam track added to vtx	516	751	304	590
Extra Daughters found	535	552	1685	1723
tracks merged	31809 OK: 31211 (98.1%)	26630 OK: 26038 (98.7%)	3577	2139
Final number of Reconstructed vertices	4101 with $n \geq 3$ (MC true: 5031)	4523 with $n \geq 3$ (MC true: 5875)	7099 with $n \geq 3$	6556 with $n \geq 3$

# Fragments' angular distributions

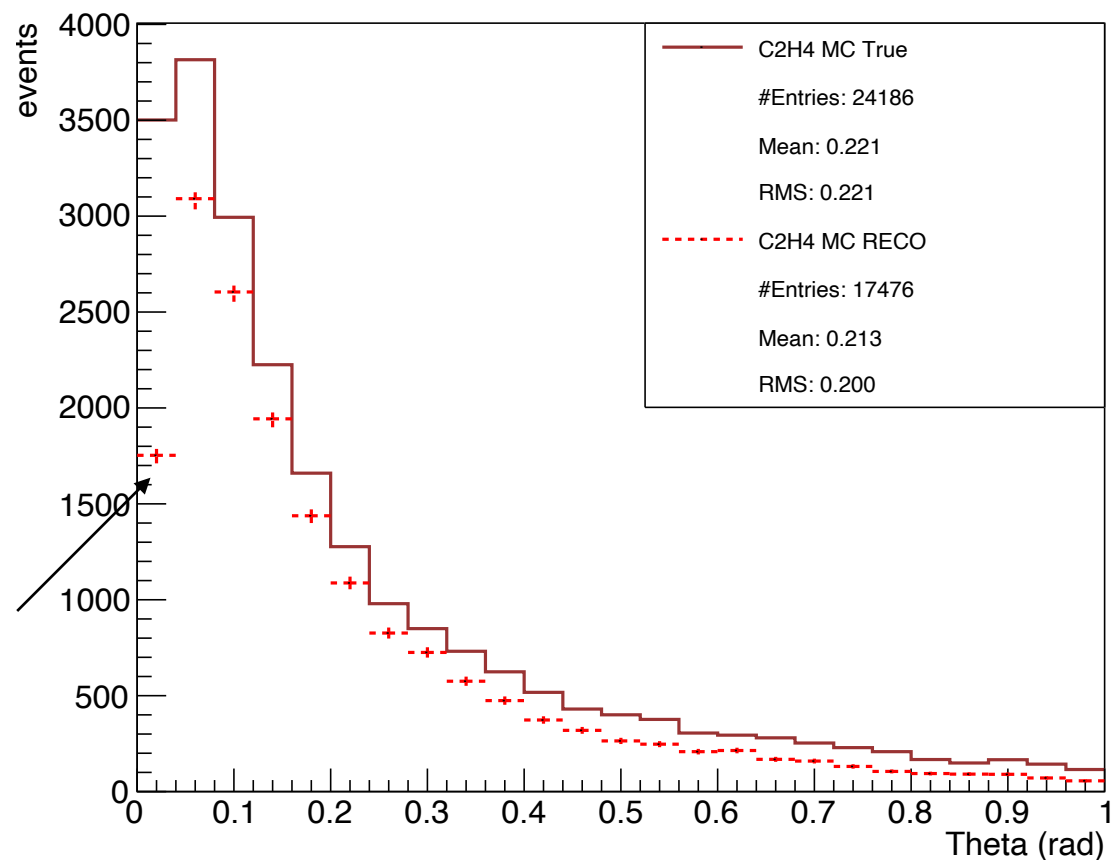
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between TRUE MC (solid line) and reconstructed MC (dashed crosses)



