

# Group Meeting

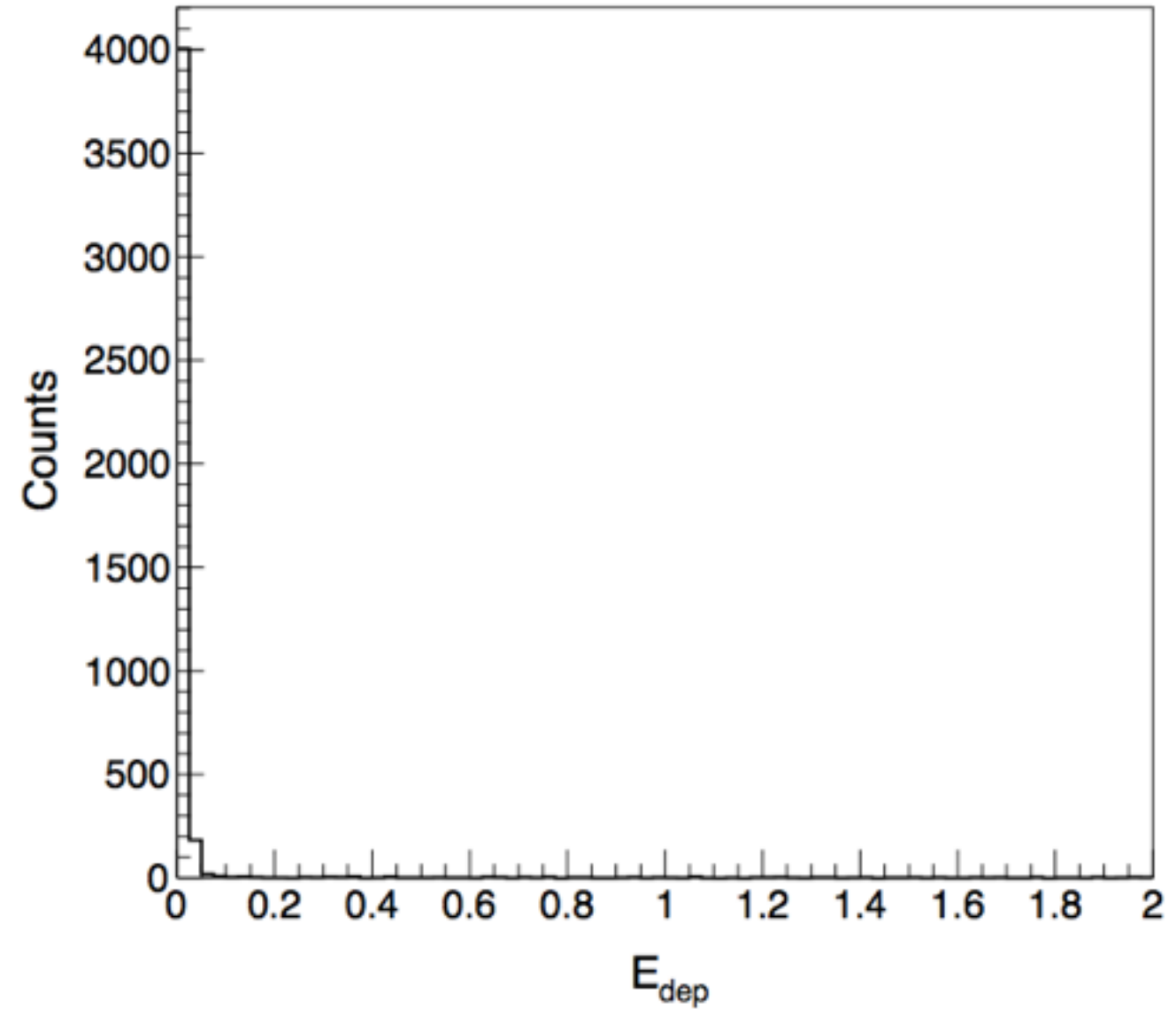
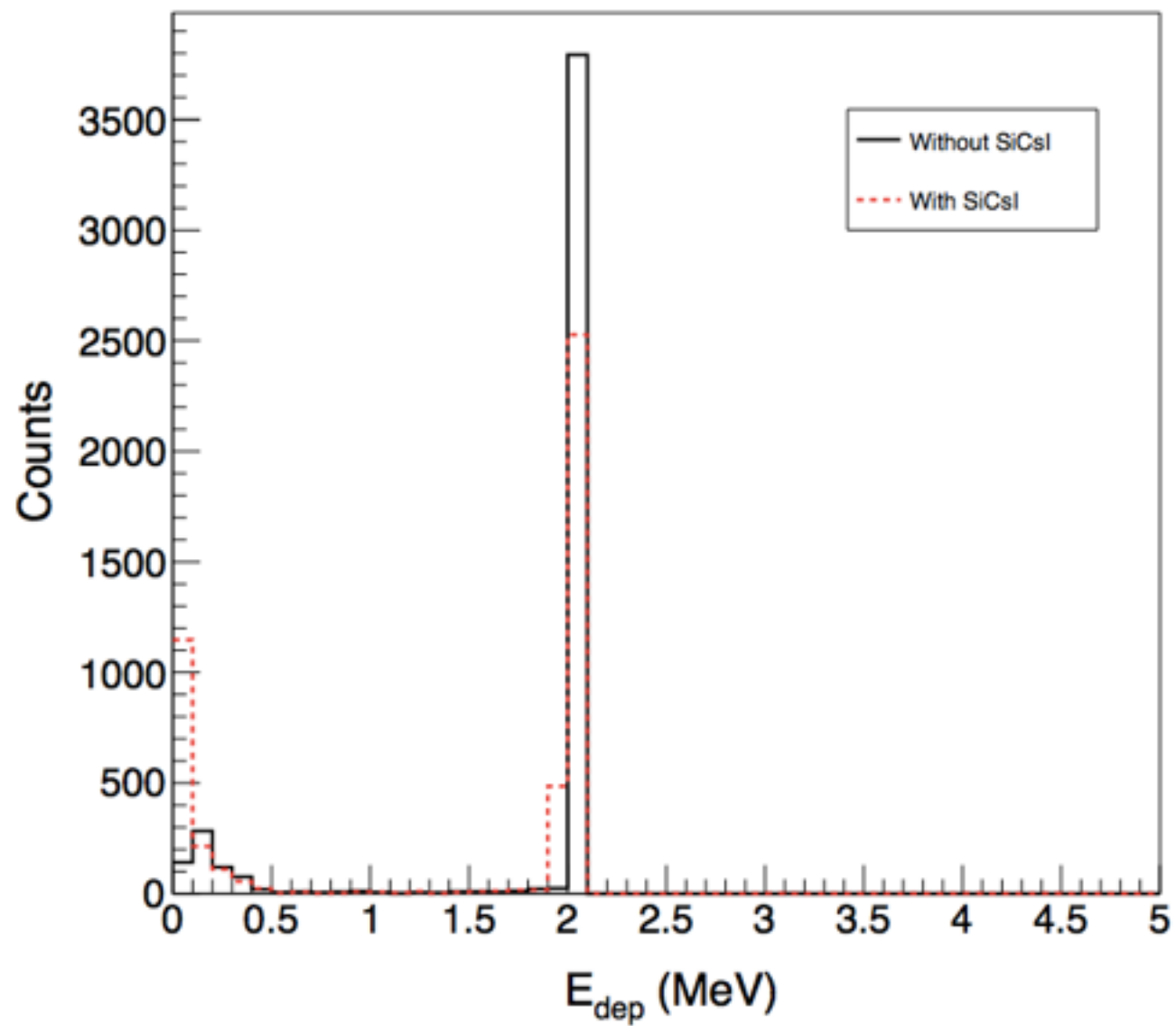
Status of LAMPS-low simulation

Jaebeom, Jaehee

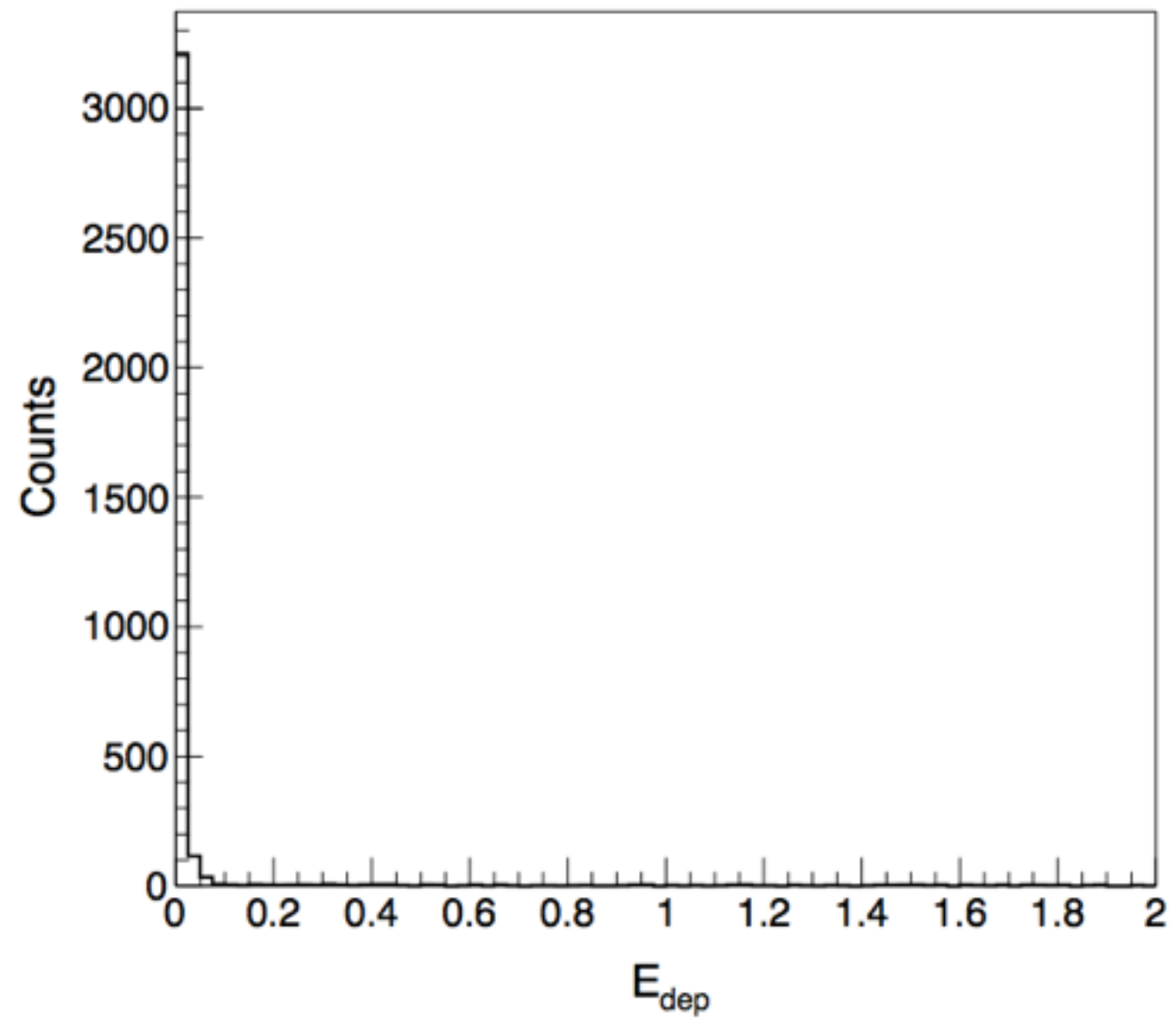
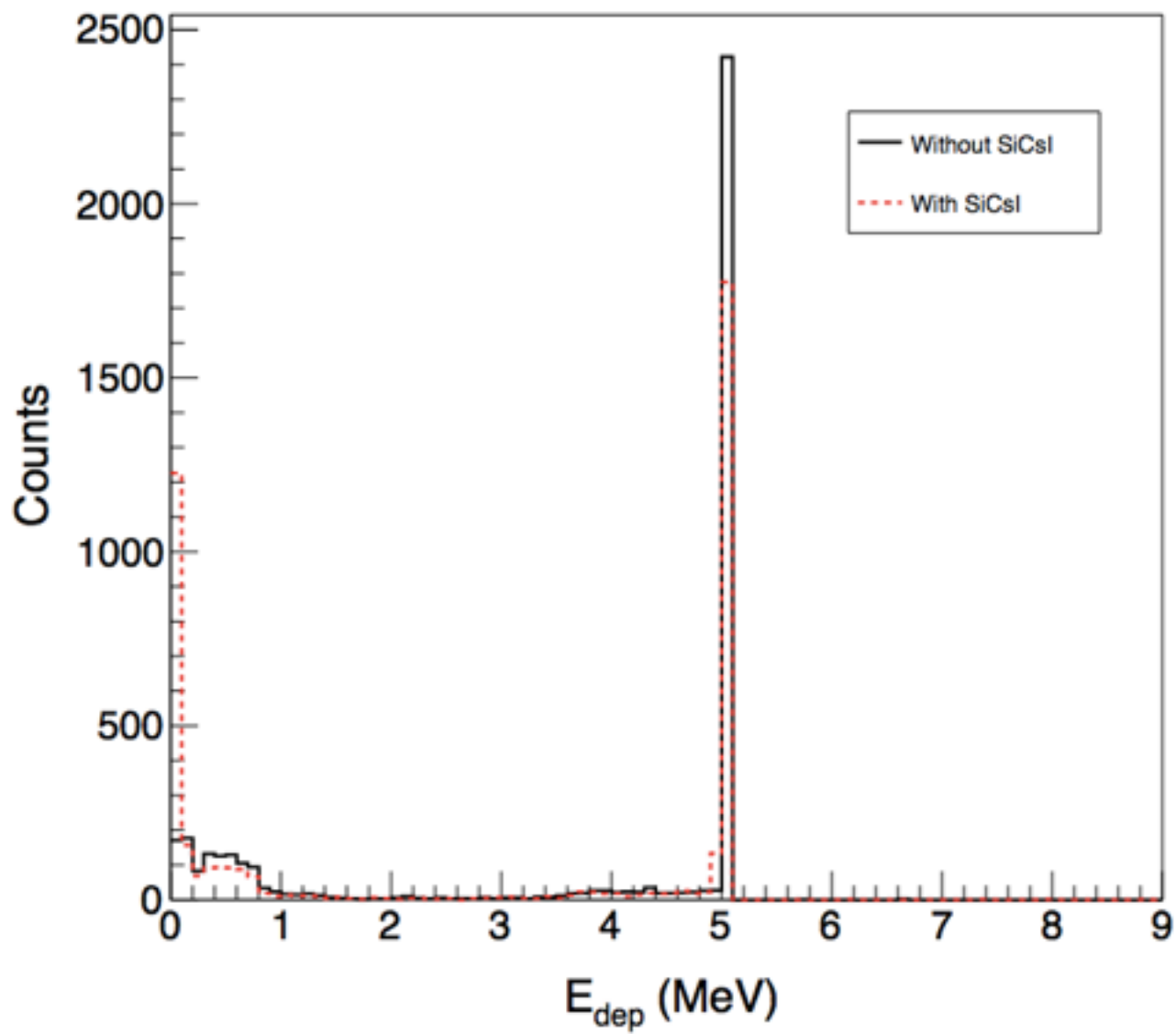
# Neutron detector simulation

