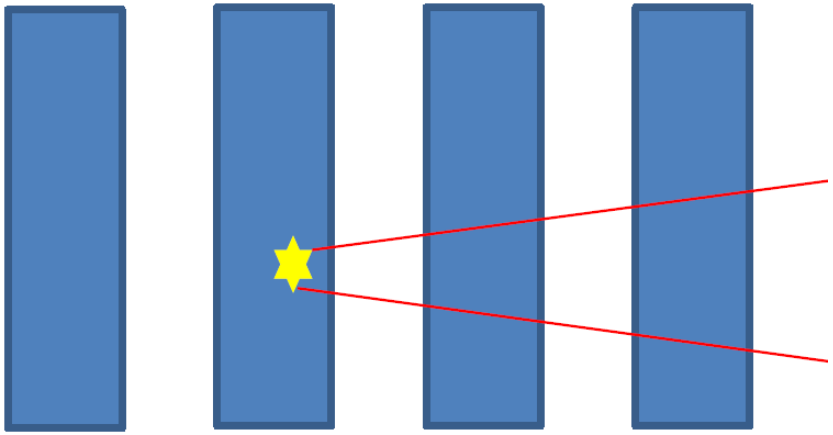
Neutron Detector Simulation
2013 / 09 / 13



Korea University
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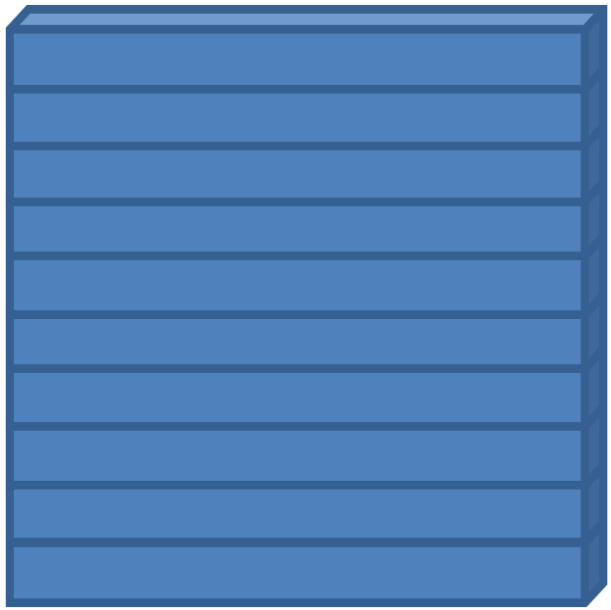
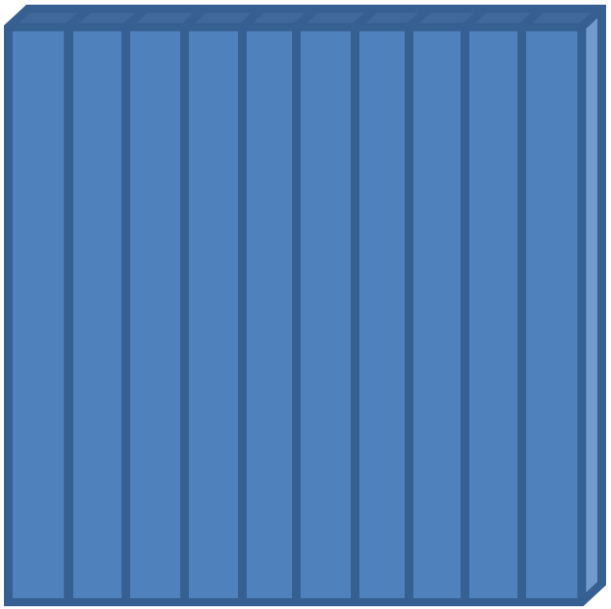
BumGon Kim