GSI1: Carbon Target



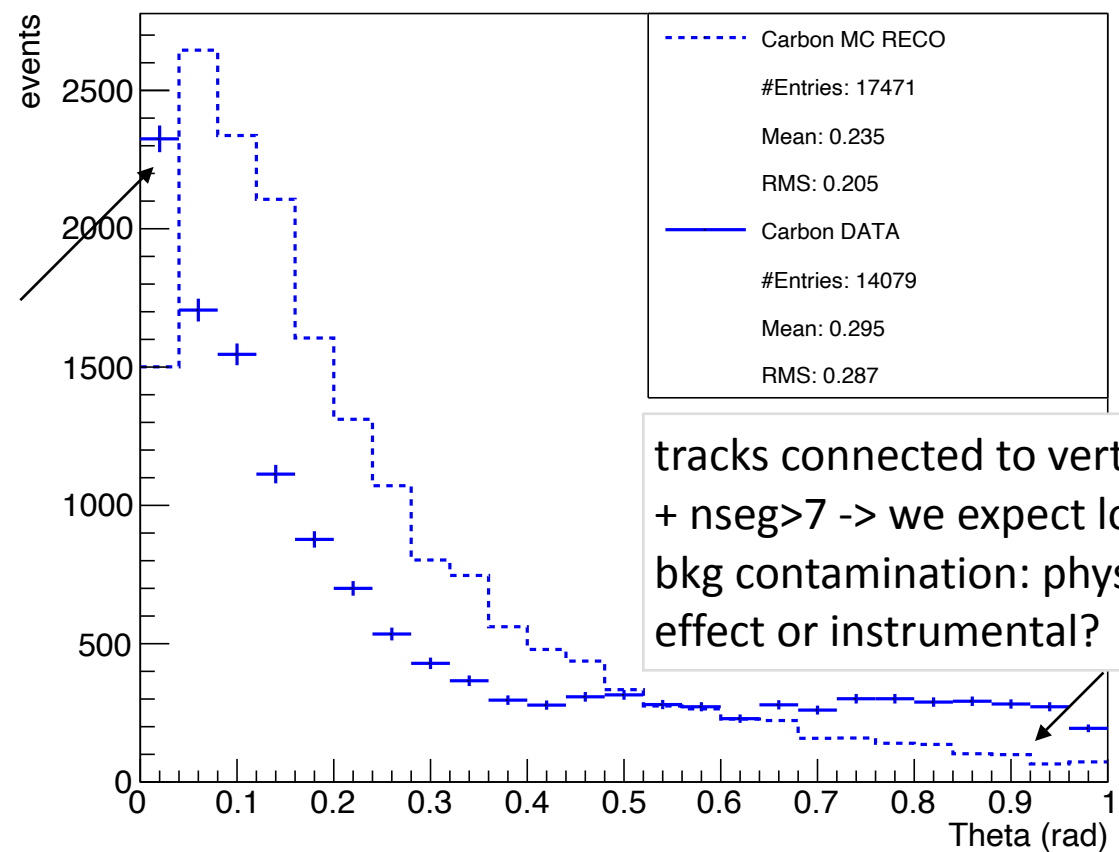
GSI2: C2H4 Target

# Fragments' angular distributions

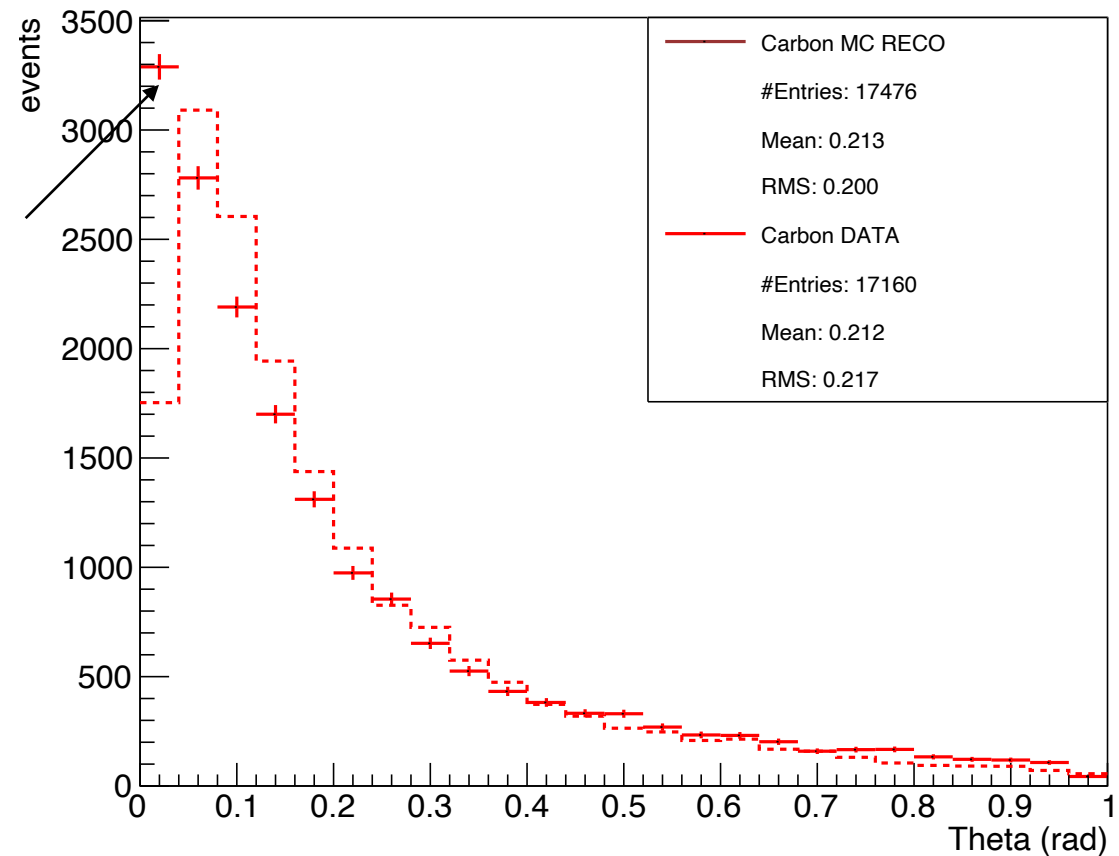
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between reconstructed MC (dashed line) and DATA (solid crosses)



