

BENCHMARKING OF ACTIVATION REACTION DISTRIBUTION IN AN INTERMEDIATE ENERGY NEUTRON FIELD



T.Ogawa*¹,

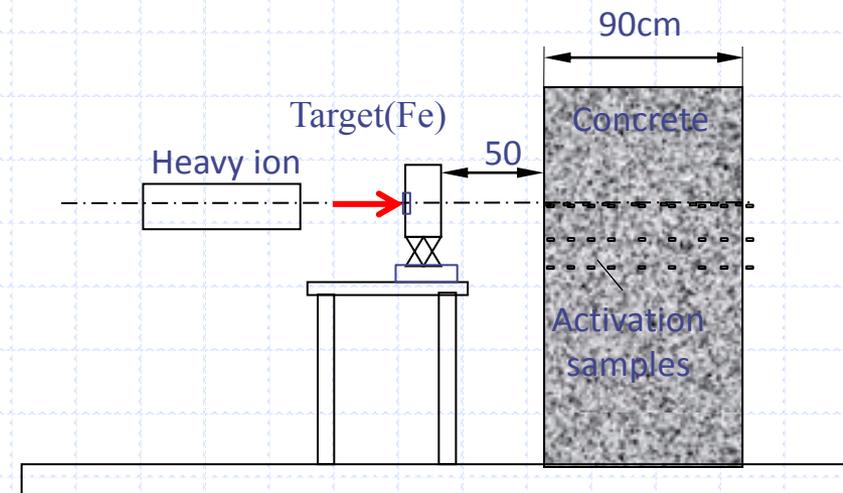
M. N. Morev*¹, T. Iimoto*², T.Kosako*¹

*1: Graduate school of Engineering, The University of Tokyo

*2: The University of Tokyo

Problem description

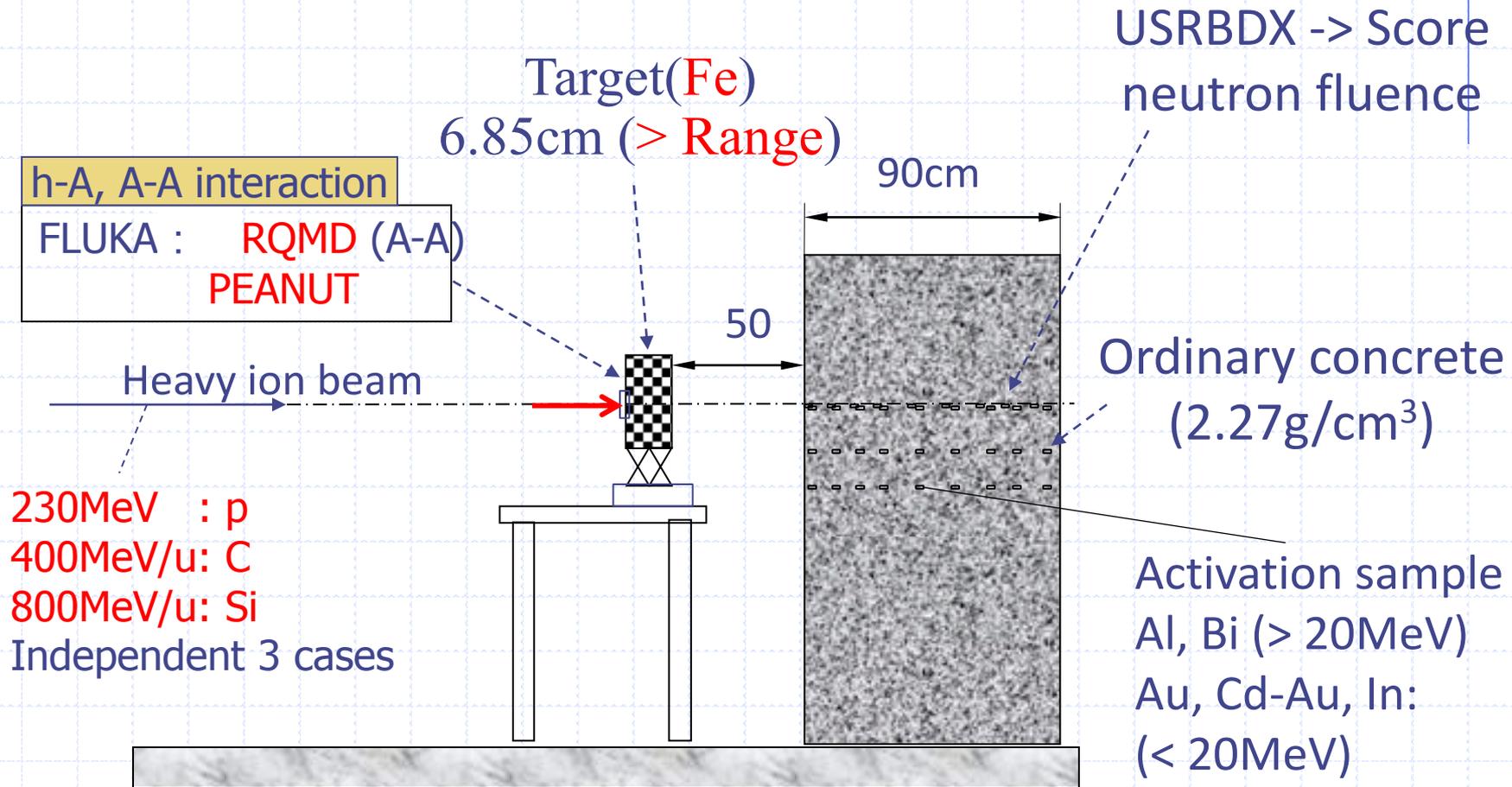
- Activation of concrete exposed to Ion(Fe,xn) field
- $E > 100 \text{ MeV/a}$
- Activation analysis
 - (n, γ) reaction
 - Various sources (p, C, Si)