Neutron Bar Detector



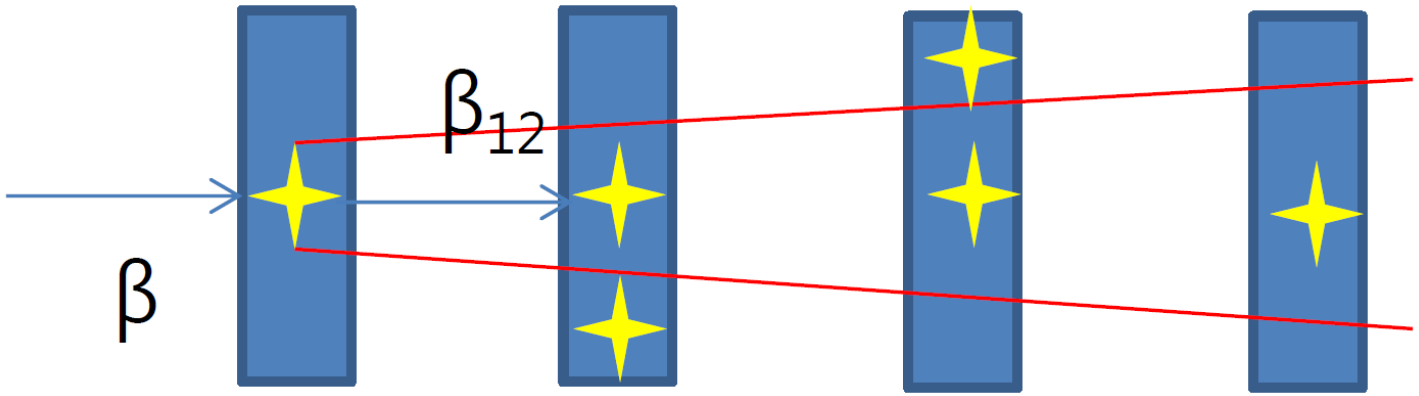
Horizontal



Vertical

- Horizontal layer + Vertical layer = 1 Stack
- Structure to know the locations where neutrons have passed.
  → To recognize the path where neutrons have traveled.

Multi-neutron Recognition Basic Algorithm



1. Geometric Condition

- 1st layer : within 30 cm from 1st hit.
- 2nd layer : 40 cm
- 3rd layer & 4th layer : 60 cm

2. Betha Condition

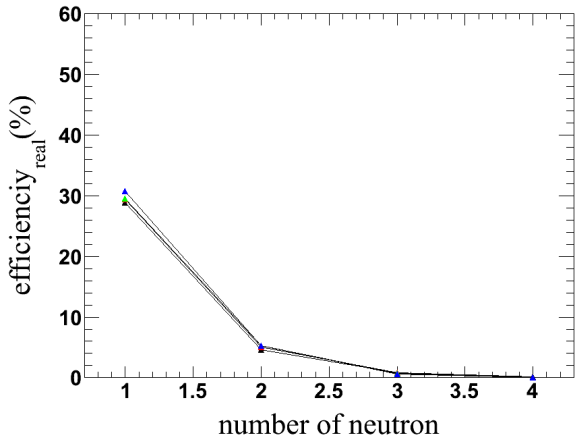
- $\beta > \beta_{12}$: earlier incoming, larger velocity(loss of energy).

(Correction!)The Number of Stacks & Real Efficiency

Real Efficiency(%) = (# of well recognized)/(# of event-Null event) * (1-fake rate) * 100

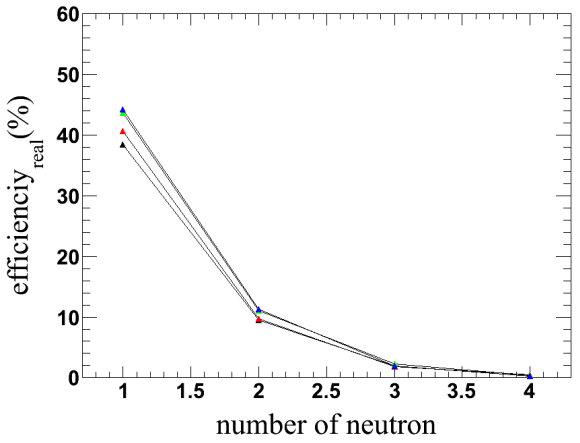
Neutron Energy : 100 ~ 300 MeV, Time Resolution : 0.3 ns