- 1 Silicon (100 $\mu$ m), 1 Csl (5cm), 1 Scintillator (20cm)
- Neutron run : each 5000 event for different energy
- Energy : 3MeV, 5MeV, 7MeV, 10MeV, 15MeV

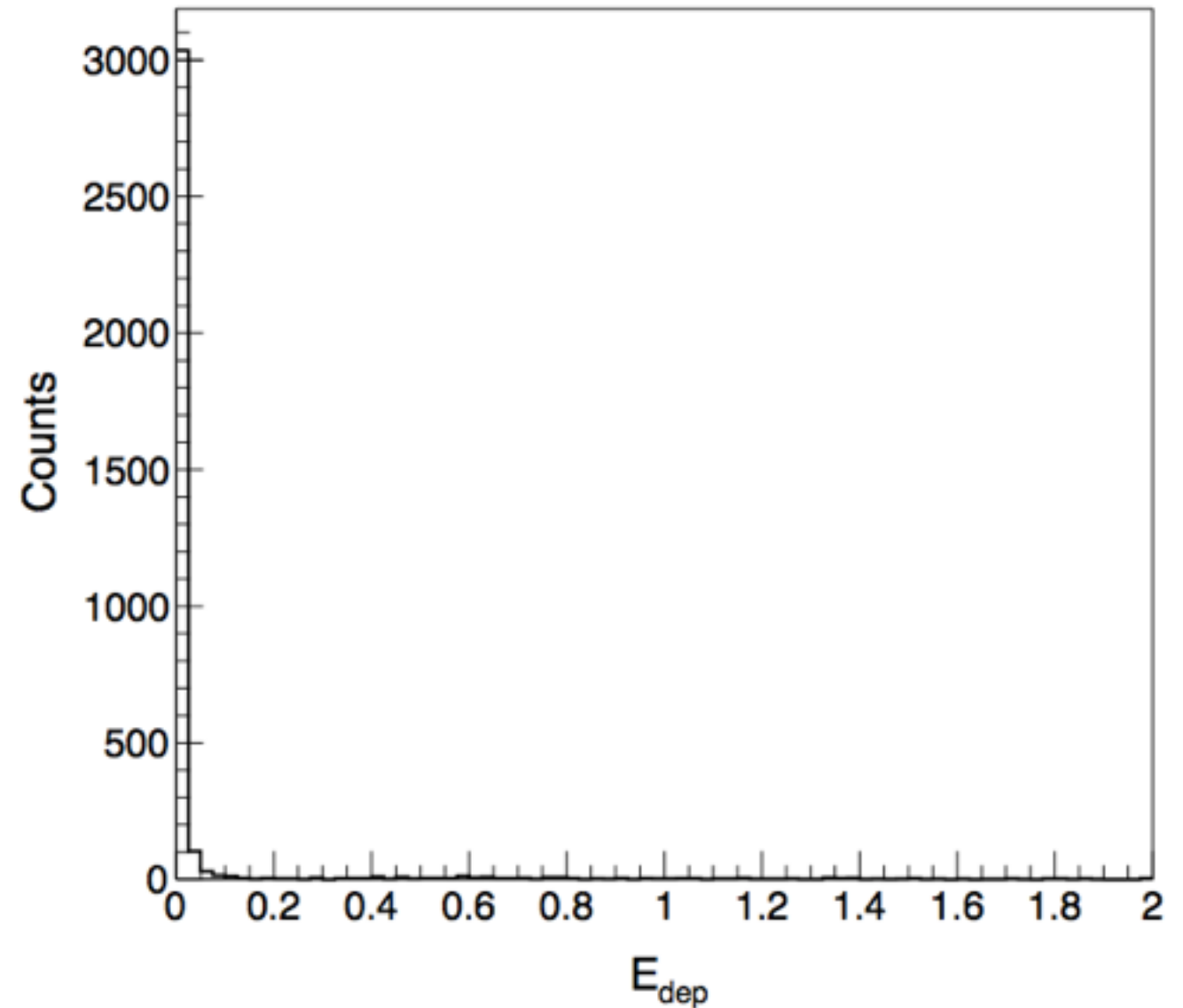
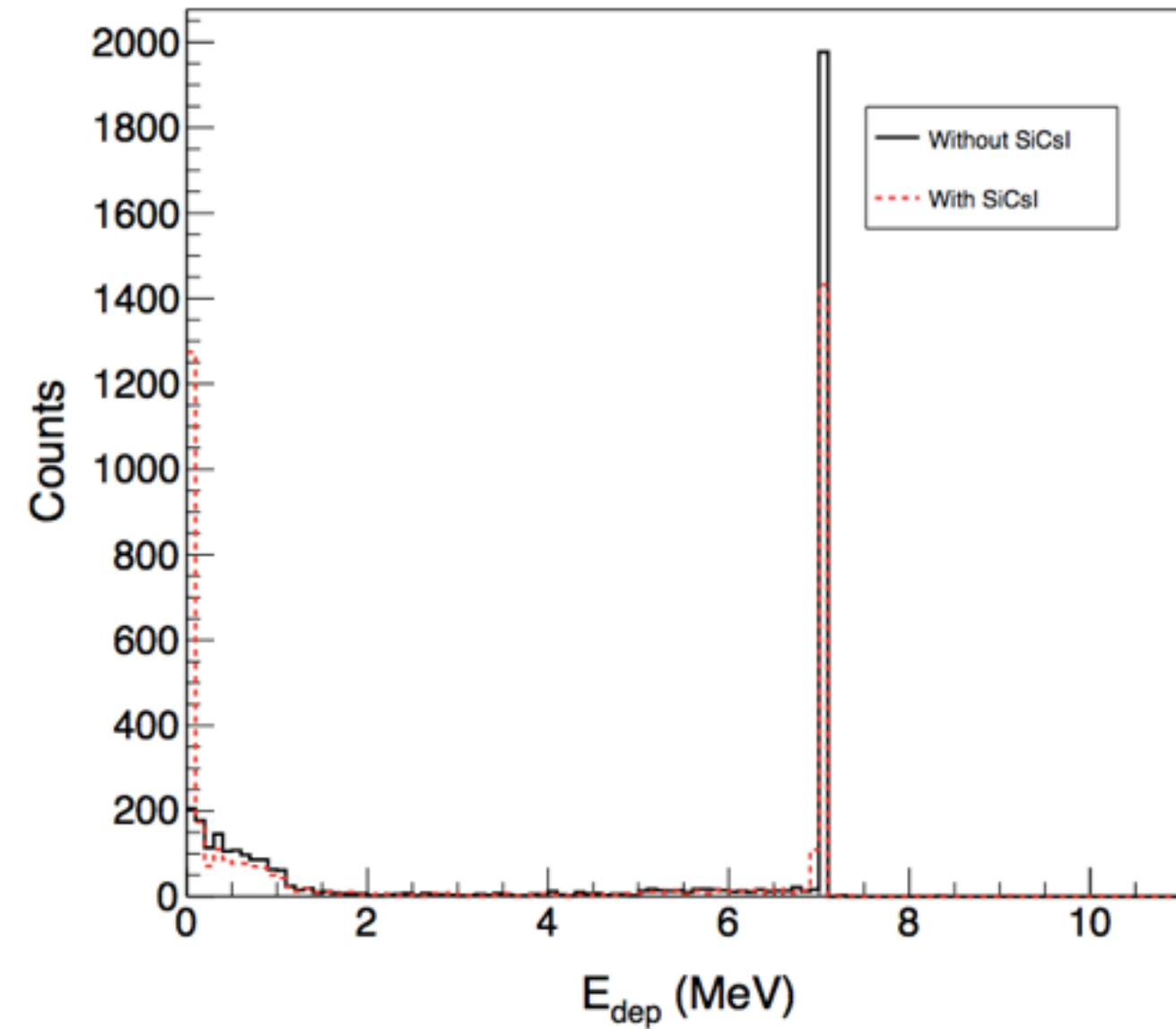
# 3MeV - 5000 events



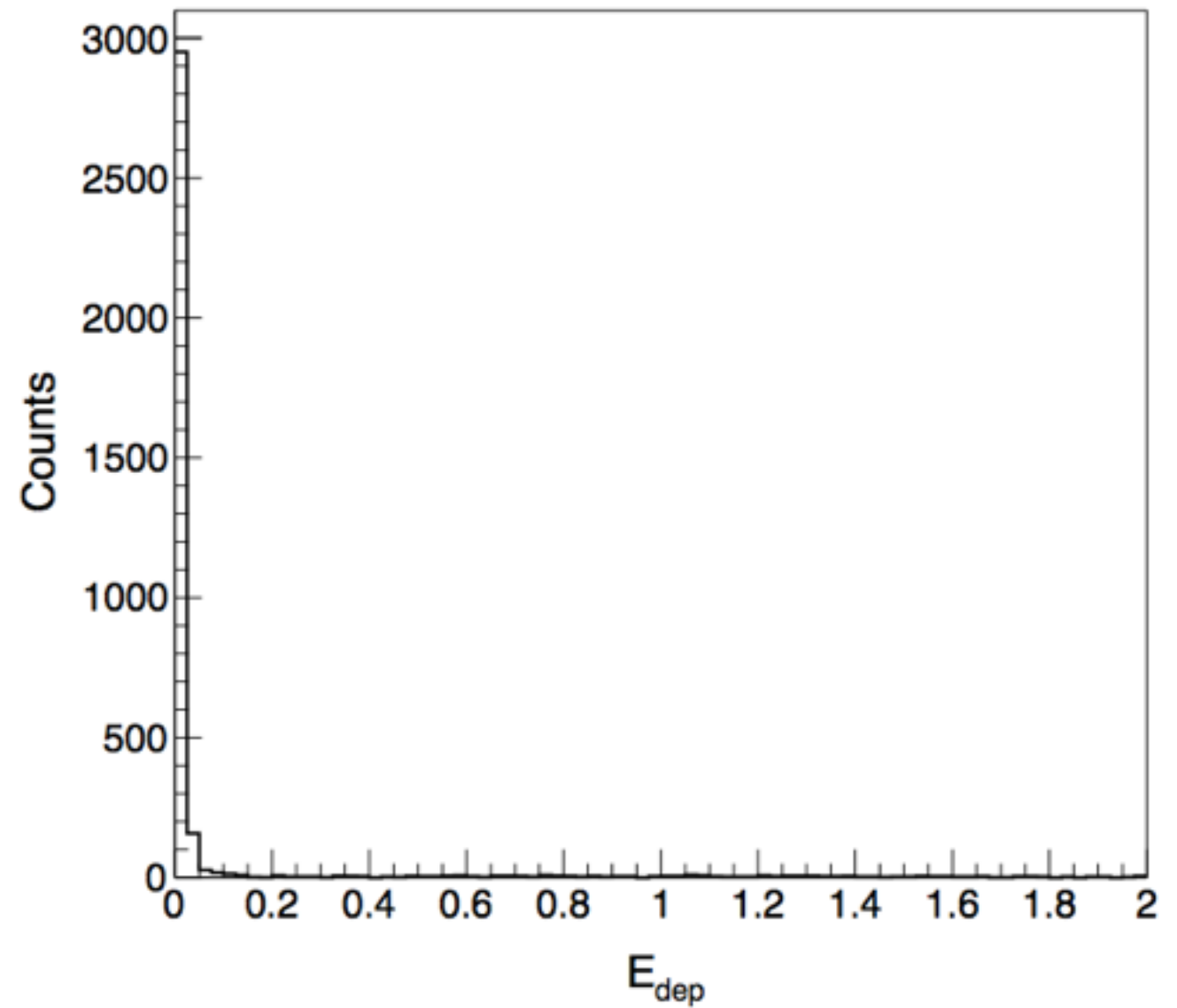
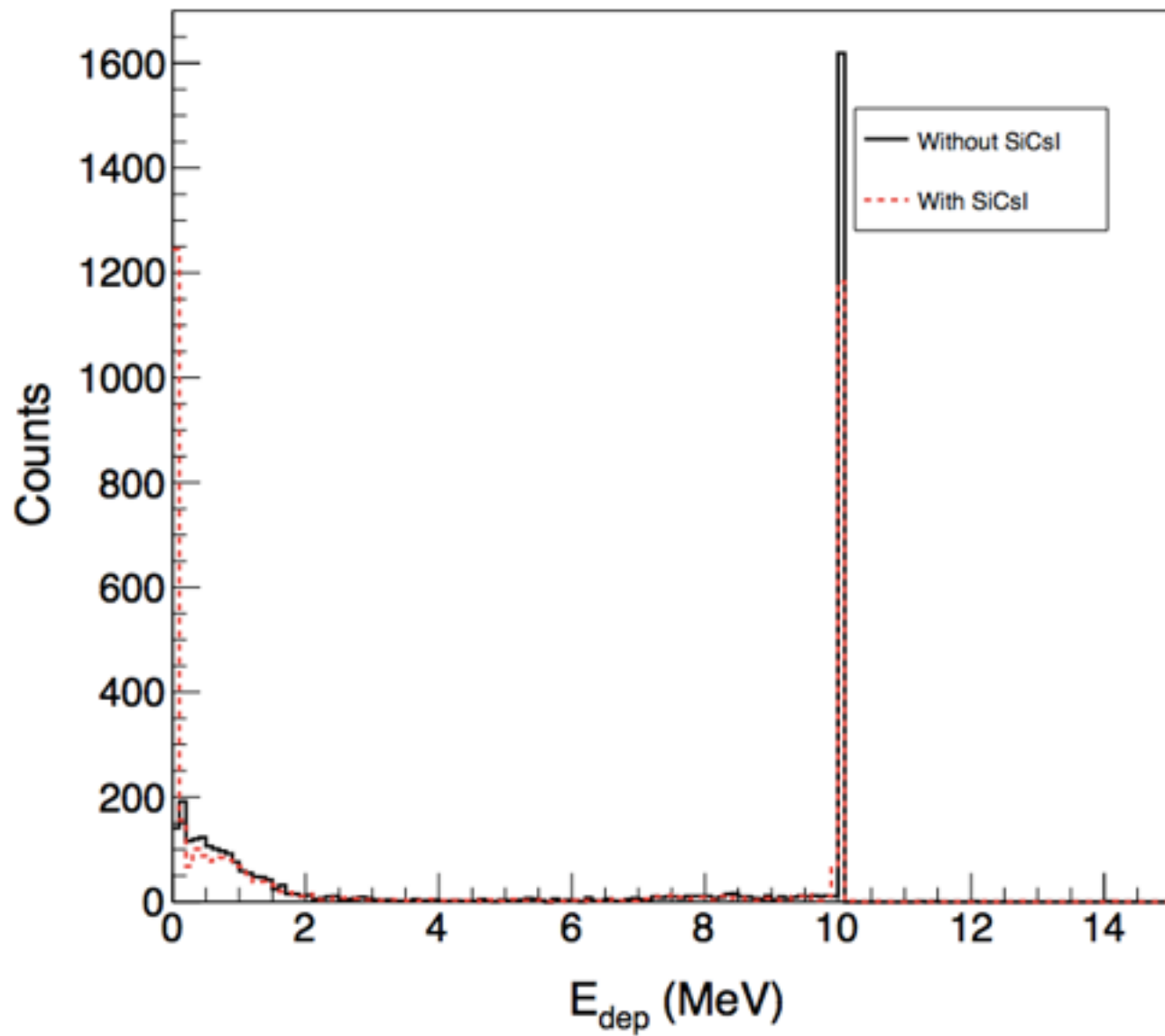
# 5MeV - 5000 events