- Exp/FLUKA Comparison

$\approx \pm 20\% \sim 30\%$

Setup



FLUKA setup

☆Link RQMD

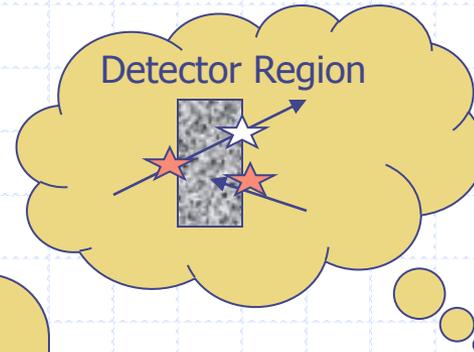
`$FLUPRO/flutil/ldpmqmd -o flukadpm3 -m fluka`

☆PHYSICS options

Physics Evaporation the latest model

Physics Coalescence

→ For better estimate of the source term



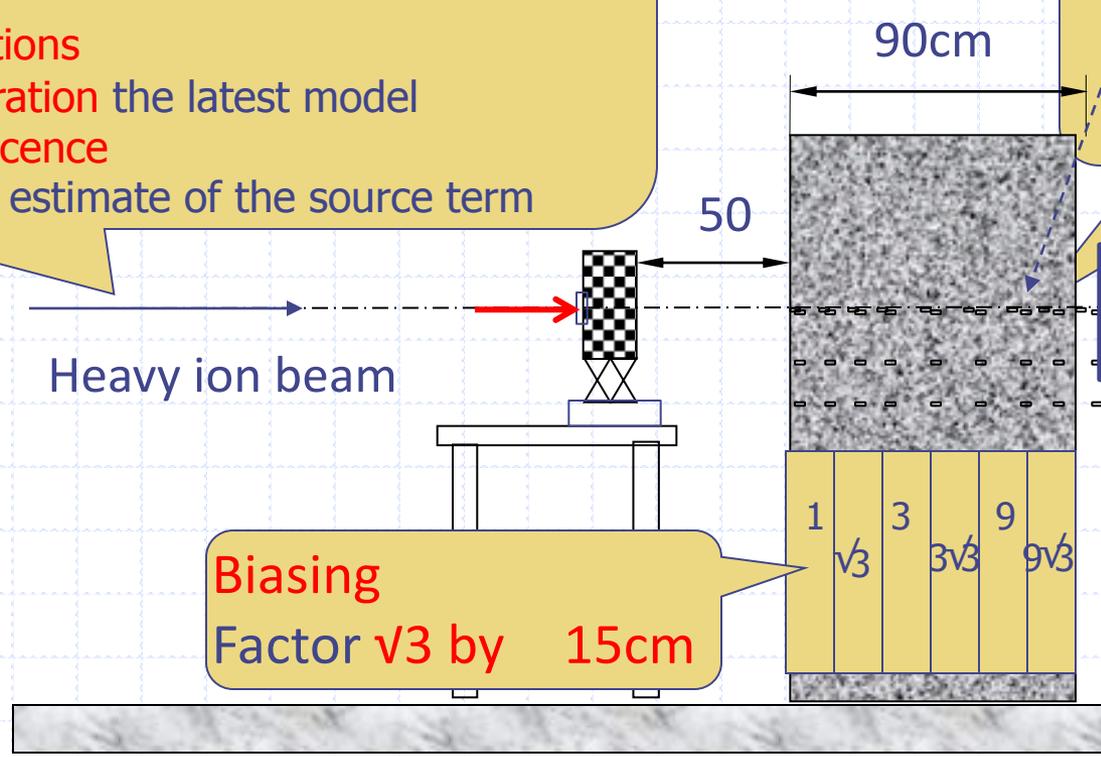
☆USRBDX

Fluence scoring
One way scoring

260 Groups (~20MeV)
30 Groups (20M~3GeV)

×
Evaluated X-section

||
Activation



Heavy ion beam

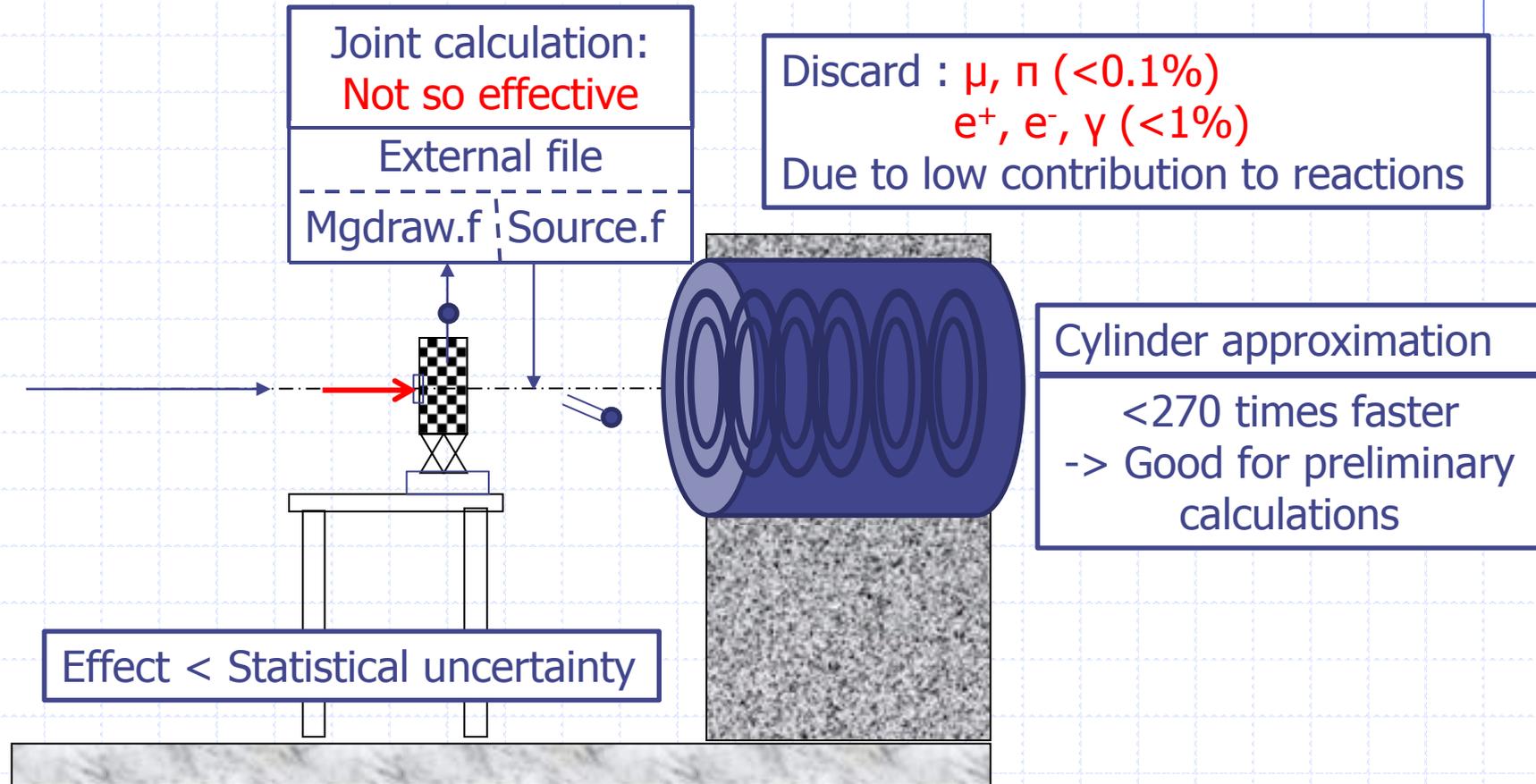
50

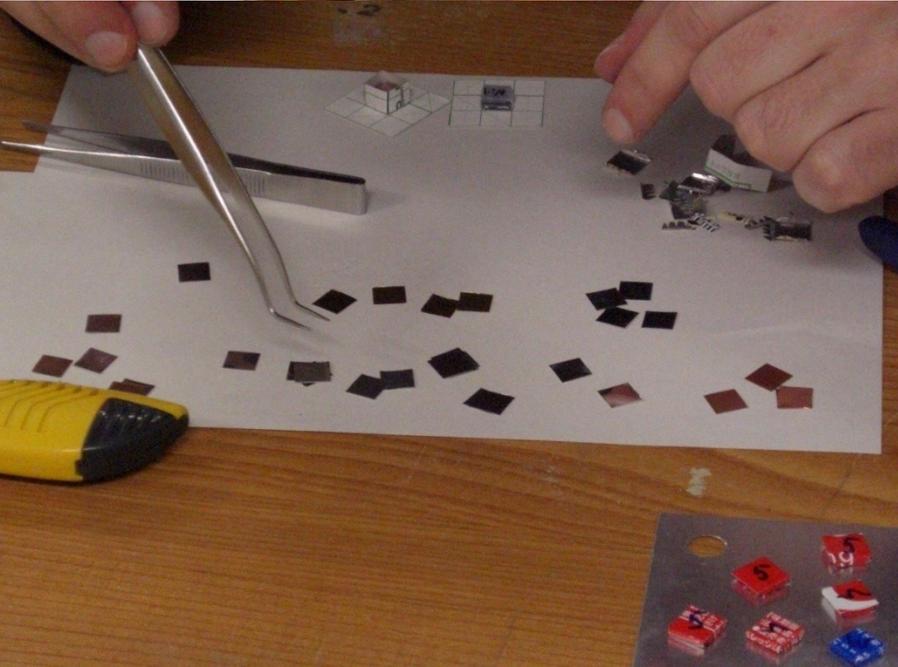
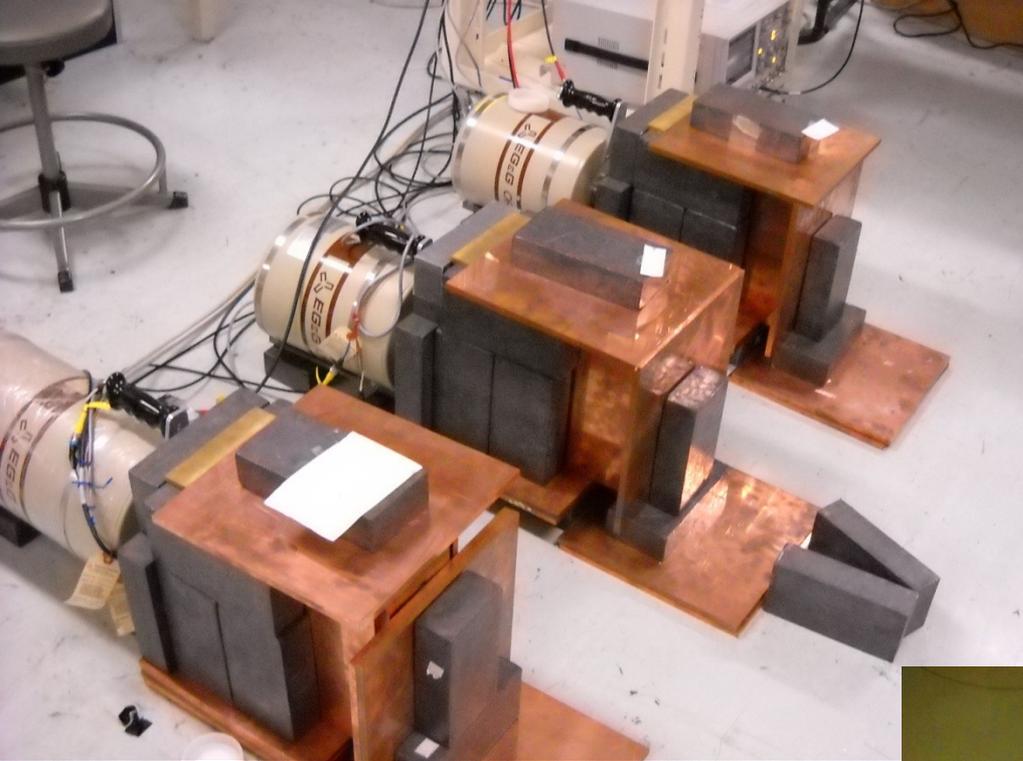
90cm