GSI1: Carbon Target



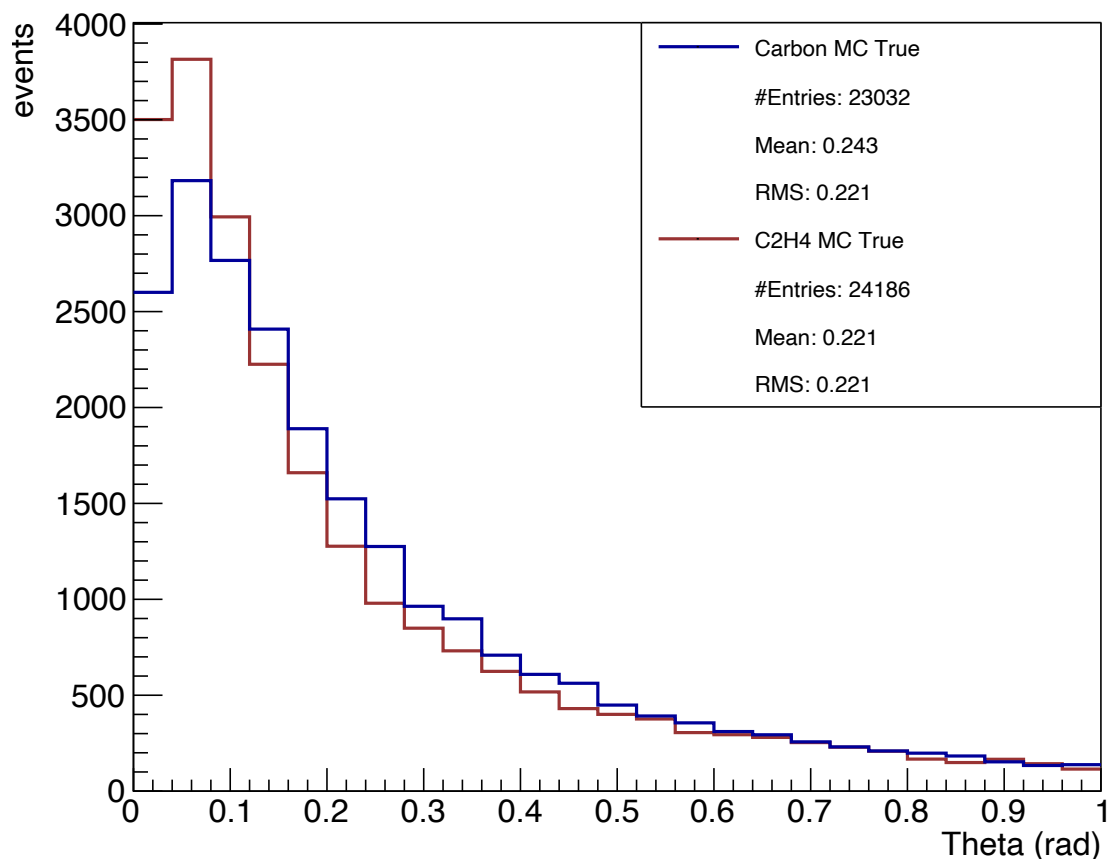
GSI2: C2H4 Target

# Fragments' angular distributions

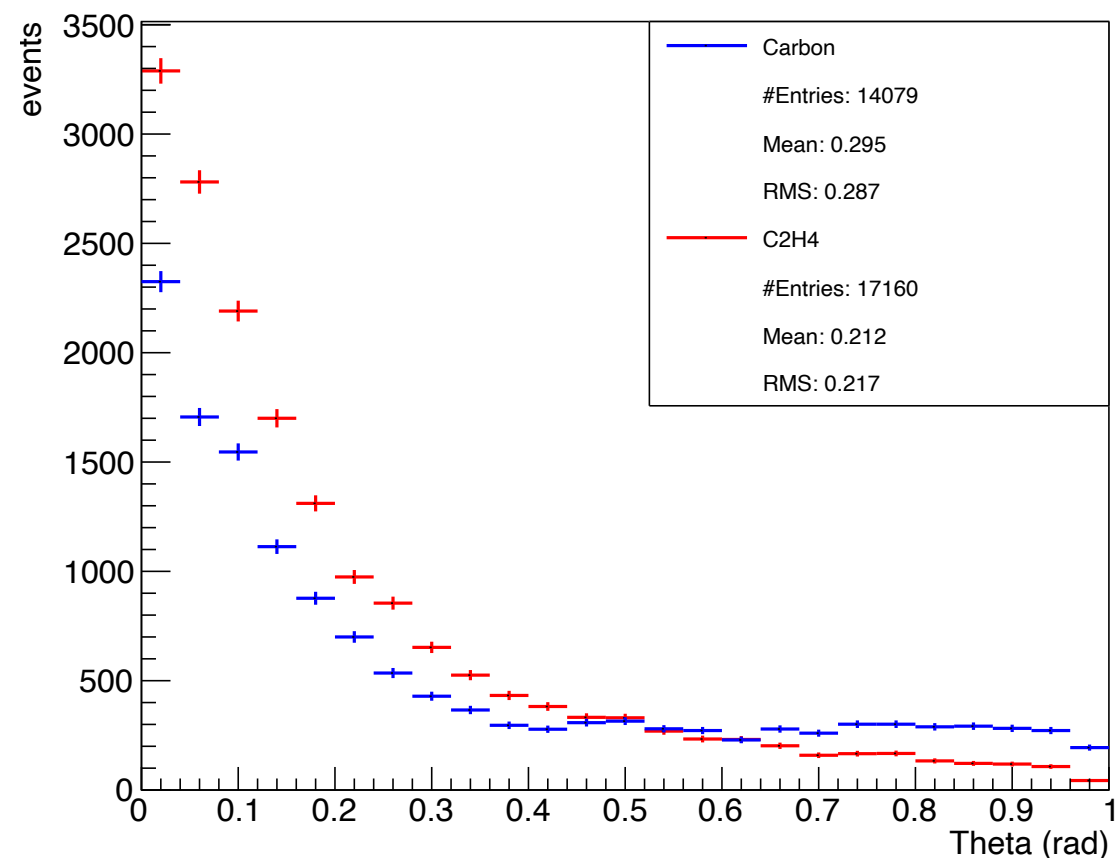
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between GSI1 and GSI2 in TRUE MC