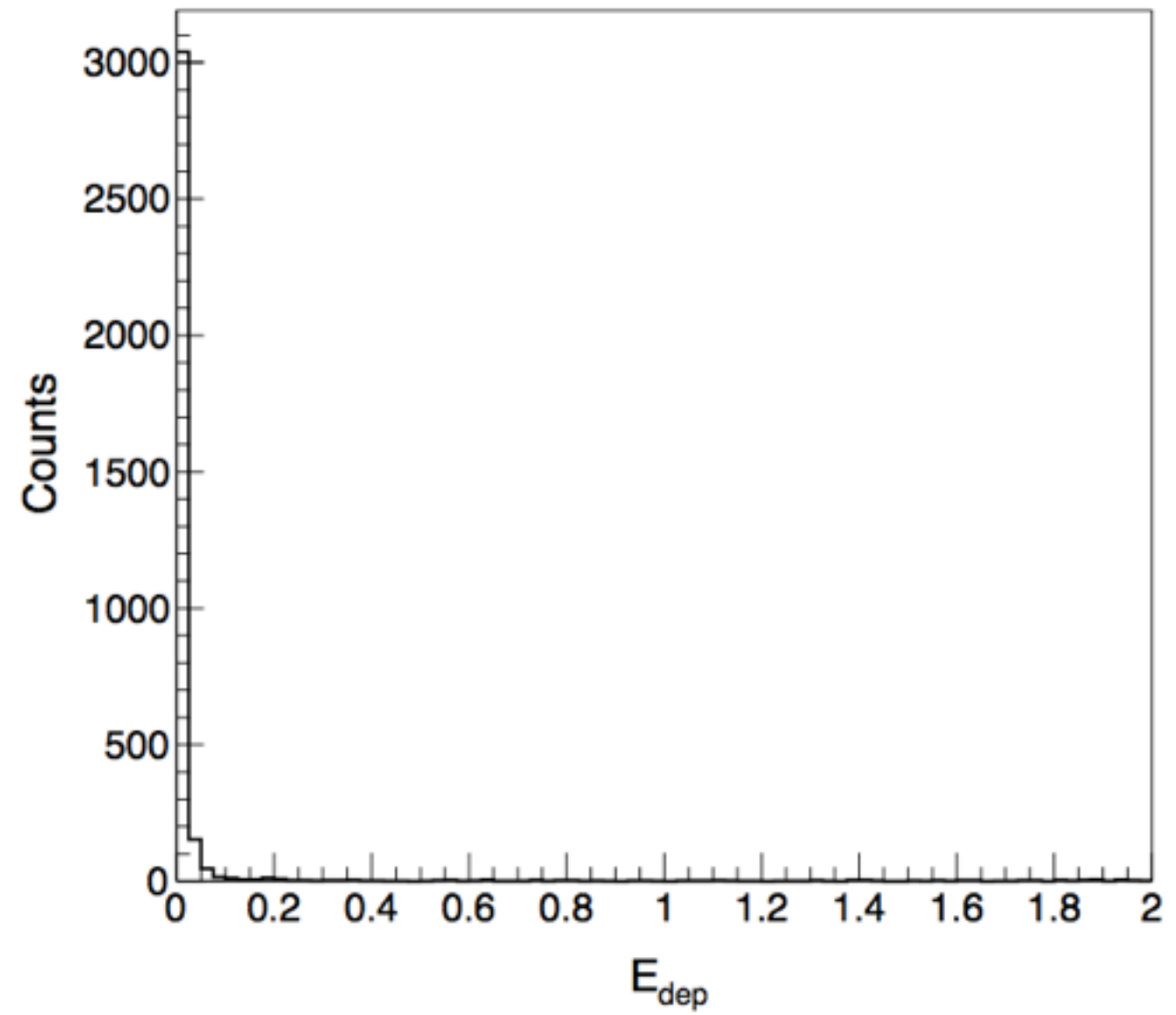
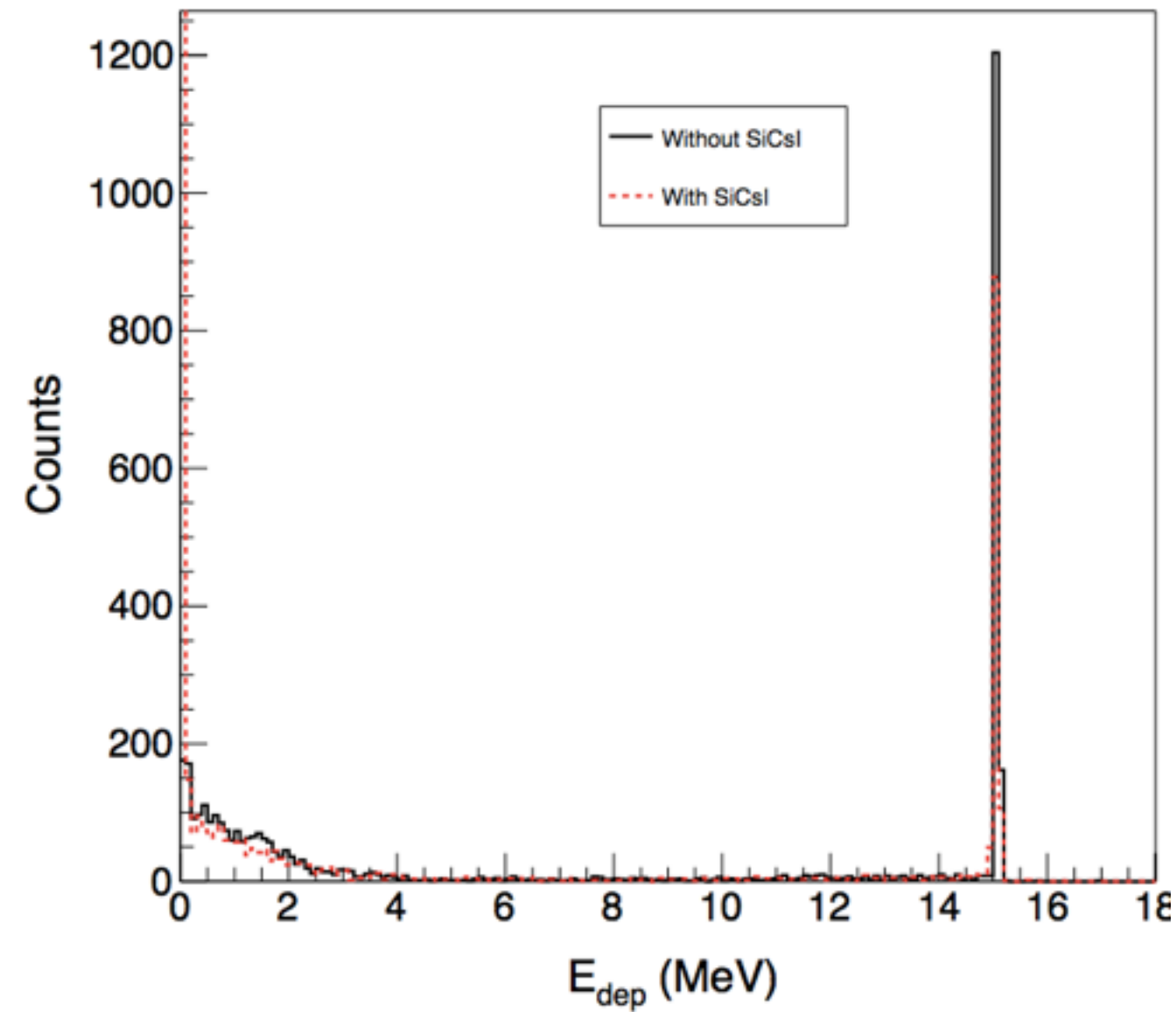
# 7MeV - 5000 events



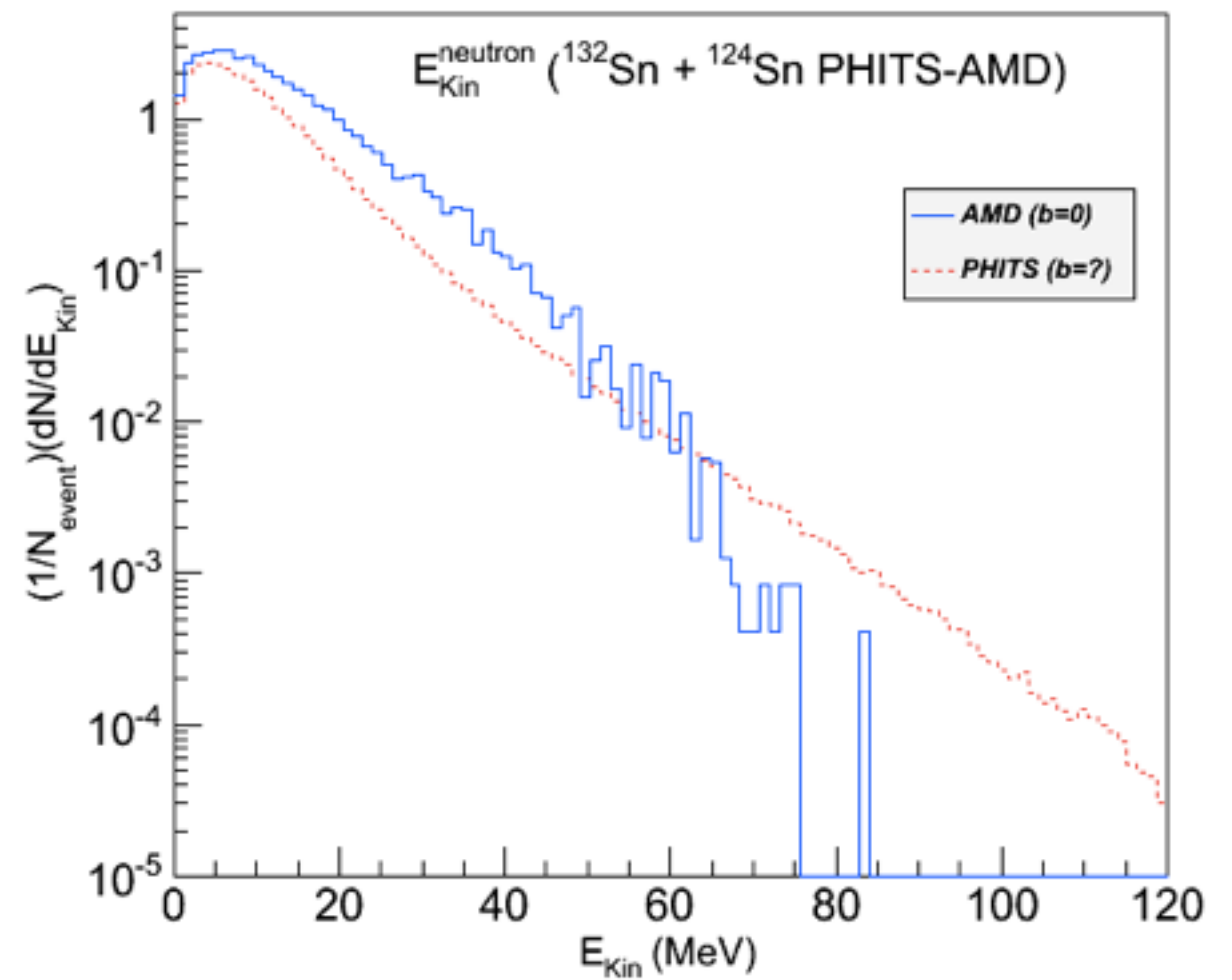
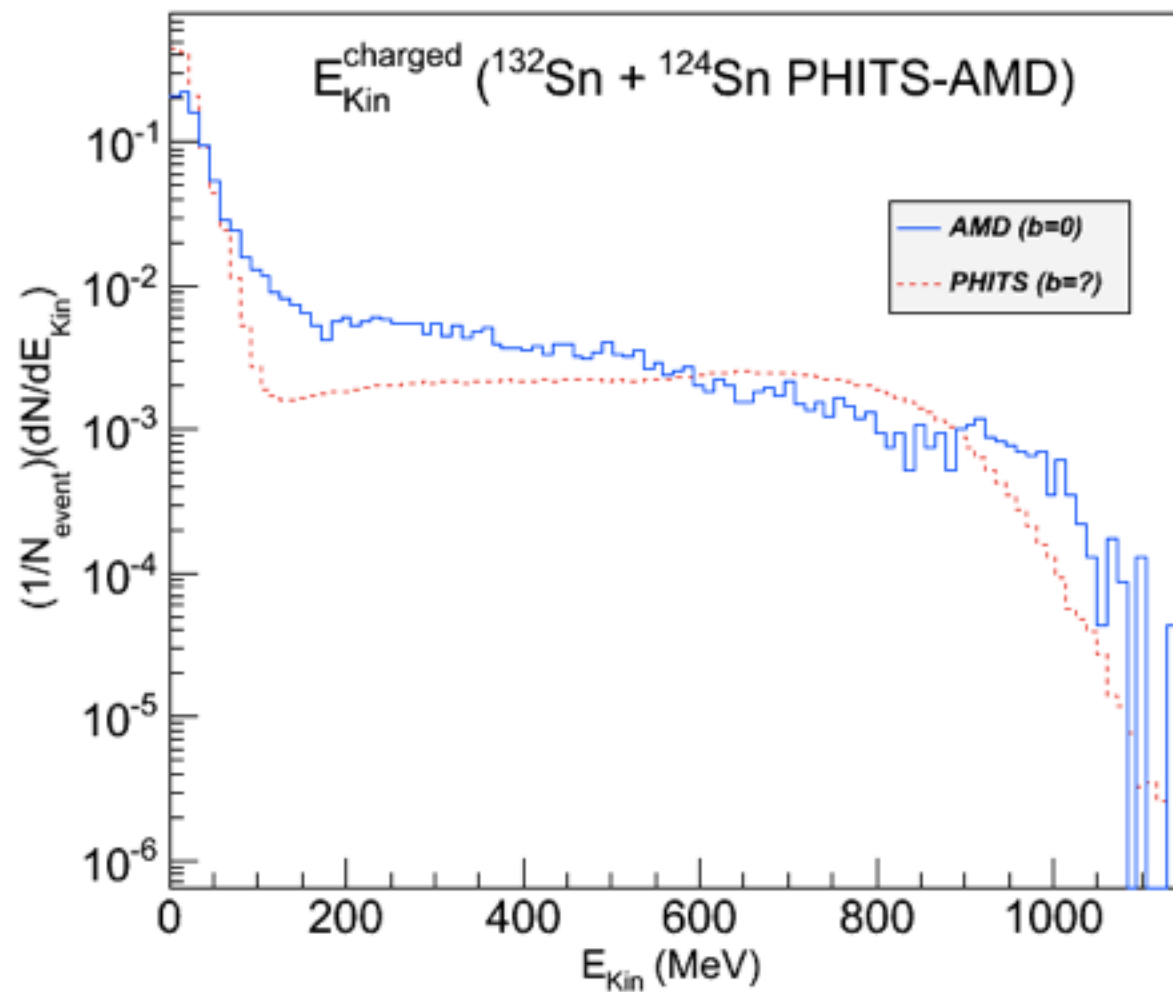
# 10MeV - 5000 events



