Update on the Analysis of GSI2 ^{16}O (200 MeV) on C_2H_4

A. Alexandrov, A. Di Crescenzo, G. De Lellis, G. Galati,
V. Gentile, A. Iuliano, A. Lauria, M. C. Montesi, A. Pastore, V. Tioukov

Università di Napoli "Federico II", INFN Napoli
Università di Bari "Aldo Moro", INFN Bari

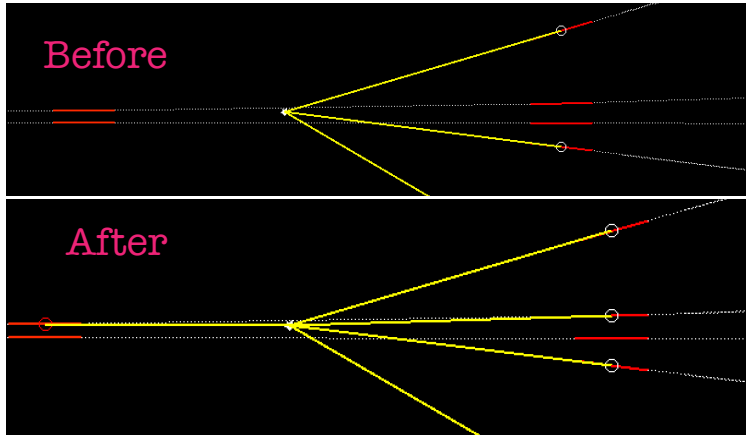
Physics Meeting, ZOOM, 03/02/2021

Scanning Progress

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: completed
  - alignment:
    GSI1: completed
    GSI2: completed
    GSI3: S1 completed
    GSI4: S1 completed
  - tracking:
    GSI2: S1+S2 completed
- 2020 (GSI5, GSI6):
  - scanning: about 240/328

Vertices Reconstruction (summary)



