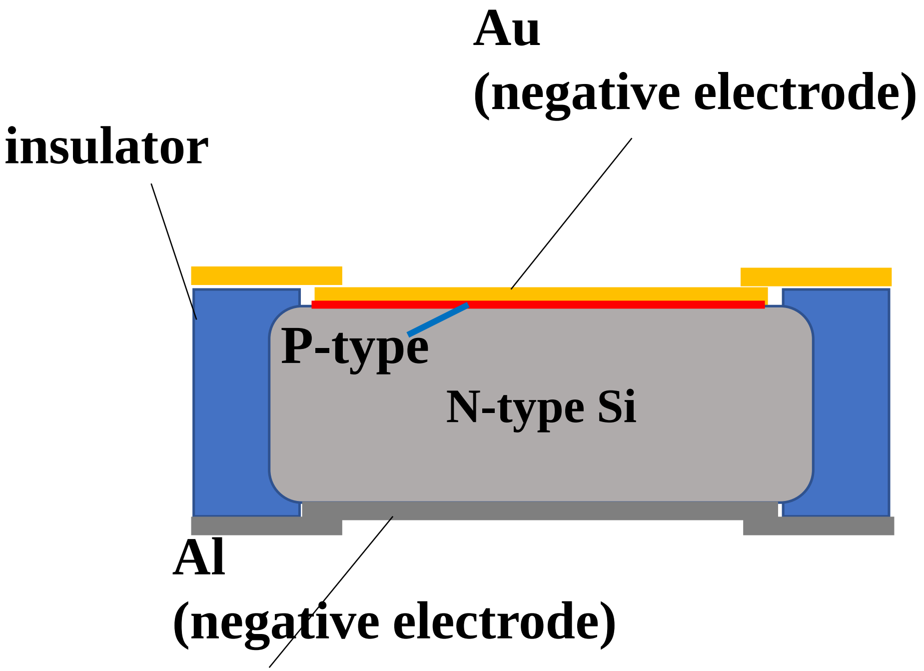
Energy spectrum

Surface barrier detector

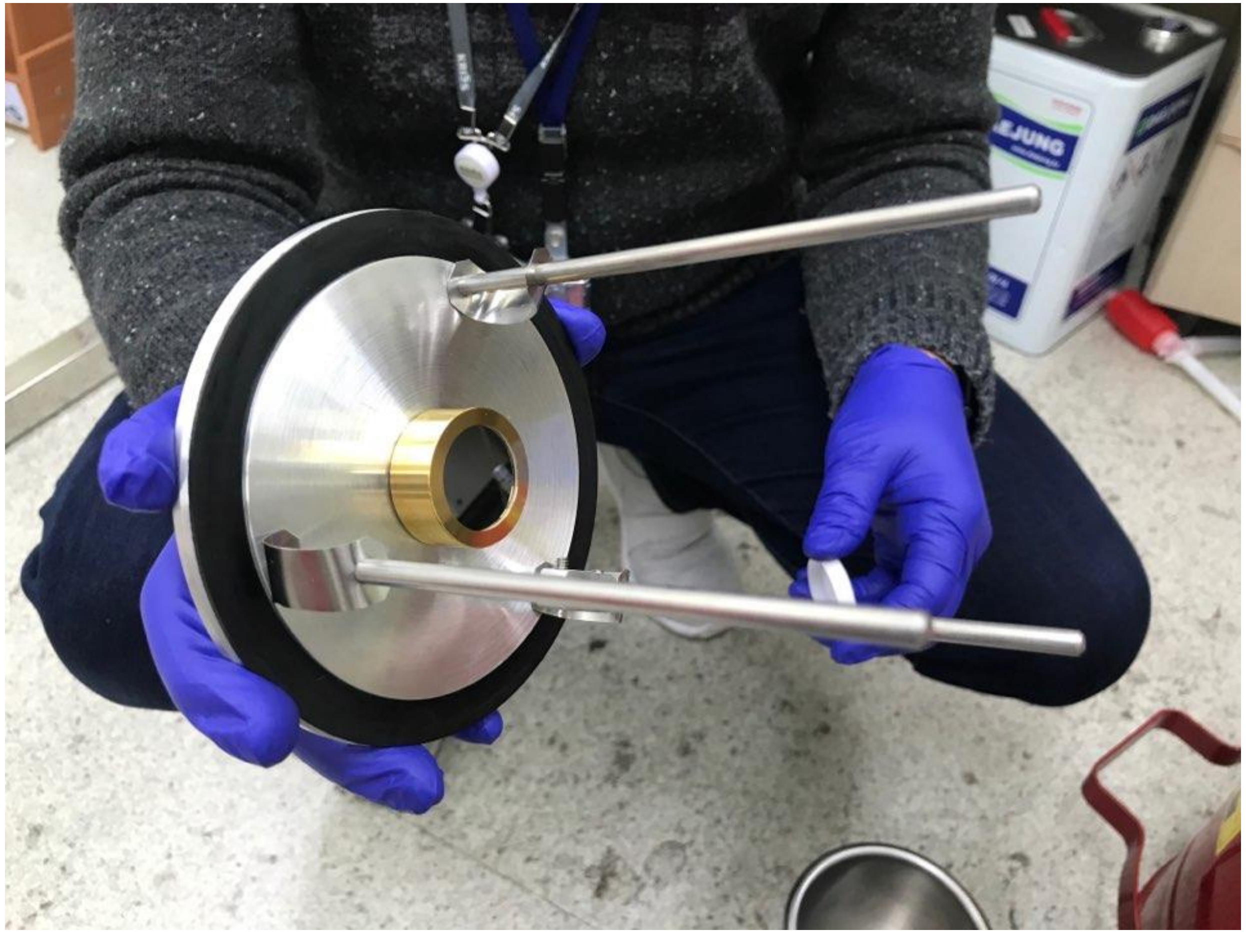
- N-type Silicon semi-conducto의 표면을 산화시켜 p-type을 만들고, 다시 그 표면을 Ni 혹은 Au 등의 금속을 얇게 흡착시켜 전극을 만듦.
- 공핍층에 energy deposit이 생기면 electron-hole pair가 만들어지고, electron과 hole은 전류를 만든다.
- 이 때의 전류의 크기를 측정하여 energy deposit을 계산한다.
- Depletion region이 매우 얇기 때문에 alpha particle, 무거운 하전입자를 검출할 때, 혹은 그 energy spectrum을 측정할 때 사용한다.



실제 Surface Barrier Detector

높이차?

