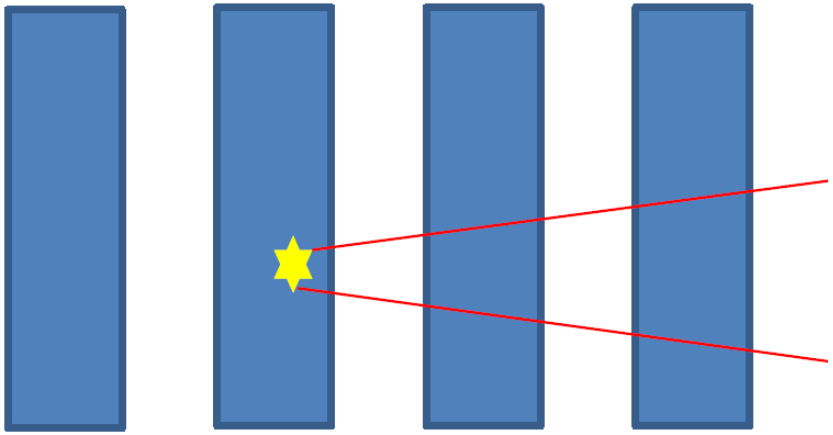
Neutron Detector Simulation
2014 / 04 / 11



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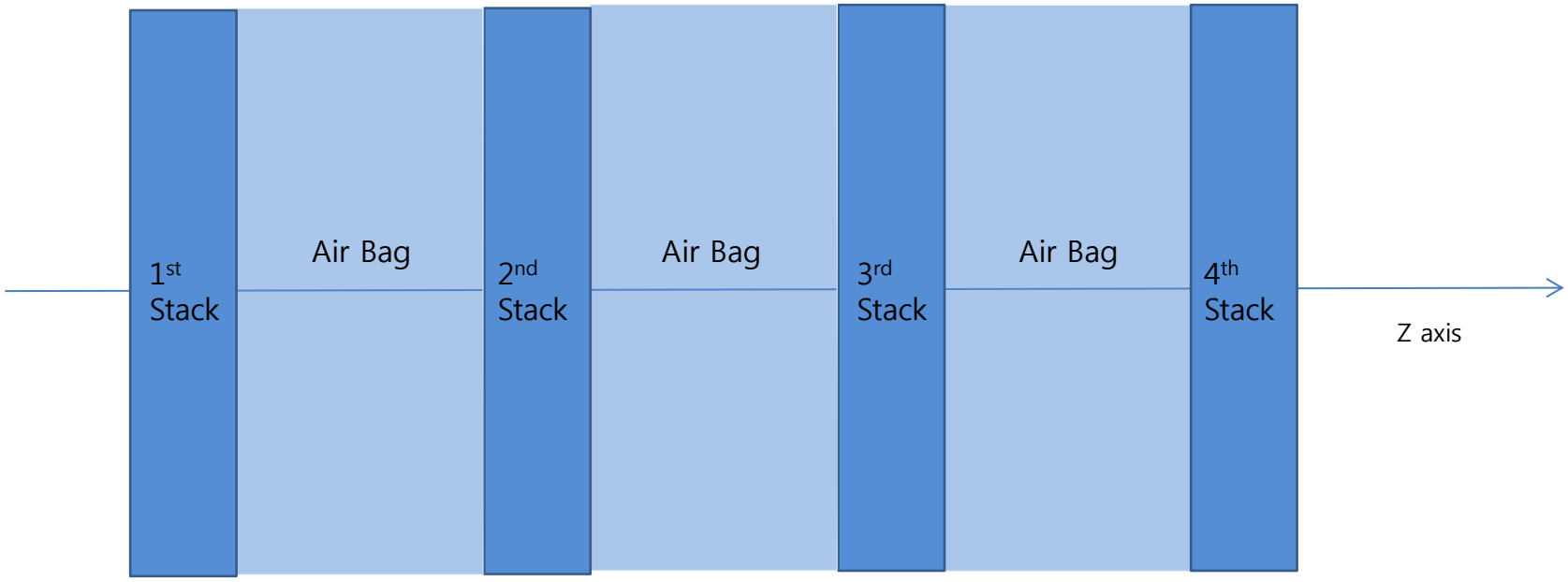
Change in Detector Code

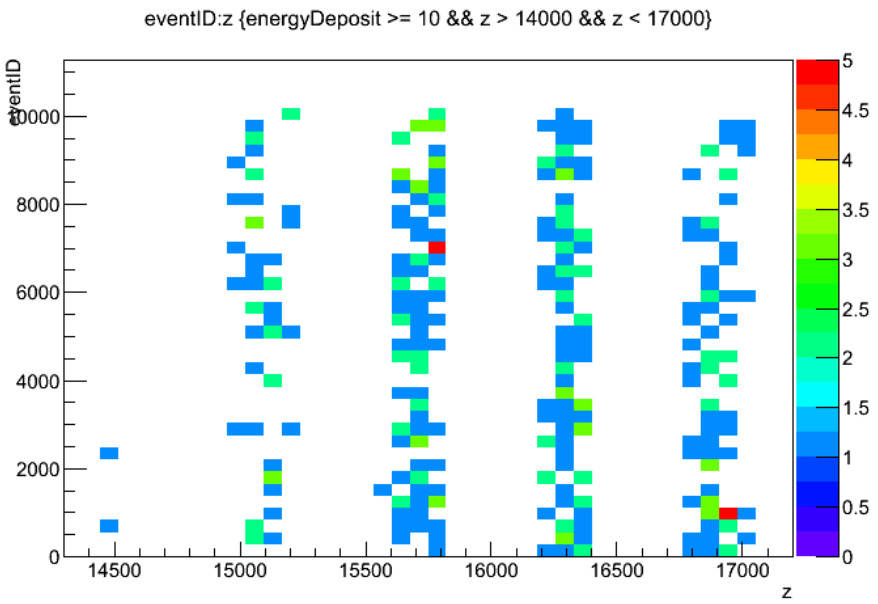
- " Air Bag " between Stacks
- Air
  - Density : 1.2929×10^{-3} g/cm^3
  - N, O, Ar, etc.
  - Just same with air in Lab. Volume.