- Comparison between GSI1 and GSI2 in DATA



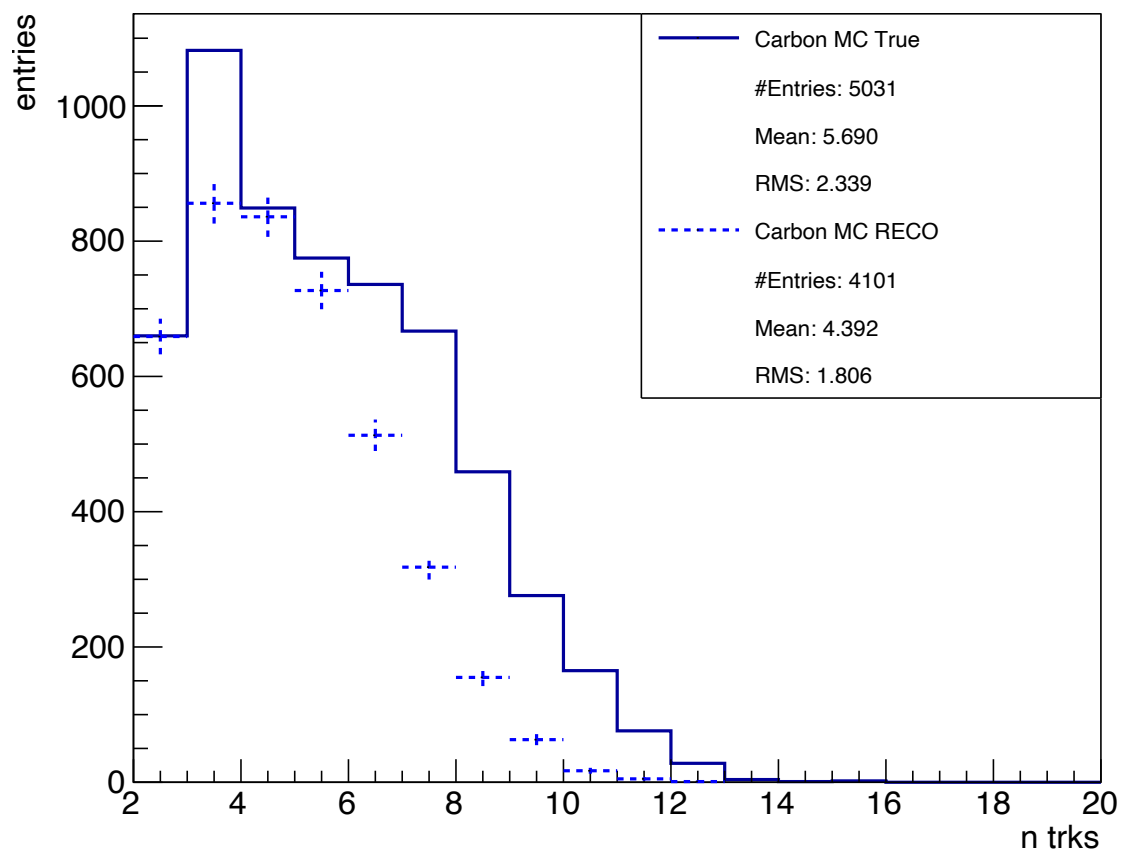


# Fragments' multiplicity

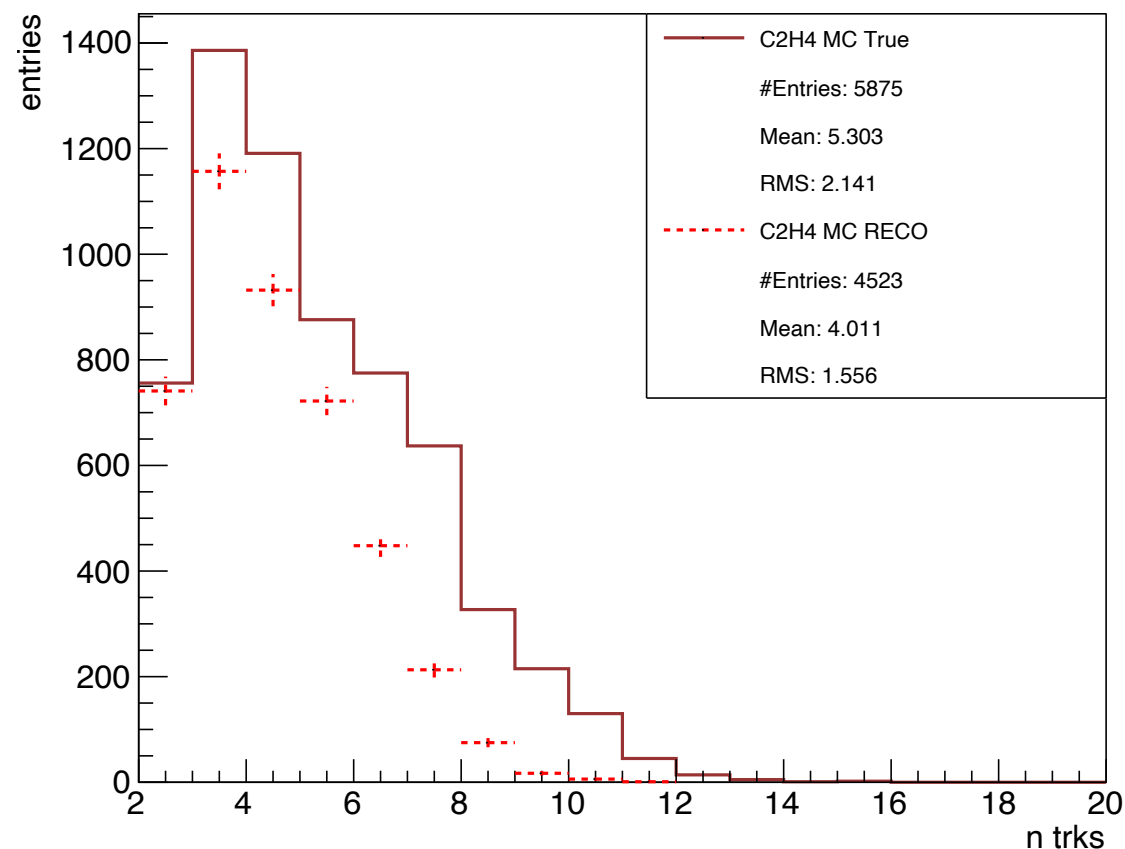
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between TRUE MC (solid line) and reconstructed MC (dashed crosses)