03

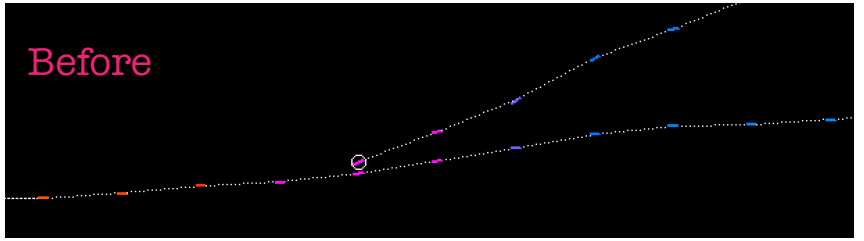
O→N+p

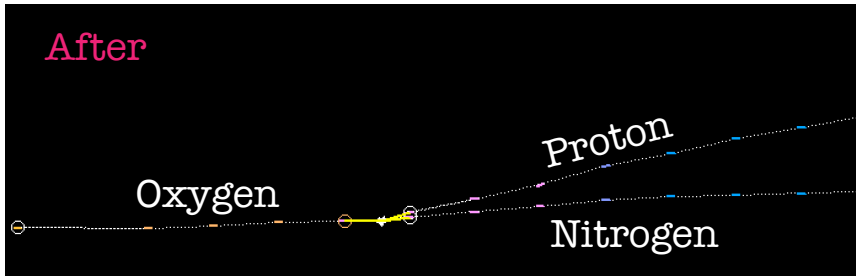
02

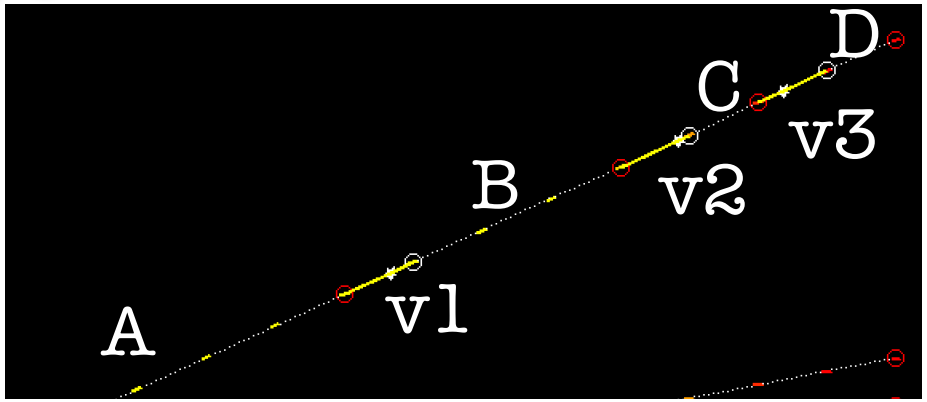
Find incoming oxygen

01

2-prong vertices







Vertices Selection: new results

	Monte Carlo		
	Before	Now	
Entries	11350	9918	
n≥3	4660	5848	
n=2	6690	4070	
vtx good n≥3	3912	4926	26%
vtx good n=2	1472	644	-56%
tot good	5384	5570	

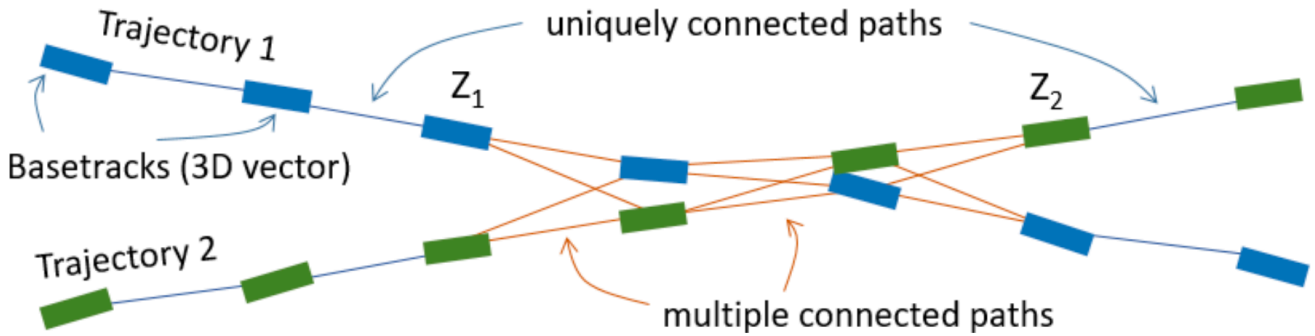
Data		
Before	Now	
12412	11338	
3748	4928	31%
8664	6410	-26%

- MC: A vertex is considered good if it has at least 2 tracks belonging the same MC event
- MC: We are about to reach the number of expected vertices (**~6300**)

- Improvements in tracking reconstruction could help in finding the missing vertices: a wrong segment attached to the beginning or end of the track could prevent the vertices reconstruction

New tracking estimator

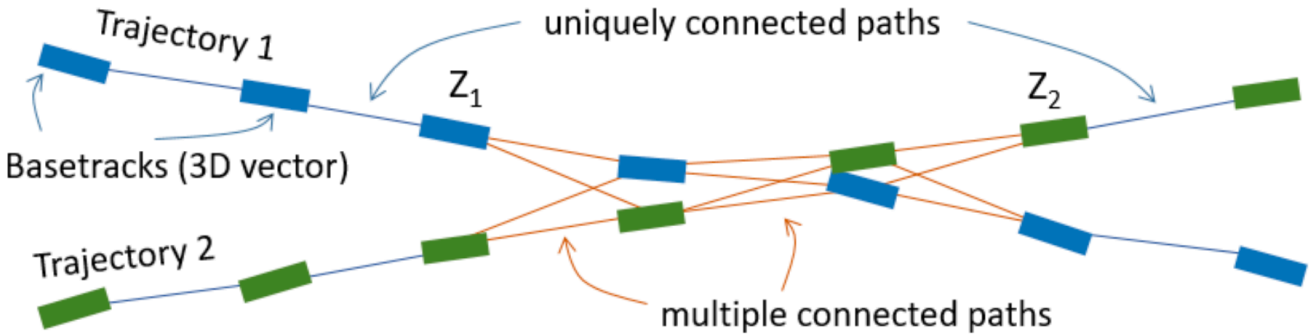
- New tracking algorithm to reconstruct tracks in the environment with high track density and narrow angular spread