Surface Barrier Detector



Vaccum chambe의 뚜껑에 부착된 Surface Barrier Detector

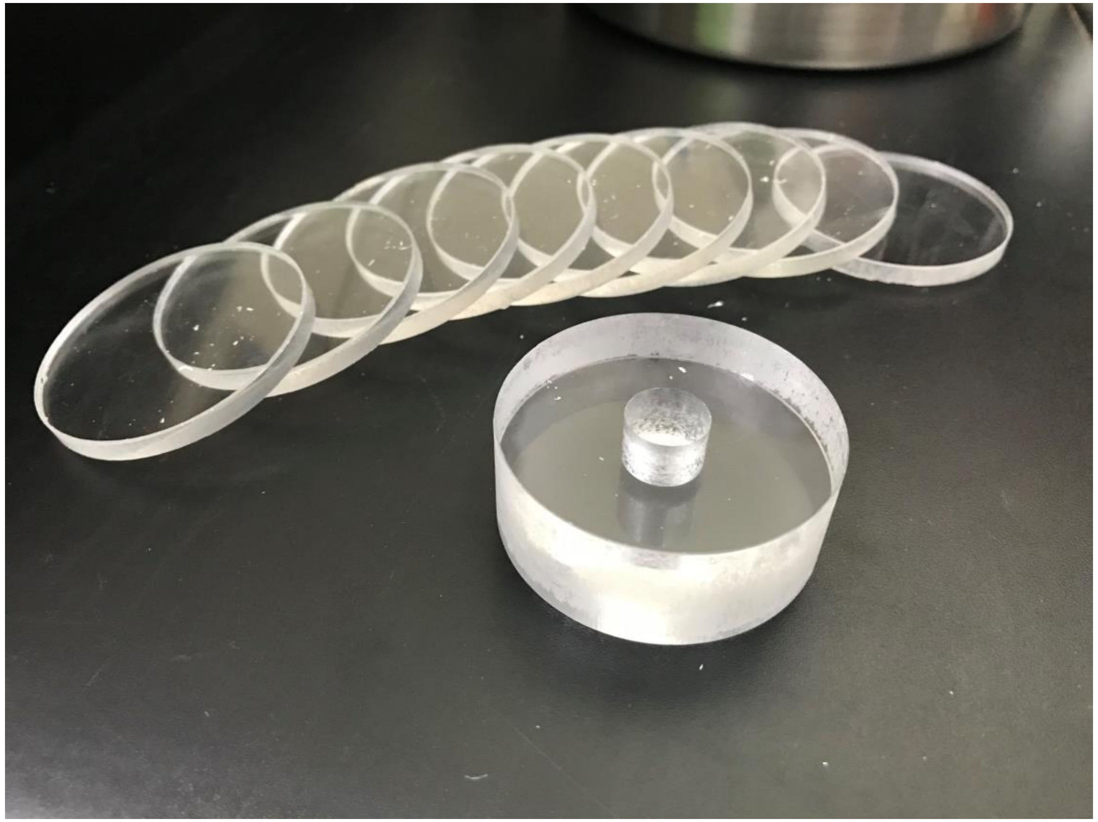
Vaccum Chamber

Vaccum chamber

Vaccum chamber

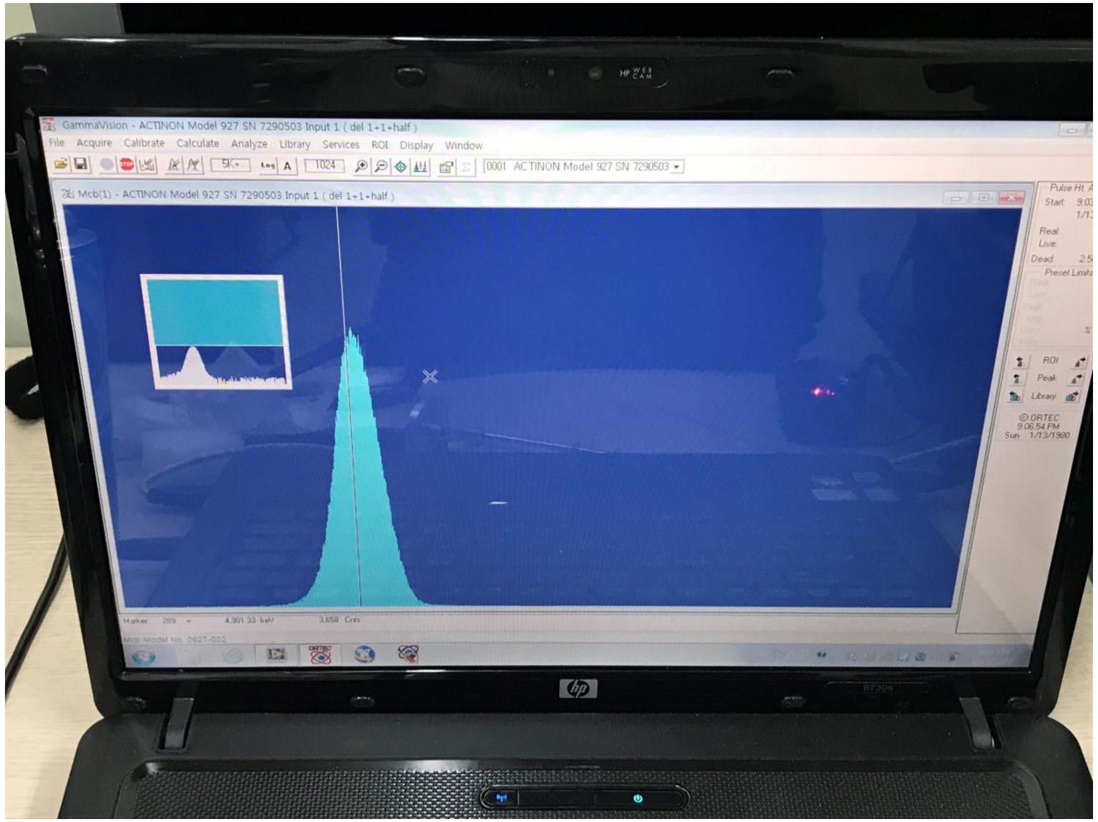
Vaccum pump

Source holder



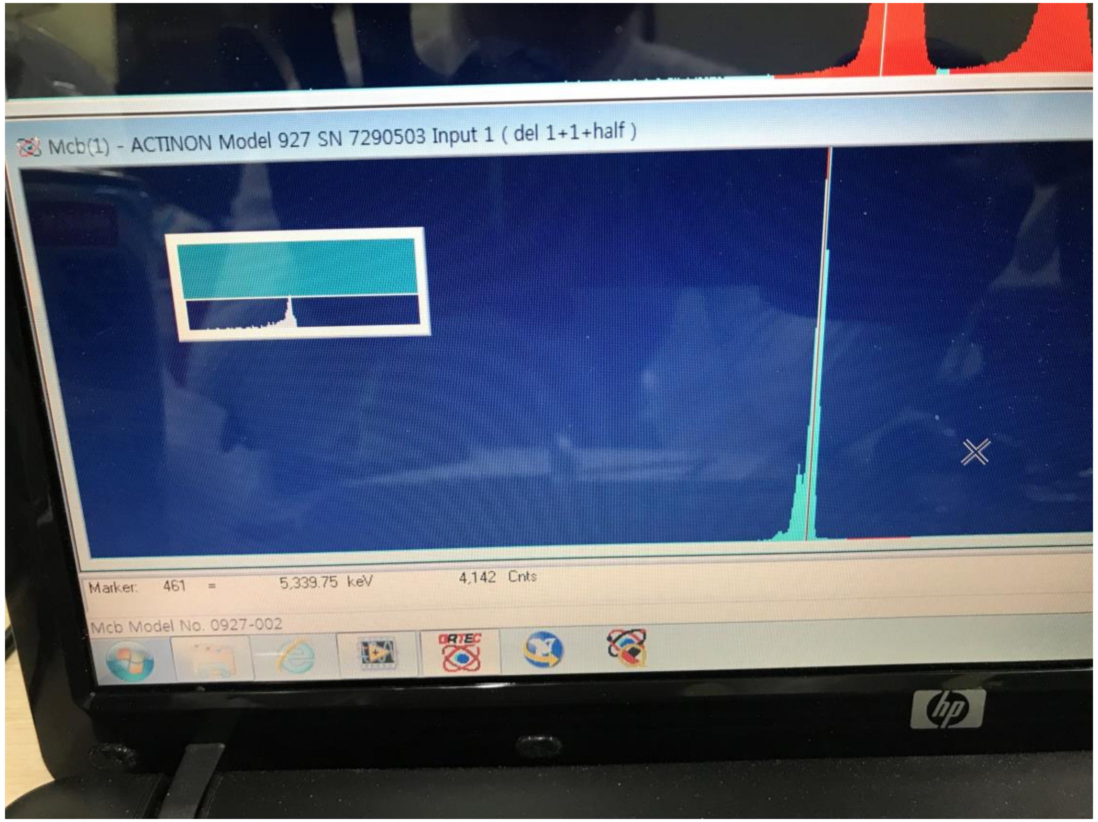
Alpha particle Energy spectrum 측정