# 15MeV - 5000 events



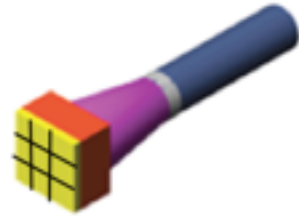
# AMD&PHITS – Kinetic Energy (Charged/Neutron)





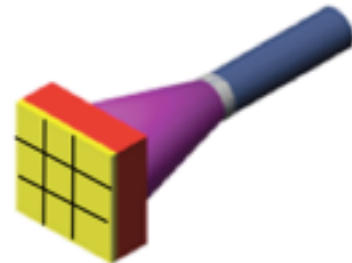
# SiCsI Geometry

**Total 58 detector units**  
 ( $17.5^\circ < \theta_{lab} < 77.5^\circ$ )  
 9 x 9 x 0.01 cm<sup>3</sup> Si (3 x 3 Pad)  
 9 x 9 x 5 cm<sup>3</sup> CsI (PMT readout)



CsI(T1) cover polar angle  $17.5^\circ \sim 150^\circ$   
 $17.5^\circ \sim 77.5^\circ$  : 4 detector pieces  
 (15° interval)

**Total 35 detector units**  
 ( $78^\circ < \theta_{lab} < 150^\circ$ )  
 15 x 15 x 0.01 cm<sup>3</sup> Si (3 x 3 Pad)  
 15 x 15 x 5 cm<sup>3</sup> CsI (PMT readout)



$78^\circ \sim 150^\circ$  : 3 detector pieces  
 (24° interval)

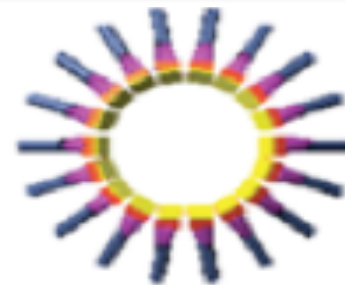
**8units**  
**25°**



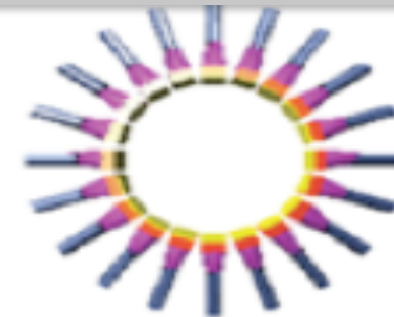
**12units**  
**40°**



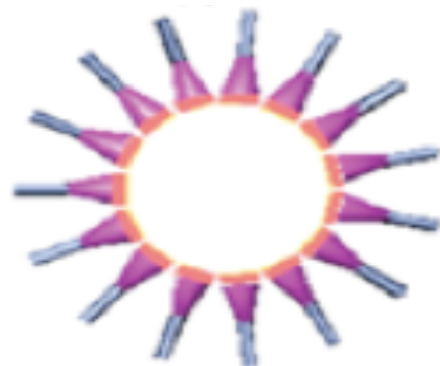
**18units**  
**55°**



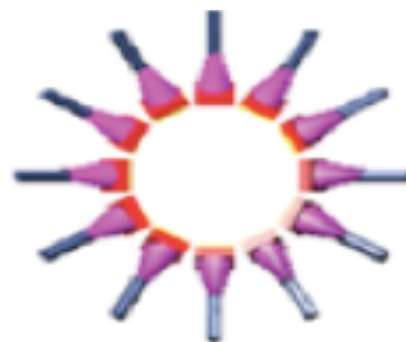
**20units**  
**70°**



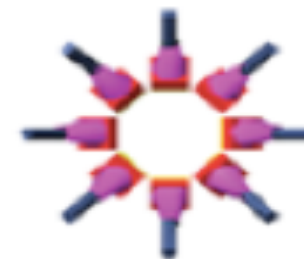
**15units**  
**90°**



**12units**  
**114°**



**8units**  
**138°**



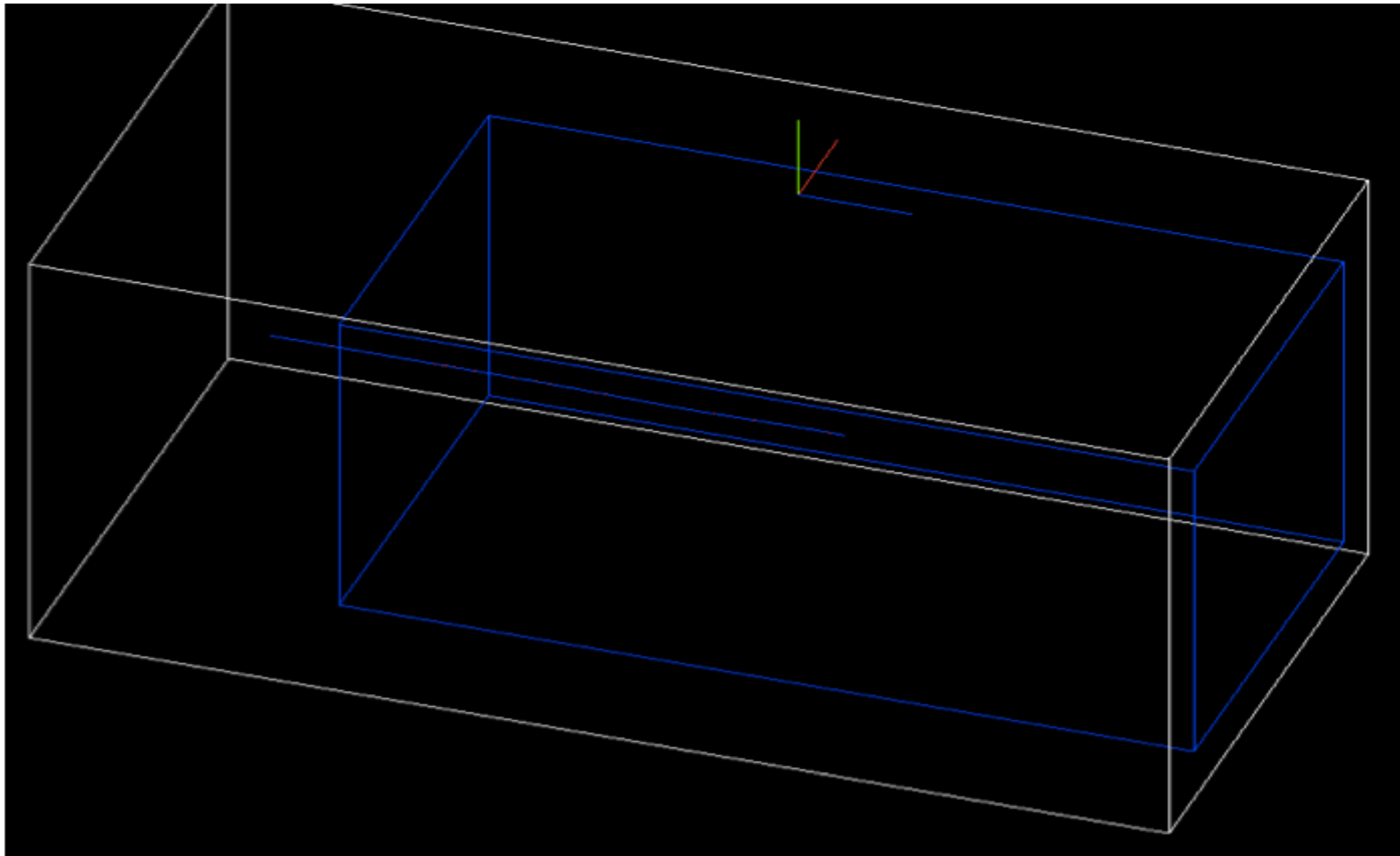
# 1st ring – change to vacuum

	N_gen( $\Delta\theta$ )	N_det( $\Delta\theta$ )	Det.CovRange (%) (simulation)	Det.CovRange (%) (geometrical)	# of particle/ Det.cell/event	Occupancy
1 : (17.5°< $\theta$ <32.5°)	2.67	1.53	57.25	58.43	0.191	0.0156
2 : (32.5°< $\theta$ <47.5°)	1.98	1.14	57.56	57.62	0.095	0.0077
3 : (47.5°< $\theta$ <62.5°)	1.71	1.14	66.88	67.81	0.063	0.0052
4 : (62.5°< $\theta$ <77.5°)	1.17	0.73	62.33	65.69	0.037	0.0030
5 : (77.5°< $\theta$ <102°)	1.10	0.84	76.36	79.11	0.056	0.0046
6 : (102°< $\theta$ <126°)	0.56	0.37	67.47	70.70	0.031	0.0025
7 : (126°< $\theta$ <150°)	0.25	0.14	57.03	64.35	0.018	0.0014

# Jihoon Chang

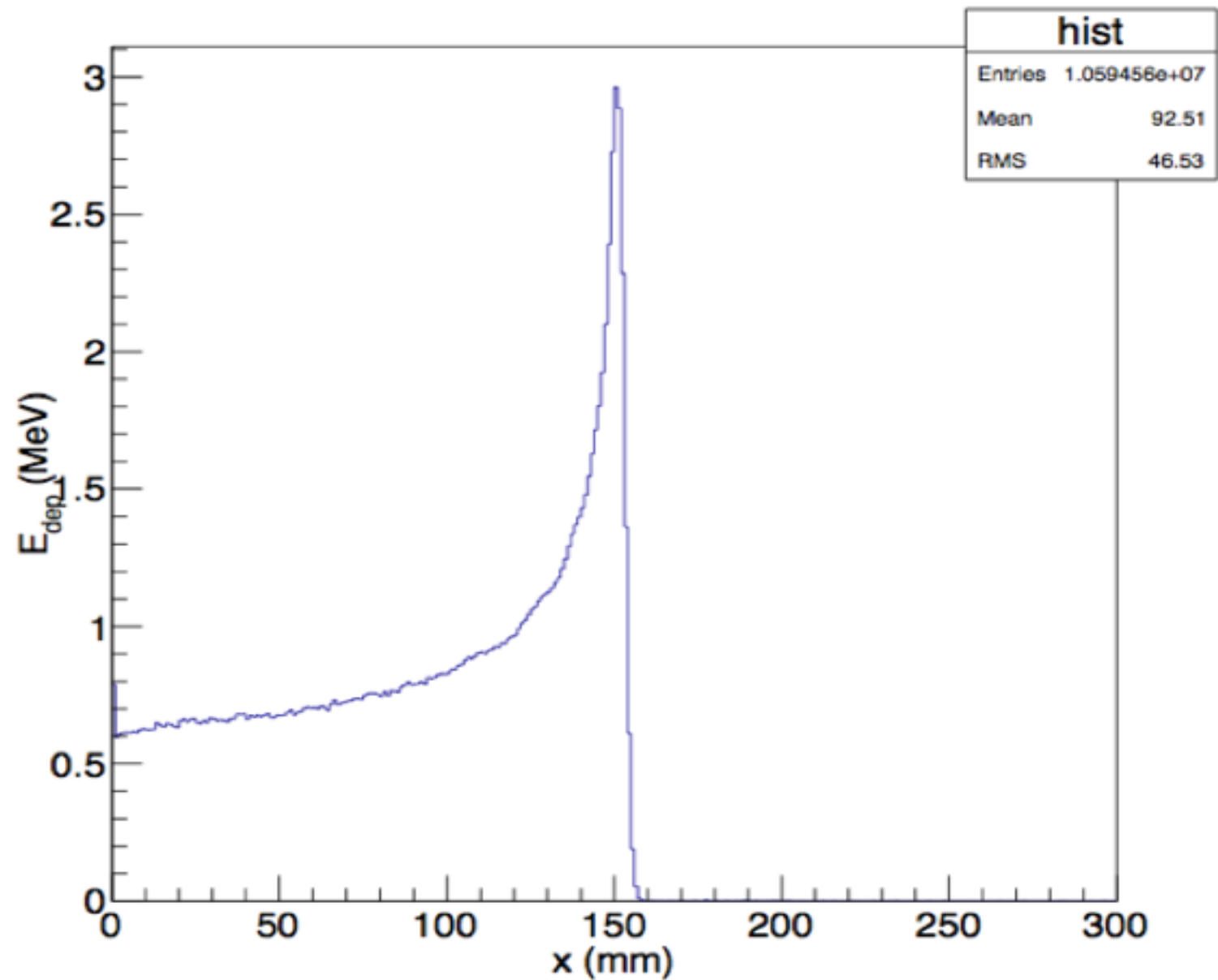
- Study c++ & root : making root file, drawing histogram, understanding tree and so on..
- Geant4 Study : practice with a simple example