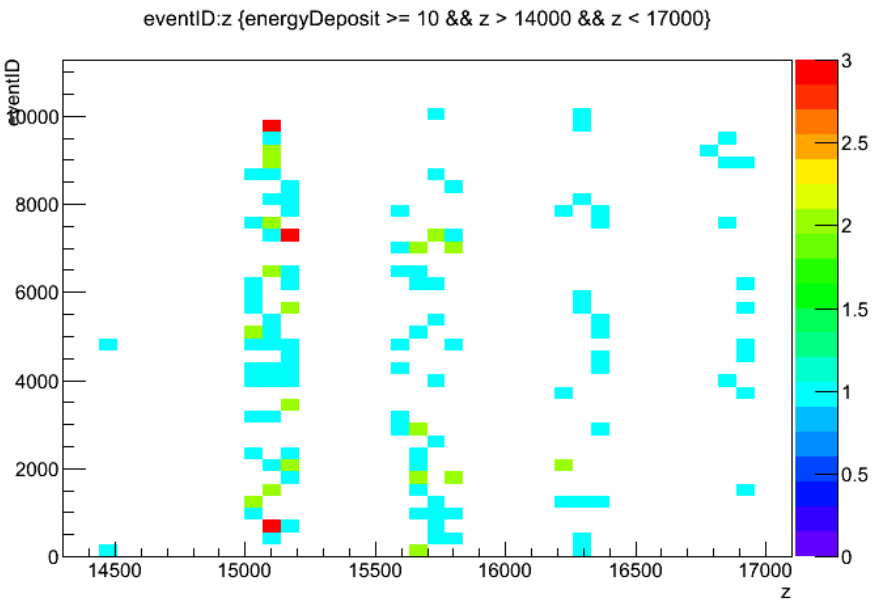
With Air Bag VS. Without Air Bag

- Pinpoint neutron beam with energy : 300 MeV
- 2D histogram(the number of hits)– eventID : z position
- Threshold : 10 MeV

With Air Bag



Without Air Bag

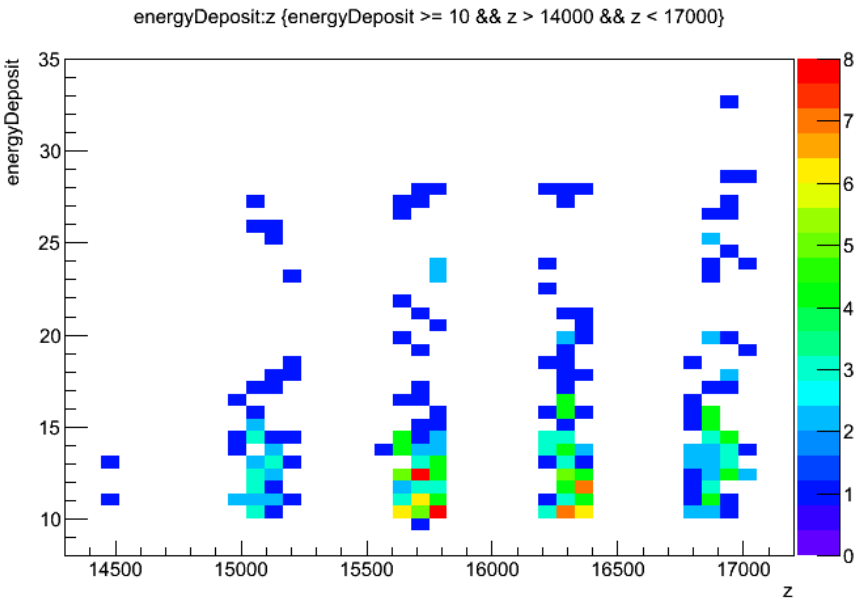


- In simulation, without Air Bag, most neutrons just disappear in the gap.

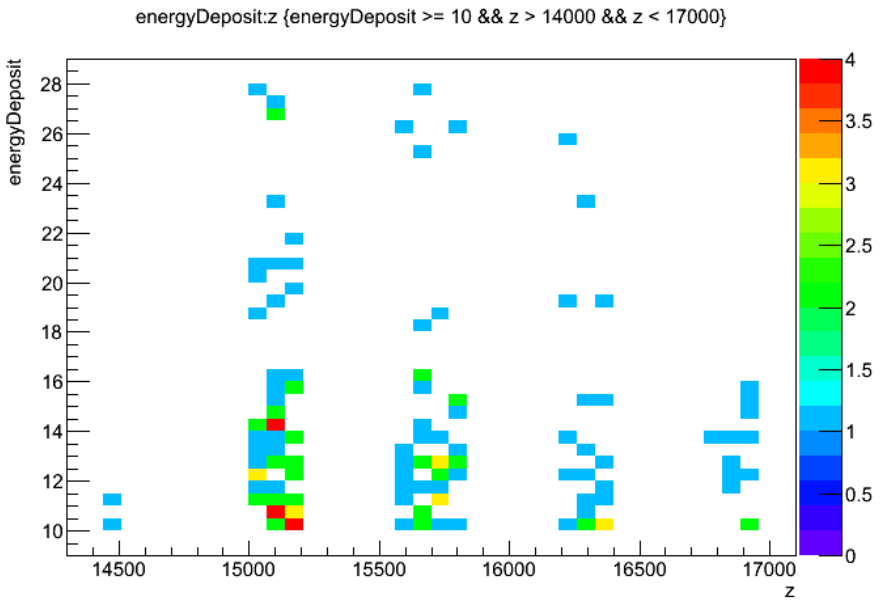
With Air Bag VS. Without Air Bag

- Pinpoint neutron beam with energy : 300 MeV
- 2D histogram(the number of hits) – energyDeposit : z position
- Threshold : 10 MeV