2 stack, **40 cm gap**

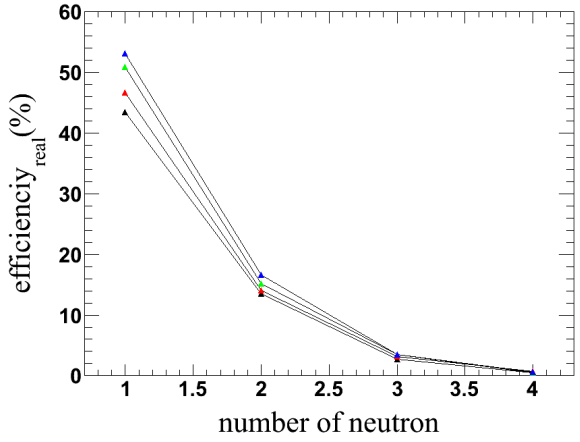


Black : 3 MeV,
Red : 5 MeV,
Green : 7 MeV,
Blue : 10 MeV

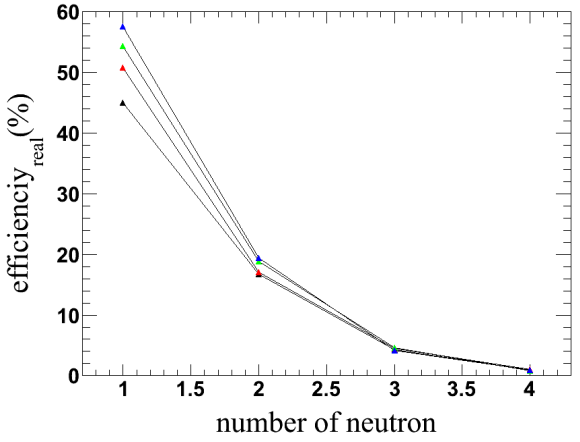
4 stack, **40 cm gap**



6 stack, **40 cm gap**



8 stack, **40 cm gap**

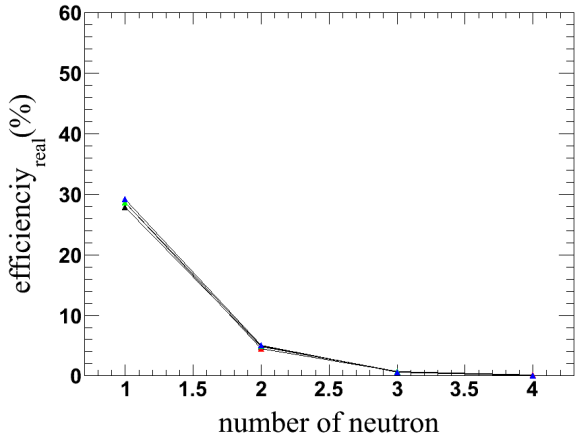


The Number of Stacks & Real Efficiency

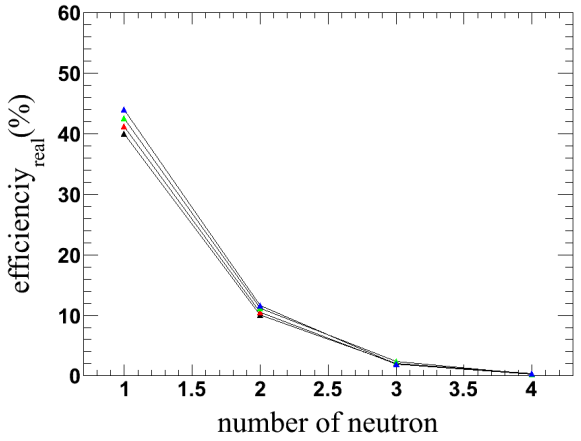
Real Efficiency(%) = (# of well recognized)/(# of event-Null event) * (1-fake rate) * 100

