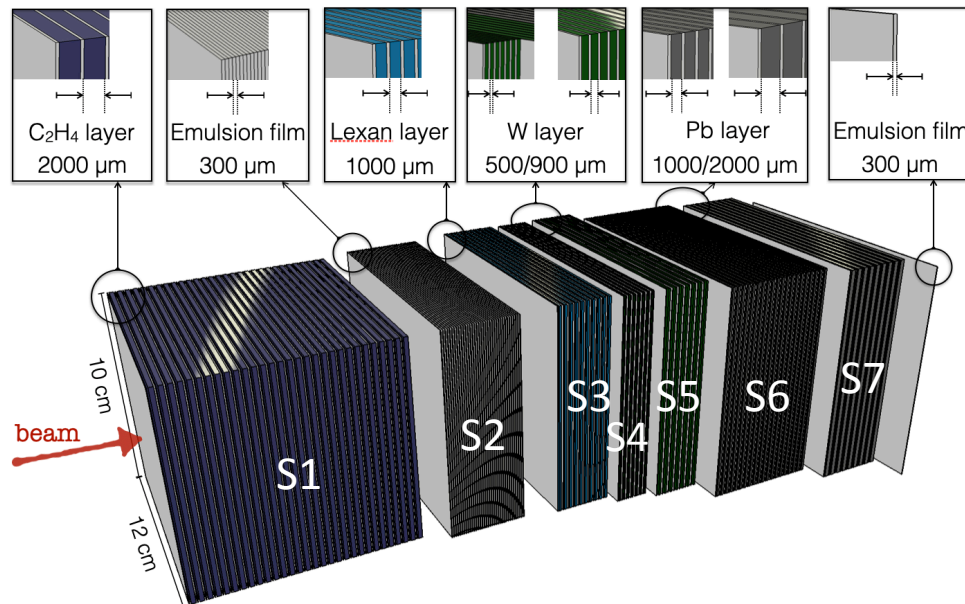# UPDATE ON THE ANALYSIS OF GSI2 $^{16}$O (200 MEV)

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*
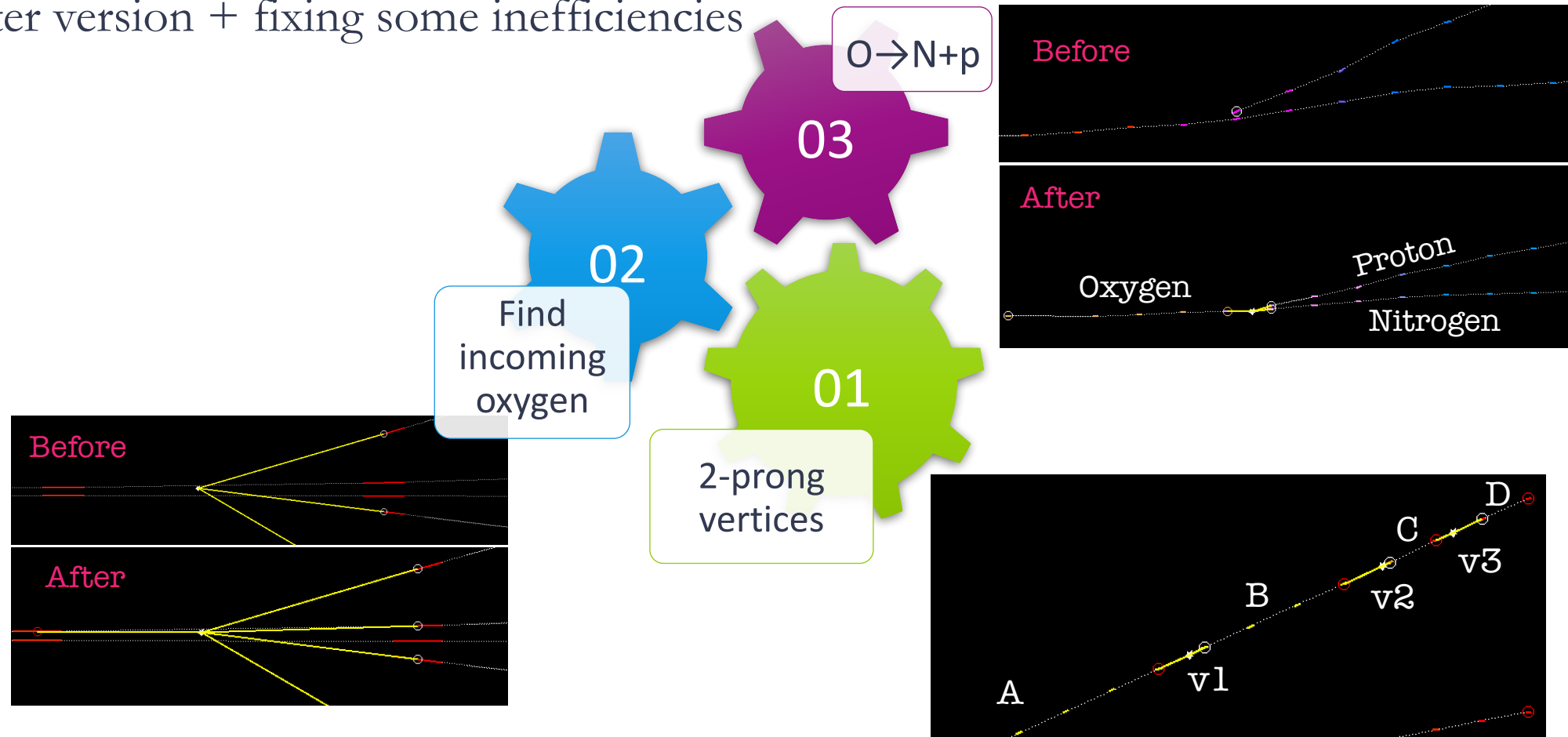
Physics Meeting, ZOOM, 03/03/2021