With Air Bag



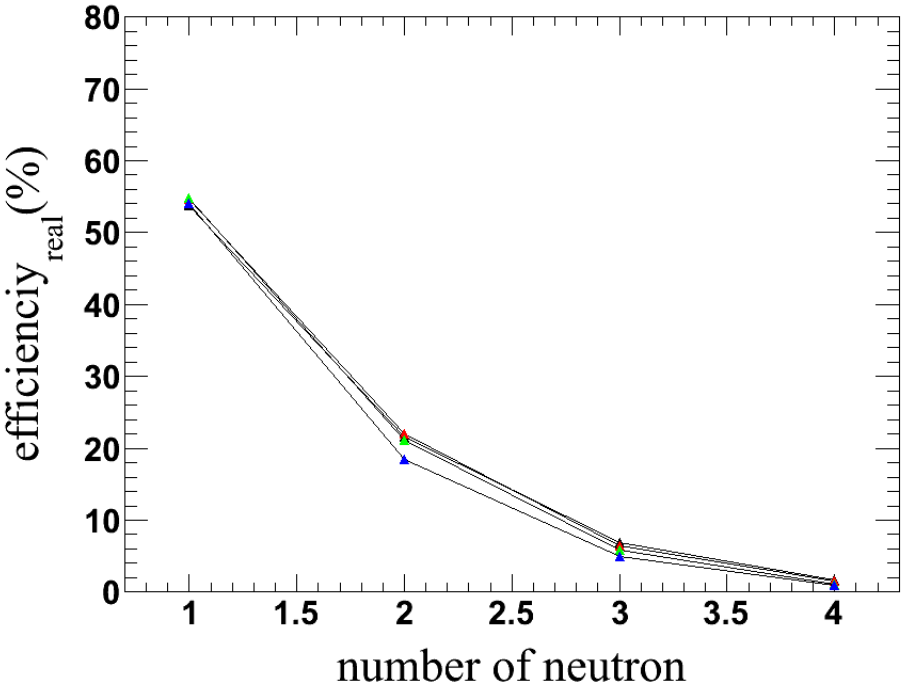
Without Air Bag



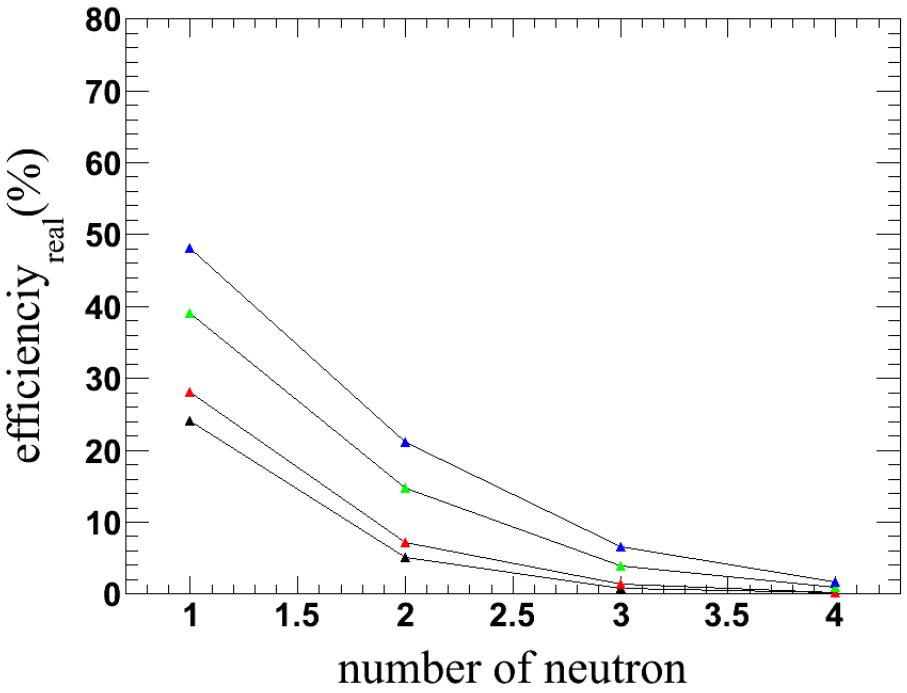
Black : 3 MeV
Red : 5 MeV
Green : 7 MeV
Blue : 10 MeV