Neutron Energy : 100 ~ 300 MeV, Time Resolution : 0.3 ns

2 stack, **60 cm gap**

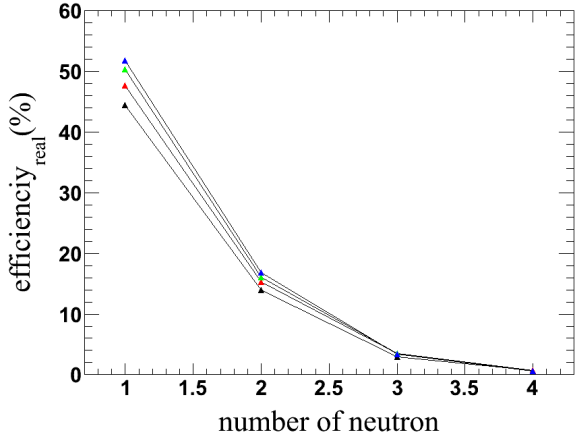


4 stack, **60 cm gap**

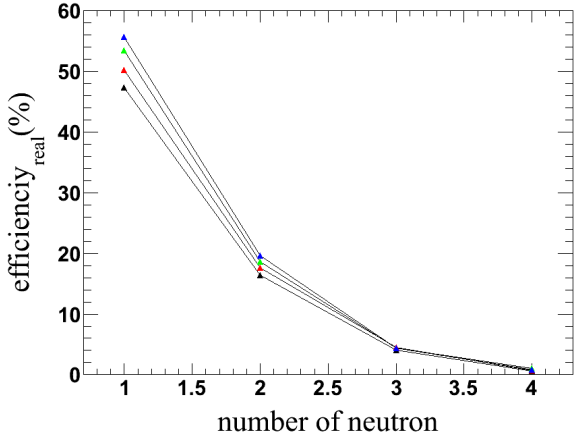


Black : 3 MeV,
Red : 5 MeV,
Green : 7 MeV,
Blue : 10 MeV

6 stack, **60 cm gap**

