



GSI2021 analysis: O+C₂H₄ and O+H cross sections

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GSI2021 data

- SC, BM and TW information used in the analysis
- 400 MeV/u 16 O beam on C target (5 mm) and C₂H₄ target (10 mm)

Background subtraction

Possible out-of-target fragmentation:

• **Subtraction** of data from a no-target run



Cross section measurement

Angular differential cross section

$$\frac{d\sigma}{d\Omega}(Z) = \left(\frac{Y_{TG}(Z,\theta)}{N_{prim,TG}} - \frac{Y_{no TG}(Z,\theta)}{N_{prim,no TG}}\right) \frac{1}{N_{TG} \epsilon(Z,\theta)\Delta\Omega}$$



Cross section measurement

Angular differential cross section

$$\frac{d\sigma}{d\Omega}(Z) = \left(\frac{Y_{TG}(Z,\theta)}{N_{prim,TG}} - \frac{Y_{no TG}(Z,\theta)}{N_{prim,no TG}}\right) \frac{1}{N_{TG} \epsilon(Z,\theta)\Delta\Omega}$$

- Number of primaries: evaluated after selection cuts on SC and BM
- Rescaling factor for fragmentation trigger events (see <u>Riccardo</u> <u>Ridolfi slides of XVI FOOT Collaboration Meeting – 25 June 2024</u>)
- Small background statistics (only ~57000 events)

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• Total cross section: integrated from angular cross section (0° - 5.7°)

MC simulation analysis

- Monte Carlo simulations used to extract purities and efficiencies
- Analysis method validation: true cross section from MC compared to the reconstructed cross section for MC simulations using the same analysis carried out on physical data



Unfolding: angle mixing



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Analysis flow

- Efficiencies and purities calculated from the Monte Carlo simulations
- Purities applied **separately** for signal and background
- Background subtraction
- Unfolding
- Cross section calculation (with efficiencies)

Z = 3





400 MeV/u 16 **0** beam on C_2H_4 target

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400 MeV/u 16 **0** beam on C_2H_4 target

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Z = 7





400 MeV/u 16 **0** beam on C_2H_4 target

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Results: total cross section



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• Starting from a previous result with a **graphite (C)** target and the results obtained with the **polyethylene (C_2H_4)** target:

$$\sigma[p] = \frac{\sigma[C_2H_4] - 2\sigma[C]}{4}$$

 Starting from a previous result with a graphite (C) target and the results obtained with the polyethylene (C₂H₄) target:

$$\sigma[p] = \frac{\sigma[C_2H_4] - 2\sigma[C]}{4}$$



Literature comparison





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Starting FLUKA comparison

Angular cross section Z4

Angular cross section Z5



400 MeV/u ¹⁶0 beam on C_2H_4 target

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Starting FLUKA comparison



400 MeV/u ¹⁶0 beam on C_2H_4 target

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Starting FLUKA comparison



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Conclusions

- 400 MeV/u ¹⁶ O beam on C and C₂H₄ target
- Angular differential cross section and total cross section measurement
- Cross section for a proton target obtained subtracting C cross section from the C_2H_4 one
- **Good agreement** with the limited data available
- First angular cross section evaluation for p target
- Proton cross section: uncertainties under evaluation

Thank you for your attention !

Back-up slides



Z = 3



400 MeV/u ¹⁶0 beam on C target



Z = 5



400 MeV/u ¹⁶0 beam on C target

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Z = 7



400 MeV/u ¹⁶0 beam on C target

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Results: total cross section



Cross section measurement





Charge identification

 Data for 400 MeV/u ¹⁶0 beam on a 1 cm thick C₂H₄ target

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Z = 2

Z = 3



Z = 4

Z = 5



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Z = 6

Z = 7



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Unfolding: angle mixing

Reconstructed angle with true information from the BM and reconstructed fragment track using the TW

Reconstructed angle with reconstructed track the BM and true fragment track





Z = 3

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Z = 2

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Efficiency

Z = 5

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Z = 4



Efficiency

Z = 7

Z = 6

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Efficiency