All Condns. with 0 cm Gap

Energy : 100 MeV

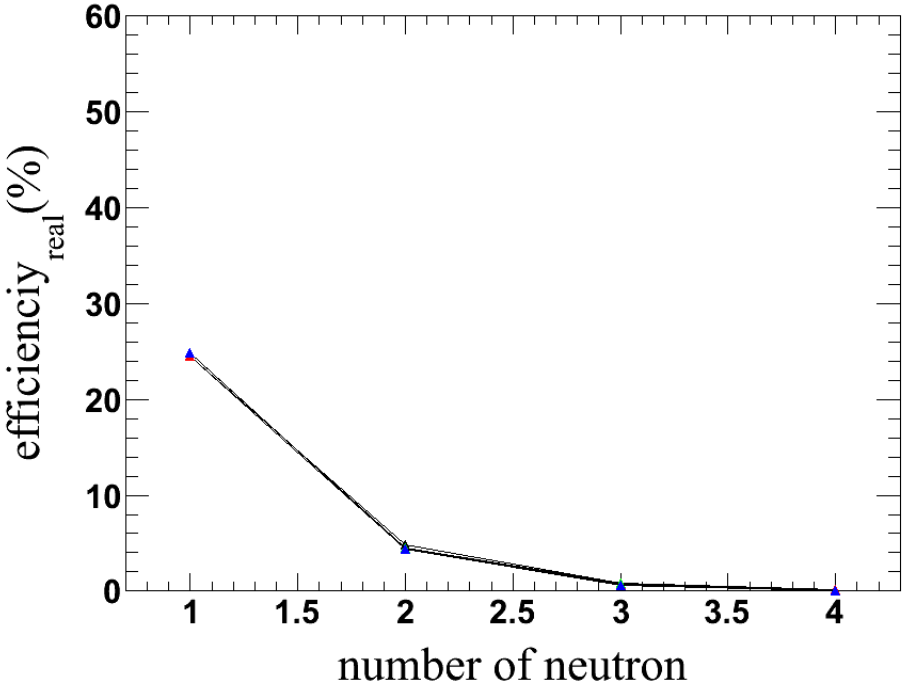


300 MeV

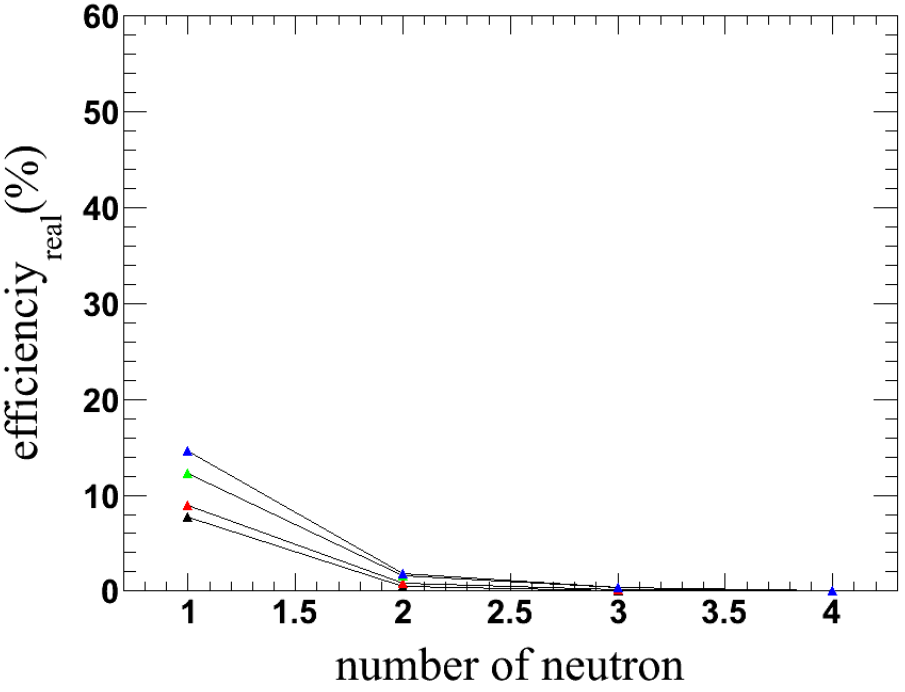


All Condns. with 60 cm Gap, without Air Bag

Energy : 100 MeV



300 MeV

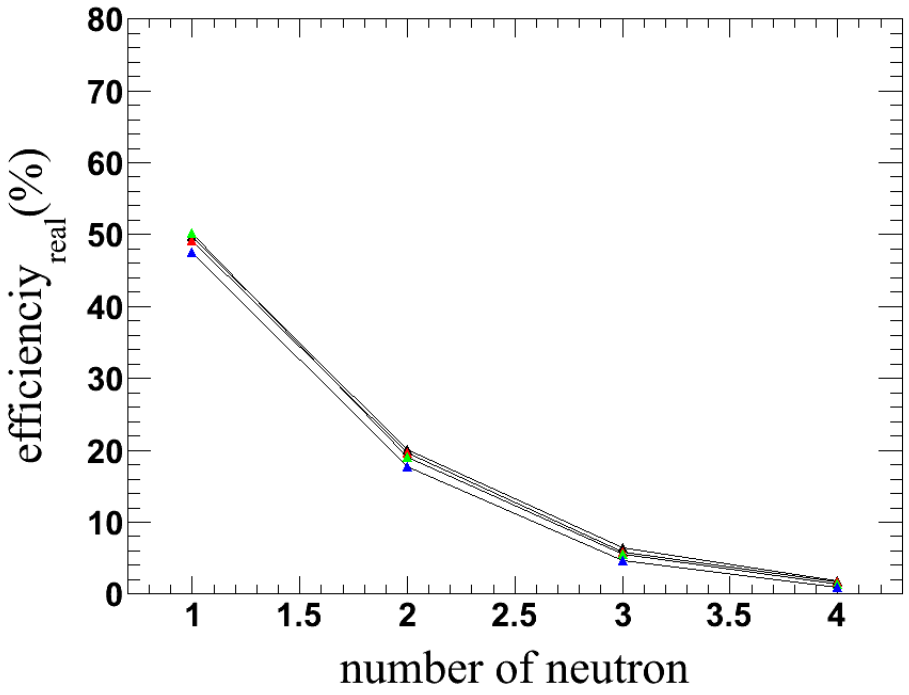


Black : 3 MeV
Red : 5 MeV
Green : 7 MeV
Blue : 10 MeV

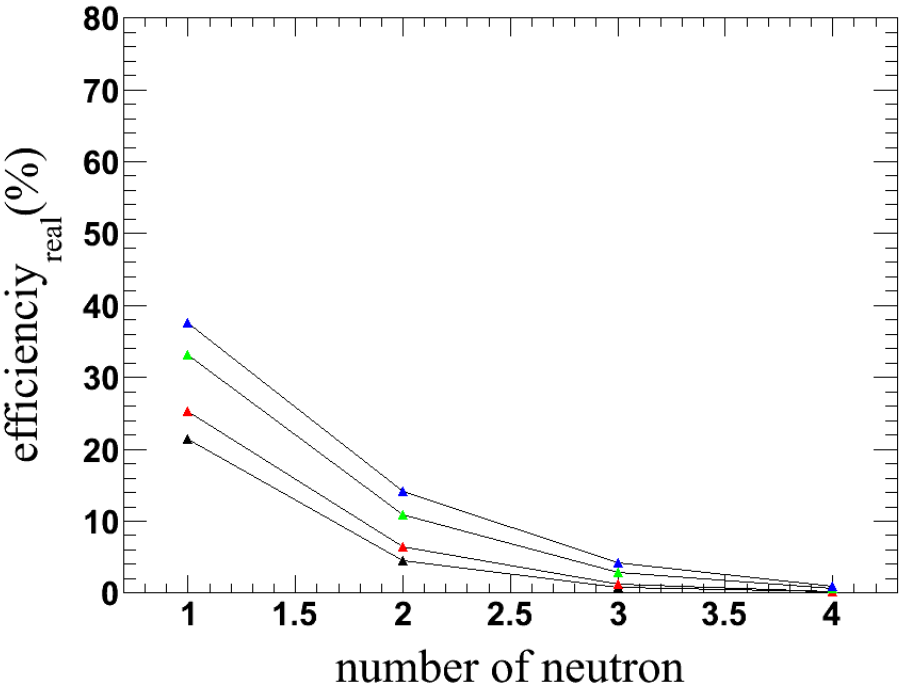
Black : 3 MeV
Red : 5 MeV
Green : 7 MeV
Blue : 10 MeV