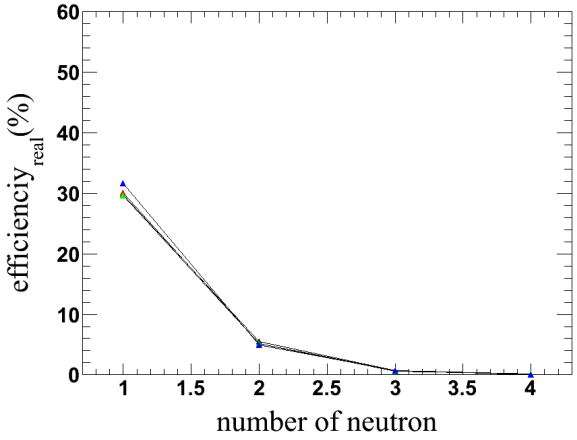


8 stack, **60 cm gap**

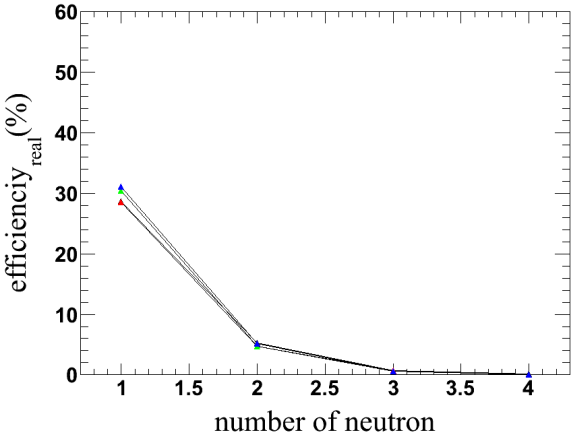


Two Stacks & Gap

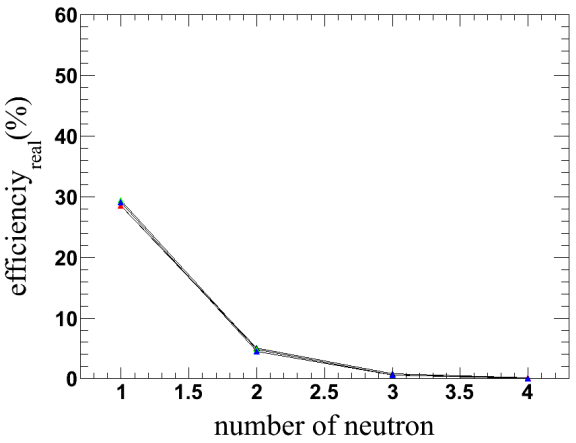
20 cm gap



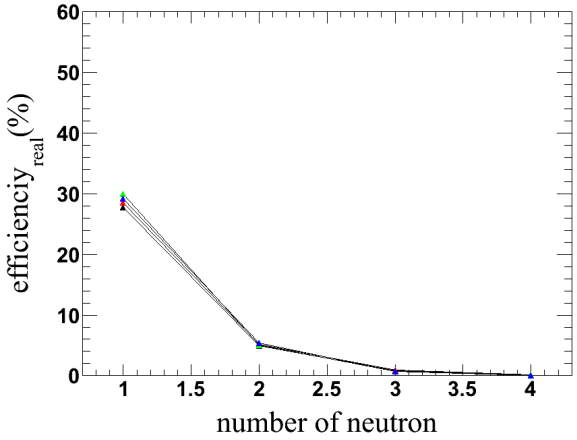
40 cm gap



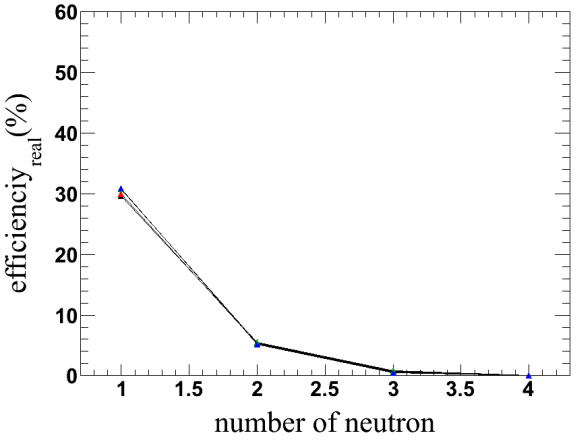