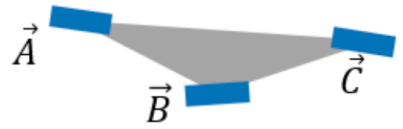
- When it faces multiple path candidates, the algorithm keeps all possible paths (TO DO)
- For each path, it evaluates a test variable based on average of area made by segments involved in the possible paths

New tracking estimator

- New tracking algorithm to reconstruct tracks in the environment with high track density and narrow angular spread

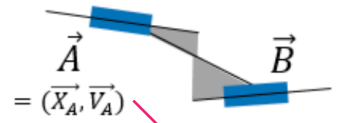


area by basetrack position



$$a^{pos} = \frac{1}{2} \cdot |\overrightarrow{AB} \times \overrightarrow{AC}|$$

area by basetrack vector



$$a^{angle} = \frac{1}{2} \cdot \frac{|\overrightarrow{AB}|}{2} \cdot \left| (\overrightarrow{V_A} + \overrightarrow{V_B}) \times \frac{\overrightarrow{AB}}{2} \right|$$

Each segment is described by a 3D coordinates vector X = (x,y,z) and a 3D vector V = (tan θx, tan θy, 1)

$$a^{avarage} = \frac{\left(\sum_i^{n-2} a^{pos} + \sum_i^{n-1} a^{angle} \right)}{n - 0.5}$$

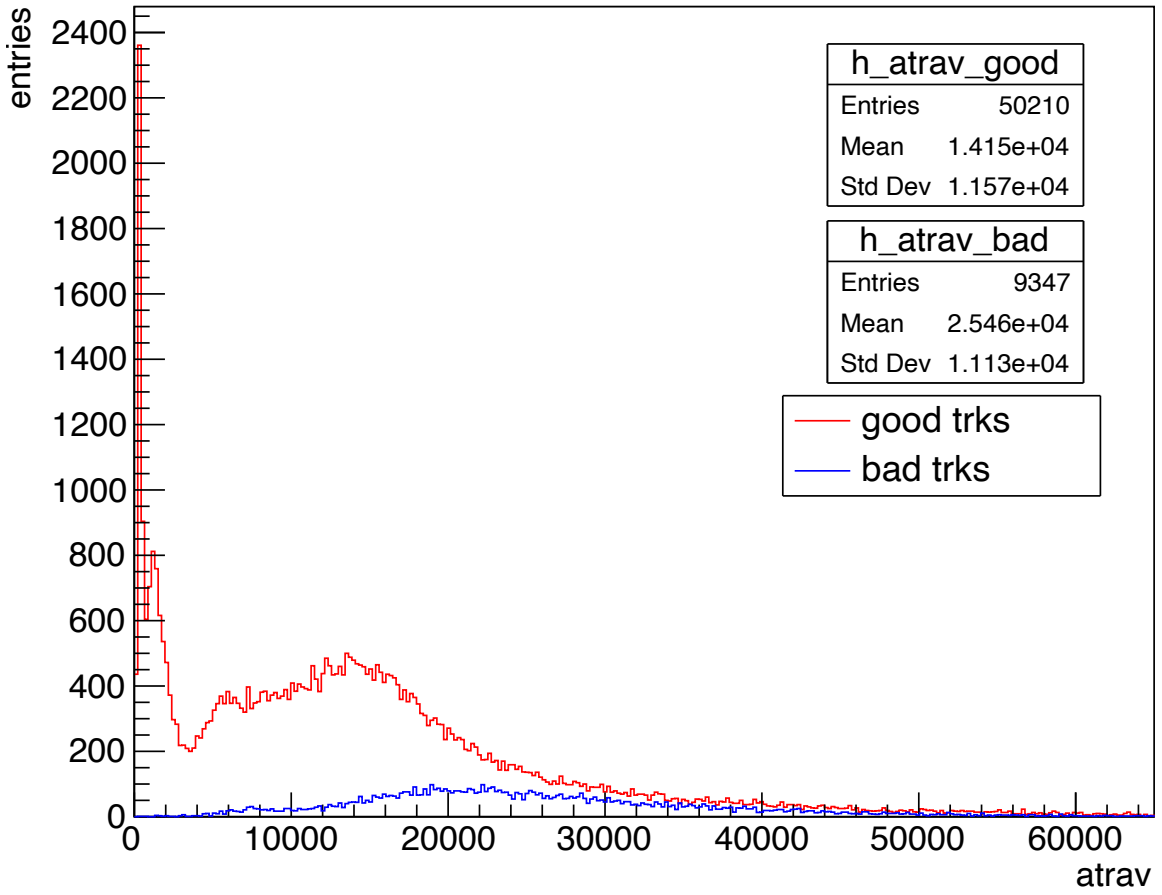
n is the number of segments involved in the path