# Jihoon Chang - Scintillator



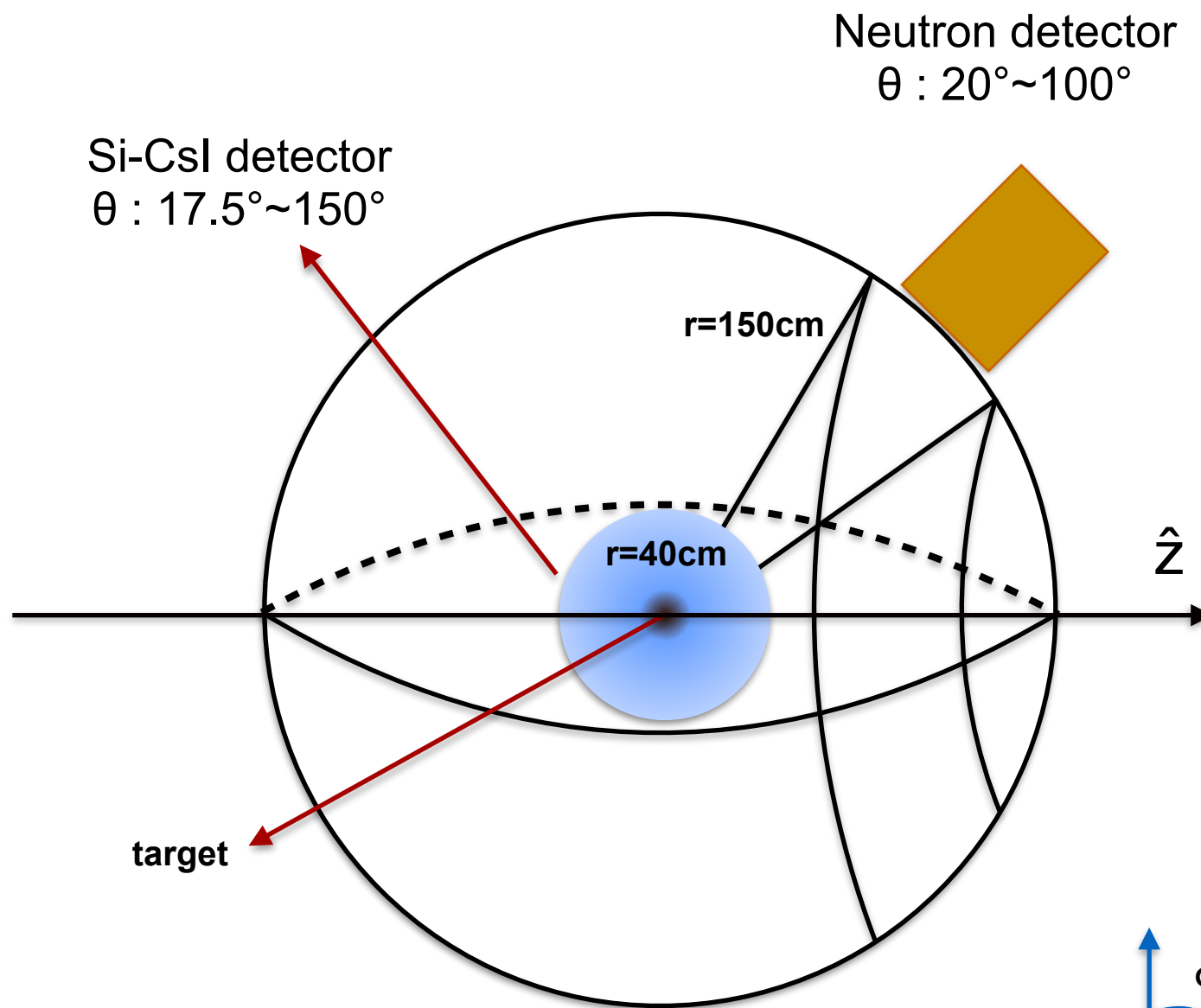
# Jang ji hoon - Purpose

- Event Number : 10000
- Proton Beam : 150 MeV
- Lab Size : 20x20x40 cm
- Detector Size : 15x15x30 cm



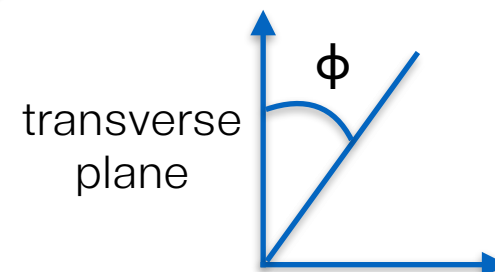
Back- up

# Neutron detector geometry



Neutron detector size :  $15 \times 15 \times 20 \text{cm}^3$

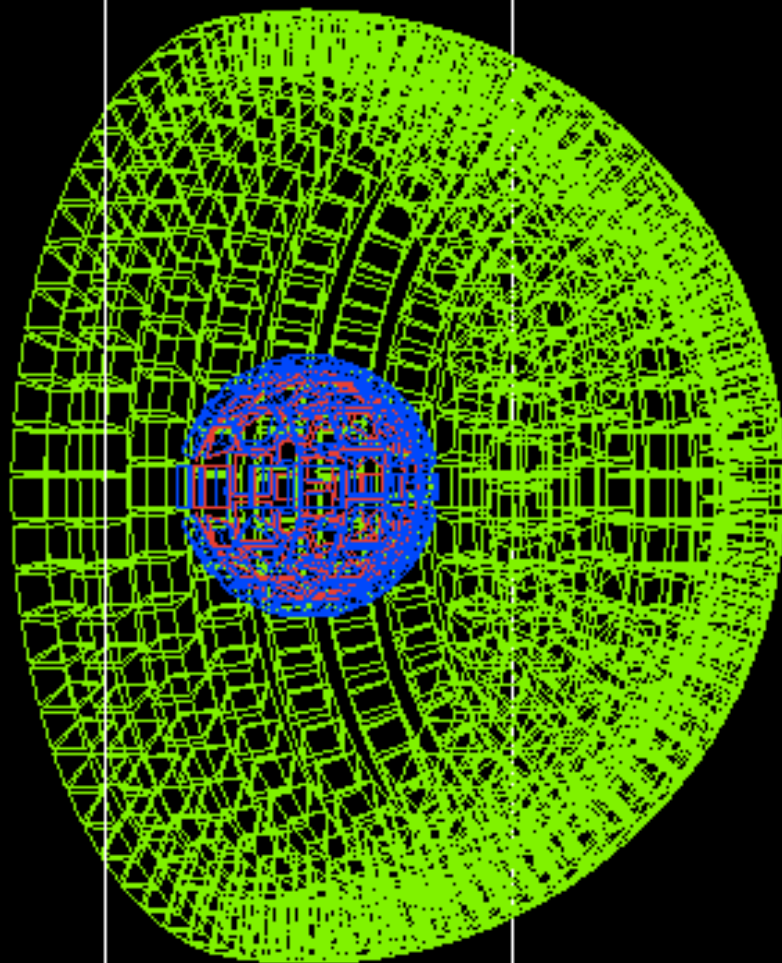
	# of Det.
ring 1 : $20^\circ \sim 28^\circ$	20
ring 2 : $28^\circ \sim 36^\circ$	30
ring 3 : $36^\circ \sim 44^\circ$	36
ring 4 : $44^\circ \sim 52^\circ$	43
ring 5 : $52^\circ \sim 60^\circ$	49
ring 6 : $60^\circ \sim 68^\circ$	53
ring 7 : $68^\circ \sim 76^\circ$	57
ring 8 : $76^\circ \sim 84^\circ$	60
ring 9 : $84^\circ \sim 92^\circ$	61
ring 10 : $92^\circ \sim 100^\circ$	61
all	470



Non-realistic design - just to see the scattering of neutrons in Csl detector

Realistic :  $\phi = \pm(45^\circ \sim 135^\circ)$

# LAMPS-low detector geometry

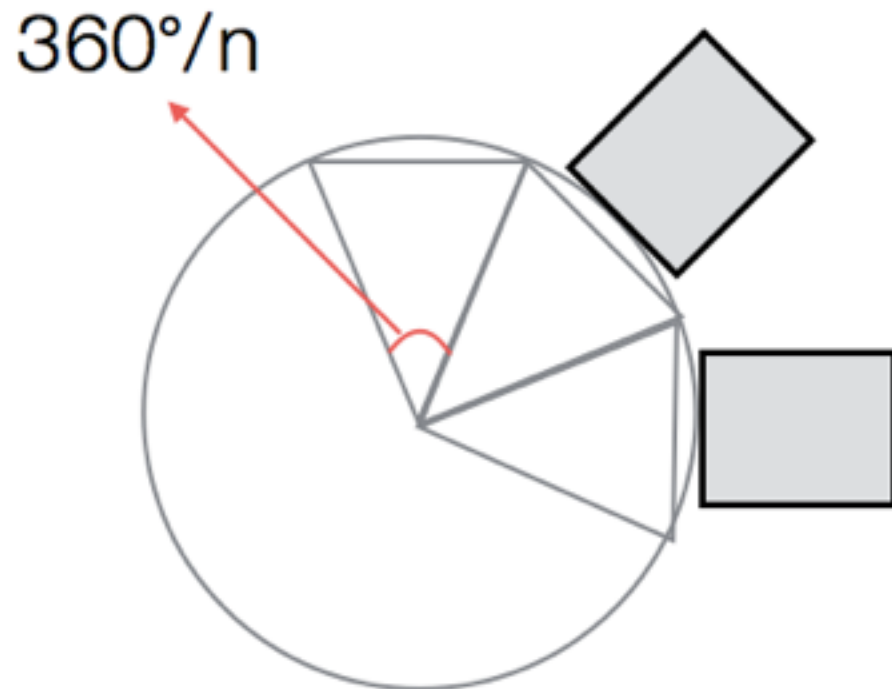
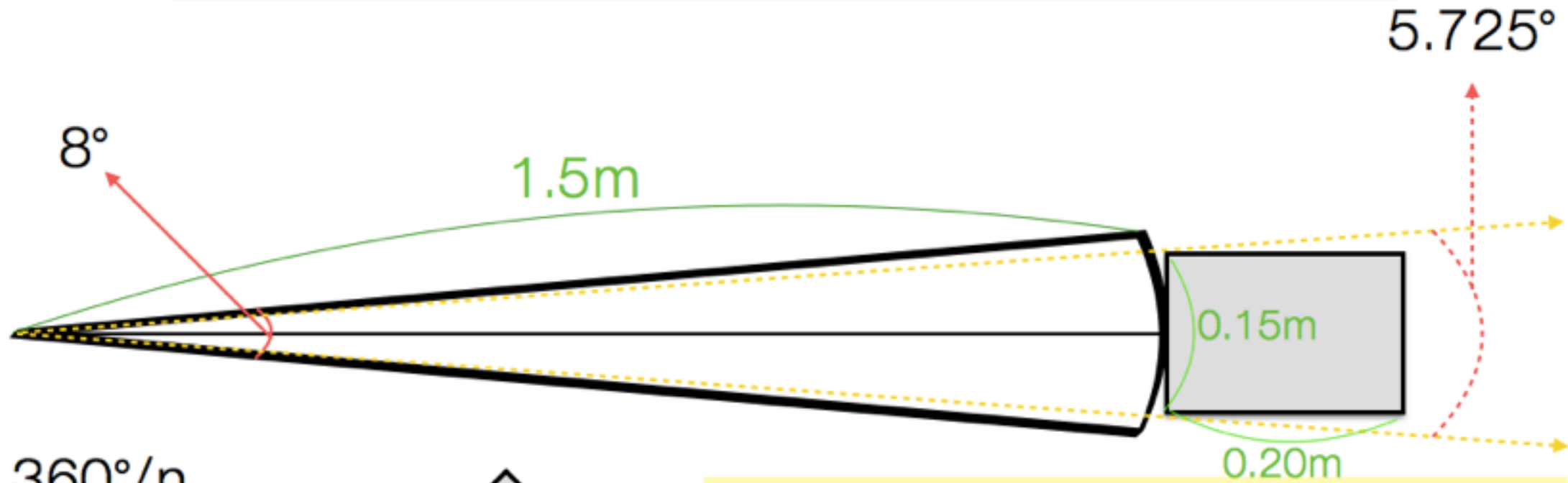


View in Geant4

red : Si detector  
blue : CsI detector  
green : Neutron detector



# Neutron detector geometry



- Area of detector :  
 $470 \times 0.225\text{m}^2 = 10.58 \text{ m}^2$
- Area of surface between  
 $\theta = 20^\circ \sim 100^\circ : 15.74 \text{ m}^2$
- $(10.58/15.74) \times 100\% = 67.22\%$

# Neutron detector geometry

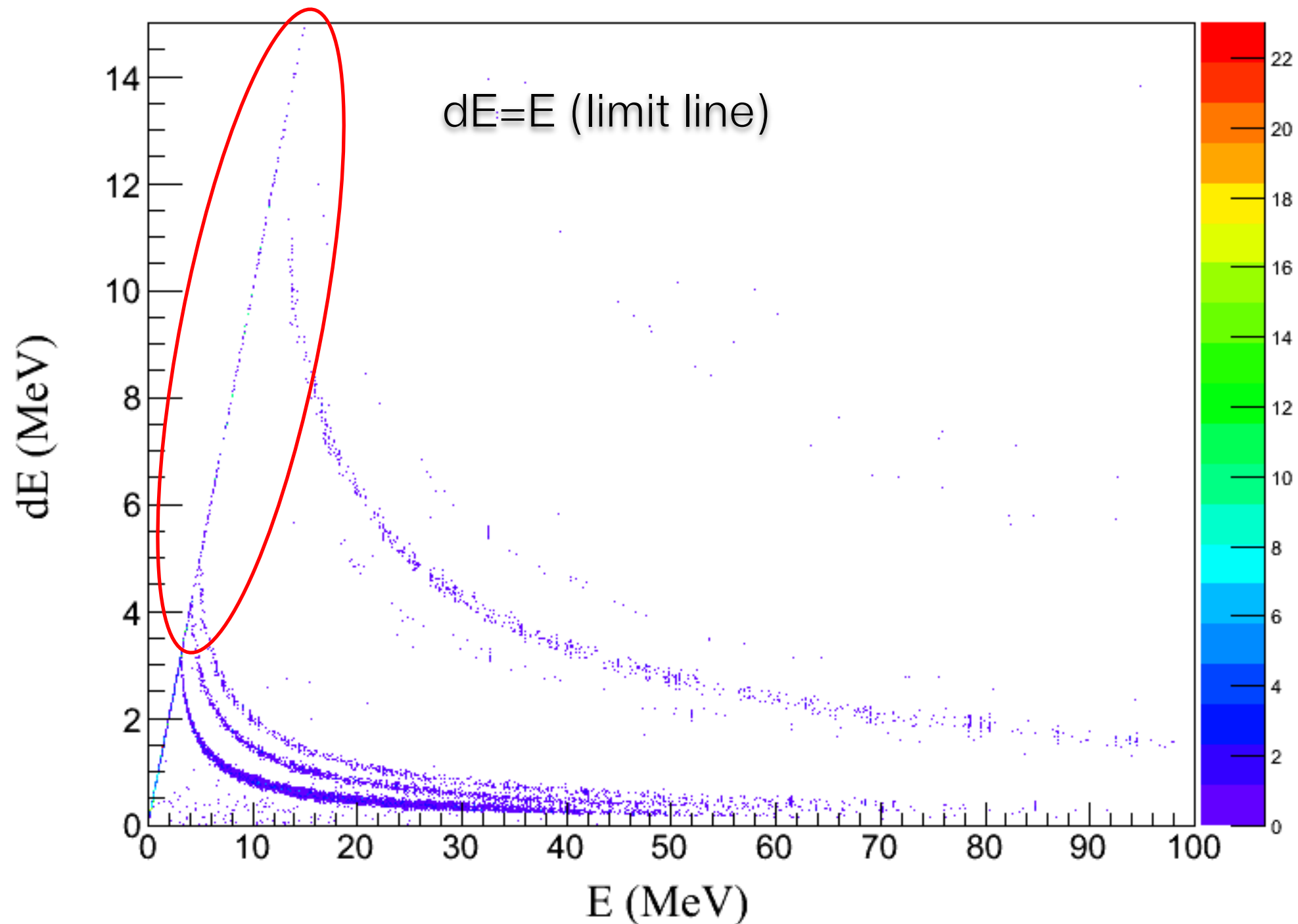
Time of Flight

$$E_K = E_0 \left[ (1 - v^2/c^2)^{-1/2} - 1 \right], \quad E_0 : \text{rest mass}$$