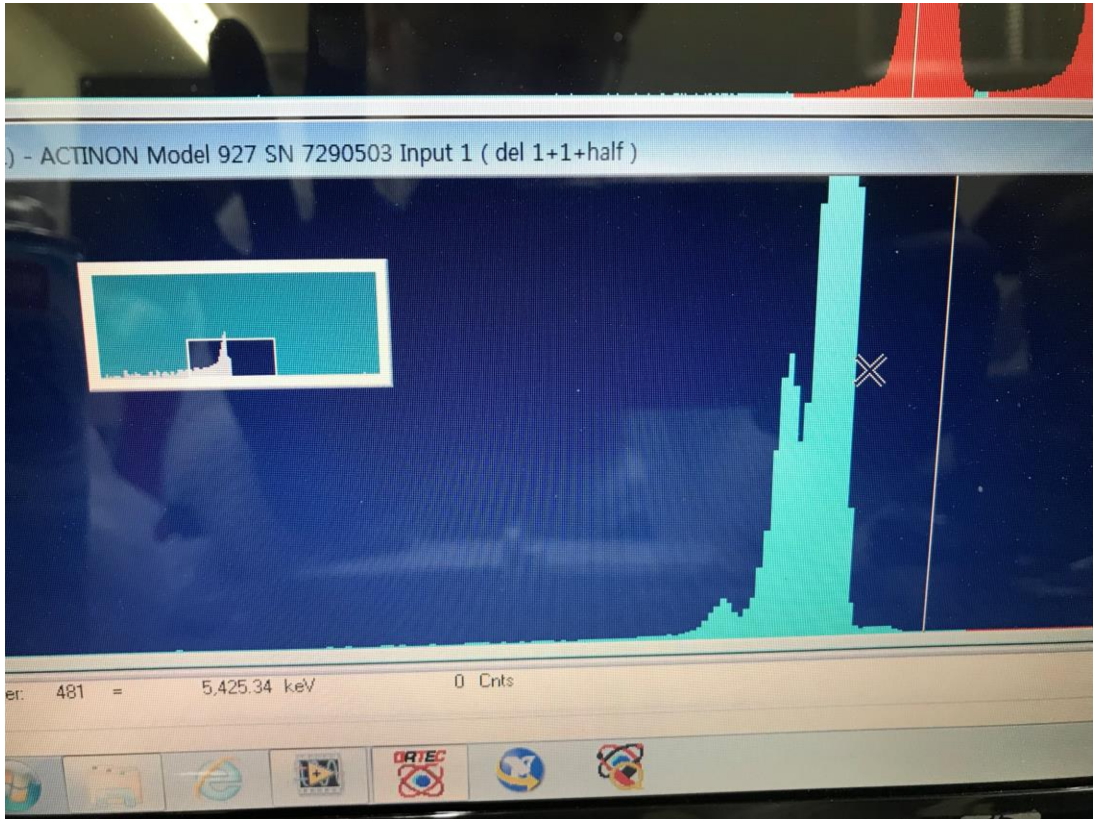
- Vaccum chamber 내부를 vaccum 상태로 만들고 241-Americium source가 Surface Barrier detector를 바라보도록 하고 Energy spectrum을 측정하였다.
- 측정 결과 오른쪽과 같이 Gaussian과 유사한 형태의 그래프가 나타났다.
- 이러한 형태로 나타난 이유는 진공 chamber 안의 기압이 약 680 mmHg이고 가지고 간 선원이 밀봉선원이여서 얇은 막을 통과하며 energy deposit이 있었기 때문이었다.



