Update on O+C analysis @GSI2021

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5 March 2025 - Physics meeting

Paper submitted on 31st December

At the end of January PRC rejected the article asking for a MC comparison

No further comments or suggestions were made

The MC comparison with both FLUKA and major G4 models was shown in previous meeting (and at the end of this presentation)

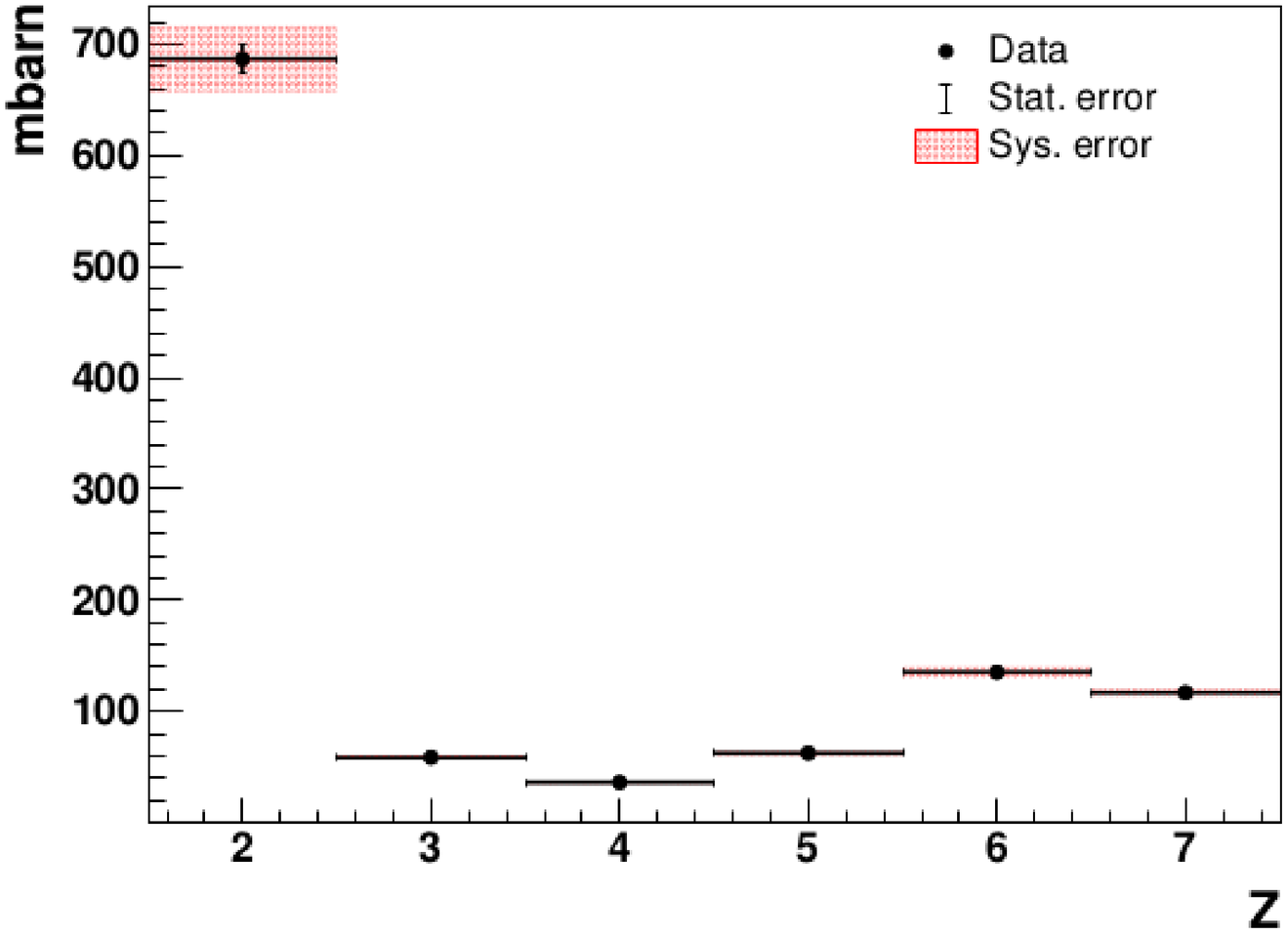
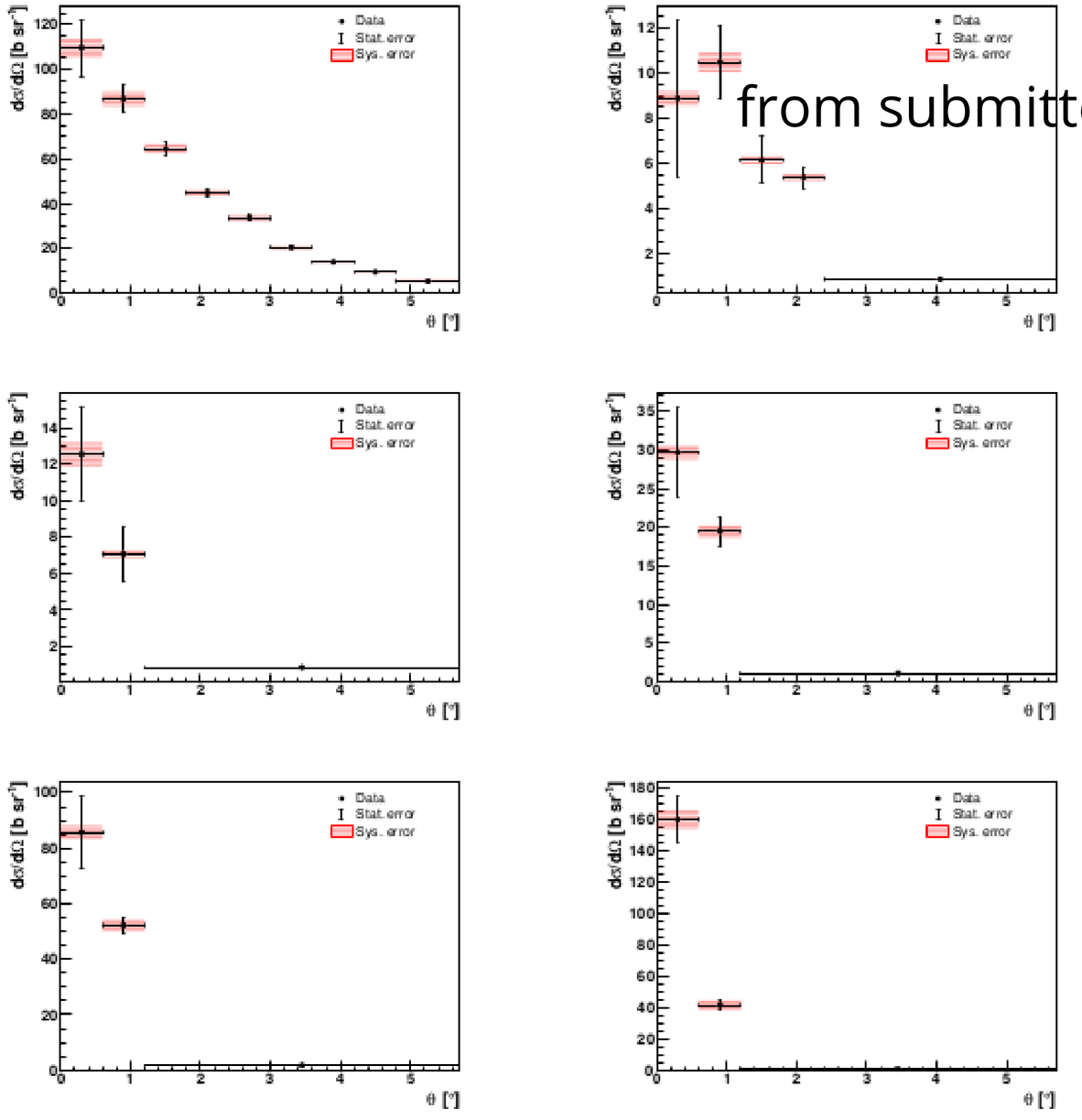