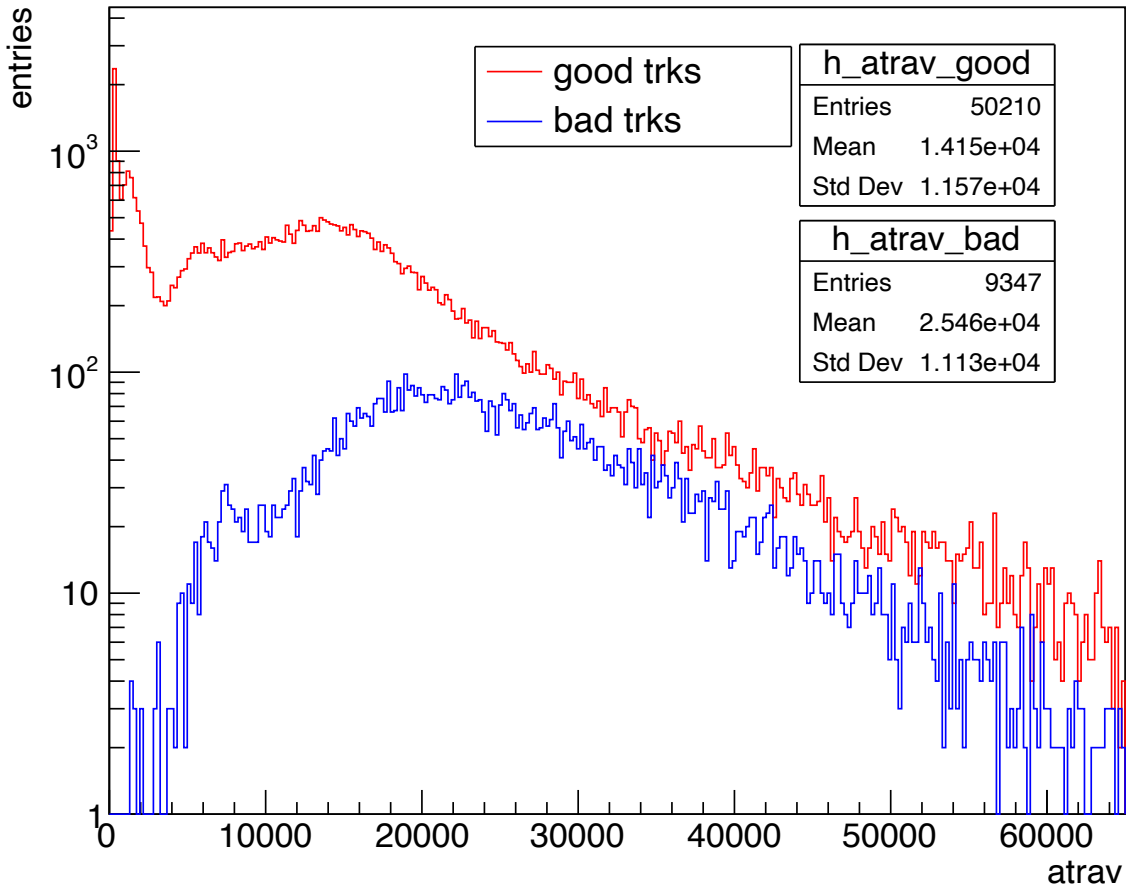
empirical value to put a higher weight on longer paths