# 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 |



C₂H₄ layer 2000 μm · Emulsion film 300 μm · Lexan layer 1000 μm · W layer 500/900 μm · Pb layer 1000/2000 μm · Emulsion film 300 μm

10 cm · 12 cm · beam · S1 · S2 · S3 · S4 · S5 · S6 · S7

- 2019 (GSI1, GSI2, GSI3, GSI4):
  - scanning: 100%
  - alignment:
    GSI1: 100%
    GSI2: 100%
    GSI3: 36%
    GSI4: 21%
  - tracking:
    GSI2: S1+S2 completed, S3
    (=S3+S4+S5+S6+S7) started
    GSI1: S1+S2 on going
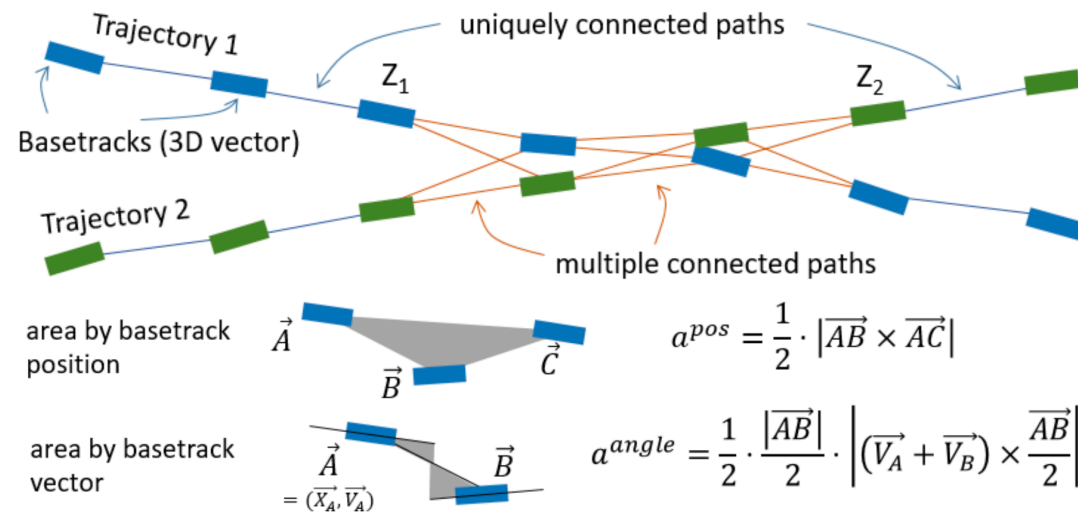
- 2020 (GSI5, GSI6):
  - scanning: about 300/328 (92%)