Biasing
Factor $\sqrt{3}$ by 15cm

1
 $\sqrt{3}$
3
 $3\sqrt{3}$
9
 $9\sqrt{3}$

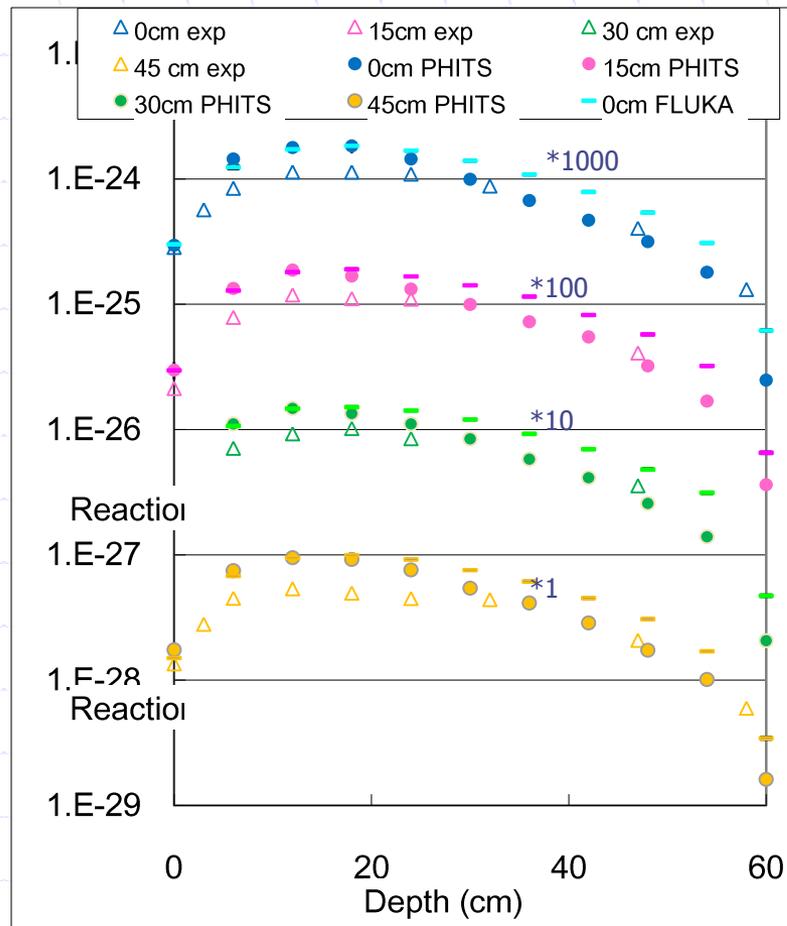
FLUKA setup(continued)



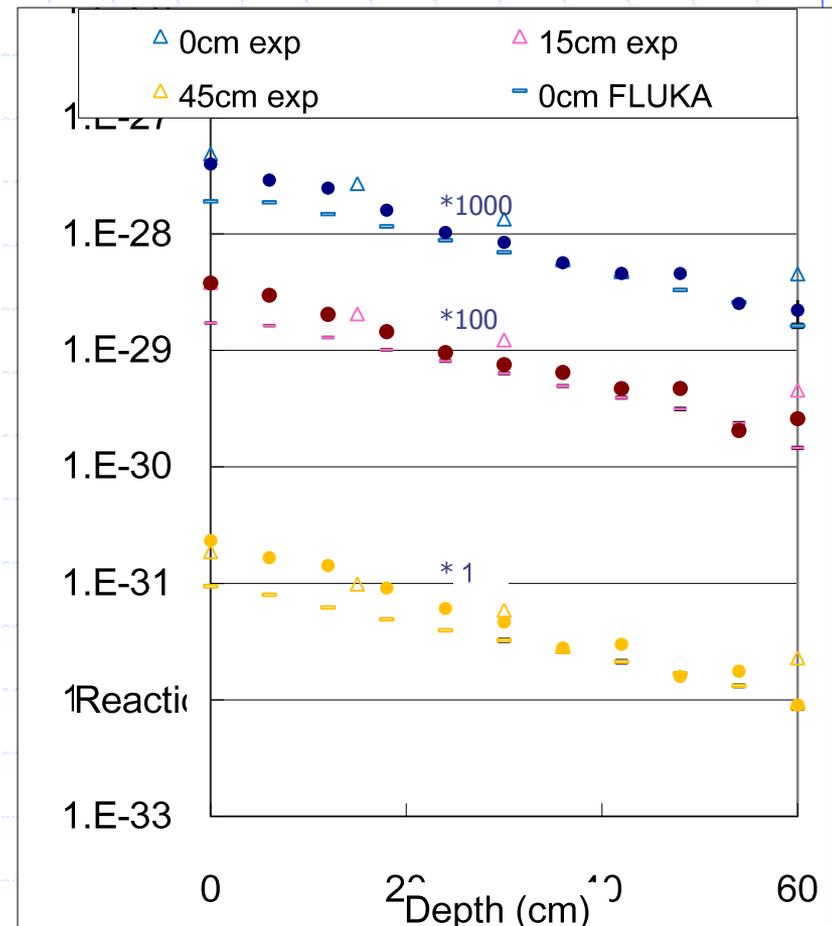


Result p 230MeV source

Au(n, γ)