FIG. 5. Elemental fragmentation cross sections for fragments $2 \leq Z \leq 7$.

from submitted paper

Element	$\sigma \pm \Delta_{stat} \pm \Delta_{sys}$ [mb]	Δ_{stat}/σ	Δ_{sys}/σ
He	$687 \pm 13 \pm 30$	1.9%	4.3%
Li	$59 \pm 3 \pm 2$	5.4%	3.2%
Be	$36 \pm 3 \pm 1$	7.6%	3.2%
B	$63 \pm 4 \pm 3$	5.7%	4%
C	$135 \pm 6 \pm 5$	4.5%	3.7%
N	$117 \pm 6 \pm 4$	5.4%	3%

TABLE I. Elemental cross sections measured in this work. The contribution of the statistical and systematic uncertainties is reported separately. The contribution of the statistical and systematic uncertainties to the final result is visible through the reported relative errors.



from submitted paper

FIG. 6. Angular differential cross sections for fragments $2 \leq Z \leq 7$.

Z	$\theta[^\circ]$	$\sigma \pm \Delta_{stat} \pm \Delta_{sys}$ [b sr^{-1}]	Δ_{stat}/σ	Δ_{sys}/σ
2	$0-0.6$	$110 \pm 13 \pm 5$	11.6%	4.3%
	$0.6-1.2$	$87 \pm 6 \pm 3$	7.2%	4%
	$1.2-1.8$	$65 \pm 3 \pm 2$	5.2%	3.1%
	$1.8-2.4$	$45 \pm 2 \pm 1$	4.7%	3.2%
	$2.4-3$	$34 \pm 1 \pm 2$	3.6%	4.4%
	$3-3.6$	$20 \pm 1 \pm 1$	4.2%	4.5%
	$3.6-4.2$	$14 \pm 1 \pm 0.5$	4.2%	3.5%
	$4.2-4.8$	$9 \pm 0.4 \pm 0.3$	4.3%	3.5%
	$4.8-5.7$	$5 \pm 0.3 \pm 0.7$	5%	14%
3	$0-0.6$	$9 \pm 4 \pm 0.3$	40%	3.7%
	$0.6-1.2$	$11 \pm 2 \pm 0.4$	15%	4.2%
	$1.2-1.8$	$6 \pm 1 \pm 0.2$	17%	3.1%
	$1.8-2.4$	$5 \pm 0.5 \pm 0.2$	9%	3%
	$2.4-5.7$	$1 \pm 0.04 \pm 0.04$	5%	4.2%
4	$0-0.6$	$13 \pm 3 \pm 0.7$	20%	5.3%
	$0.6-1.2$	$7 \pm 1.5 \pm 0.2$	21%	3.2%
	$1.2-5.7$	$1 \pm 0.1 \pm 0.03$	9%	3.5%
5	$0-0.6$	$30 \pm 6 \pm 1$	20%	3.1%
	$0.6-1.2$	$19 \pm 2 \pm 1$	10%	4.7%
	$1.2-5.7$	$1 \pm 0.1 \pm 0.05$	7%	4.3%
6	$0-0.6$	$86 \pm 13 \pm 3$	15%	3%
	$0.6-1.2$	$52 \pm 3 \pm 2$	5.5%	4.3%
	$1.2-5.7$	$2 \pm 0.1 \pm 0.08$	5.6%	4.6%
7	$0-0.6$	$160 \pm 15 \pm 6$	9%	3.9%
	$0.6-1.2$	$42 \pm 3 \pm 3$	6.8%	7.5%
	$1.2-5.7$	$1 \pm 0.1 \pm 0.03$	13%	4.4%

TABLE II. Angular differential cross section measured in this work. The contribution of the statistical and systematic uncertainties is reported separately. The contribution of the statistical and systematic uncertainties to the final result is visible through the reported relative errors.

sometimes statistical errors decrease with increasing angle -> can we increase the number of bins?