60 cm gap



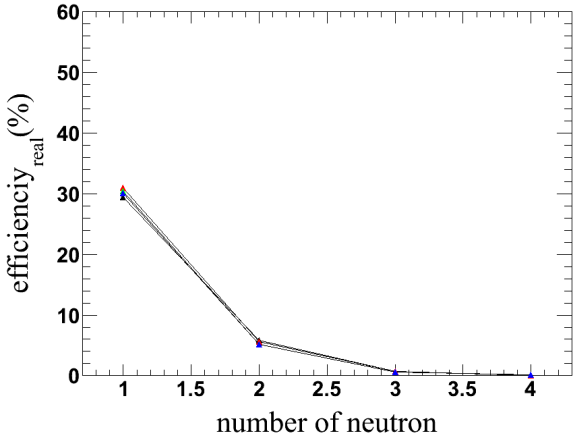
80 cm gap



100 cm gap



120 cm gap



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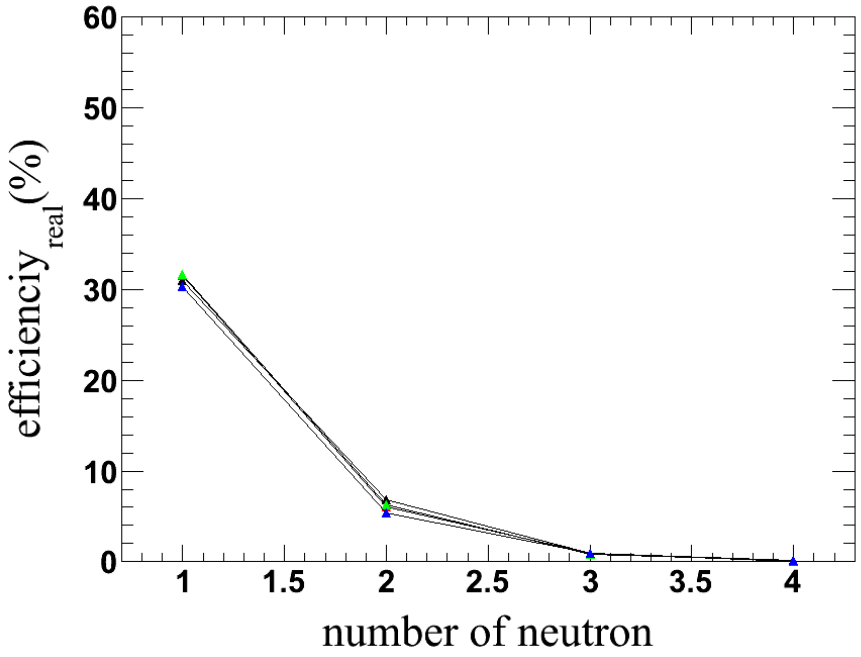
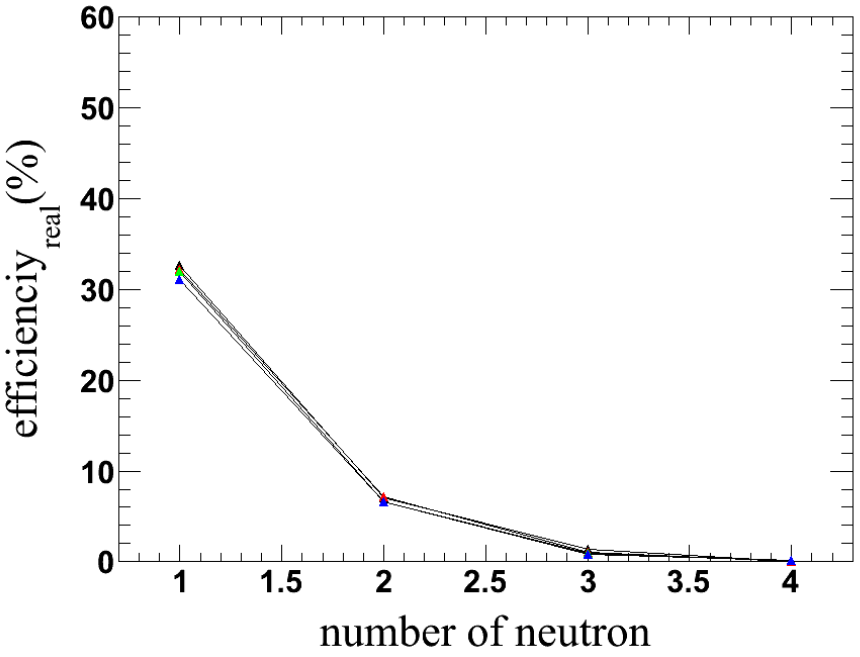
Two Stacks & Gap