첫 번째 실험 결과 spectrum

Alpha particle Energy spectrum 측정

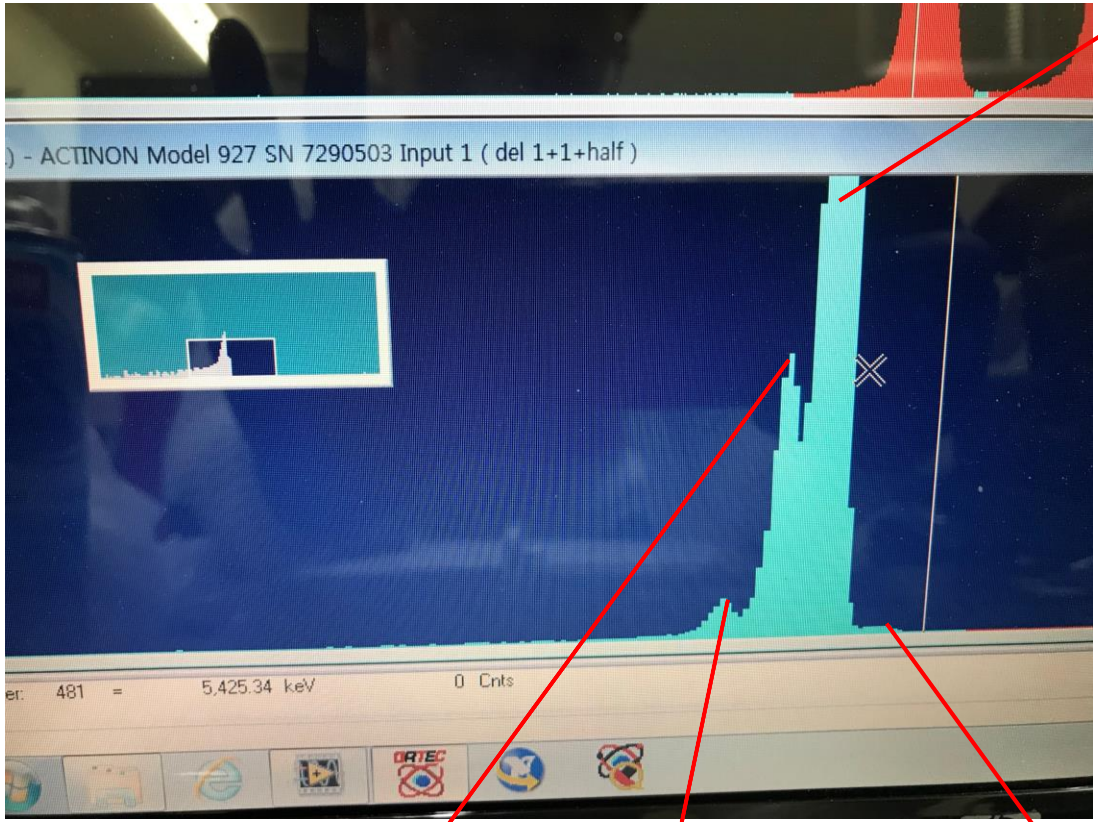




KRISS의 241-Americium source(비밀봉선원)를 이용한 Energy spectrum 측정 결과

241 Americium decay scheme

5.578 MeV (84.45%)



2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,36}$	4838,00 (13)	0,00004 (3)	47
$\alpha_{0,34}$	4882,14 (13)	0,000086	44
$\alpha_{0,33}$	4915,86 (13)	0,0007	9,5
$\alpha_{0,32}$	4971,62 (15)		
$\alpha_{0,30}$	5039,83 (15)		
$\alpha_{0,29}$	5045,49 (14)		
$\alpha_{0,28}$	5047,73 (13)		
$\alpha_{0,27}$	5091,70 (14)	0,0001	1000
$\alpha_{0,25}$	5140,81 (13)		
$\alpha_{0,24}$	5151,60 (15)	0,00011	2300
$\alpha_{0,23}$	5178,13 (13)	~ 0,0004	~ 1000
$\alpha_{0,22}$	5185,27 (13)	~ 0,0004	~ 1000
$\alpha_{0,21}$	5193,04 (16)		
$\alpha_{0,20}$	5203,70 (13)	0,0004	1400

	Energy keV	Probability × 100	F
$\alpha_{0,19}$	5219,6 (2)		
$\alpha_{0,18}$	5242,25 (13)	0,0007	1400
$\alpha_{0,17}$	5266,89 (13)	0,0003	4600
$\alpha_{0,16}$	5269,21 (13)	0,0009	1600
$\alpha_{0,15}$	5277,90 (23)	0,0006	2700
$\alpha_{0,14}$	5305,44 (13)		
$\alpha_{0,13}$	5313,40 (13)	0,0013	2100
$\alpha_{0,12}$	5321,0 (3)		
$\alpha_{0,11}$	5332,77 (13)	0,0022 (3)	1600
$\alpha_{0,9}$	5370,25 (13)	0,0005	12000
$\alpha_{0,8}$	5411,82 (13)	0,014 (3)	770
$\alpha_{0,6}$	5479,32 (13)	1,66 (3)	16,4
$\alpha_{0,5}$	5507,83 (13)	~ 0,01	≈ 4000
$\alpha_{0,4}$	5534,86 (12)	13,23 (10)	4,3
$\alpha_{0,3}$	5561,92 (12)	< 0,04	> 2000
$\alpha_{0,2}$	5578,28 (12)	84,45 (10)	1,3
$\alpha_{0,1}$	5604,62 (12)	0,23 (1)	600
$\alpha_{0,0}$	5637,82 (12)	0,38 (1)	610

241-Am Decay Scheme(reference : LNHB)

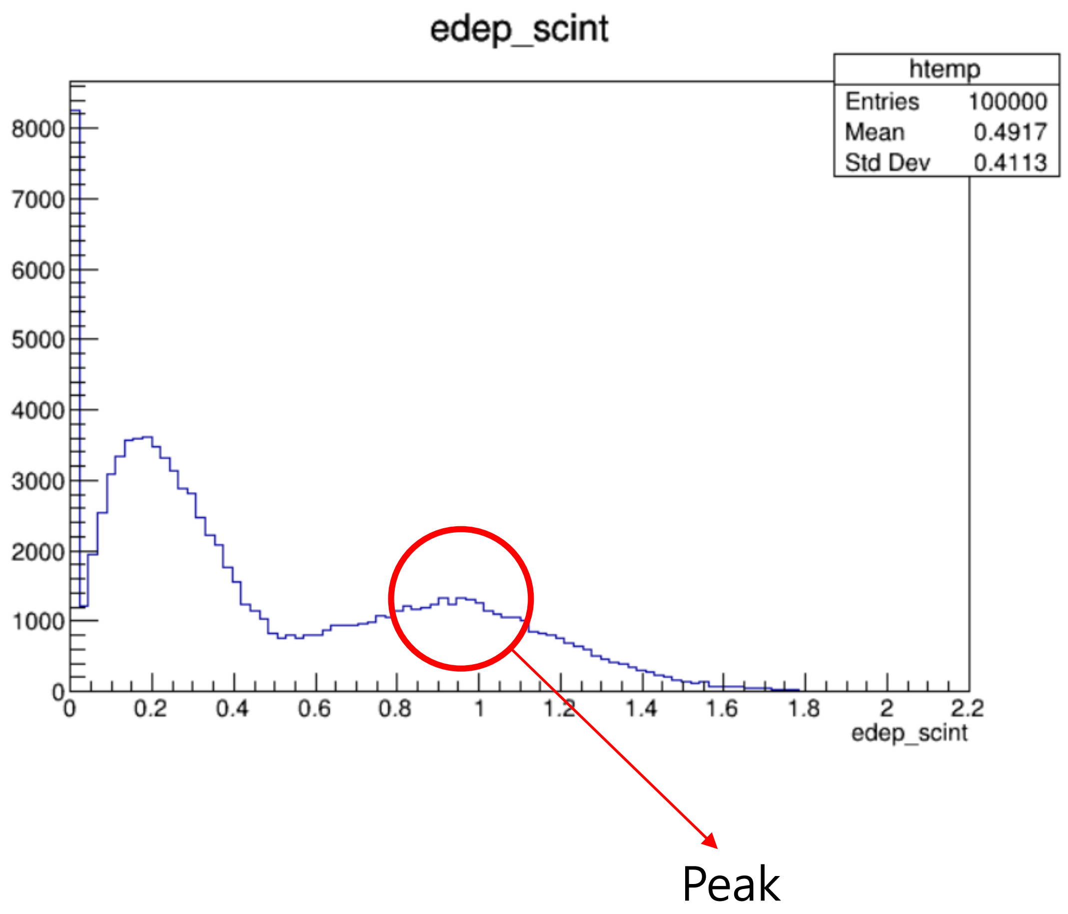
5.534 MeV(13.23%)

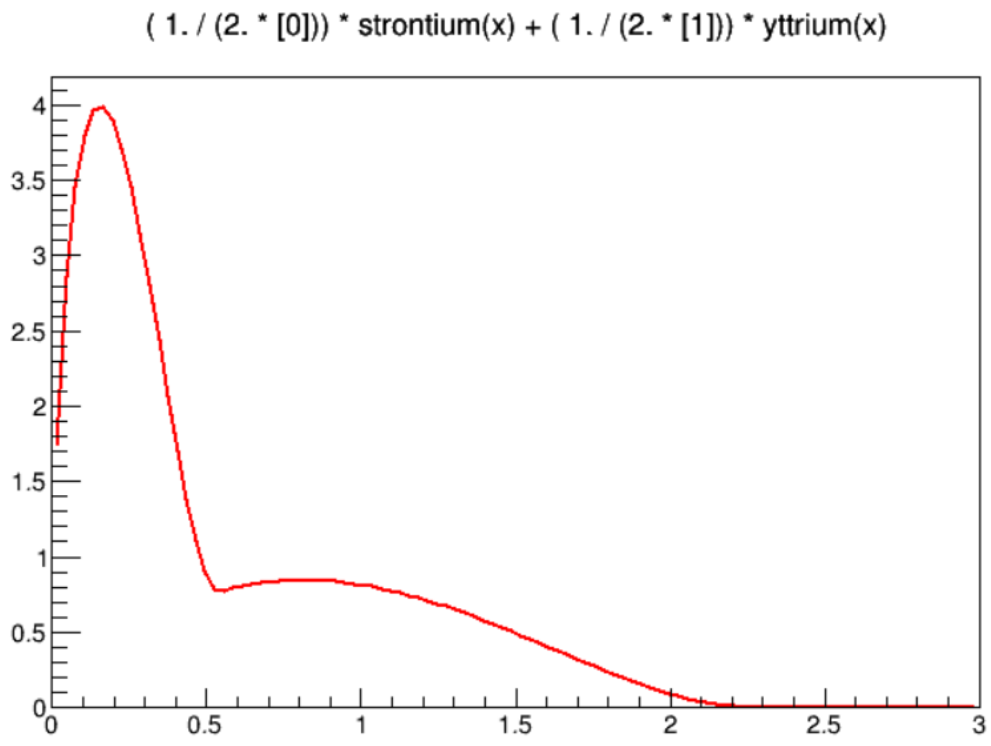
5.479 MeV(1.66%)