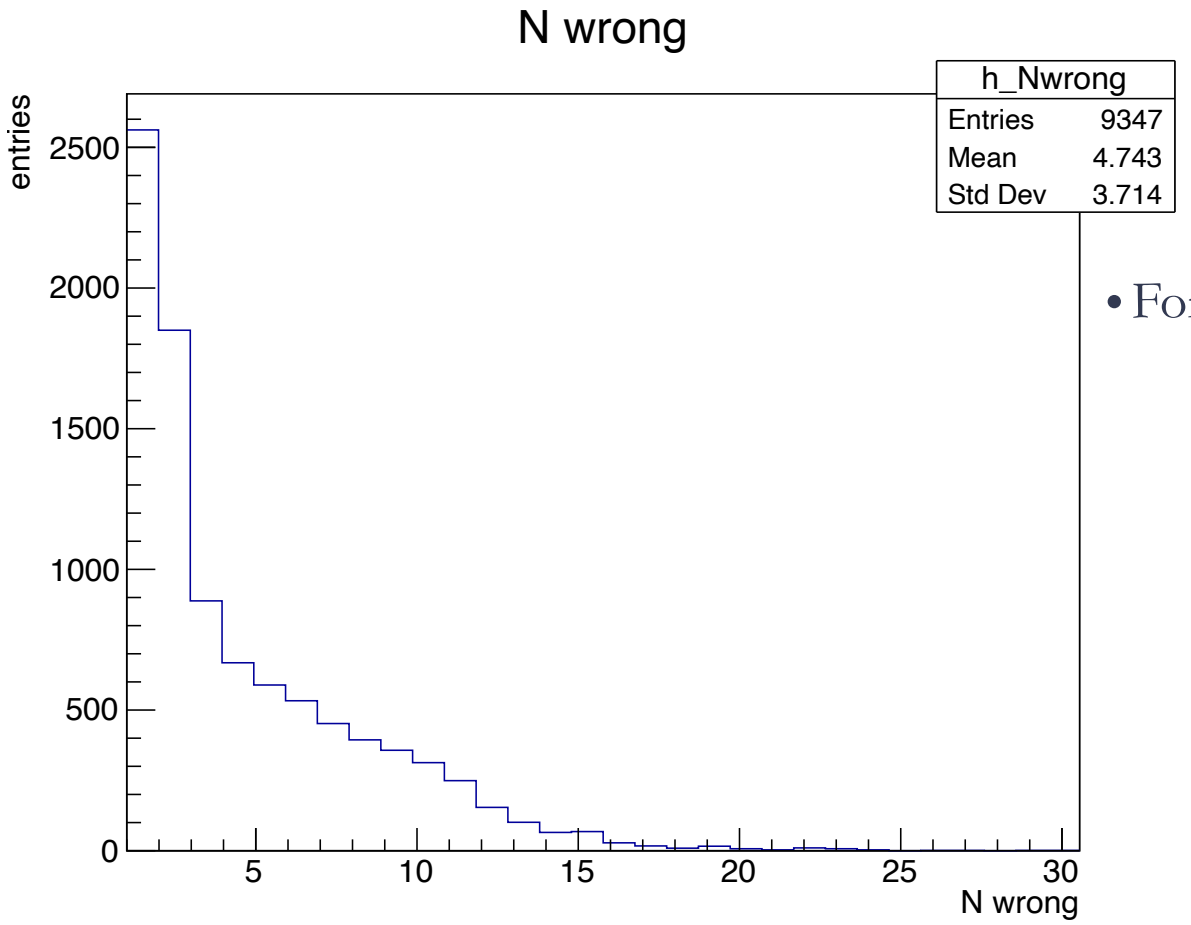
- $a^{average}$ gives the averaged area made by segments positions and angles
- The path with the smallest $a^{average}$ is chosen to be the best one