GSI1: Carbon Target



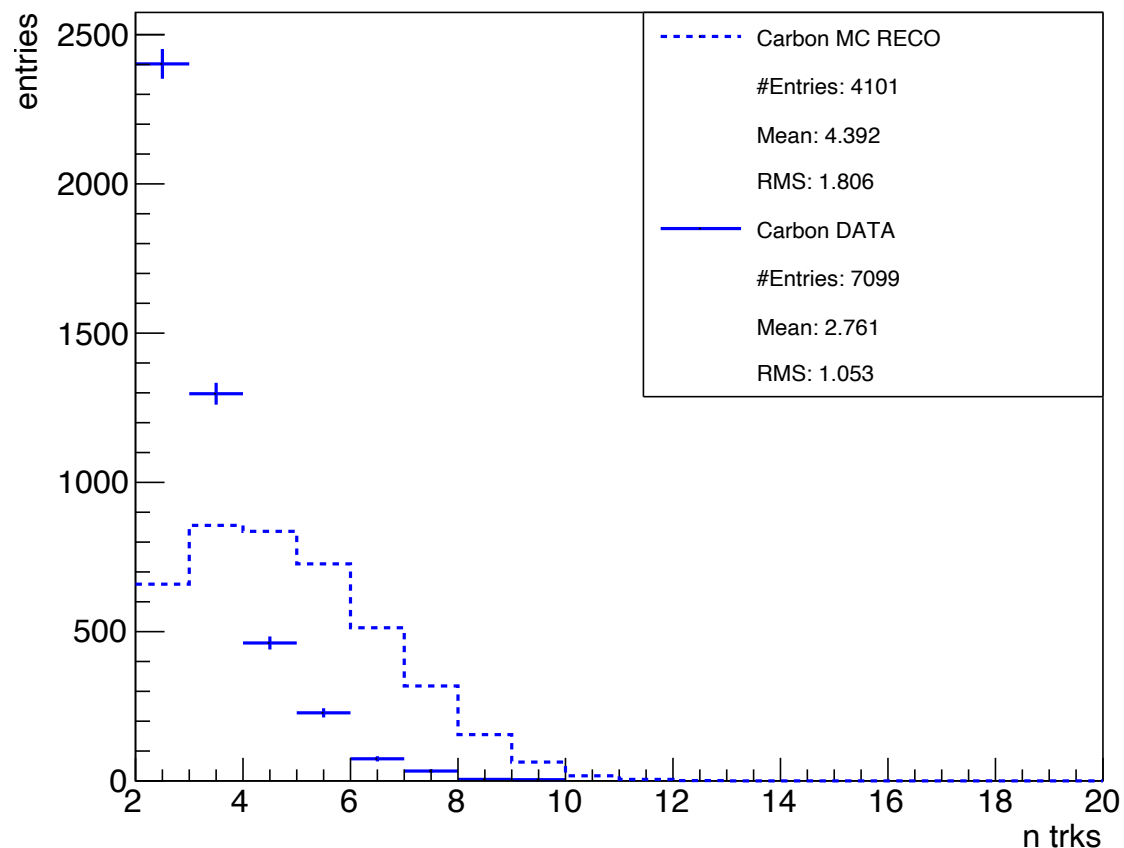
GSI2: C2H4 Target

# Fragments' multiplicity

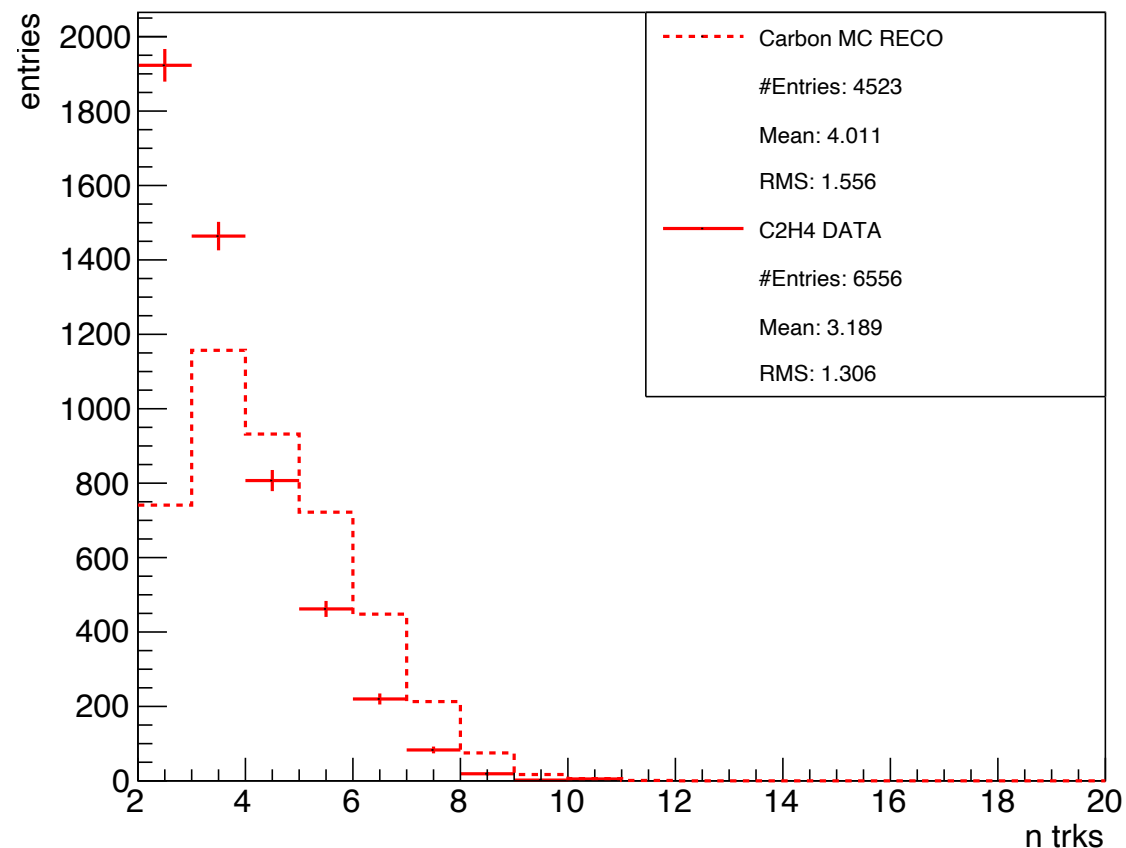
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between reconstructed MC (dashed line) and DATA (solid crosses)