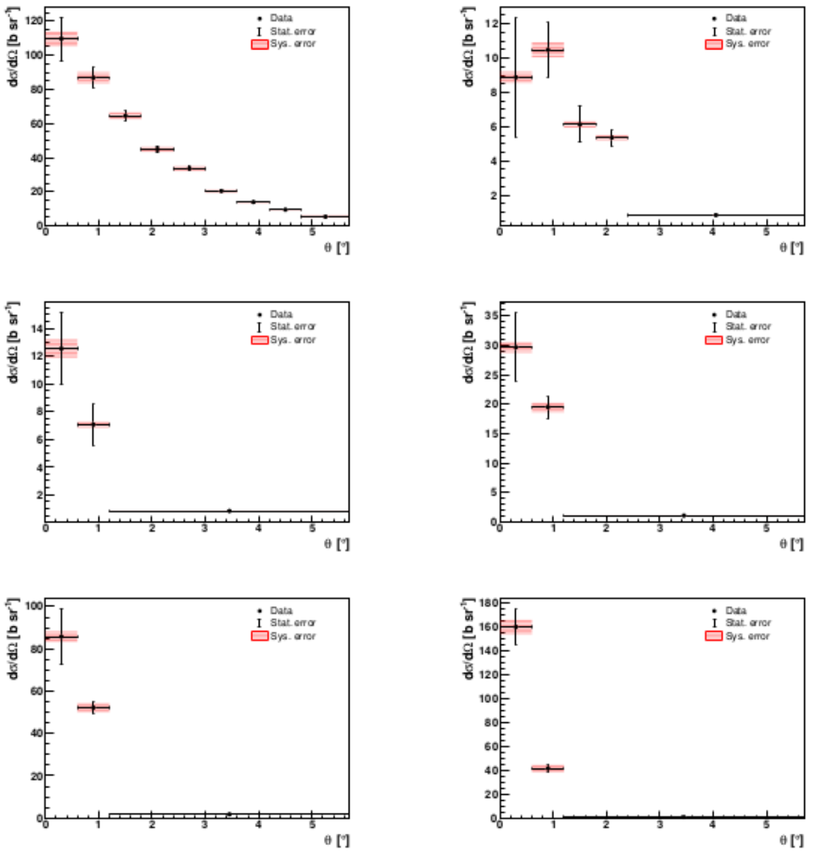


FIG. 6. Angular differential cross sections for fragments $2 \leq Z \leq 7$.

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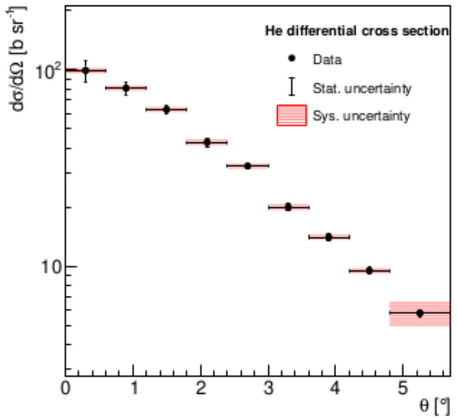
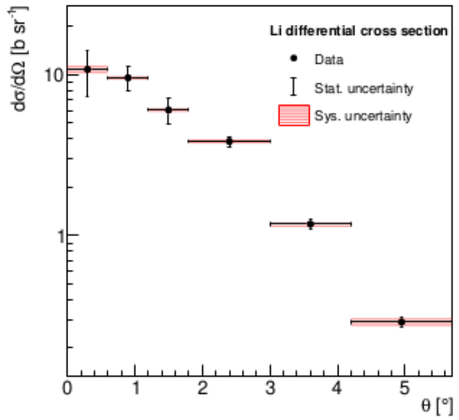
We decided to do again the analysis with more bins and some improvements came along:

- **we realized that in GSI2021 campaign there were some shifts in the geometry**
- **we improved the geometric transformation to measure the impact point of the beam on the target**
- **to fill also outer bins we asked for more MC statistics (10M primaries for C, 15M for AIR/no target)**

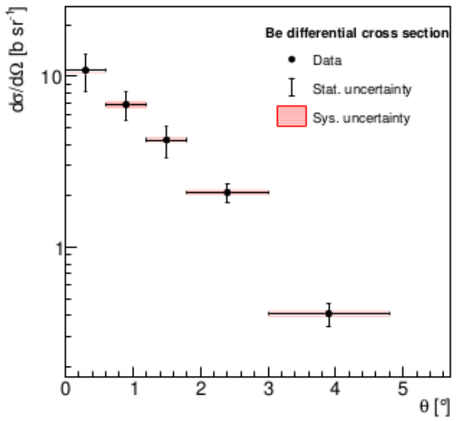
New binning chosen looking at MC simulation statistics, kinematics and data availability in background sample