All Condns. with 60 cm Gap, Air Bag

Energy : 100 MeV



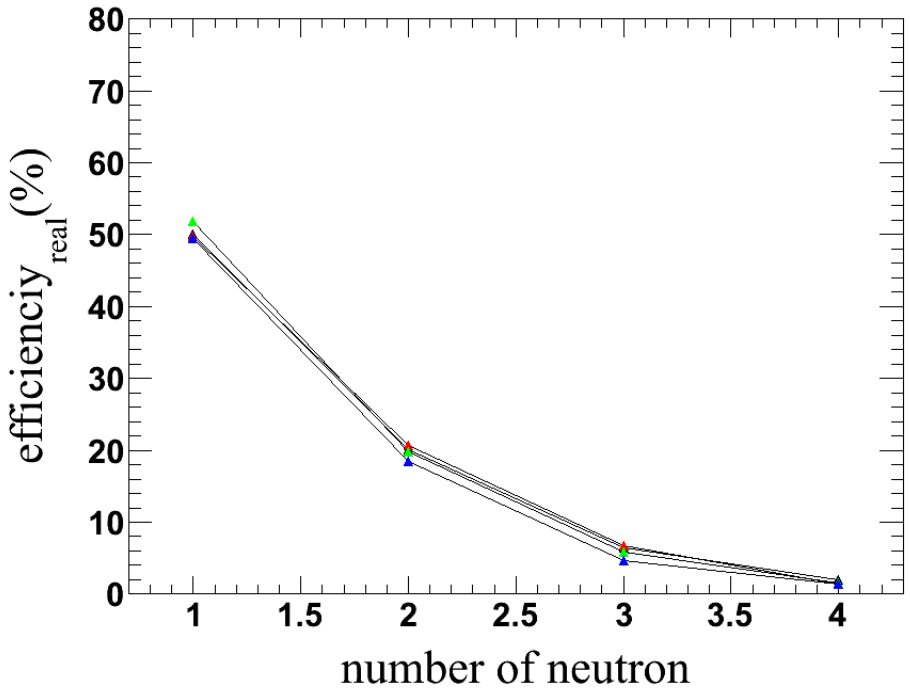
300 MeV



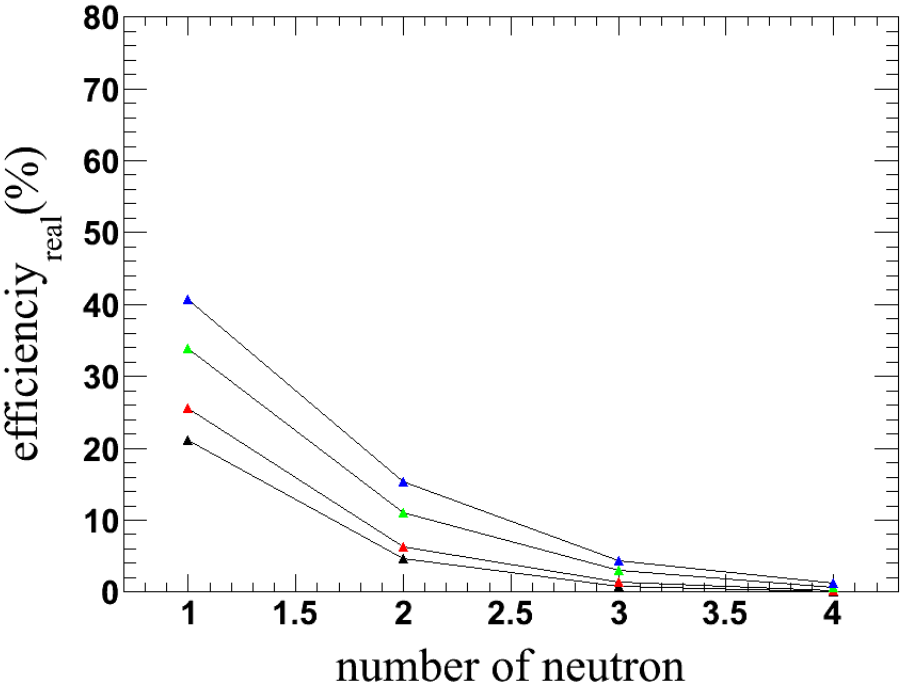
Black : 3 MeV
Red : 5 MeV
Green : 7 MeV
Blue : 10 MeV