5.604 MeV + 5.637 MeV (0.23 + 0.38 %)

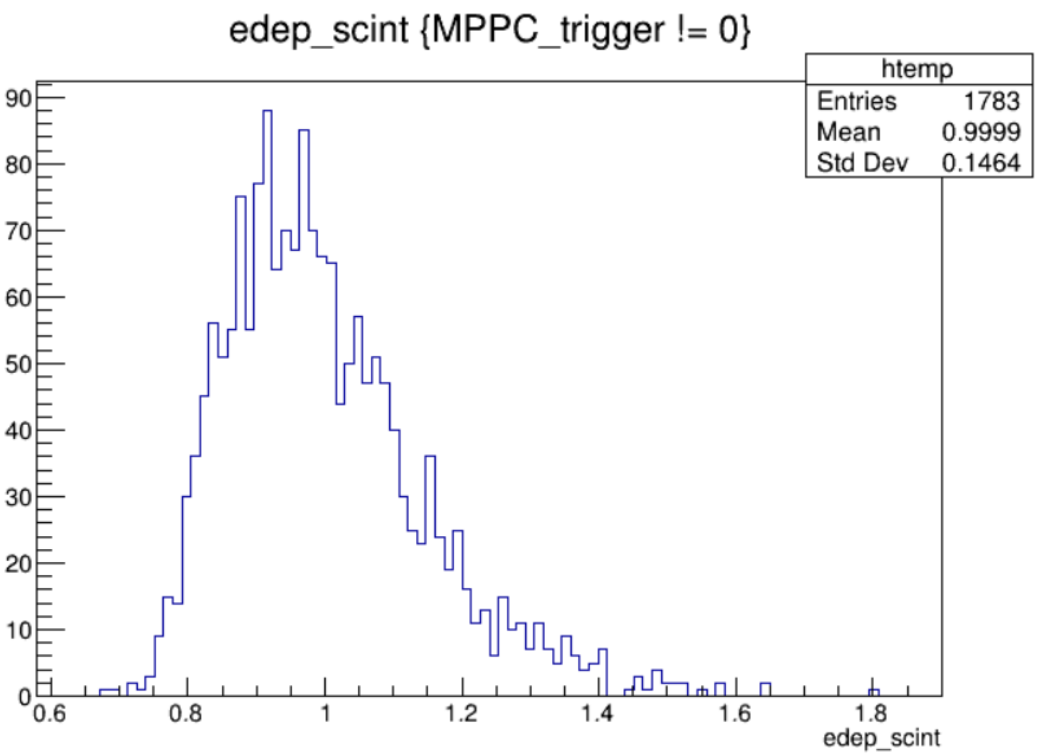
Energy deposit problem

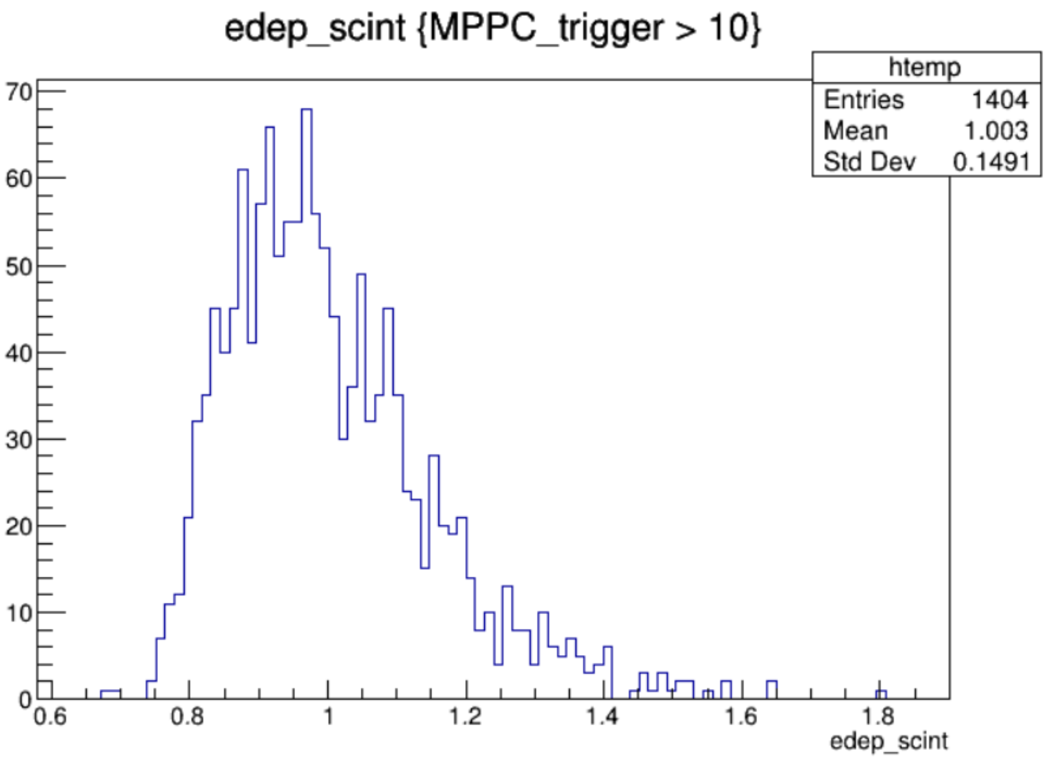
Energy deposit on scintillator