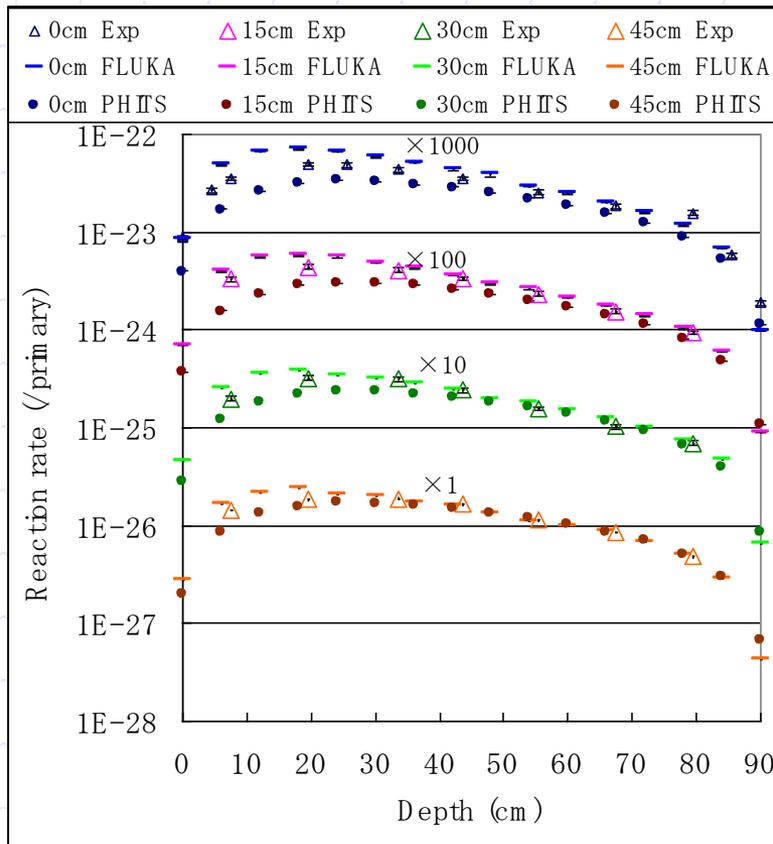


Al(n,X)Na-24

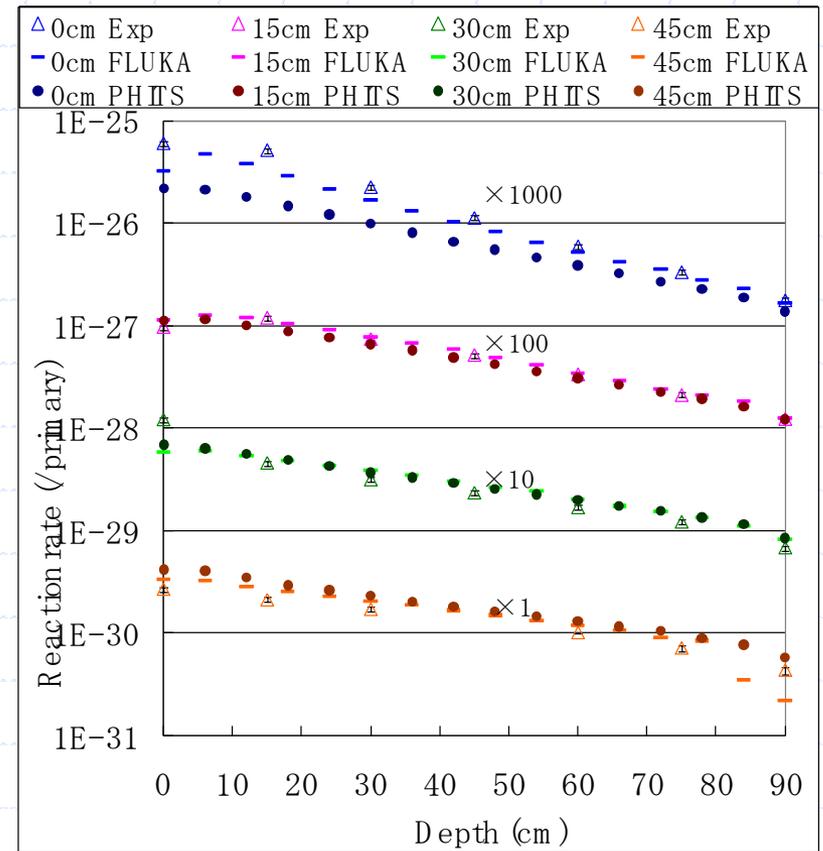


Result C 400MeV/u source

Au(n, γ)