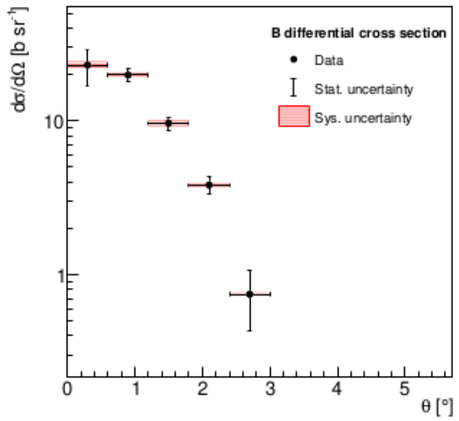
Proper binning has to be evaluated also from MC spectrum for unfolding procedure (we can’t accept MC bins with too few entries)

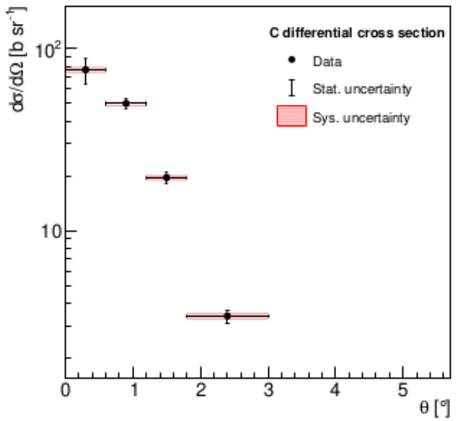

He differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

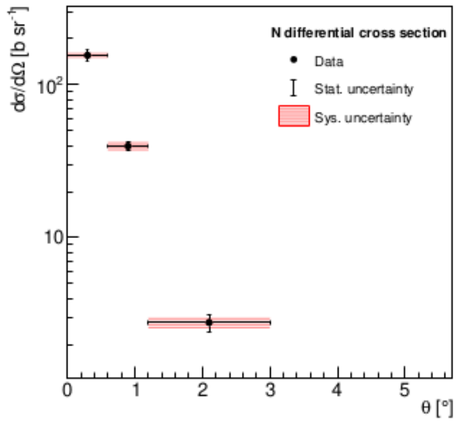

Li differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

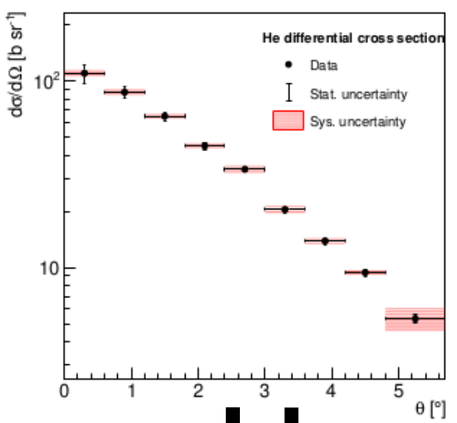
new

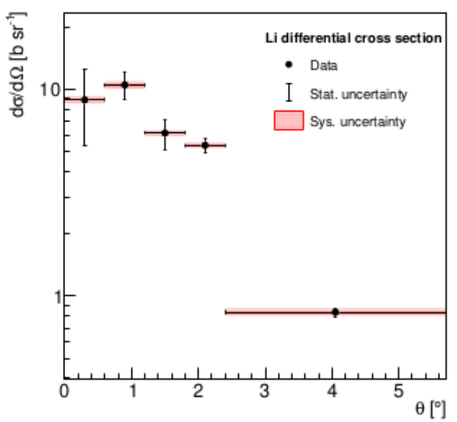

Be differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]


B differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

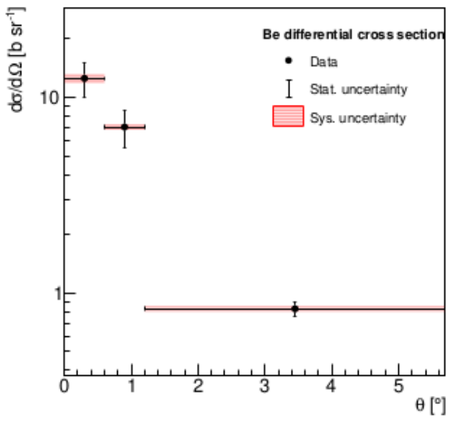

C differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

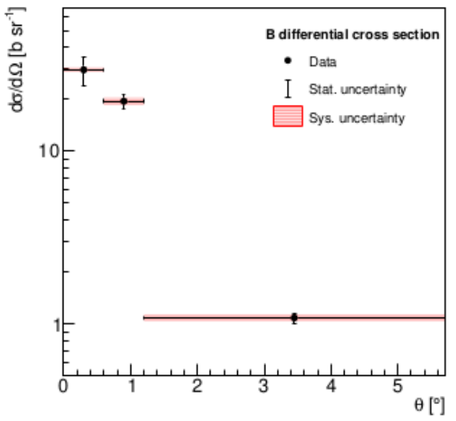

N differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

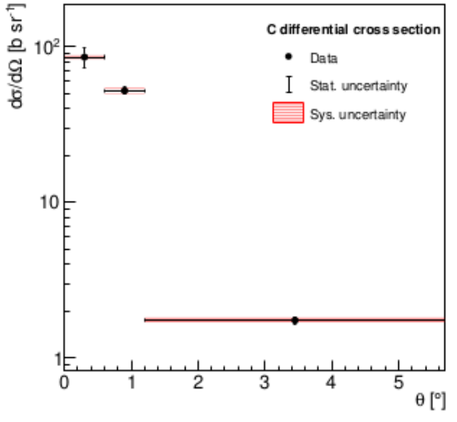

He differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