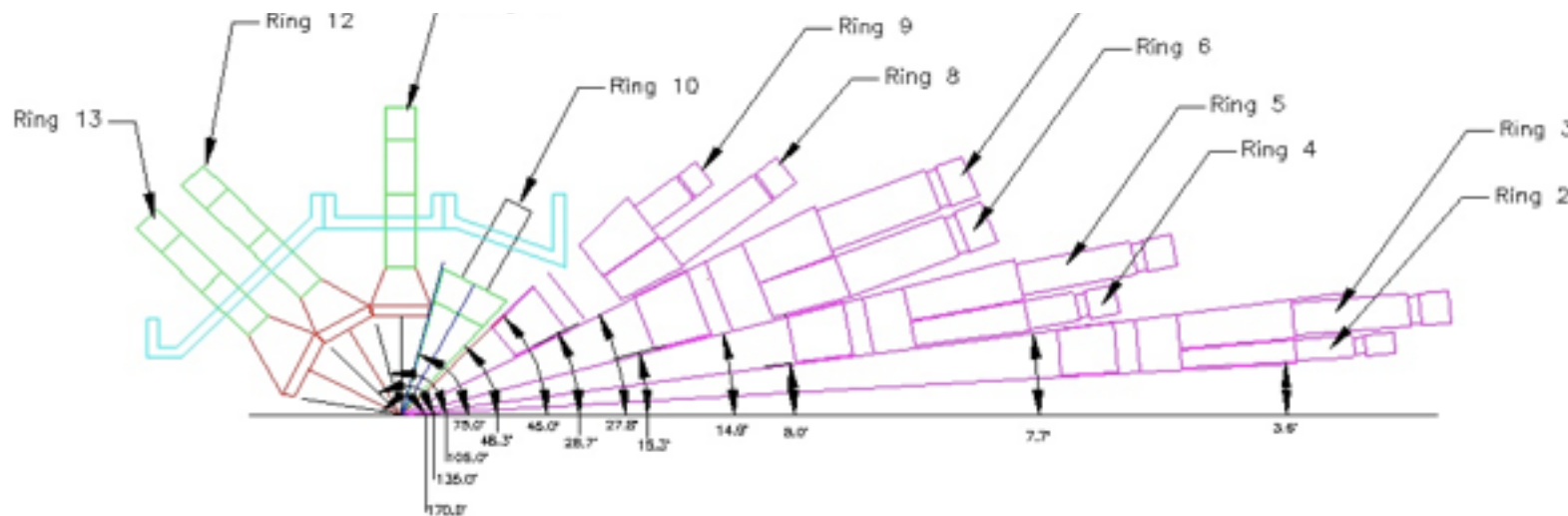
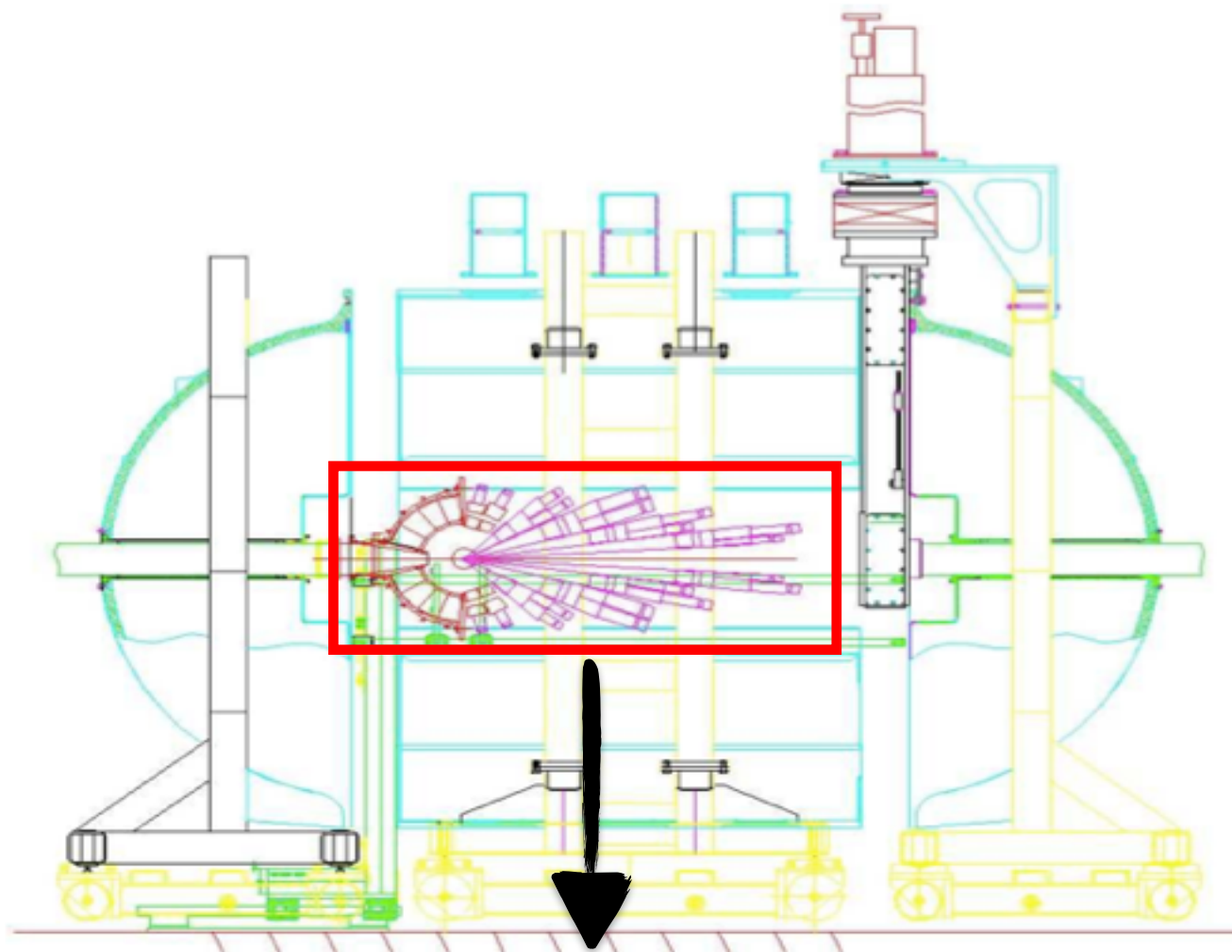
$$E_K = E_0 \left[ (1 - L^2/\Delta t^2 c^2)^{-1/2} - 1 \right]$$

# PID dE vs E

<All AMD data>



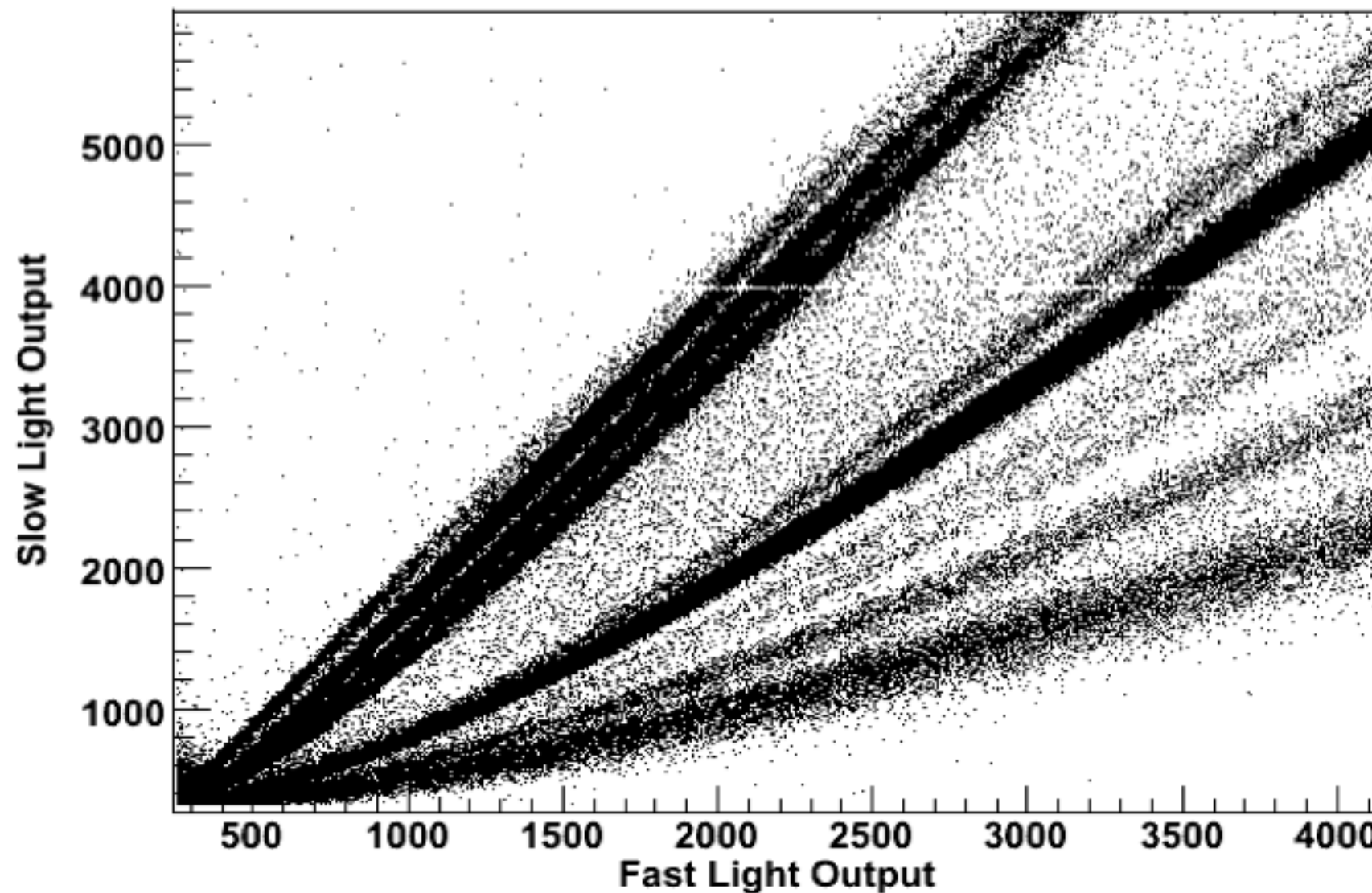
# PID - NIMROD in Texas A&M



Ring	$\Theta$ Range degrees	$\phi$ Range degrees	Telescopes Silicon number (thickness)	Super Telescopes	CsI Length cm
2	3.6-5.0	30	10 (300 $\mu$ m)	2	10.0
3	5.0-7.6	30	10 (300 $\mu$ m)	2	10.0
4	8.0-10.8	30	10 (300 $\mu$ m)	2	10.0
5	10.8-14.7	30	10 (300 $\mu$ m)	2	10.0
6	15.3-20.9	30	5 (300 $\mu$ m) 5 (150 $\mu$ m)	2	6.5
7	20.9-27.6	15	5 (300 $\mu$ m) 5 (150 $\mu$ m)	2	6.5
8	28.6-35.8	30	6 (300 $\mu$ m) 4 (150 $\mu$ m)	2	6.0
9	35.8-45.0	15	6 (300 $\mu$ m) 4 (150 $\mu$ m)	2	6.0
10	52.7-69.2	-	-	140+100 $\mu$ m	4.0
11	70.1-86.3	20	1 (300 $\mu$ m) 1(500 $\mu$ m)	-	3.0
12	93.5-110.8	20	18 (500 $\mu$ m)	-	2.8
13	110.8-128.4	20	18 (500 $\mu$ m)	-	2.8
14	128.4-147.4	20	18 (500 $\mu$ m)	-	2.8
15	147.4-167.0	20	18 (500 $\mu$ m)	-	2.8

# CsI shape discrimination

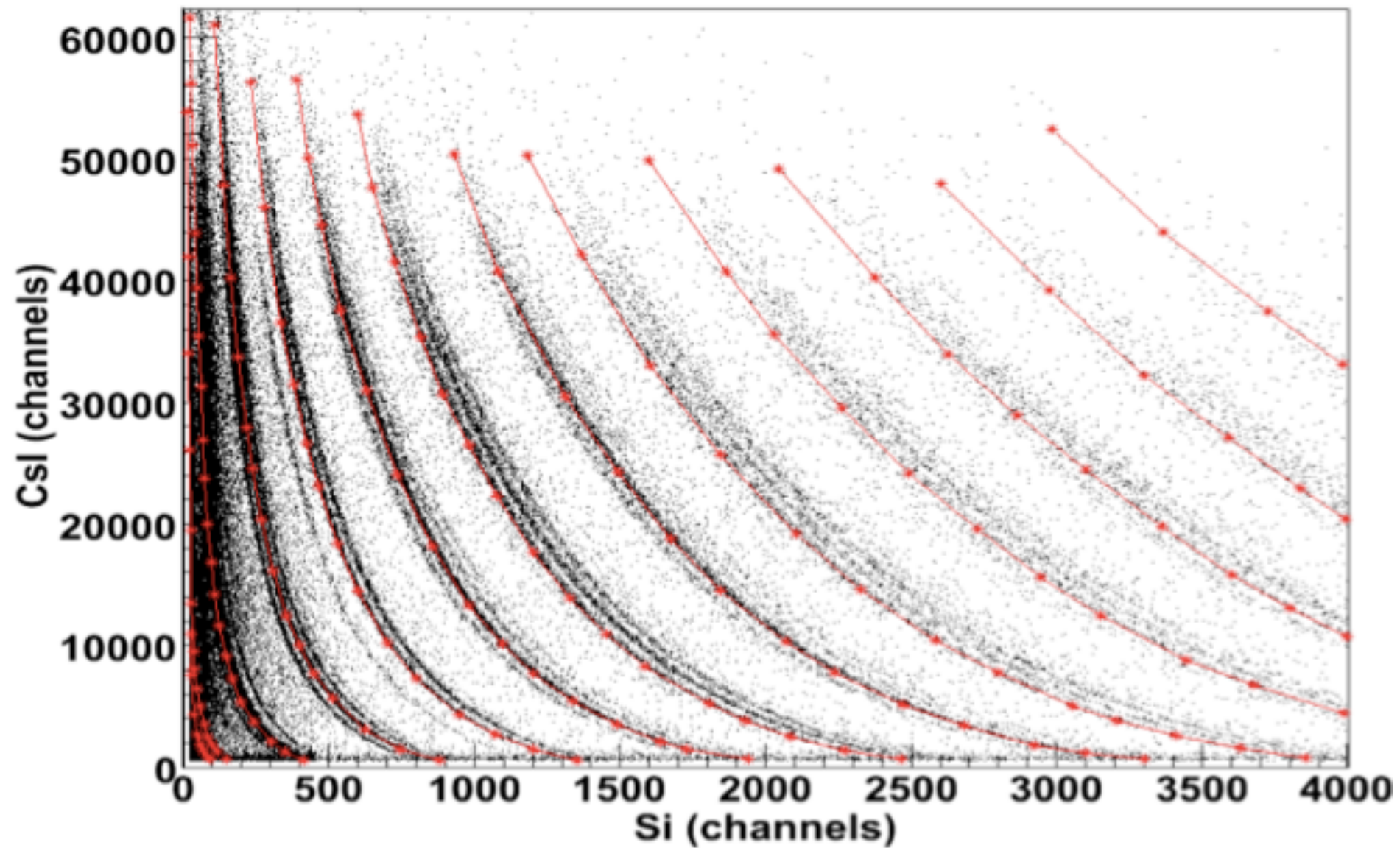
$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35 MeV/A - for Z=1,2