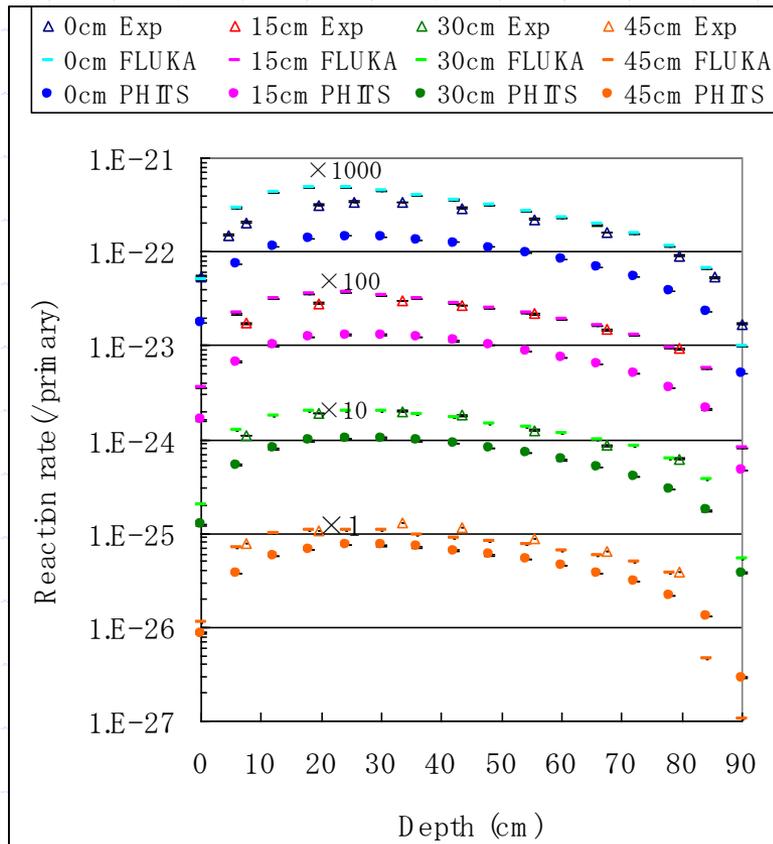


Al(n,X)Na-24

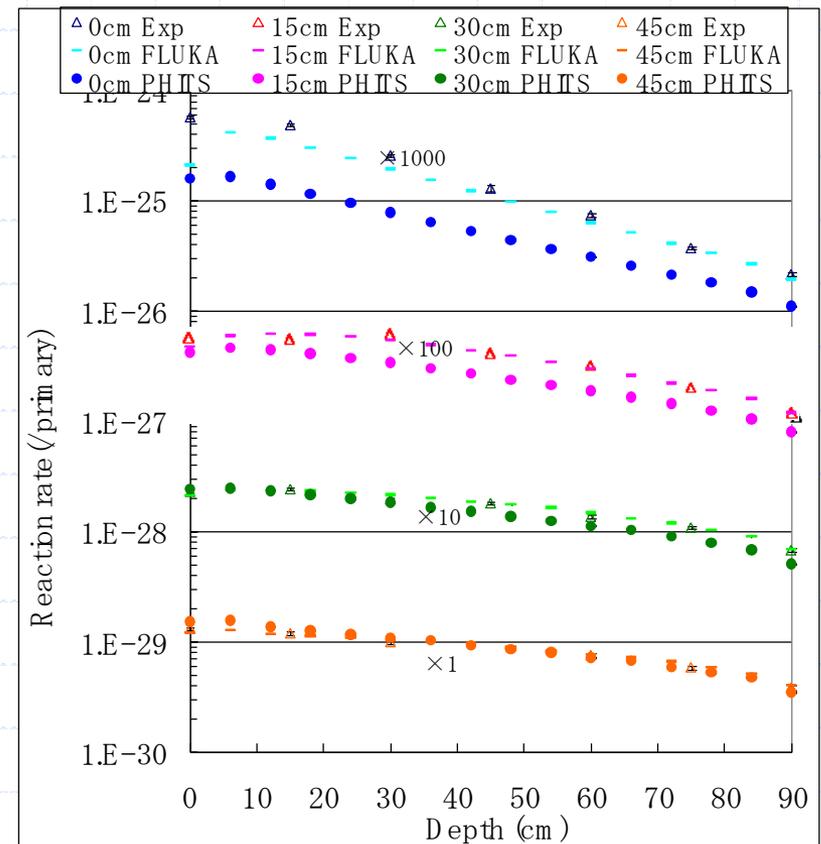


Result Si 800MeV/u source

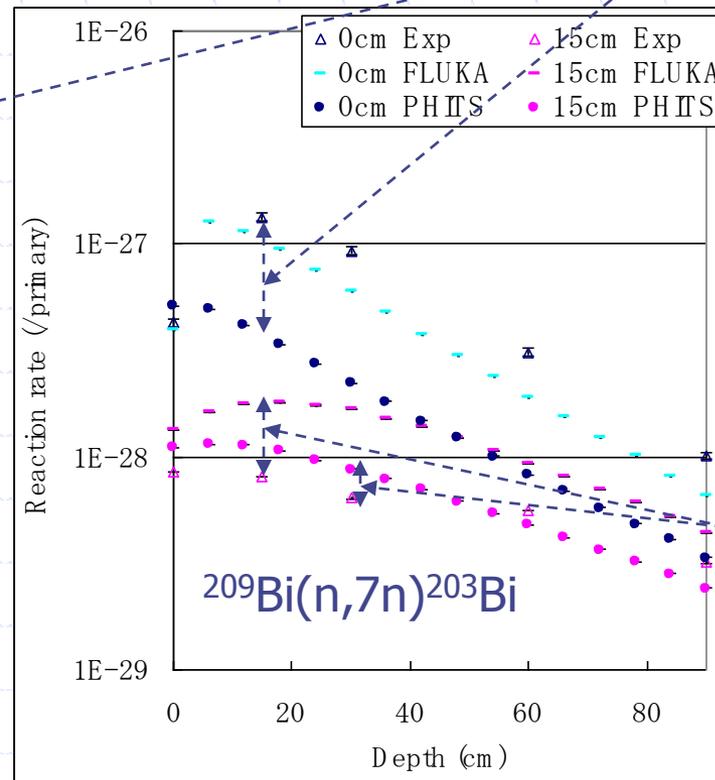
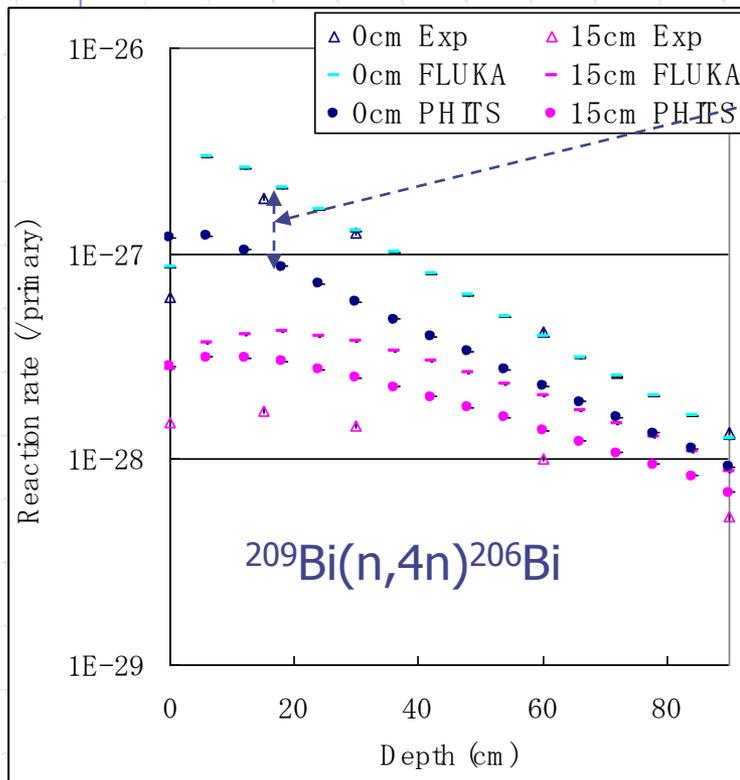
Au(n, γ)