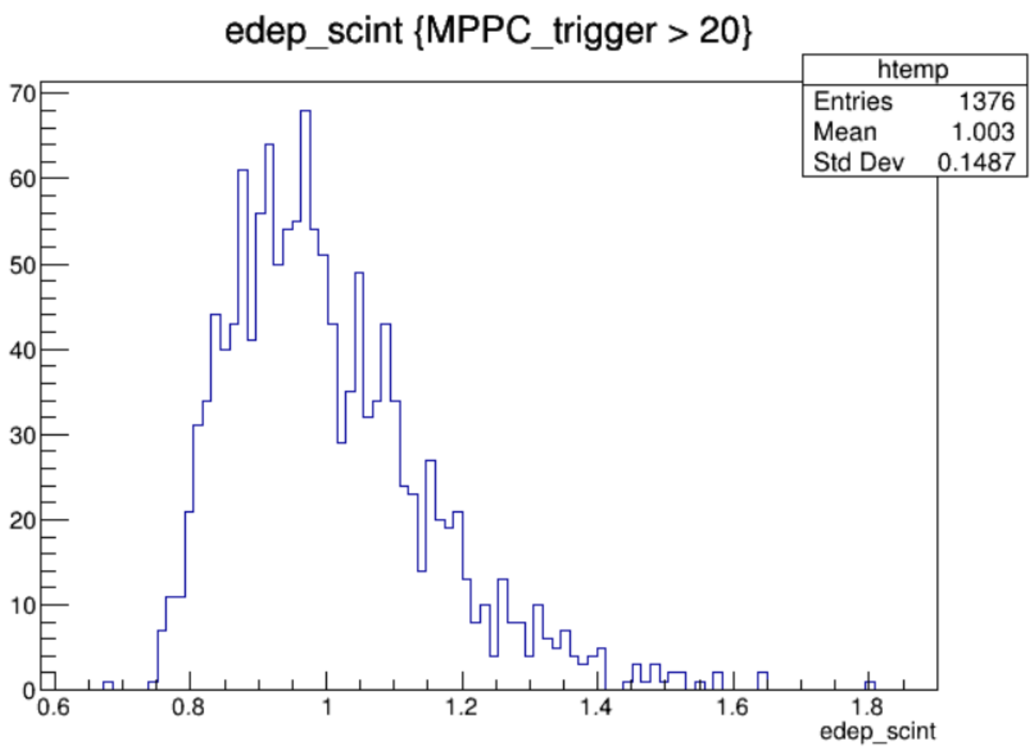


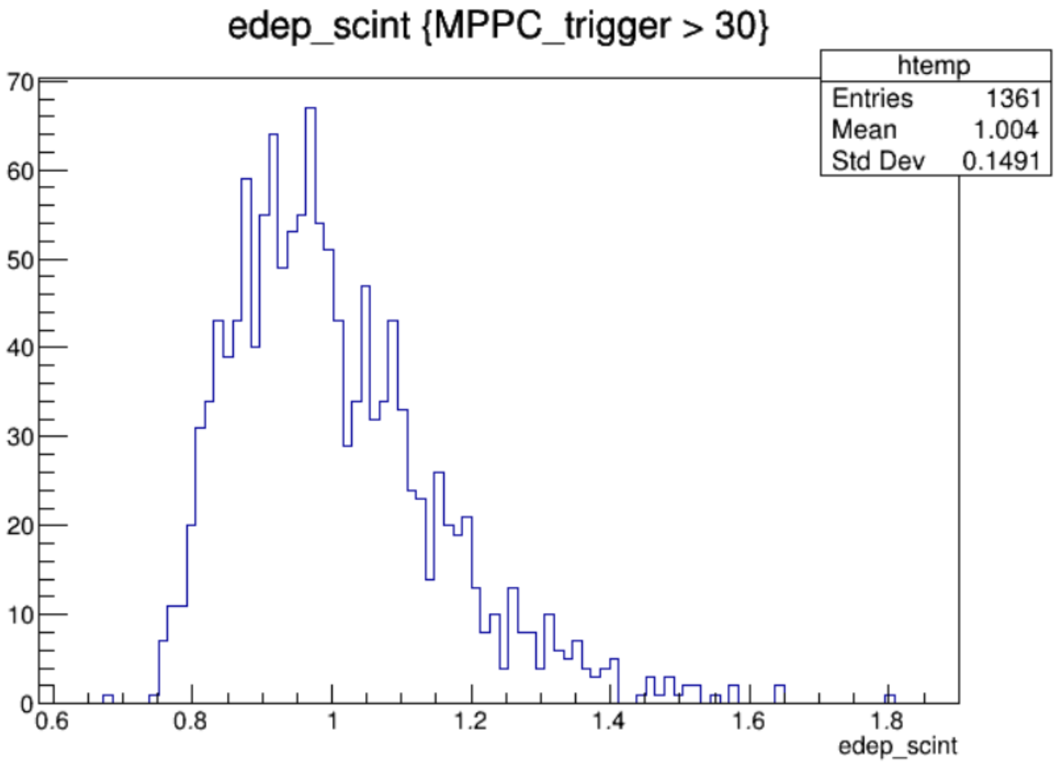
Energy deposit depending on trigger



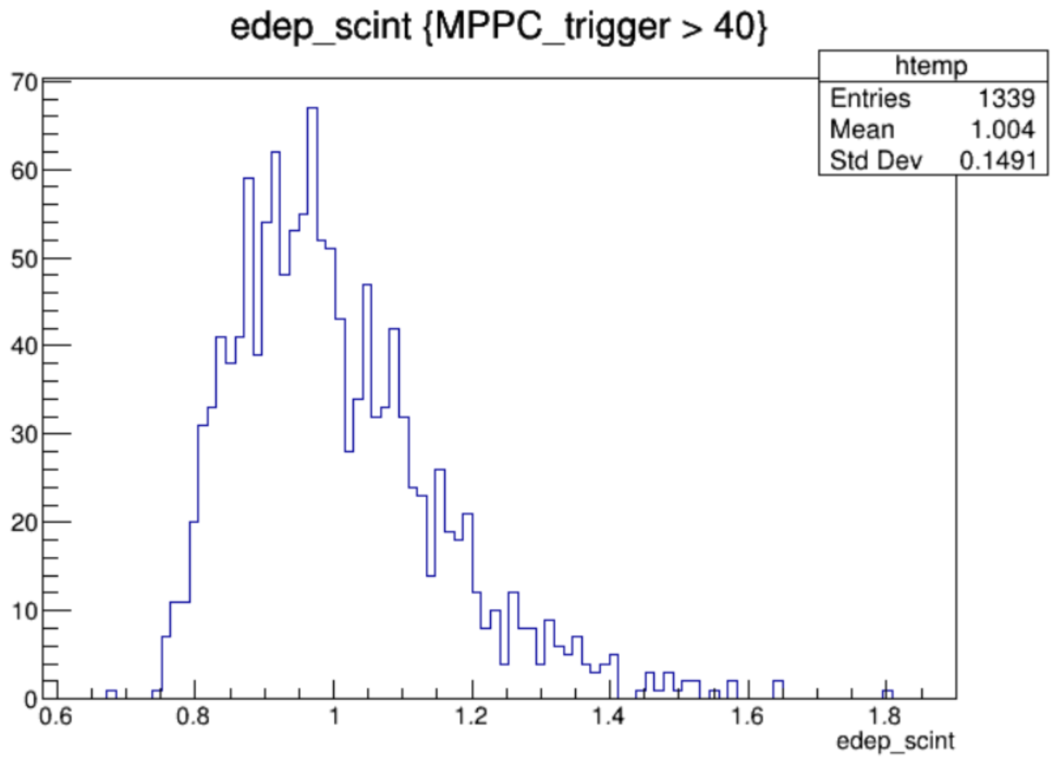


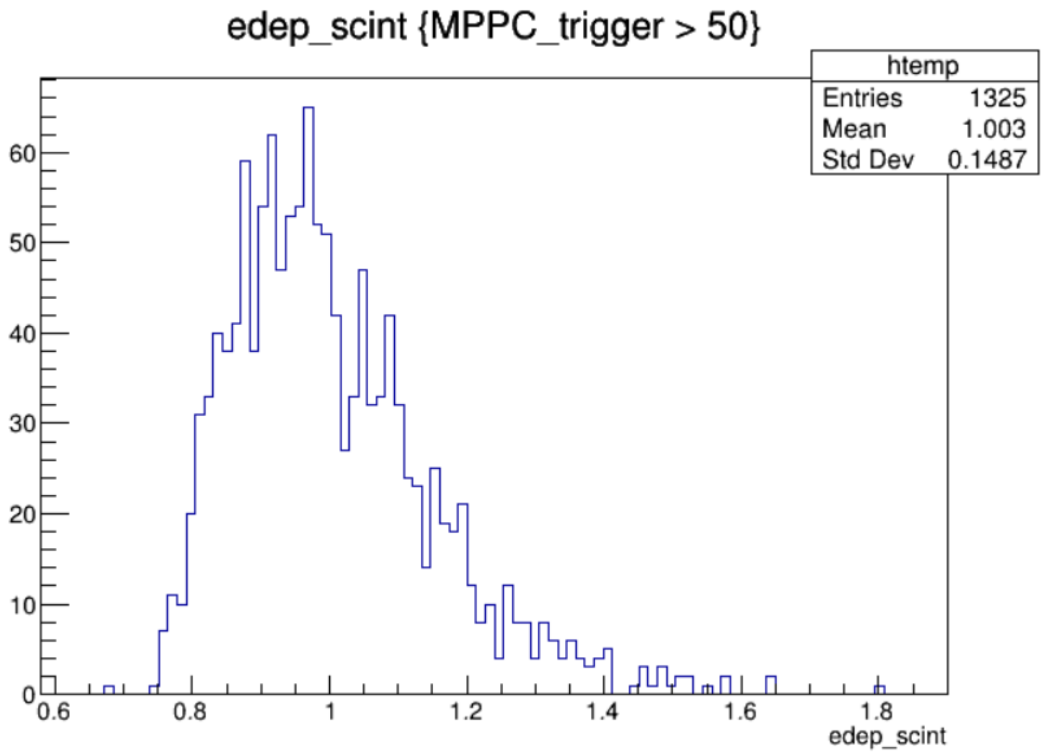