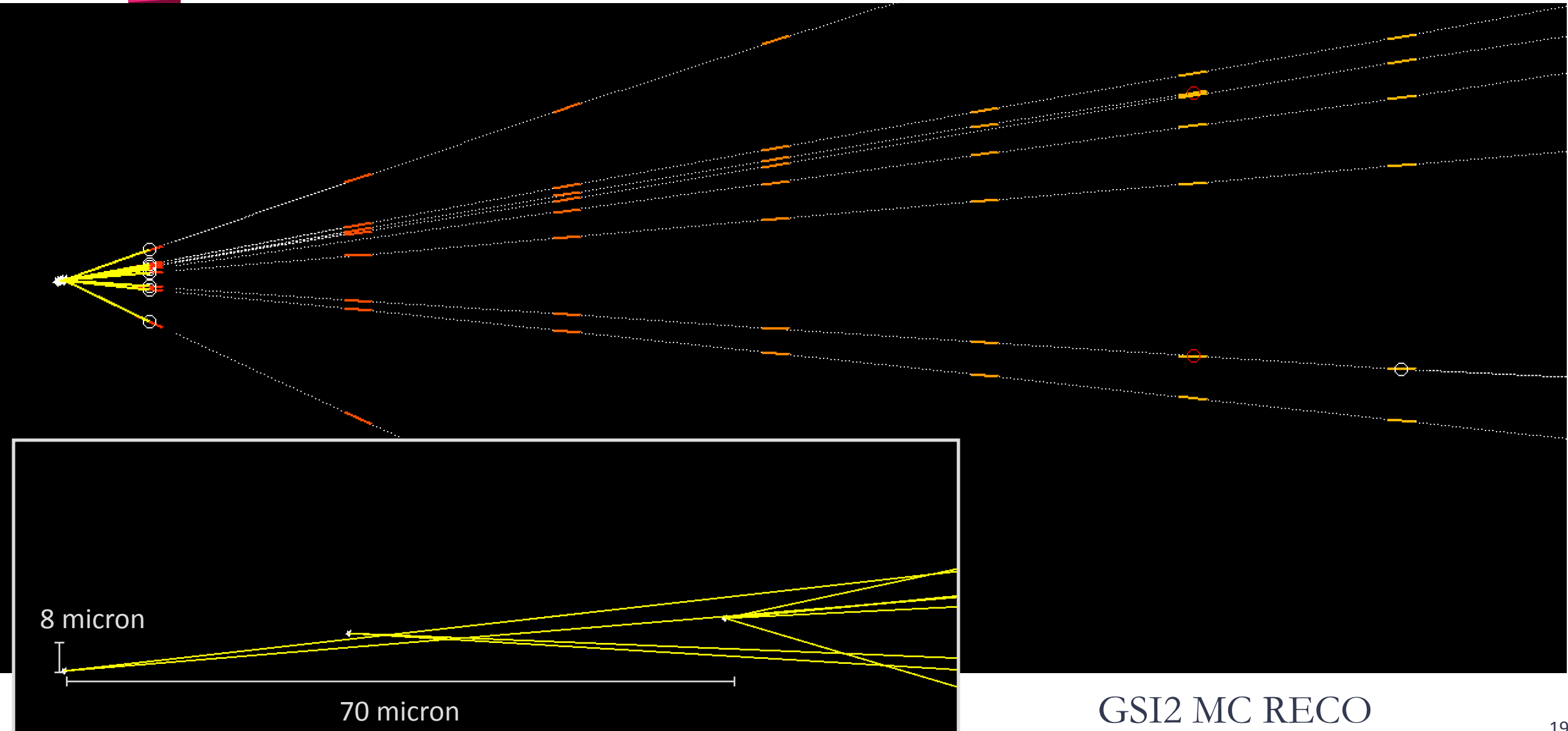


GSI1: Carbon Target



GSI2: C2H4 Target

# Possible explanation: one vertex reconstructed as many lower-multiplicity vertices

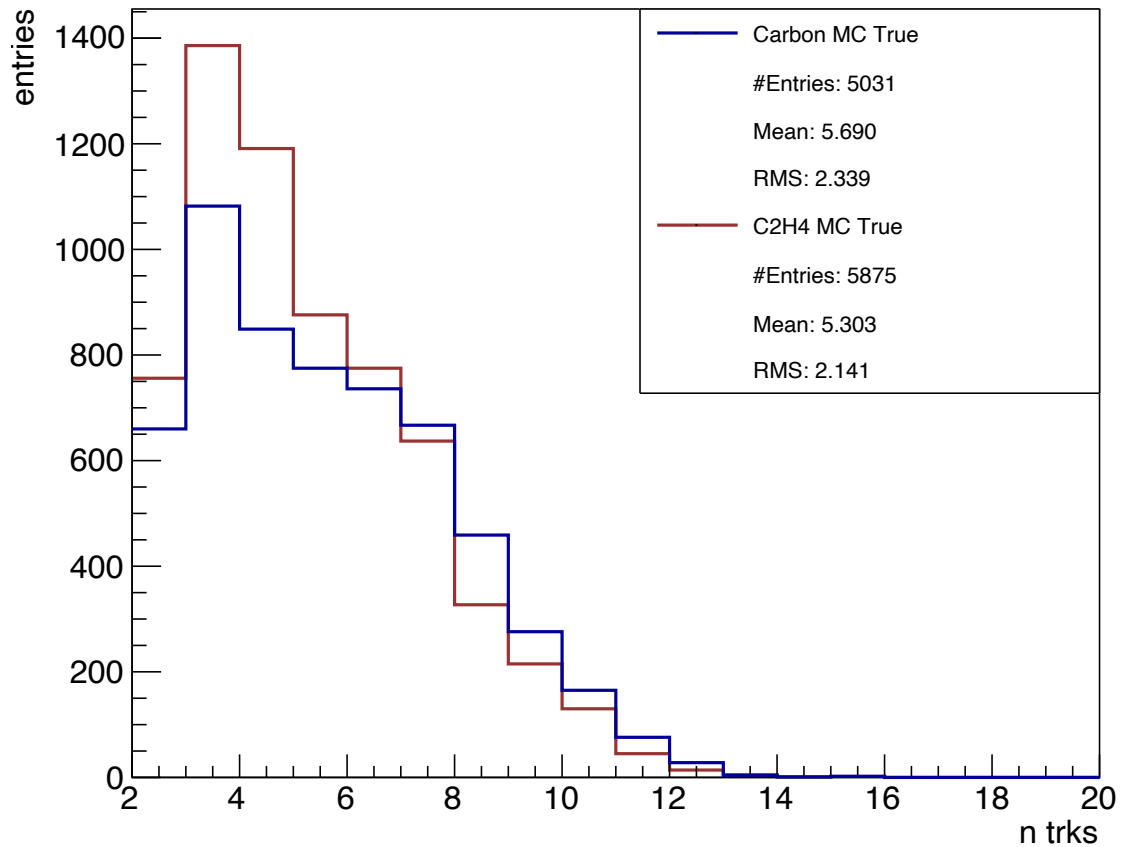


# Fragments' multiplicity

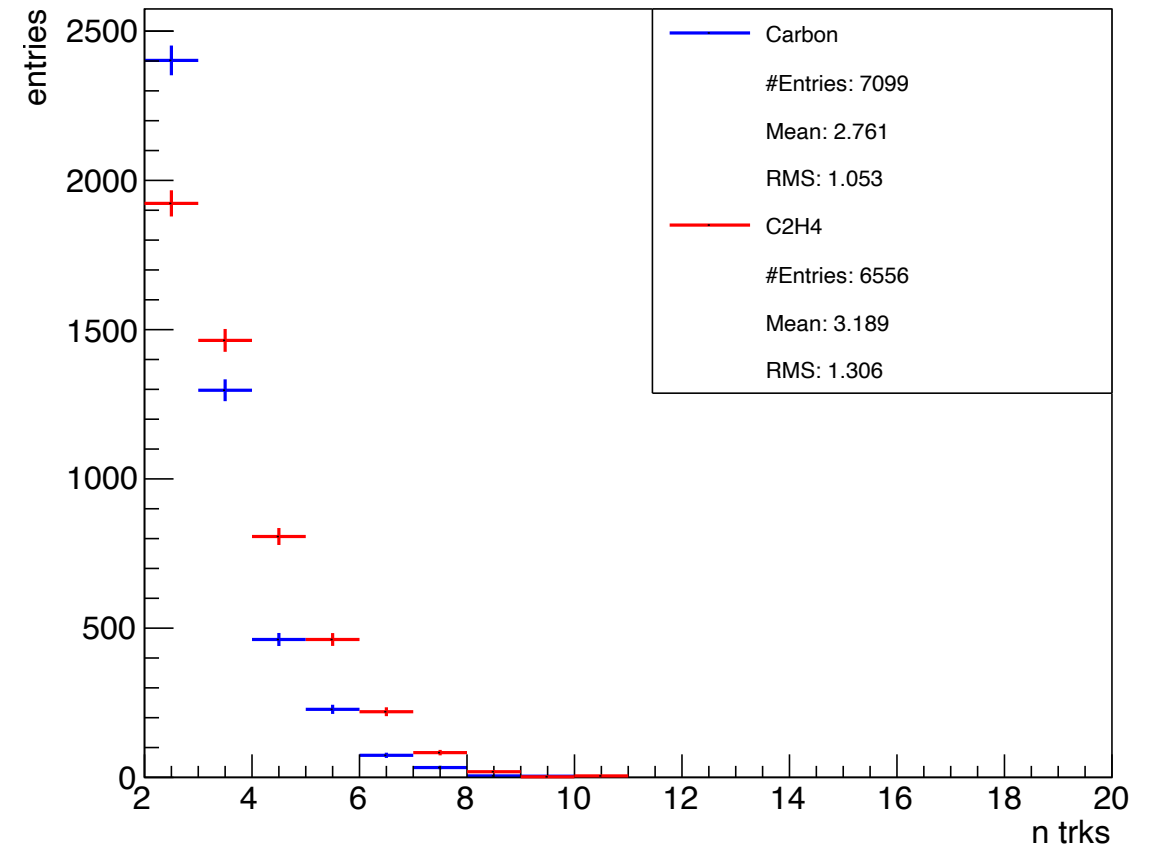
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between GSI1 and GSI2 in TRUE MC



- Comparison between GSI1 and GSI2 in DATA



# Vertexing

- Good vertices reconstruction is one of the key point to evaluate cross section
- Efficiencies for cross section measurement will be obtained:
  - comparing True and Reconstructed Monte Carlo
  - data control sample ← ongoing
- Reconstructed Monte Carlo has to reproduce detector response:
  - angle smearing
  - data-driven inefficiencies
  - introduction of data-driven background
- New improvements of vertexing algorithm after visually inspecting many displays of reconstructed MC and DATA: other “pathologies” now have been cured

# Conclusions

- Efforts for good tracking of S3-S7: still space to improve → next step will be momentum measurement
- Vertices reconstruction further improved → next step will be cross section measurement





**HANK**



**OU!**

The image features a central blue banner with the text "Back up slides" in white. The banner is set against a dark blue background and is surrounded by several colorful, 3D-style geometric shapes: a green triangle at the top left, a pink rectangular block below it, a brown rectangular block at the bottom right, and a yellow triangle at the bottom right. The text is centered within the blue banner.