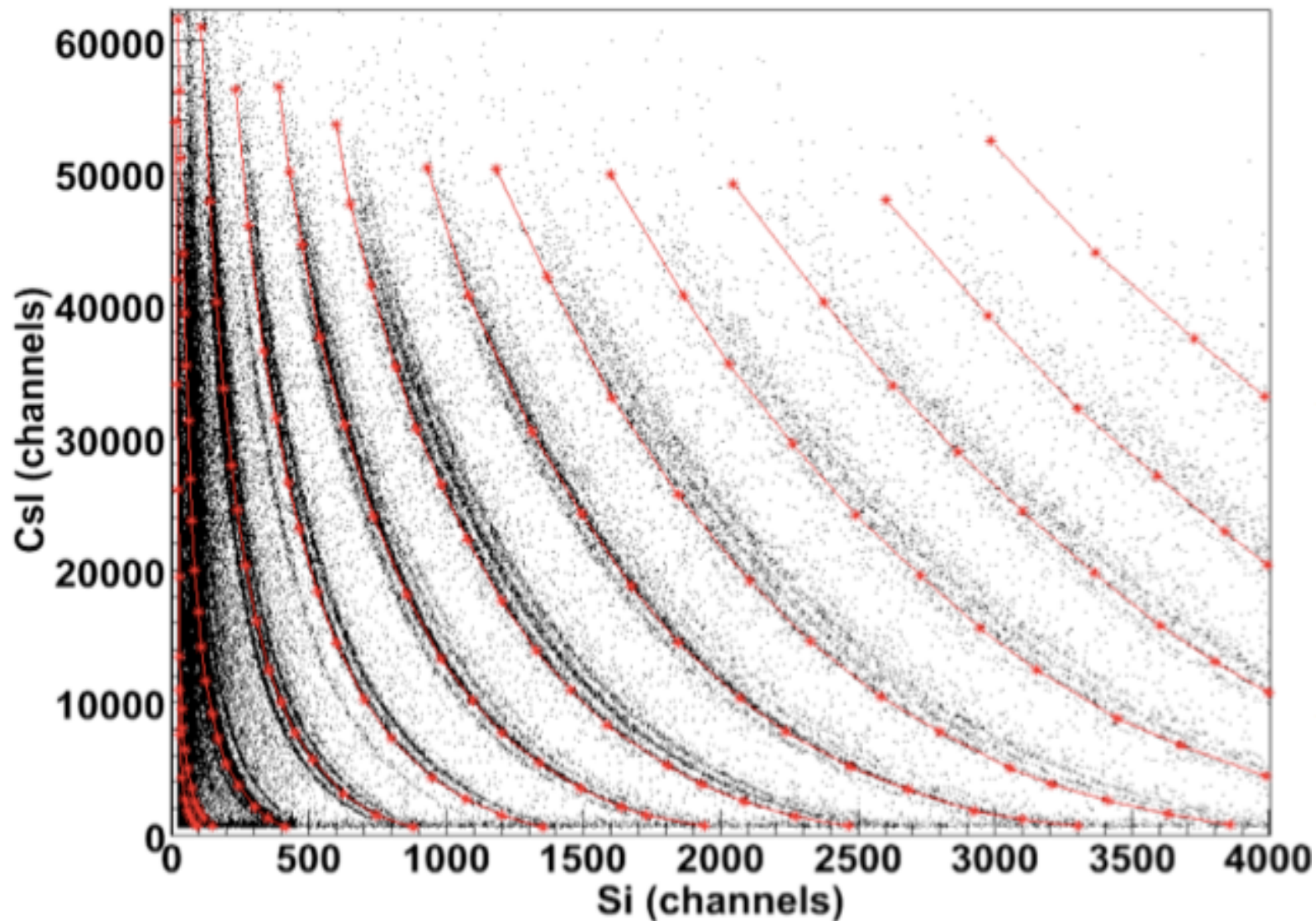
# PID Csl vs. Si

$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35MeV/A - for  $Z=3\sim 10$



# PID CsI vs. Si

$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35 MeV/A - for  $Z=3\sim 7$



$$-\frac{dE}{dx} \propto \frac{Z^2}{v^2} \propto \frac{Z^2 \cdot A}{KE}$$

$$L_X = \frac{dist_1}{|dist_1 - dist_2|} Z_2 - \frac{dist_2}{|dist_1 - dist_2|} Z_1$$

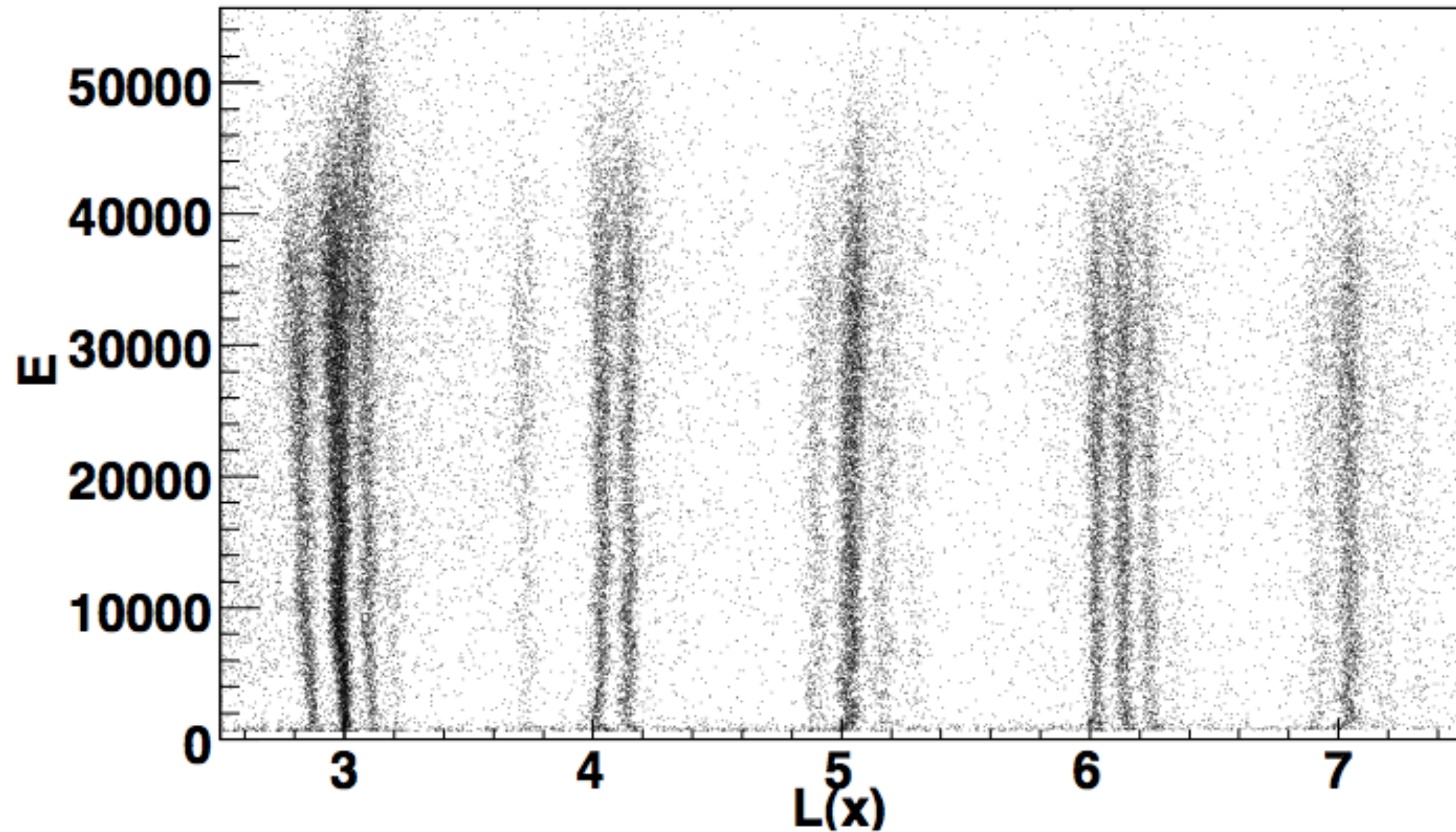
$$L_X = \frac{dist_1}{|dist_1 + dist_2|} Z_2 + \frac{dist_2}{|dist_1 + dist_2|} Z_1$$

$$L_X = \frac{dist_2}{|dist_2 - dist_1|} Z_1 - \frac{dist_1}{|dist_2 - dist_1|} Z_2$$



# PID CsI vs. Si

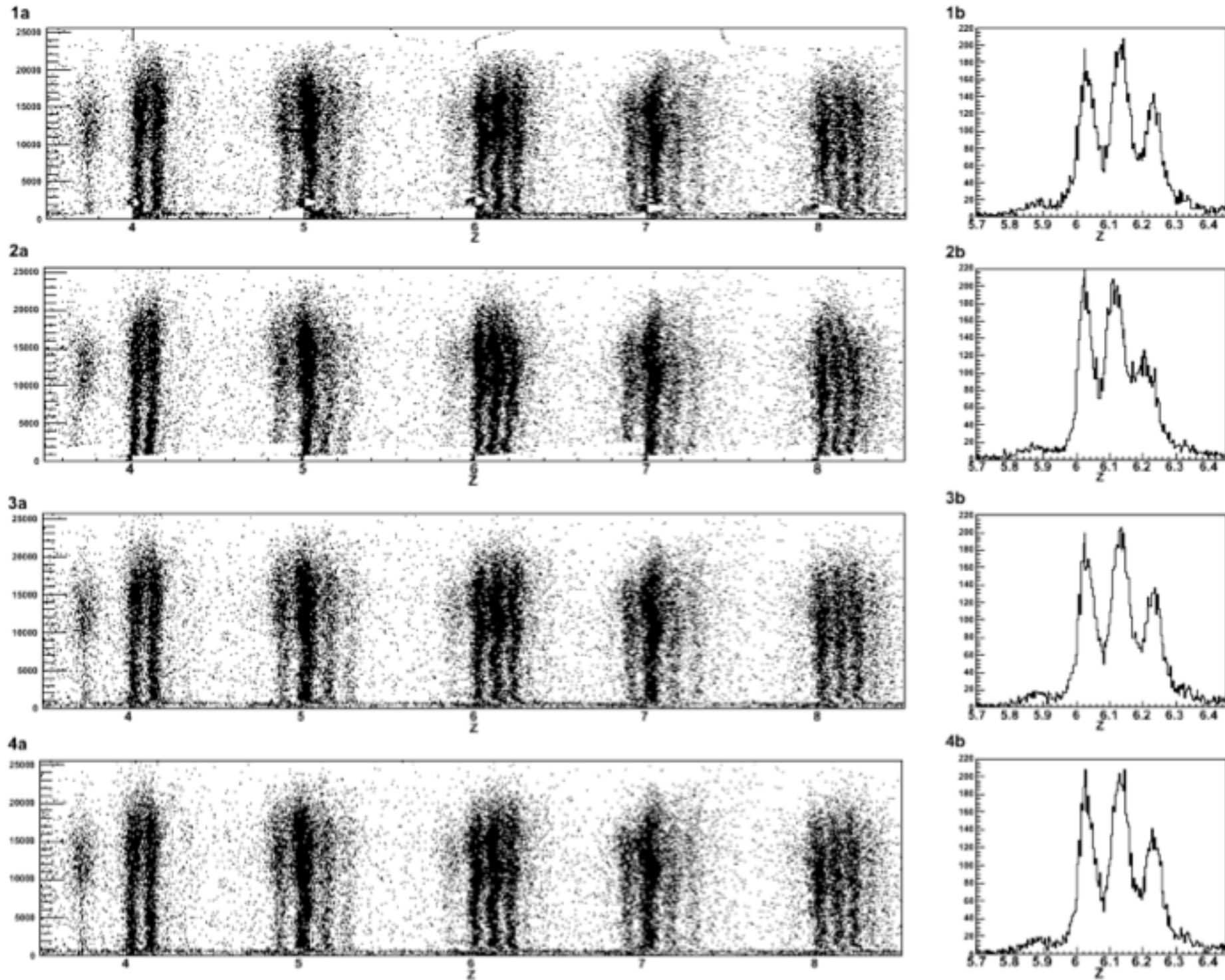
$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35 MeV/A - for  $Z=3\sim 7$