All Condns. with 40 cm Gap, Air Bag

Energy : 100 MeV

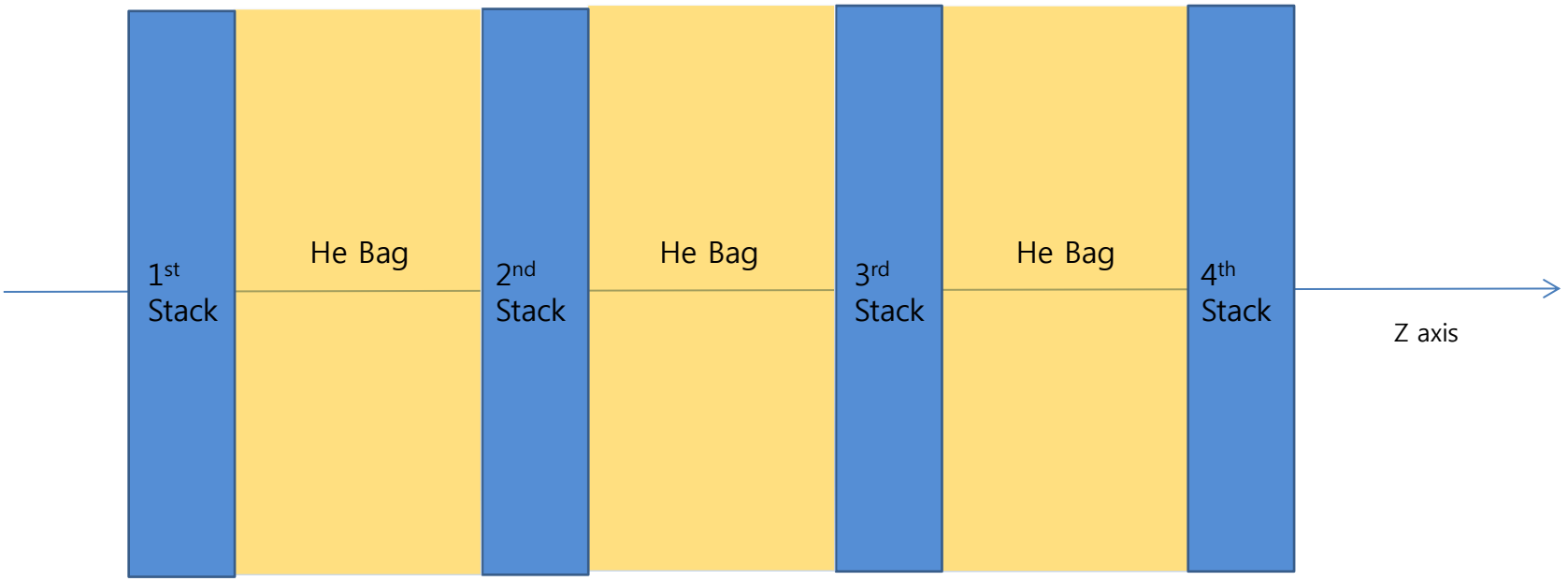


300 MeV



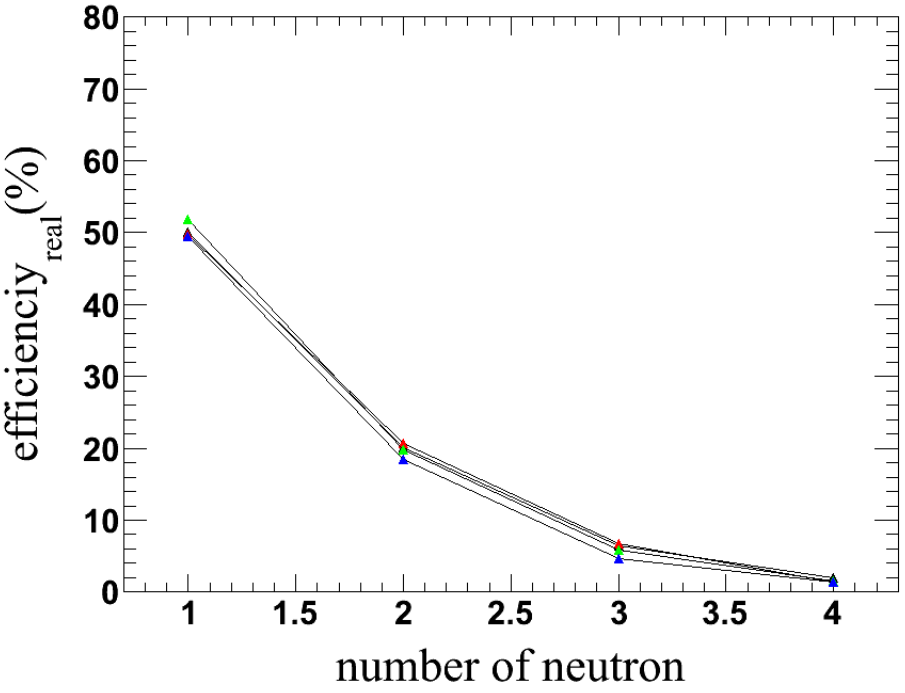
Change in Detector Construction

- Air Bag → He Bag (Density : 1.786×10^{-3} g/cm^3)