**Back up slides**

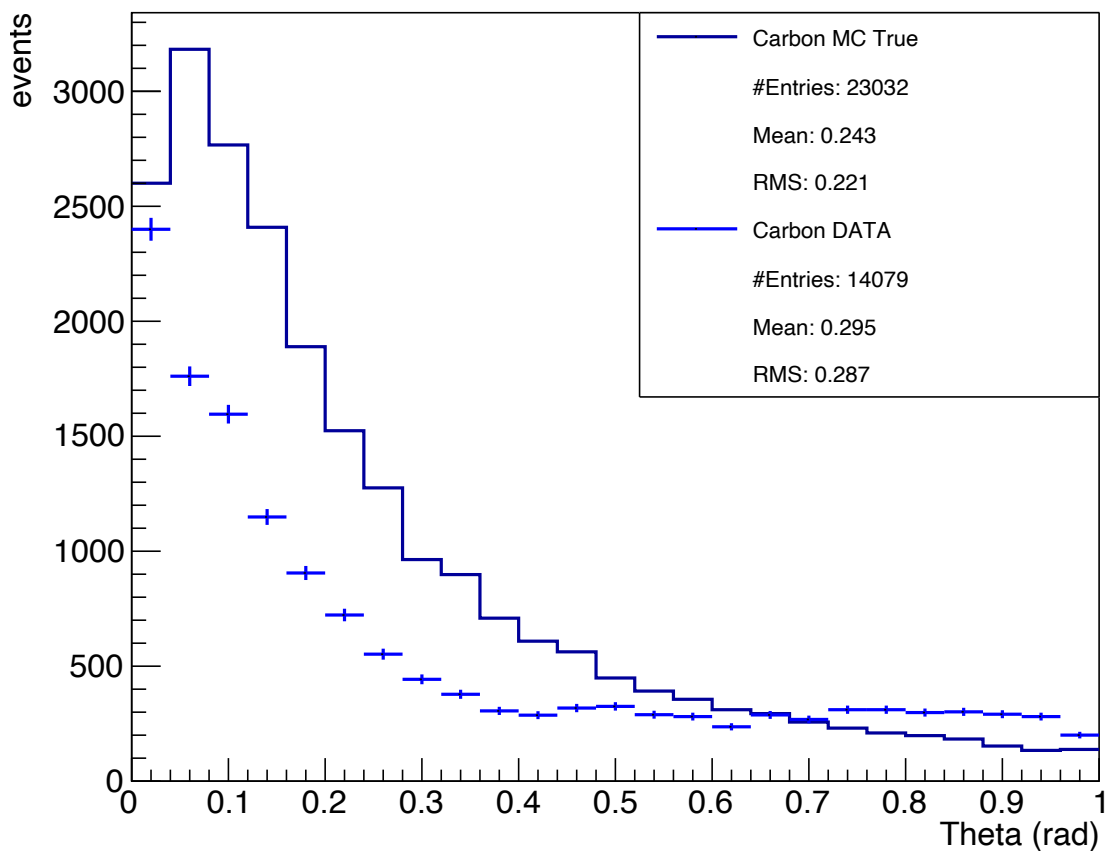


# Fragments' angular distributions

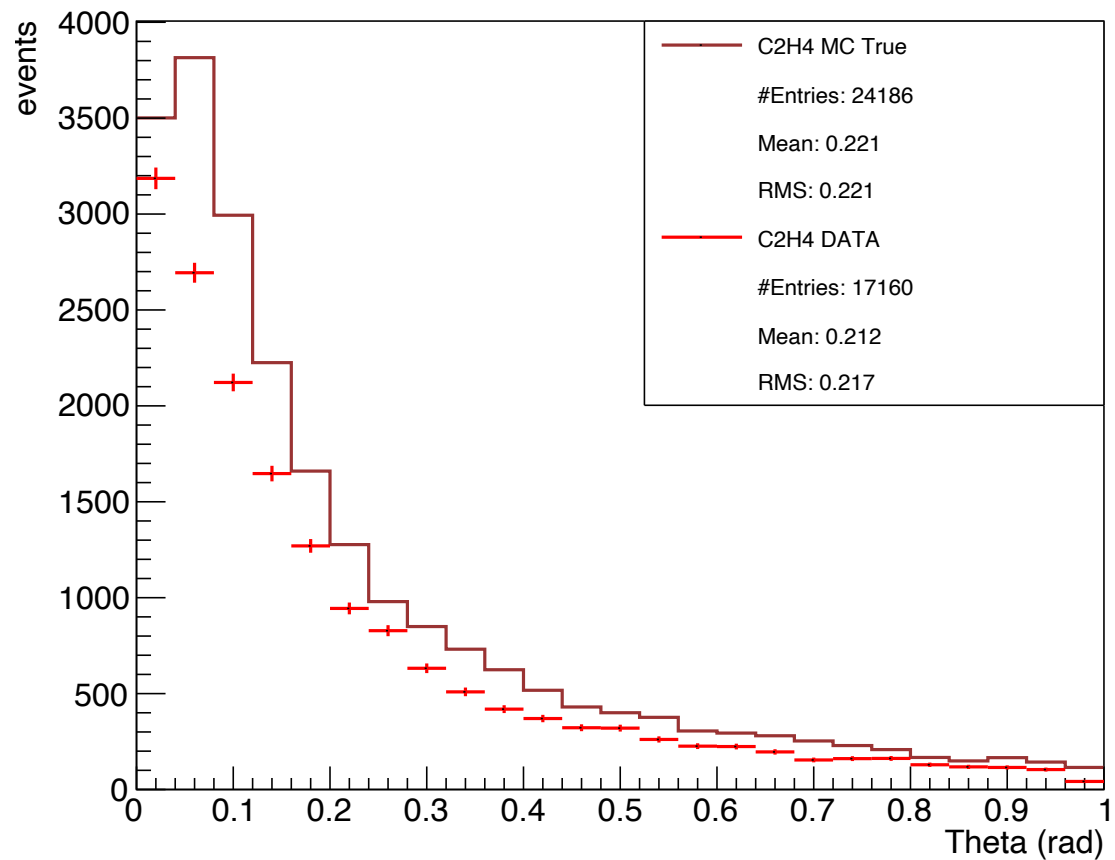
Plots normalized at the same number of beam particles