220 cm gap

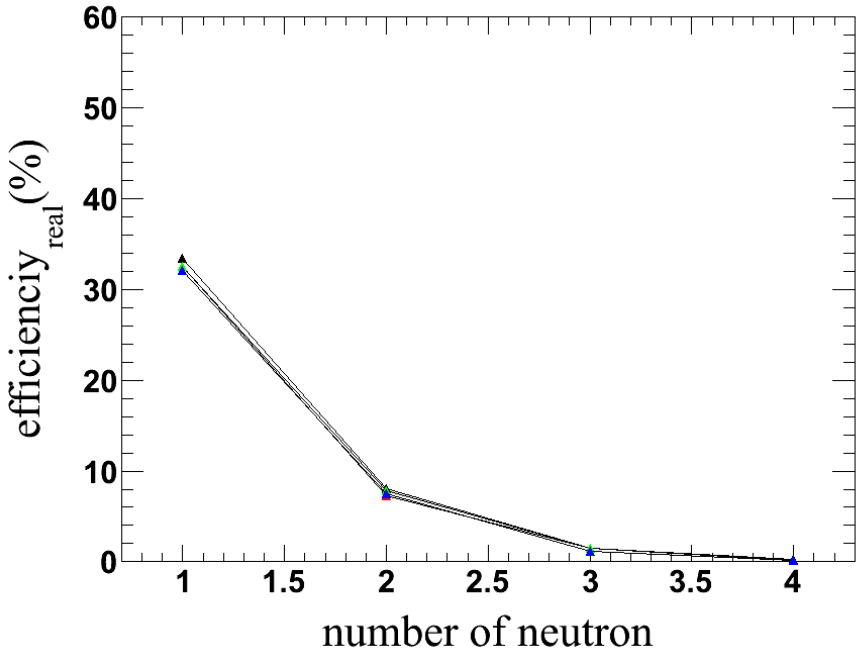


400 cm gap

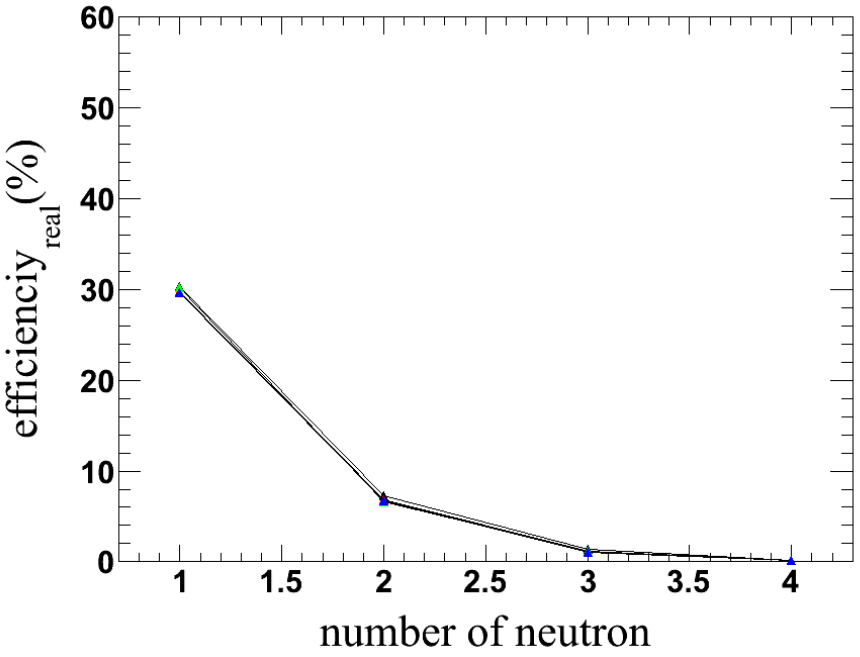


Two Stacks & Gap

800 cm gap



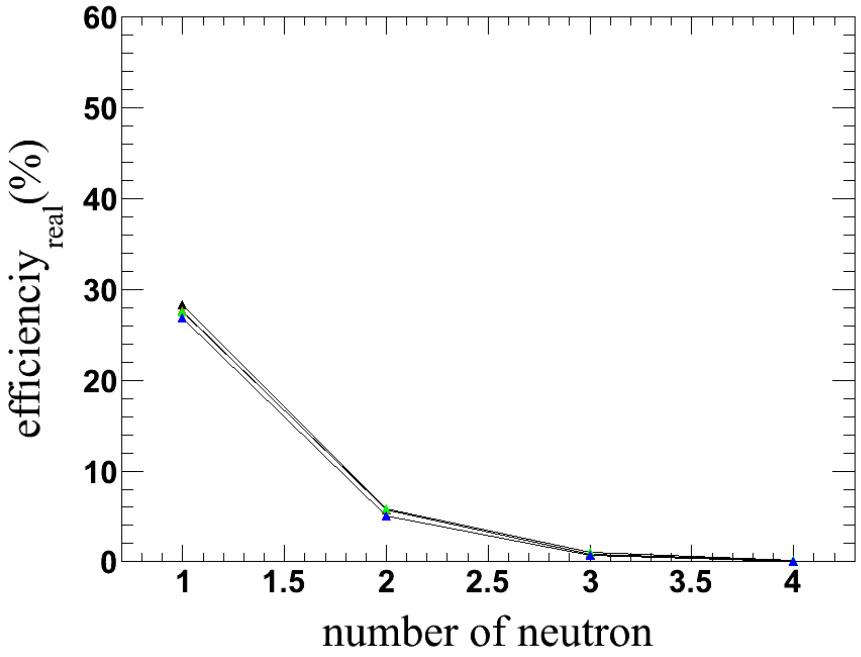
1600 cm gap



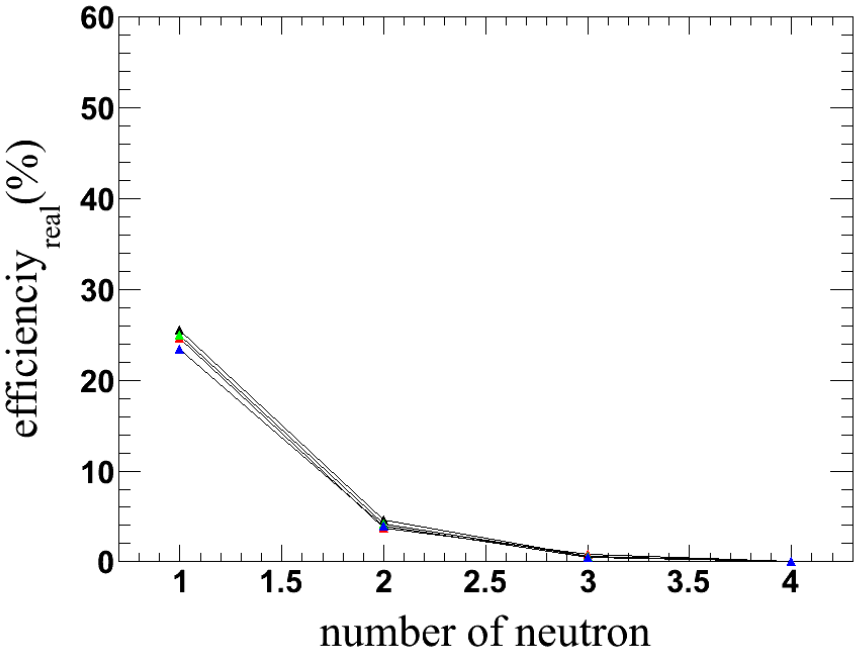
- Gap이 약 800 cm 전후일 때, efficiency 가 가장 높다.

Two Stacks & Gap

3200 cm gap



6400 cm gap



- Gap이 800 cm 보다 커질수록, efficiency가 점차 감소한다.
  → Back Scattering 의 감소에 의한 영향보다, gap의 증가로 인한 영향이 더 커진다.

Analysis

- When the threshold is 3 & 5 MeV, efficiency of the case of the 60 cm gap is higher than that of the case of the 40 cm gap.

- When the threshold is 7 & 10 MeV, efficiency of the case of the 40 cm gap is higher than that of the case of the 60 cm gap.

- In the event of two stacks, in the region of the gap is longer than 20 cm & shorter than 80 cm, efficiency becomes lower gradually as long as the length of the gap becomes longer.
  → It may be caused by decrease of the cross section (decrease of the solid angle) by the result of increase of the length of the gap.

Analysis

- In the region of the length of the gap is longer than 80 cm & shorter than 800 cm,
  efficiency becomes gradually higher as long as the length of the gap becomes longer.
  → It may be caused by weakening of the effect of back scattering by the result of increase of the length of the gap.

- In the region of the length of the gap is longer than 800 cm,
  efficiency becomes lower as long as the length of the gap becomes longer.
  → It may be caused by the domination of the effect of decrease of the cross section(decrease of the solid angle) by the result of increase of the length of the gap.

Conclusion

- In case of the two stacks(in the region of the length of the gap is longer than 40cm & shorter than 800 cm), as long as the length of the gap become longer, efficiency become gradually higher.

- But, in the event of many neutrons, change of the gap is insignificant.

- Need to find another ways to improve the efficiency.