# Vertices Reconstruction: what's going on

- Algorithm too slow
- Working on a faster version + fixing some inefficiencies

O→N+p

03

02

Find incoming oxygen

01

2-prong vertices



Before

After

Oxygen

Proton

Nitrogen



Before

After



A    v1    B    v2    C    v3    D

# New tracking estimator: what's going on

- New tracking algorithm to reconstruct tracks in the environment with high track density and narrow angular spread
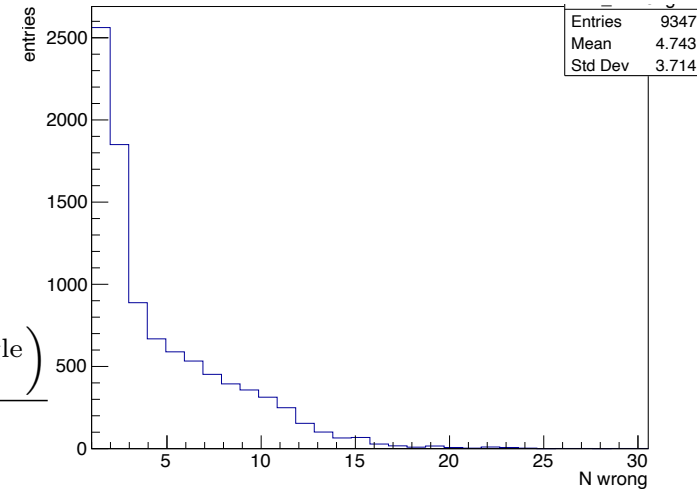
**Number of wrong segments**



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

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

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

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

$n$ is the number of segments involved in the path

empirical value to put a higher weight on longer paths

- After some checks on the goodness of the new estimator, we are implementing it in our tracking algorithm
- Tests will be done on the tracks that were not well reconstructed with the standard algorithm (based on $\chi^2$ evaluated on two consecutive segments)

# GSI2 $^{16}$O (200 MeV) on $C_2H_4$ target
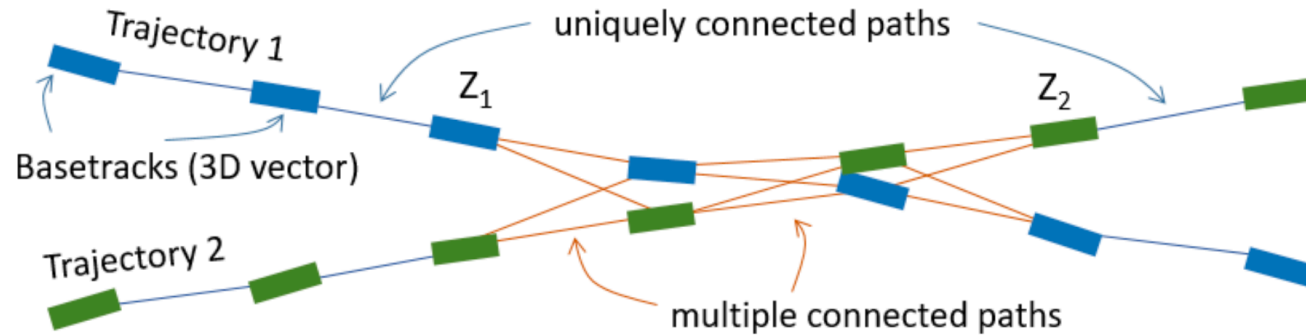
- Tracks reconstruction for S3 (and followings)

# GSI1 $^{16}$O (200 MeV) on C target

- MC simulation production with Fluka 2020: on-going
- Data tracking and vertices reconstruction for S1 and S2: on-going
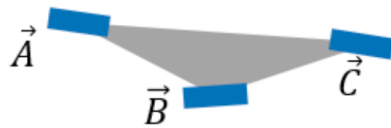- Charge reconstruction for S2

# New tracking estimator

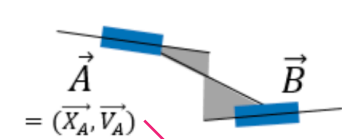- New tracking algorithm to reconstruct tracks in the environment with high track density and narrow angular spread



area by basetrack position

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

area by basetrack vector

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

$= (\vec{X_A}, \vec{V_A})$

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

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

$n$ 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 $\chi^2$).
- A track is defined "bad" if it has at least one segment different from other ones.