Requirement: at least 3 tracks in the vertex (beam included, if reconstructed)

- Comparison between TRUE MC (solid line) and DATA (solid crosses)



GSI1: Carbon Target

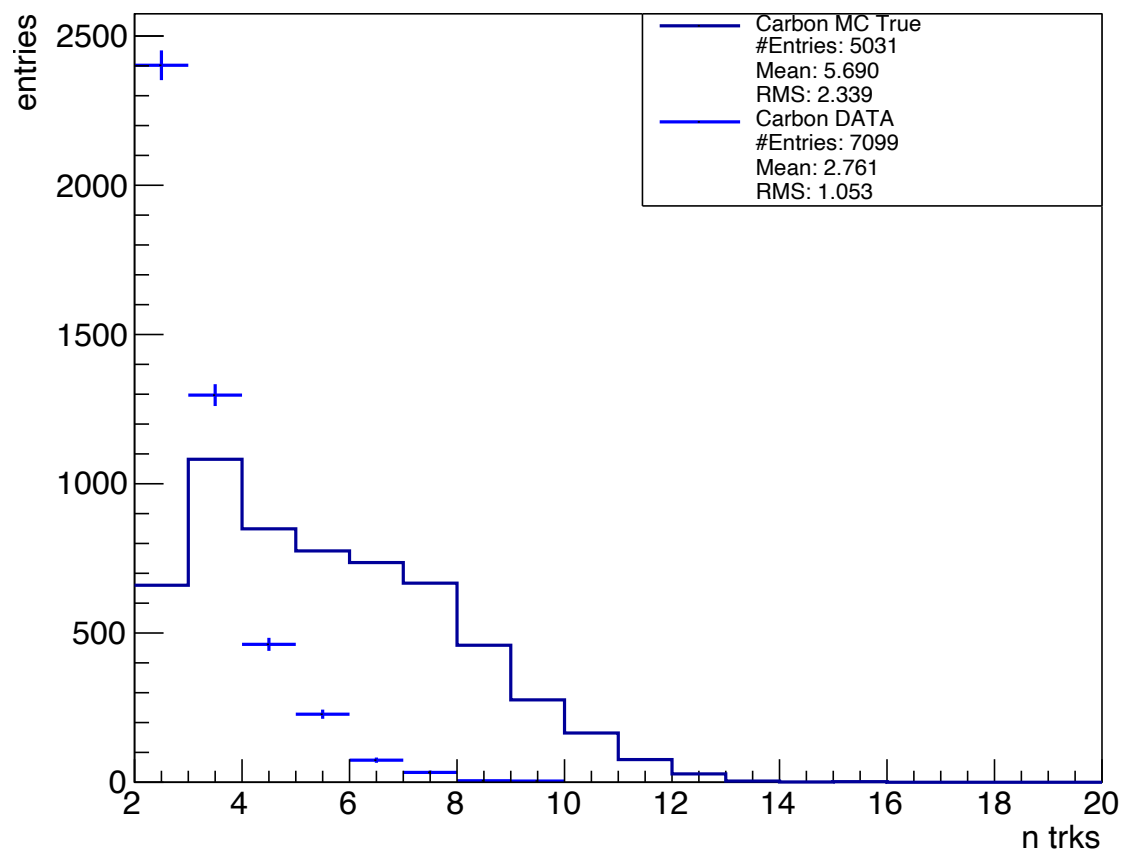


GSI2: C2H4 Target

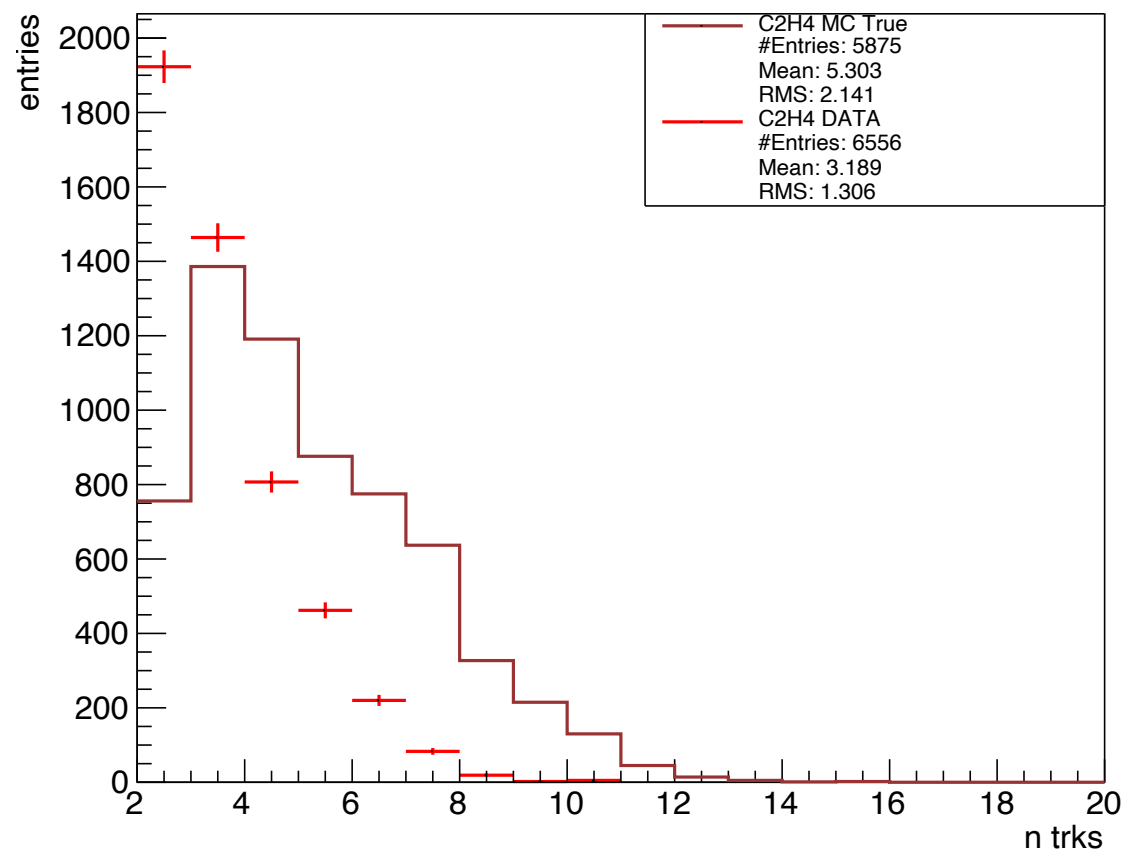
# Fragments' multiplicity

Plots normalized at the same number of beam particles

- Comparison between TRUE MC (solid line) and DATA (solid crosses)



GSI1: Carbon Target



GSI2: C2H4 Target