- He : Neutrons are less scattered in Helium than in commom air

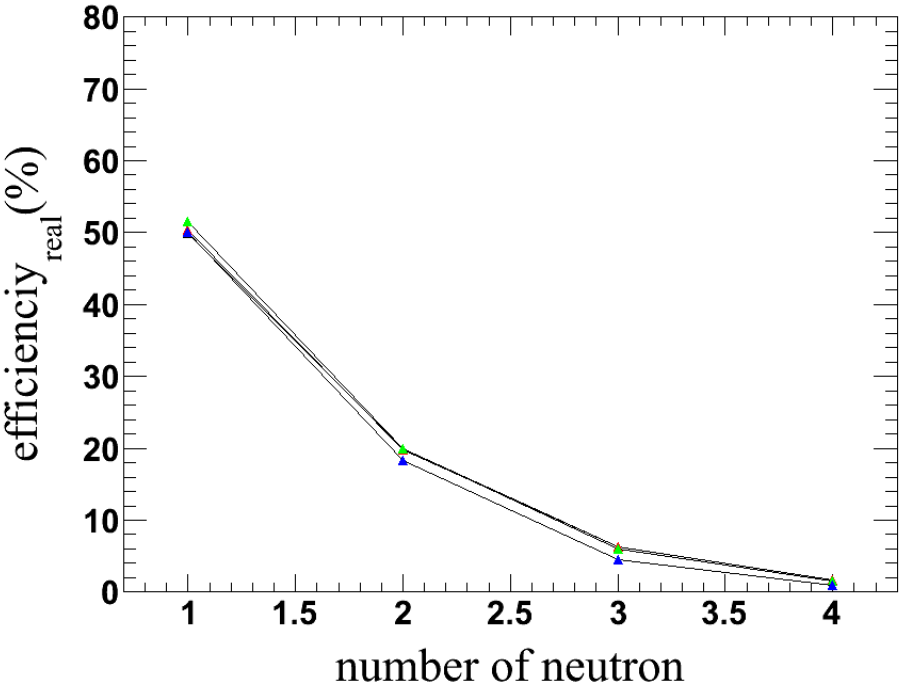


All Condns. with 40 cm Gap, 100 MeV, He Bag

Air Bag



He Bag

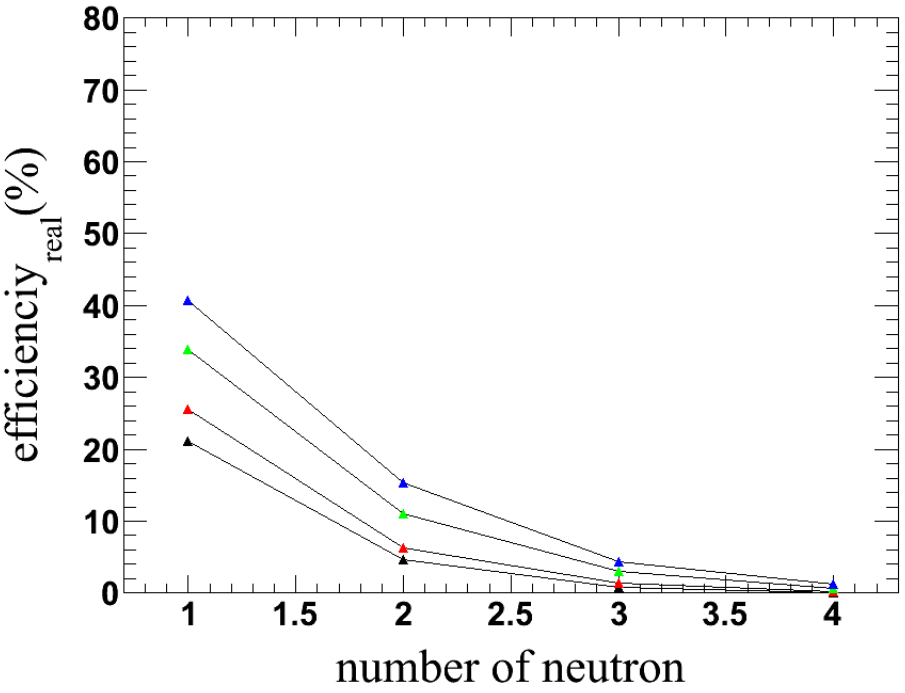


- No difference.