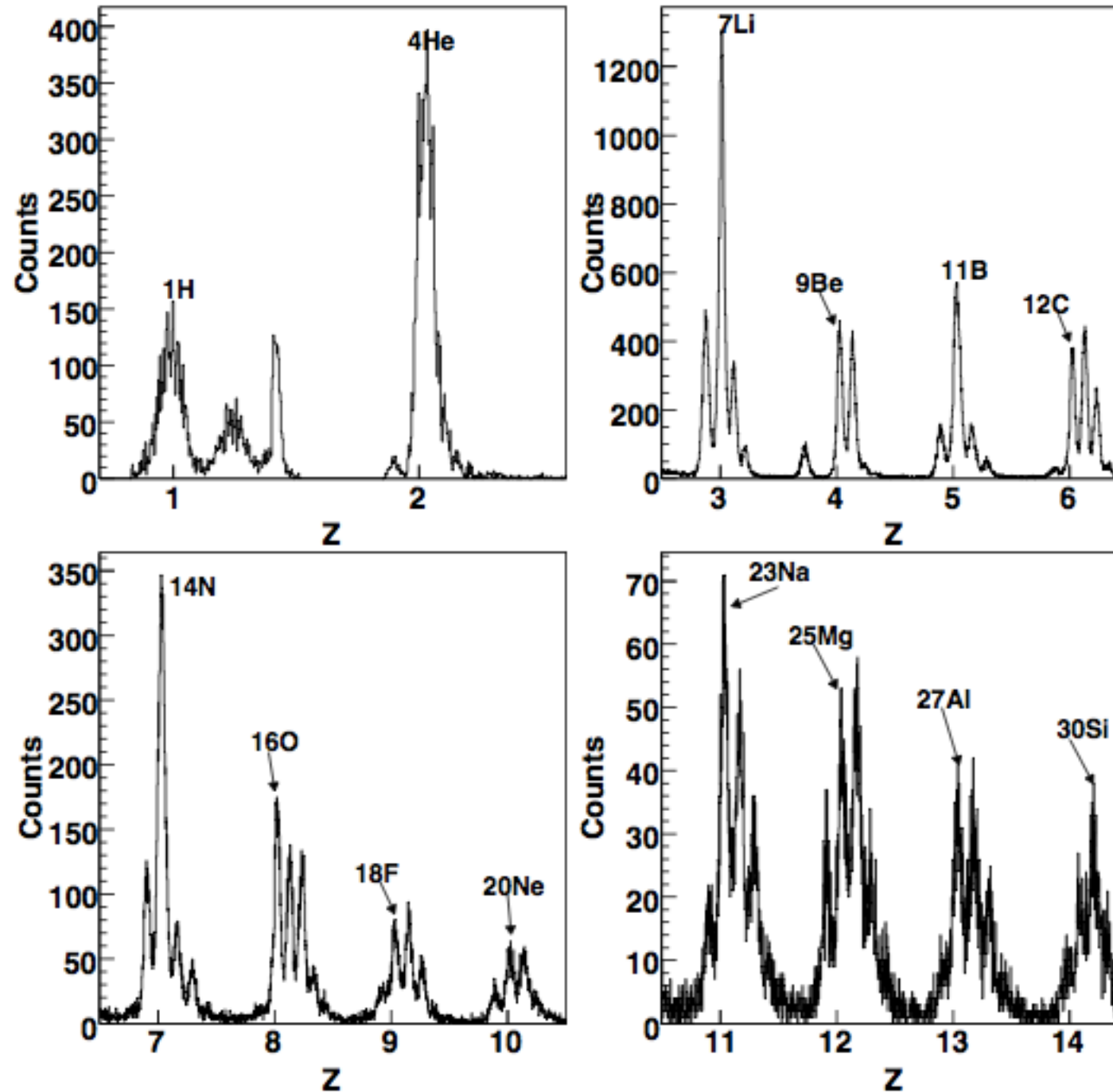
# PID - Z distribution

$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35MeV/A



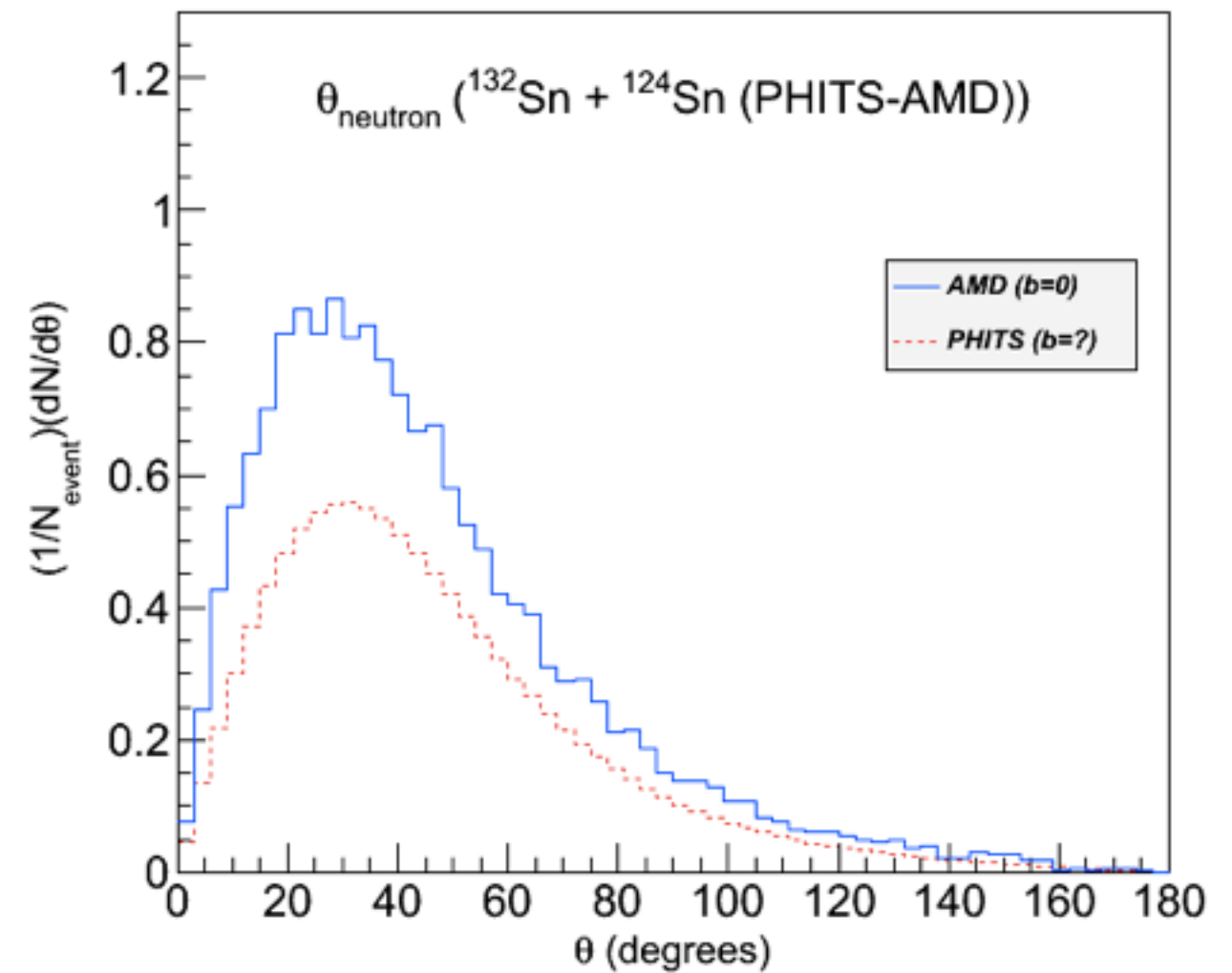
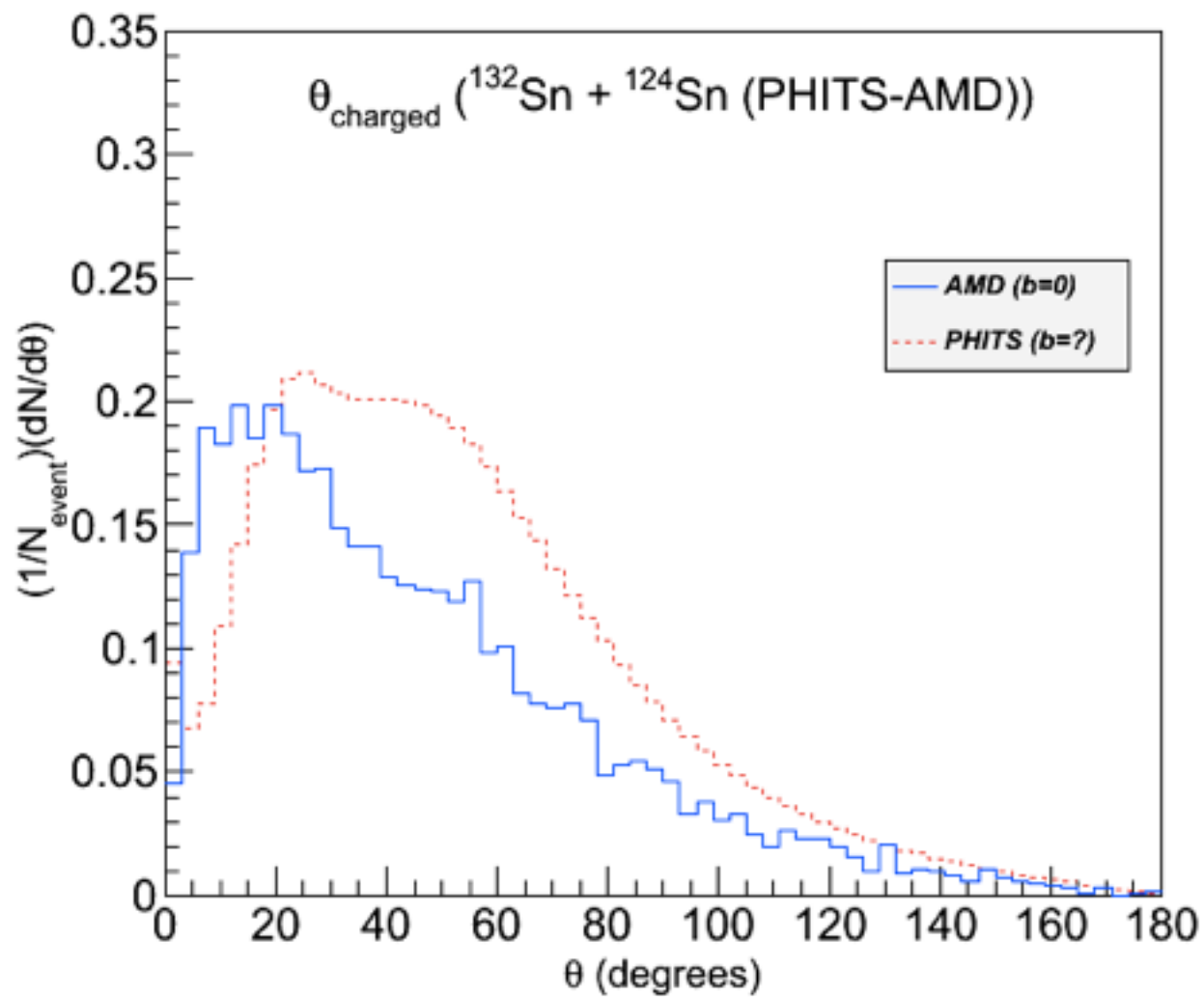
# PID - mass distribution

$^{86,78}\text{Kr} + ^{64,58}\text{Ni}$  at 35MeV/A

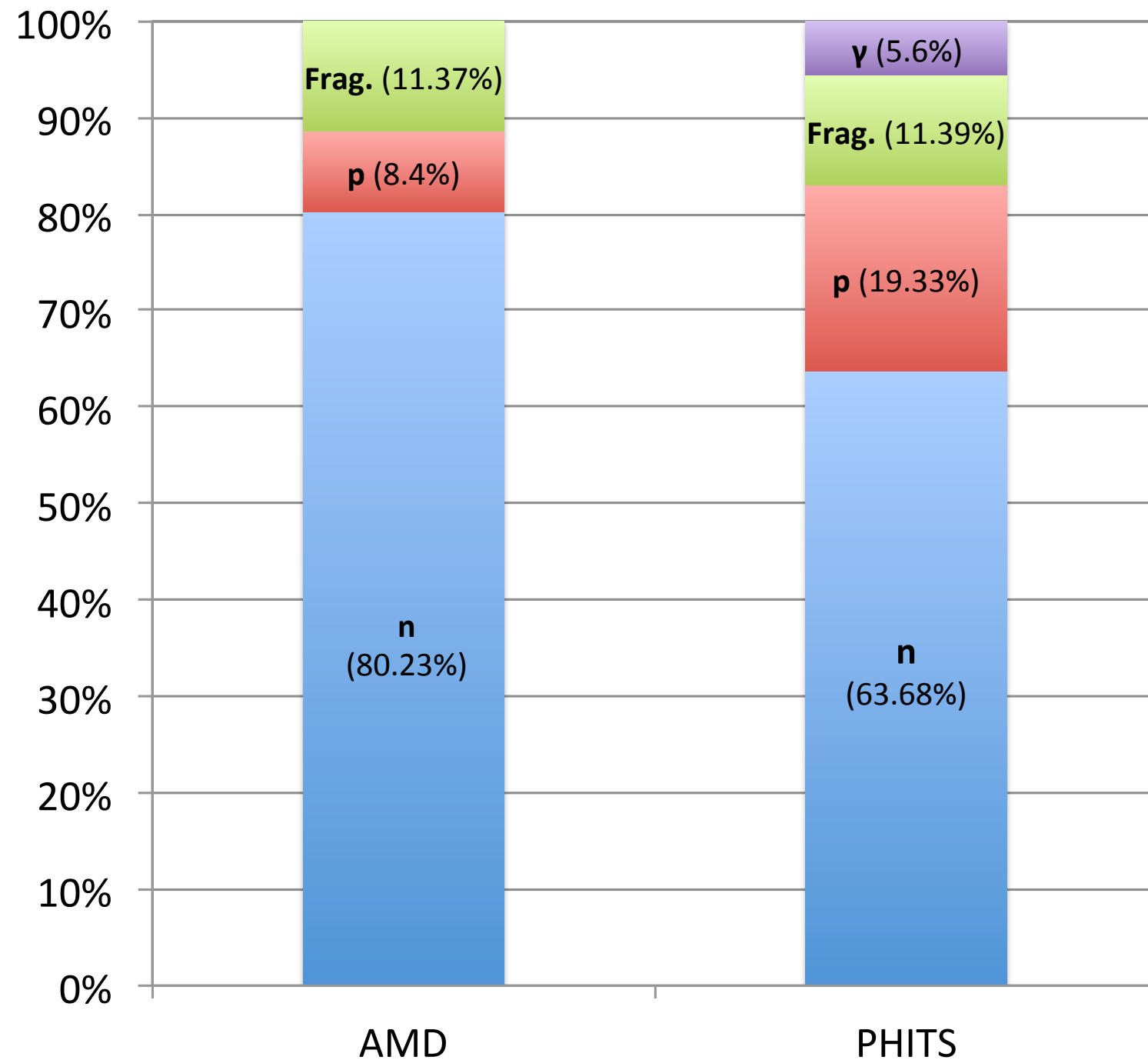


# AMD&PHITS - Theta Distribution

## (Charged/Neutron)



# AMD & PHITS



AMD :  $^{132}\text{Sn} + ^{124}\text{Sn} - (20 \text{ MeV/u})$   
impact parameter :  $b = 0$   
 $N_{\text{event}}=2010$

PHITS :  $^{132}\text{Sn} + ^{124}\text{Sn} - (18.5 \text{ MeV/u})$   
impact parameter : wide  
 $N_{\text{event}}=272018$