Energy deposit depending on trigger



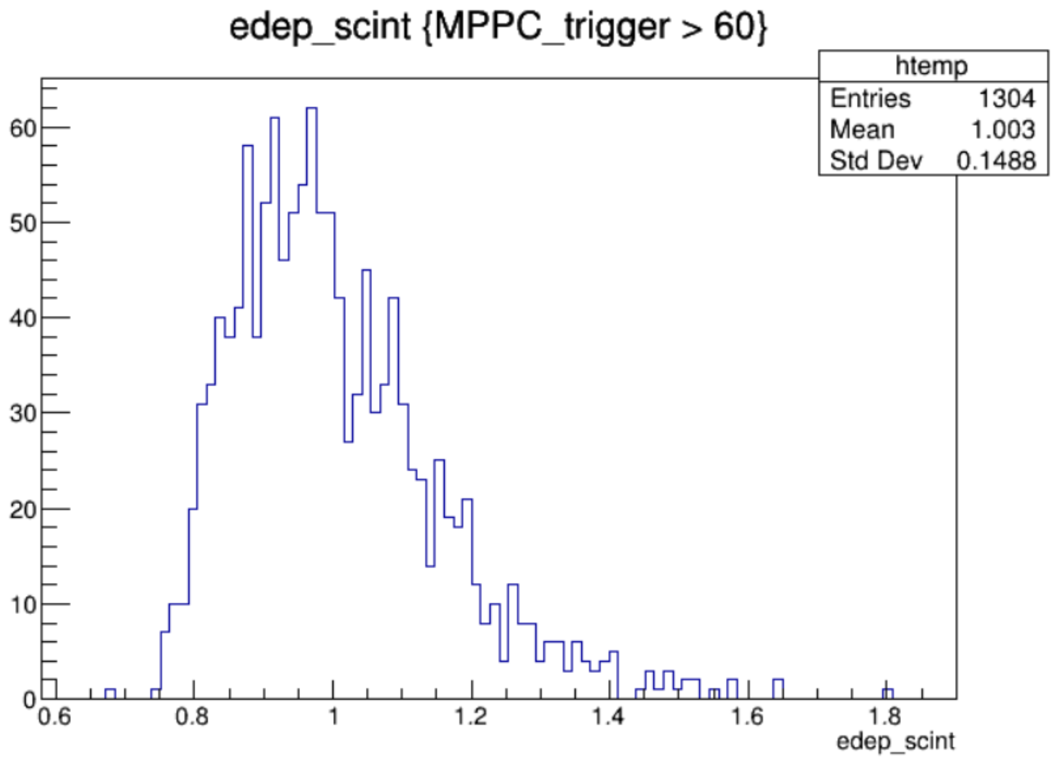


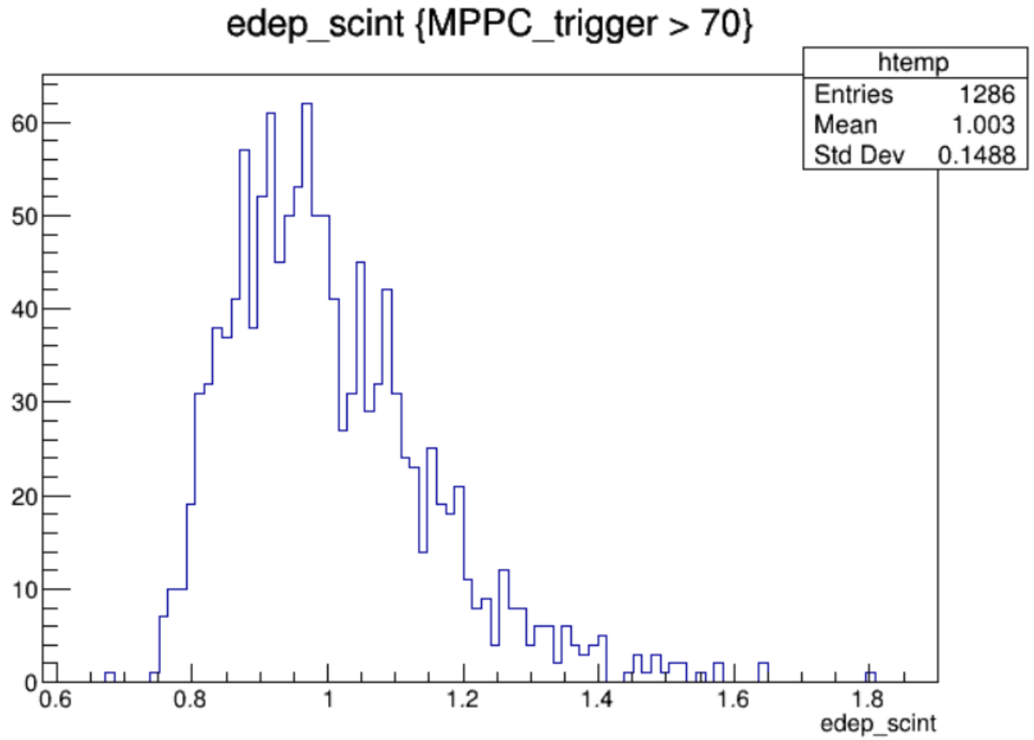
Energy deposit depending on trigger