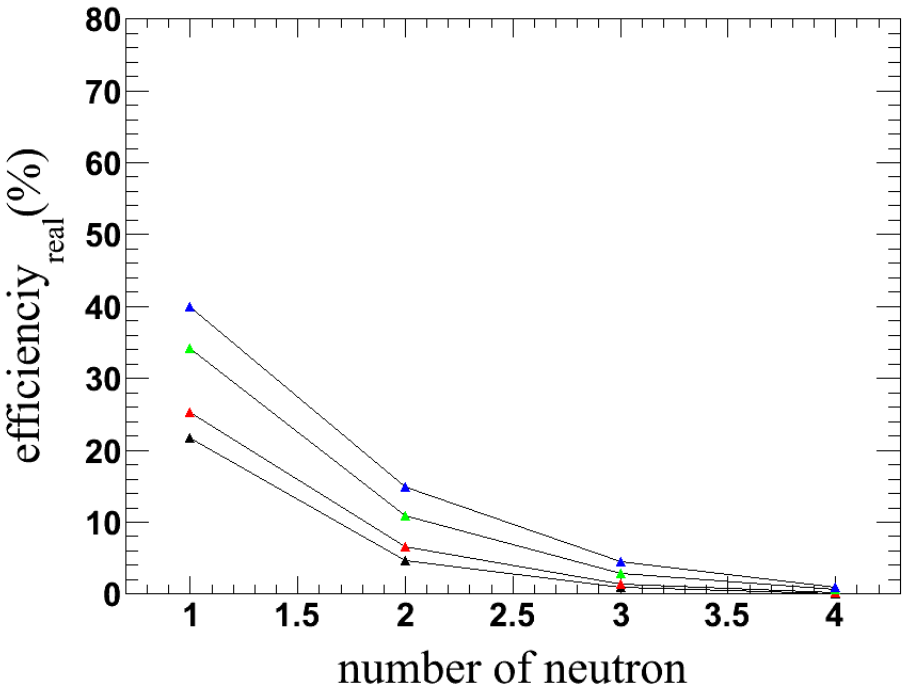
Black : 3 MeV
Red : 5 MeV
Green : 7 MeV
Blue : 10 MeV

All Condns. with 40 cm Gap, 300 MeV, He Bag

Air Bag



He Bag



- No difference.

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

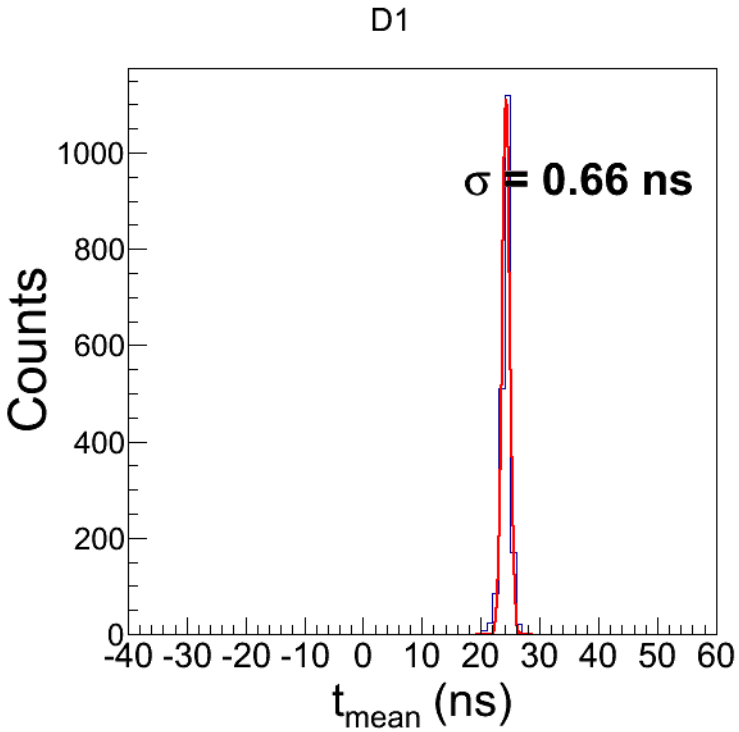
Next Step

I. Why exactly the result is different between the case of "with Air Bag" & "without Air Bag" ?

II. Still have to find out the reason of "threshold inversion" when the neutron energy is 300 MeV.

III. Need to compare the event of "Pass" with that of "Failure".

Time Resolution of Bar Detector



- Event : 2000 events
- PMT voltage
  - Ch. 1 : 1550 V
  - Ch. 2 : 1640 V
- Data time resolution $\sigma_{data} \approx 0.662$ ns
- Trigger time resolution $\sigma_{trigger} \approx 0.308$ ns
- Detector time resolution $\sigma_{detector} = \sqrt{{\sigma_{data}}^2 - {\sigma_{trigger}}^2} \approx 0.586$ ns

Progress

- Position resolution of bar detector
  - 2 m 의 bar detector에서, 한 쪽 끝에서부터 20 cm 간격마다 500 event 씩의 muon data를 받는다. 총 10개의 data를 얻는다. (완료)
  - 10개의 경우 각각에 대해서, Bar detector 양 끝에 도달하는 신호의 시간차의 평균값과 표준편차를 구한다. (완료)
  - 양쪽 끝에 도달하는 두 신호의 시간차 VS 측정 위치에서 detector 양 끝까지의 거리차를 fitting하여 그리고, 이 직선의 기울기와 y절편을 이용하여 position resolution을 구한다. (진행중)

- Voltage Upper Limit
  - Ch. 1 : 1550 V, Ch. 2 : 1640 V 에서 시작하여, 양쪽 전압을 모두 50 V 씩 올려가면서, 각각의 경우 가능한 많은 event의 data를 받는다. (현재 Ch. 1 : 1750 V, Ch. 2 : 1840 V data taking 진행중)
  - PMT의 전압을 어디까지 올릴 수 있을지 결정한다.