Al(n,X)Na-24



Result Si 800MeV/u source (Continued)



FLUKA is better at forward angle at high energy

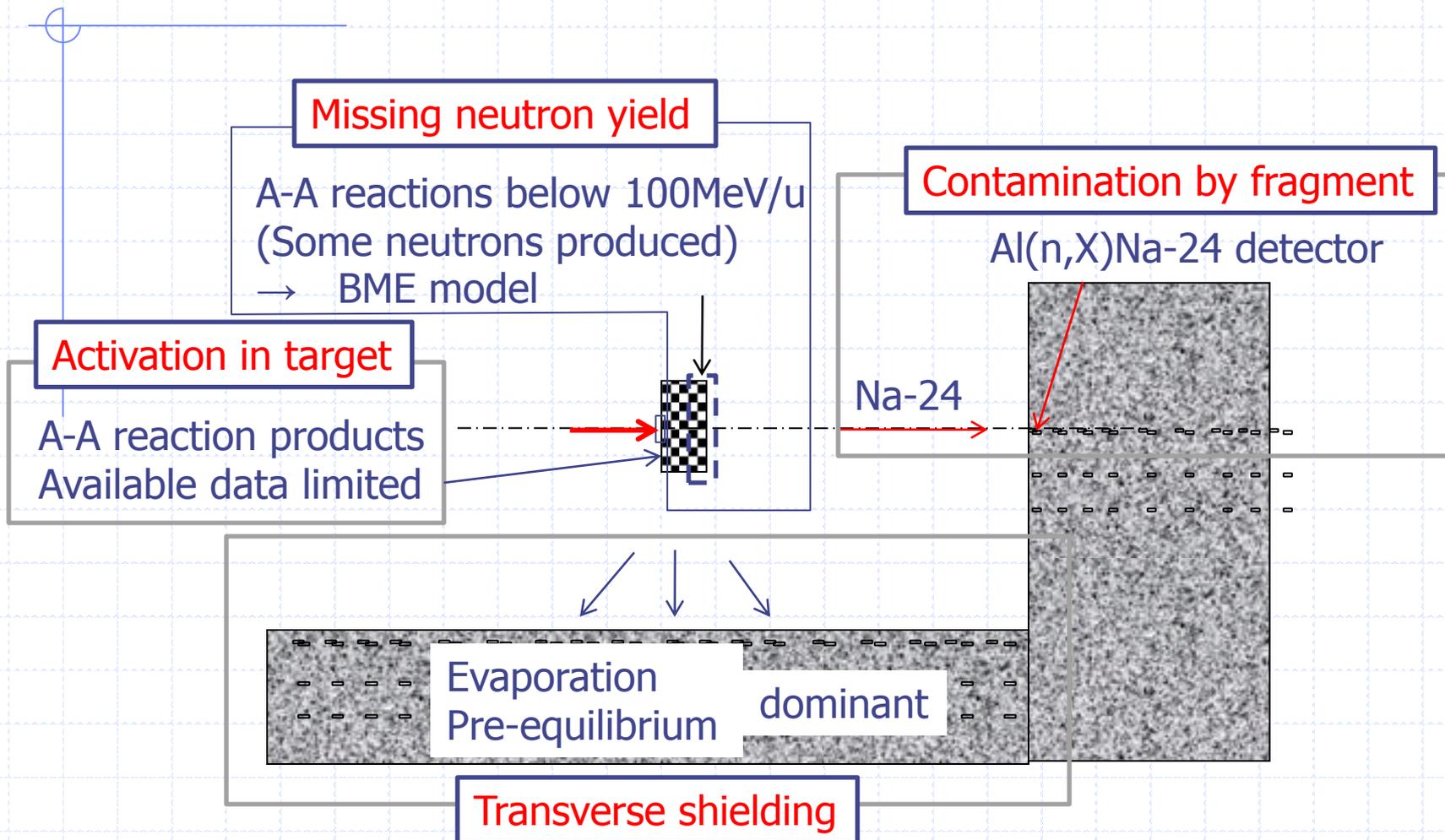
PHITS is better at large angle -> Low energy component