New tracking estimator

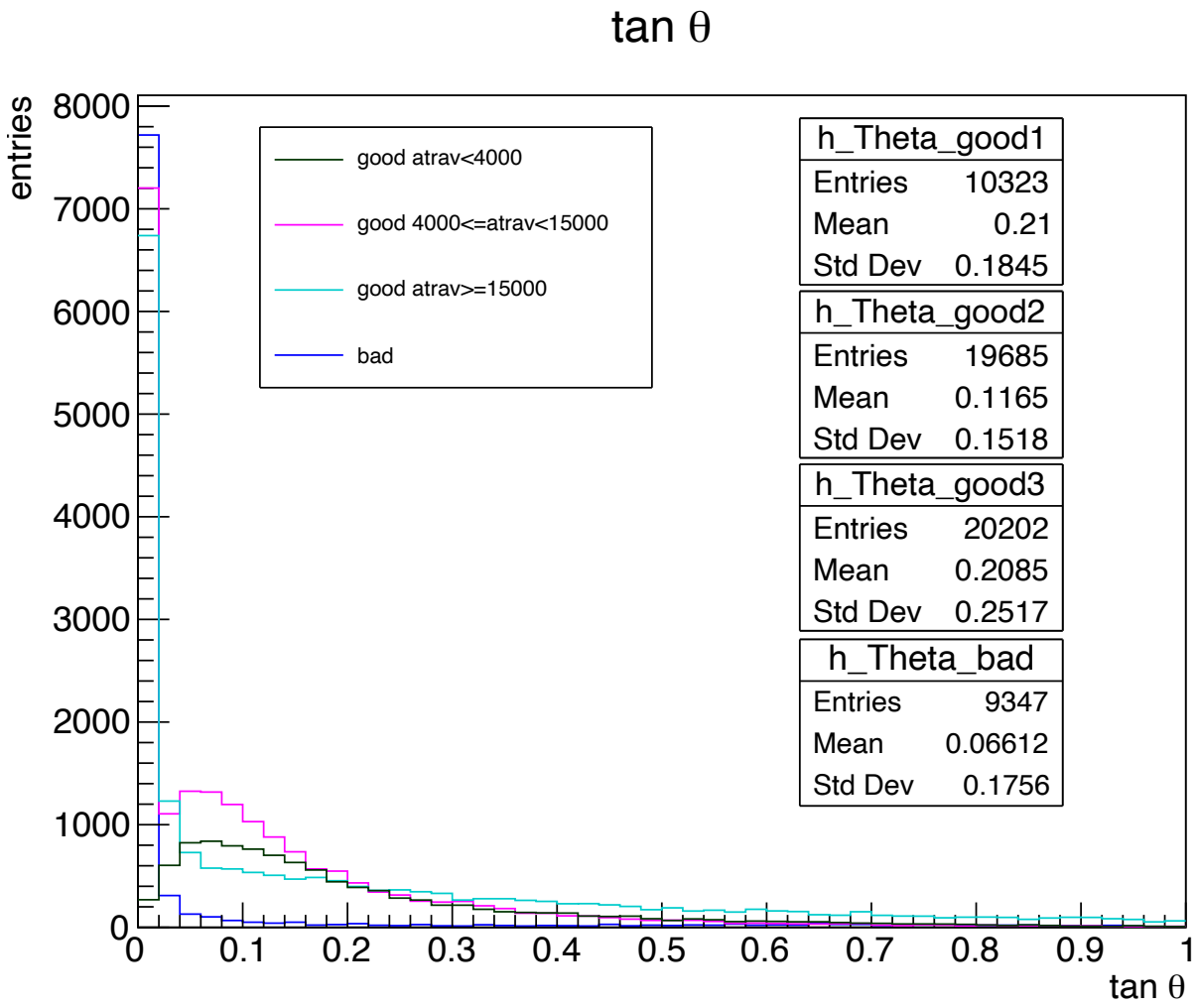
- A first check has been done on tracks already reconstructed by standard algorithm (based on χ^2).
- A track is defined "bad" if it has at least one segment different from other ones.