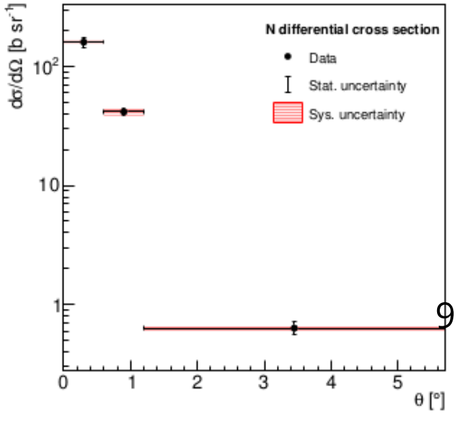

Li differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

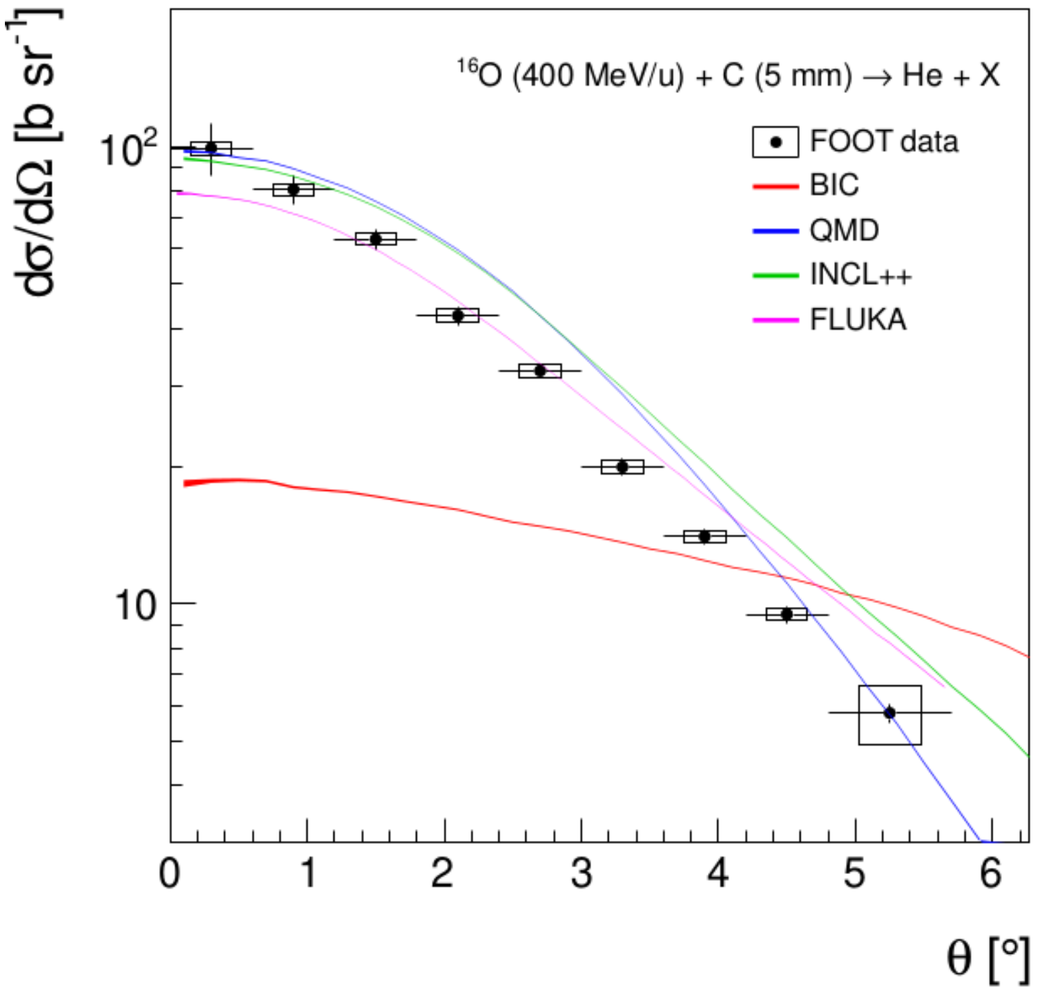
old

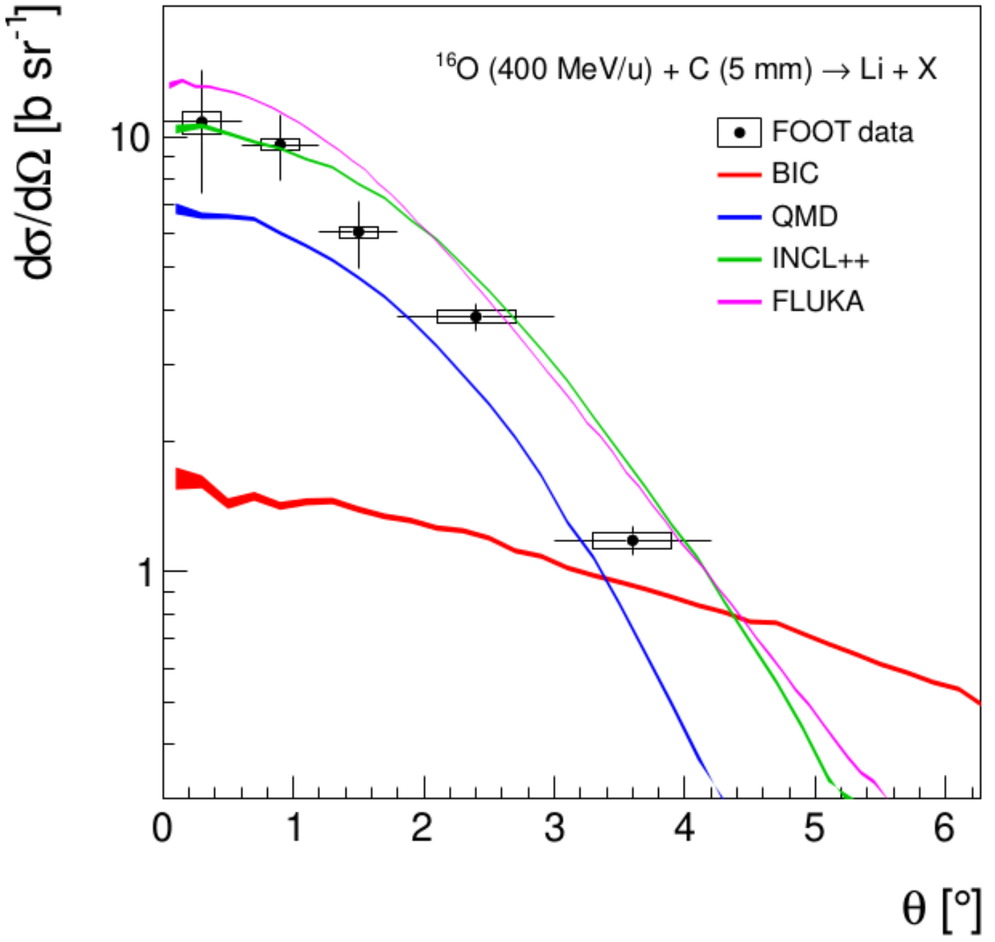

Be differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

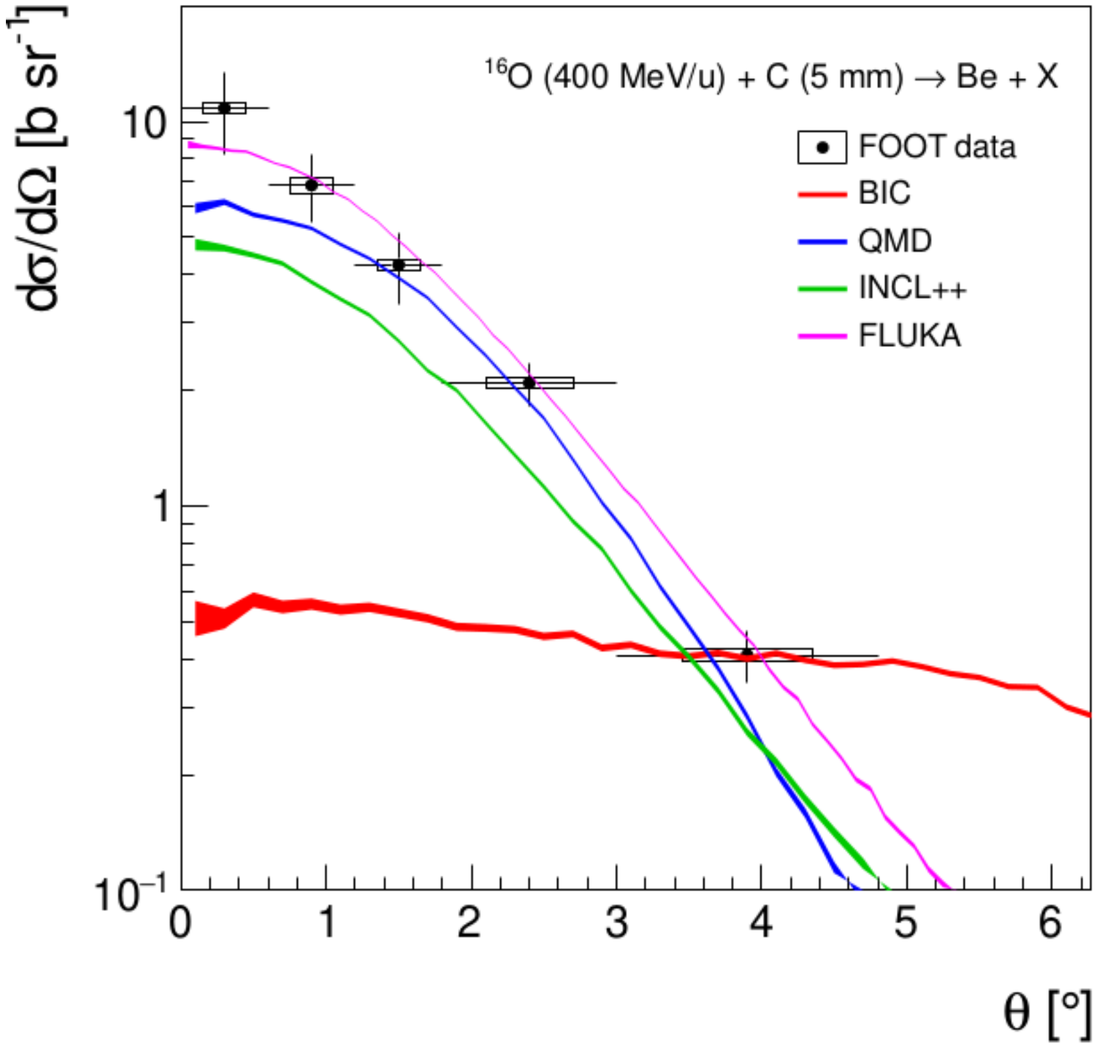

B differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

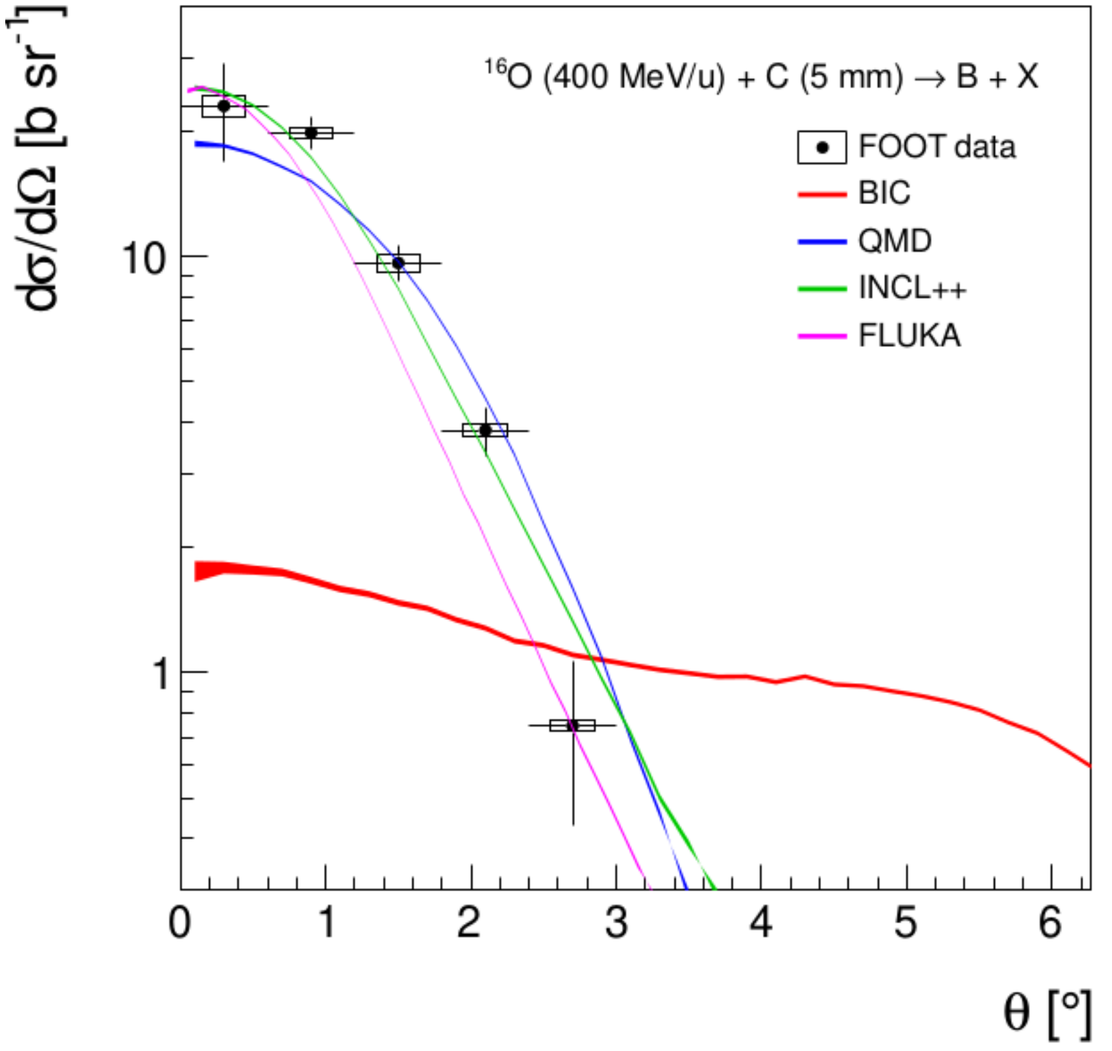

C differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

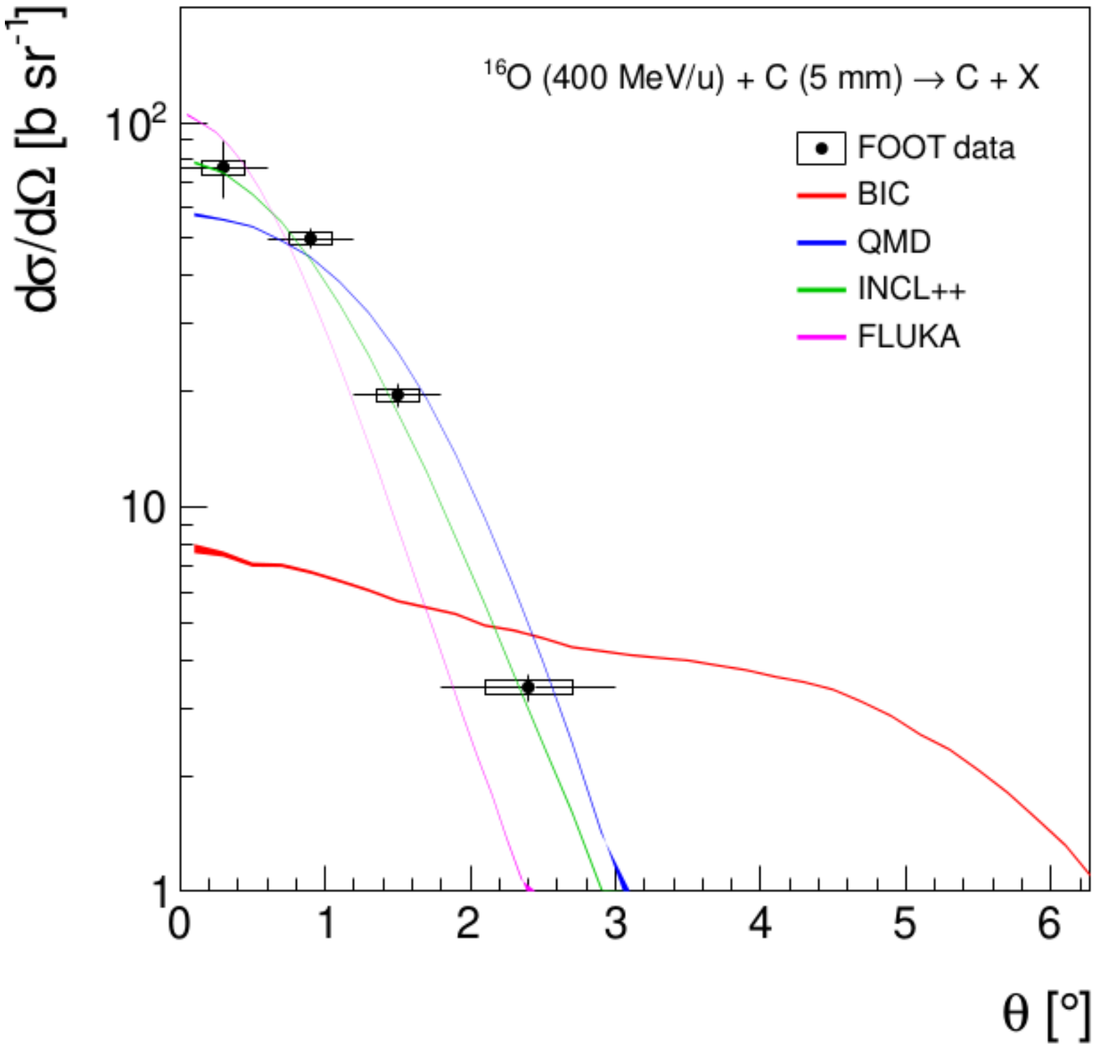

N differential cross section
Data
Stat. uncertainty
Sys. uncertainty
dσ/dΩ [b sr⁻¹]
θ [°]

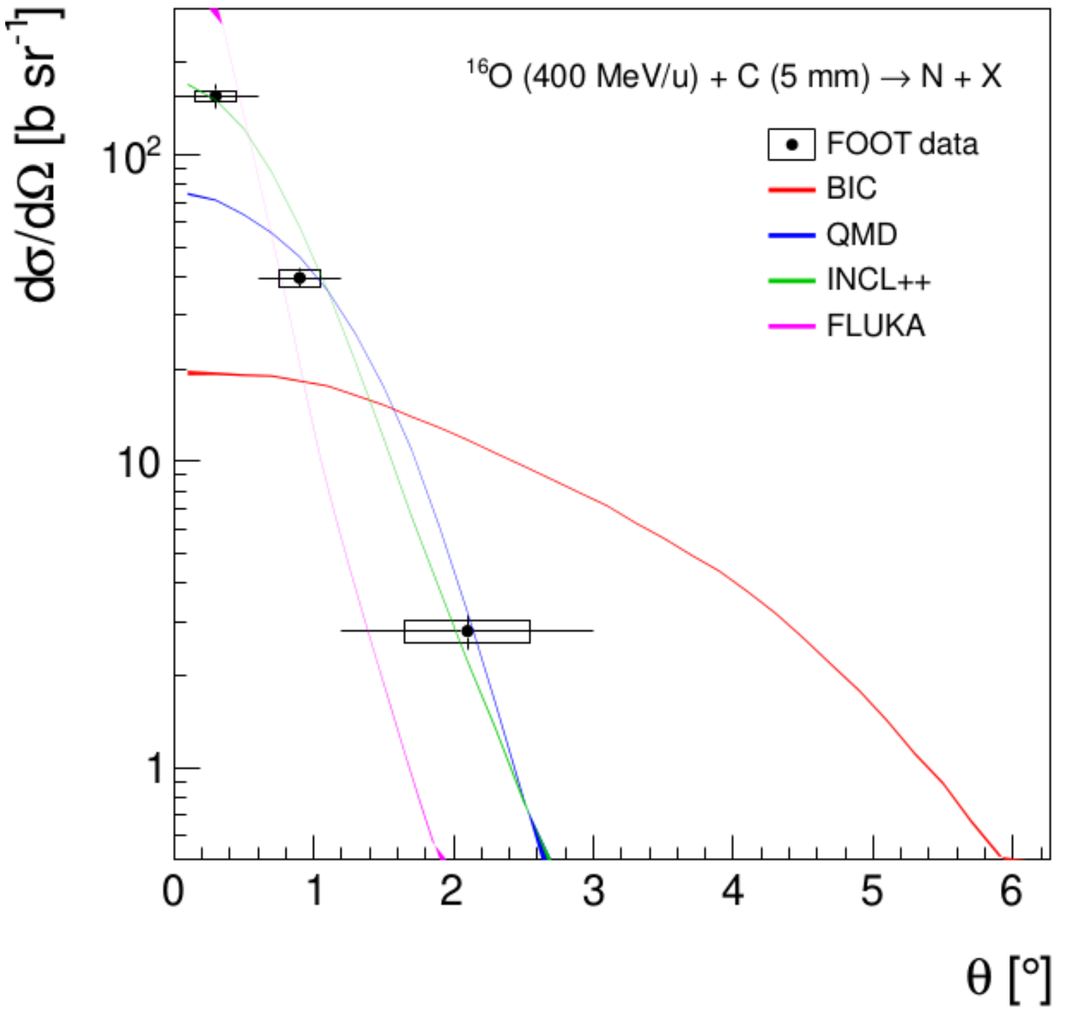

^{16}O (400 MeV/u) + C (5 mm) → He + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]


^{16}O (400 MeV/u) + C (5 mm) → Li + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]


^{16}O (400 MeV/u) + C (5 mm) → Be + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]


^{16}O (400 MeV/u) + C (5 mm) → B + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]


^{16}O (400 MeV/u) + C (5 mm) → C + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]


^{16}O (400 MeV/u) + C (5 mm) → N + X
FOOT data
BIC
QMD
INCL++
FLUKA
dσ/dΩ [b sr^{-1}]
θ [°]

Thanks for listening!