Results summary

	230 p	400 C	800 Si
Al(n,X) ²⁴ Na	PHITS	FLUKA	FLUKA
(n, γ)	PHITS	EVEN	FLUKA

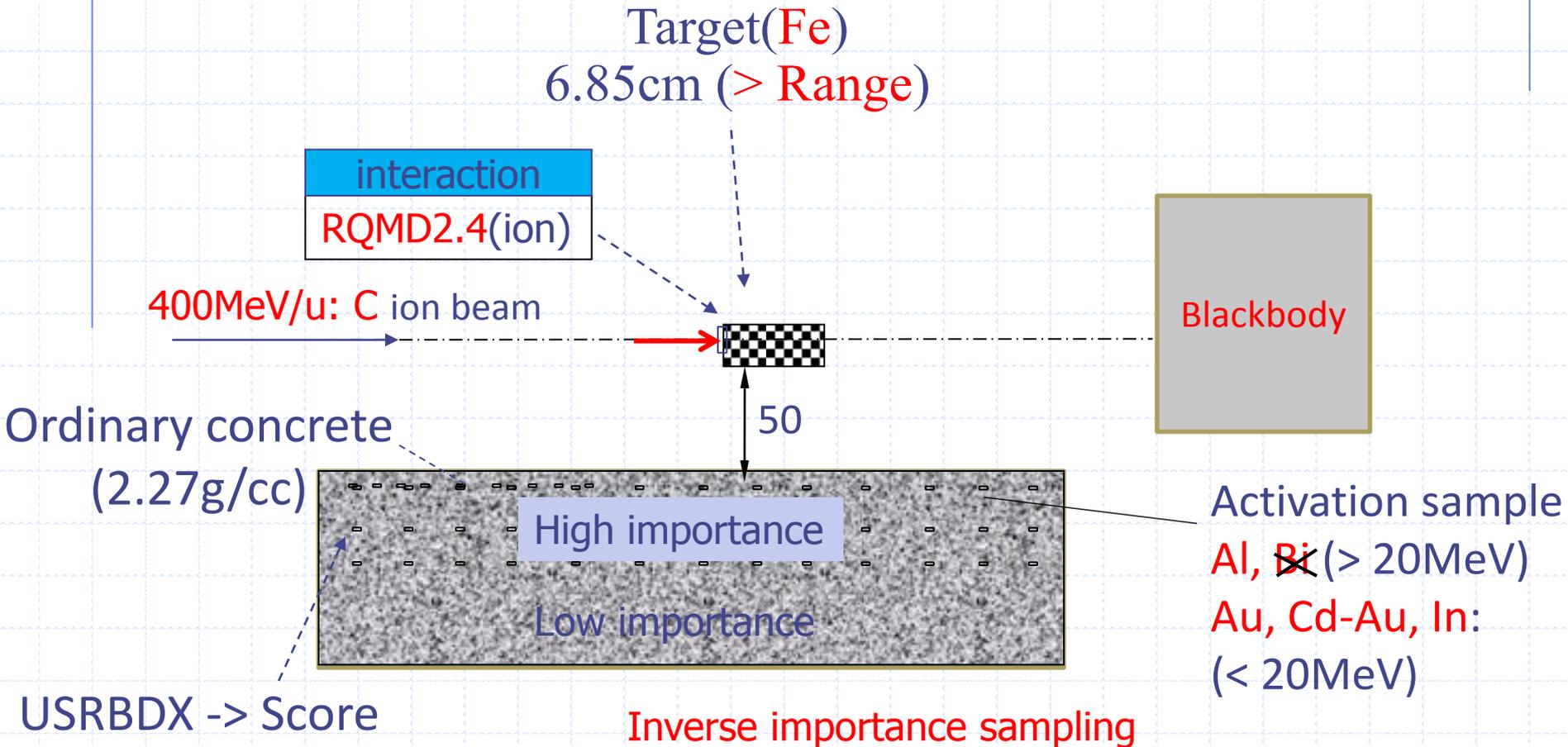
- Direction
 - 0° : Code dependent. \longrightarrow Knock-on neutrons
Proton contribution?
 - 45°: Code independent. More accurate
- (n, γ) reaction
 - Agreement 20% (neither code nor source dependent)
 \longrightarrow Total neutron flux estimation is good
- (n,sp) reaction
 - PHITS: systematic underestimation
 - FLUKA: discrepancy <30%
- Depth profile : O.K. (except for forward)
 \longrightarrow Transport is O.K.

For further discussion



For further discussion

~Transverse shielding~

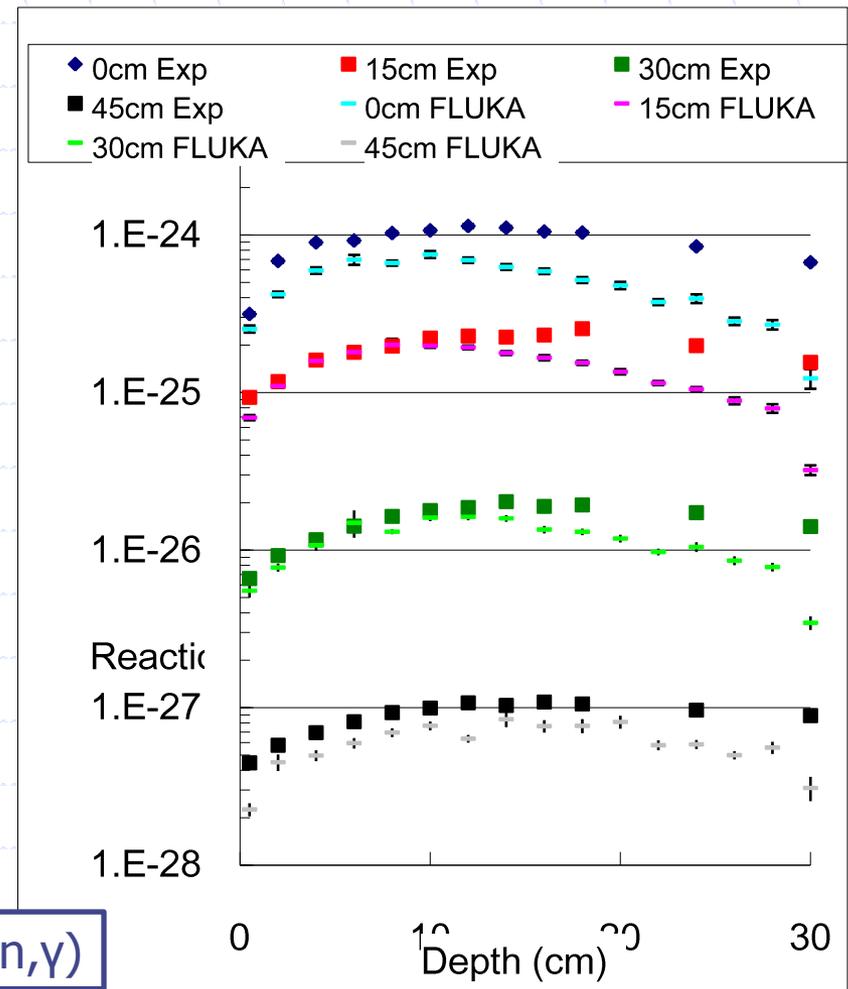


USRBDX -> Score
neutron fluence

For further discussion

~Transverse shielding~

- Spallation detectors are under analysis
- Different attenuation coefficient
 - Higher edge of neutron spectrum



$\text{Au}(n,\gamma)$

Any advice, questions, suggestions .etc are welcome