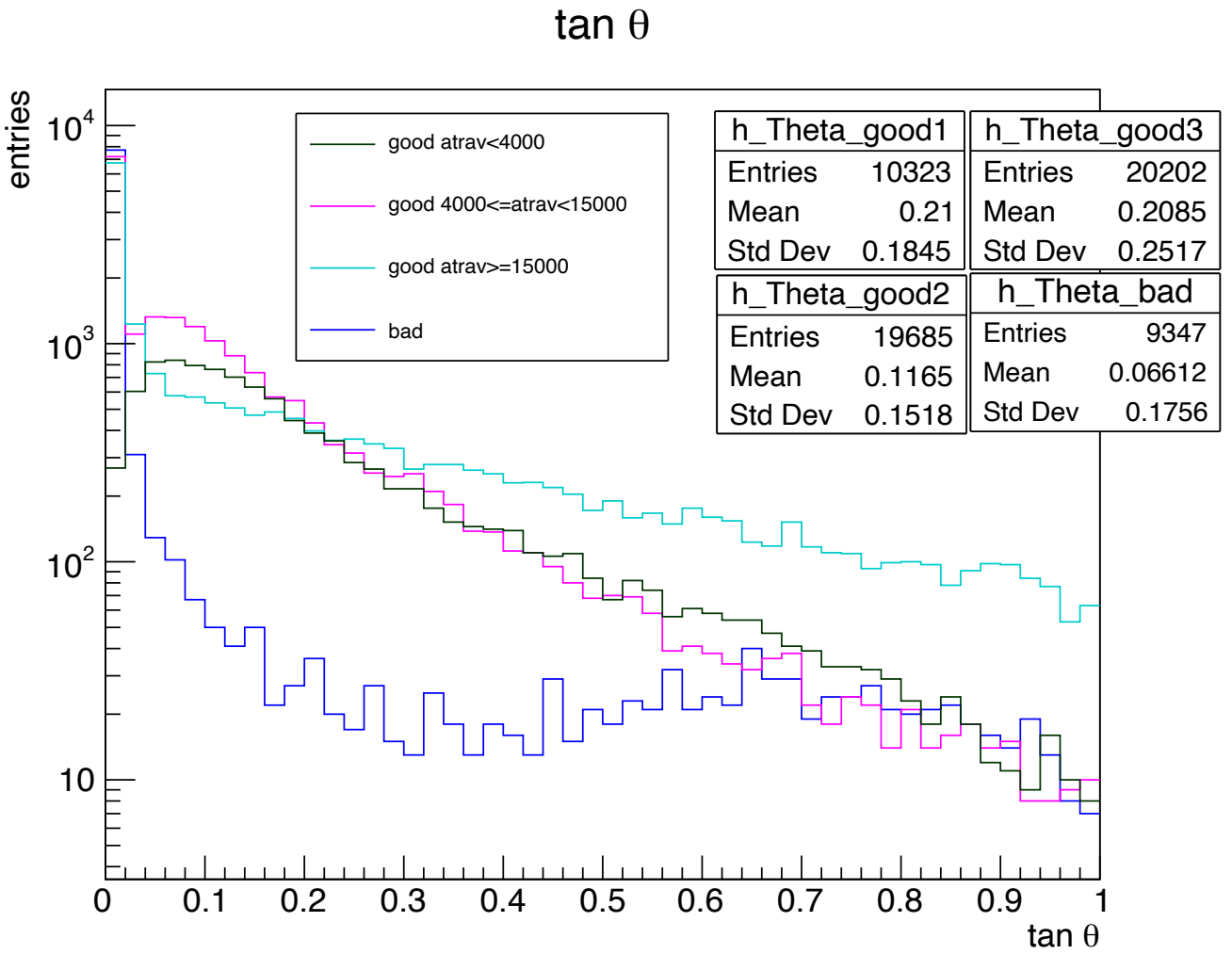


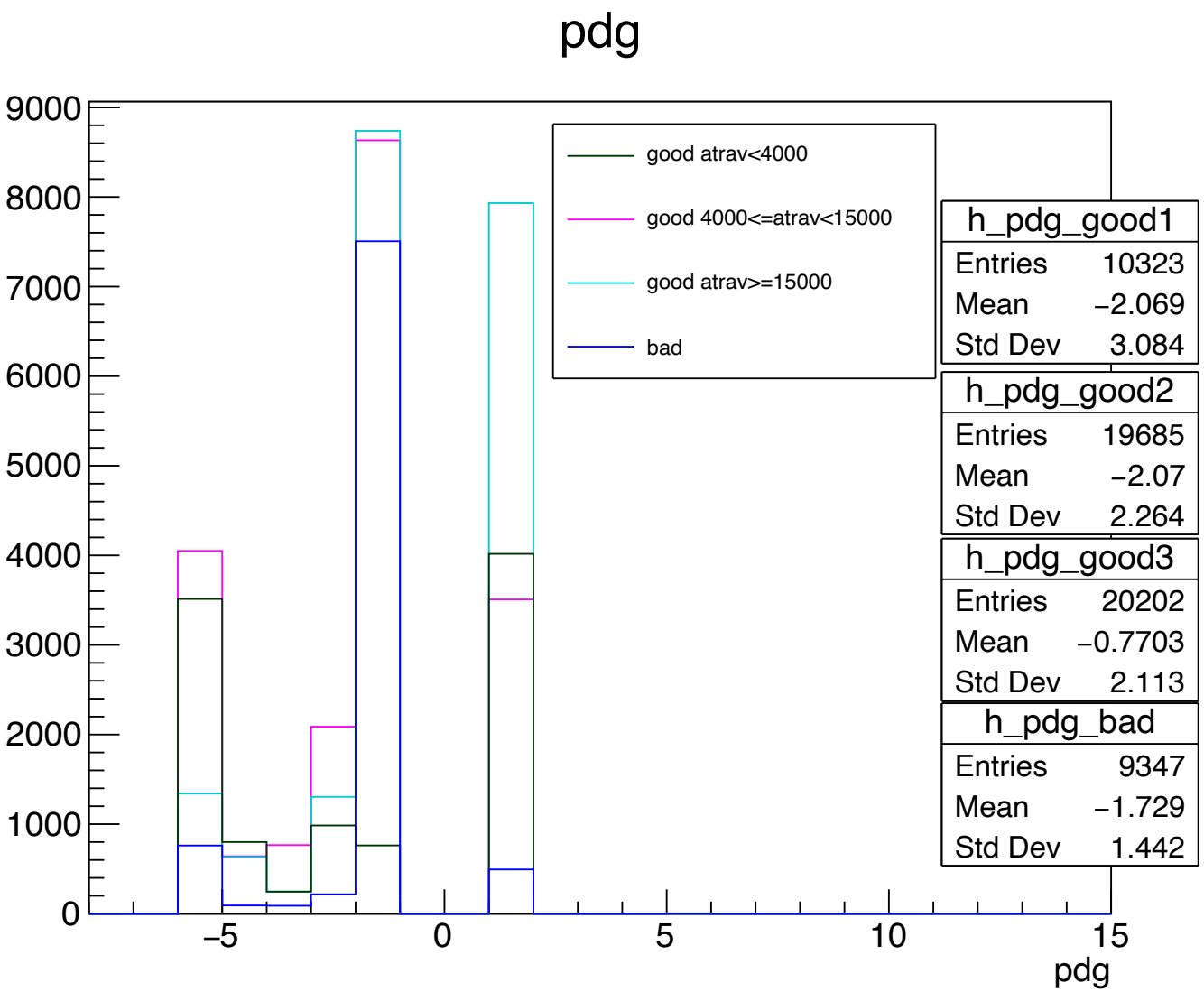




- For "bad" tracks often the first and/or last segment is wrong:
  - last wrong: 2242 cases → problem for tracks entering the vertex
  - first wrong: 5494 cases → problem for tracks exiting the vertex


tan θ
entries
good atrav<4000
good 4000<=atrav<15000
good atrav>=15000
bad
h_Theta_good1
Entries 10323
Mean 0.21
Std Dev 0.1845
h_Theta_good2
Entries 19685
Mean 0.1165
Std Dev 0.1518
h_Theta_good3
Entries 20202
Mean 0.2085
Std Dev 0.2517
h_Theta_bad
Entries 9347
Mean 0.06612
Std Dev 0.1756
tan θ


tan θ
entries
good atrav<4000
good 4000<=atrav<15000
good atrav>=15000
bad
h_Theta_good1
Entries 10323
Mean 0.21
Std Dev 0.1845
h_Theta_good3
Entries 20202
Mean 0.2085
Std Dev 0.2517
h_Theta_good2
Entries 19685
Mean 0.1165
Std Dev 0.1518
h_Theta_bad
Entries 9347
Mean 0.06612
Std Dev 0.1756
tan θ



- -6 = 4He
- -5 = 3He
- -4 = 3H = Trizio
- -3 = 2H = deuterio
- -2 = heavy ion
- 1 = protone
- 3 = elettrone
- 4 = positrone
- 7 = fotone
- 8 = neutrone
- 13 = pione+
- 14 = pione-

Conclusions

- In Monte Carlo reconstruction we miss about 700 vertices
- Improvements in tracking reconstruction could help in finding the missing vertices: a wrong segment attached to the beginning or end of the track could prevent the vertices reconstruction
- An algorithm based on a new estimator is under development to reconstruct tracks in an environment with high track density and narrow angular spread

THANK YOU!