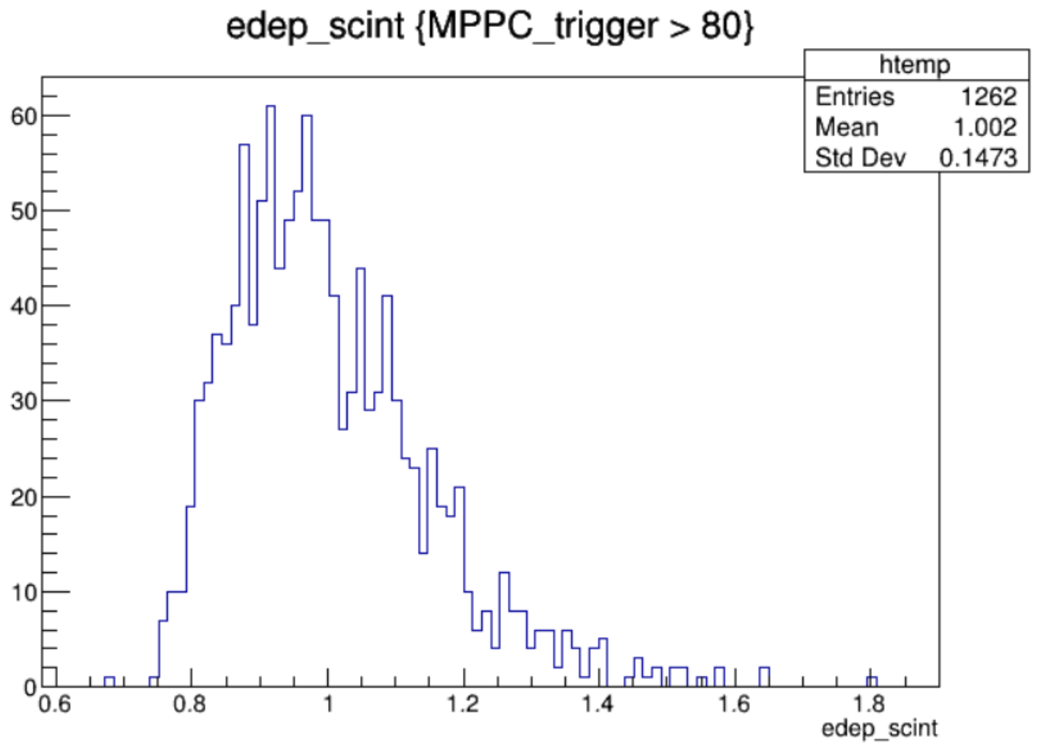


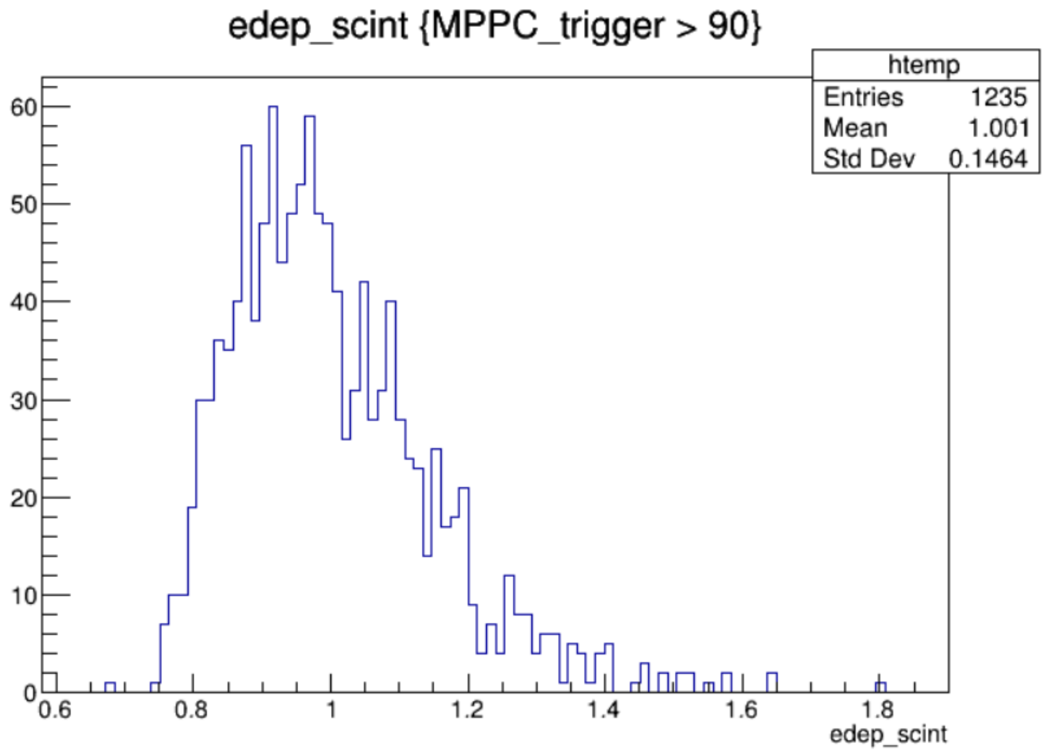
Energy deposit depending on trigger





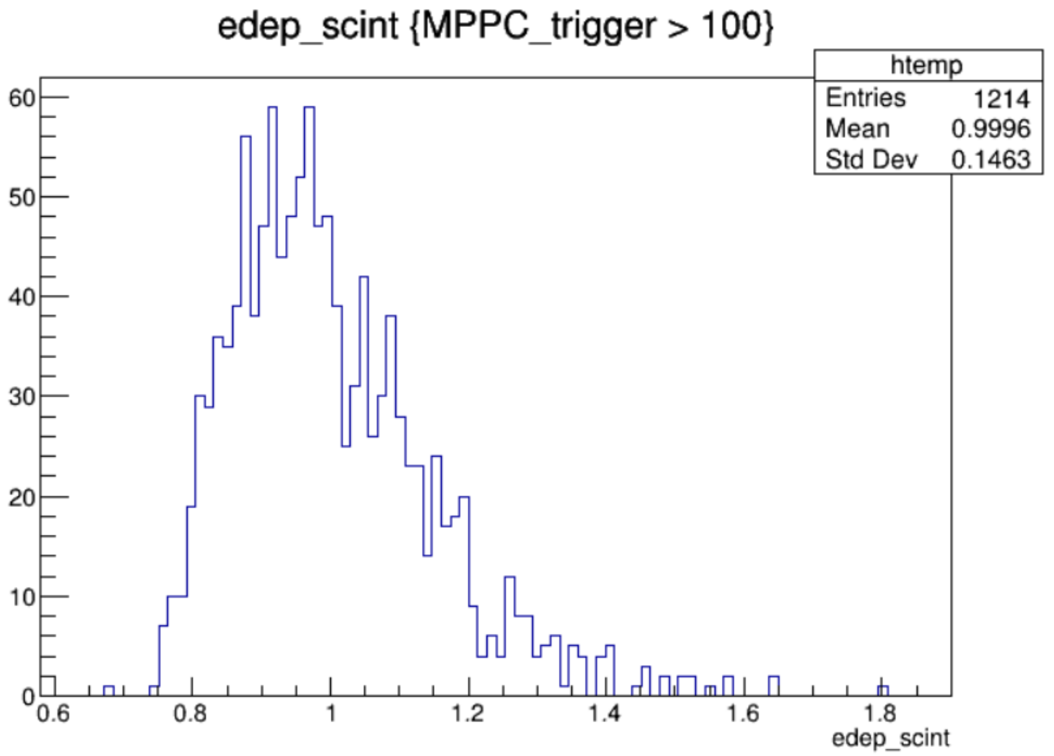
Energy deposit depending on trigger

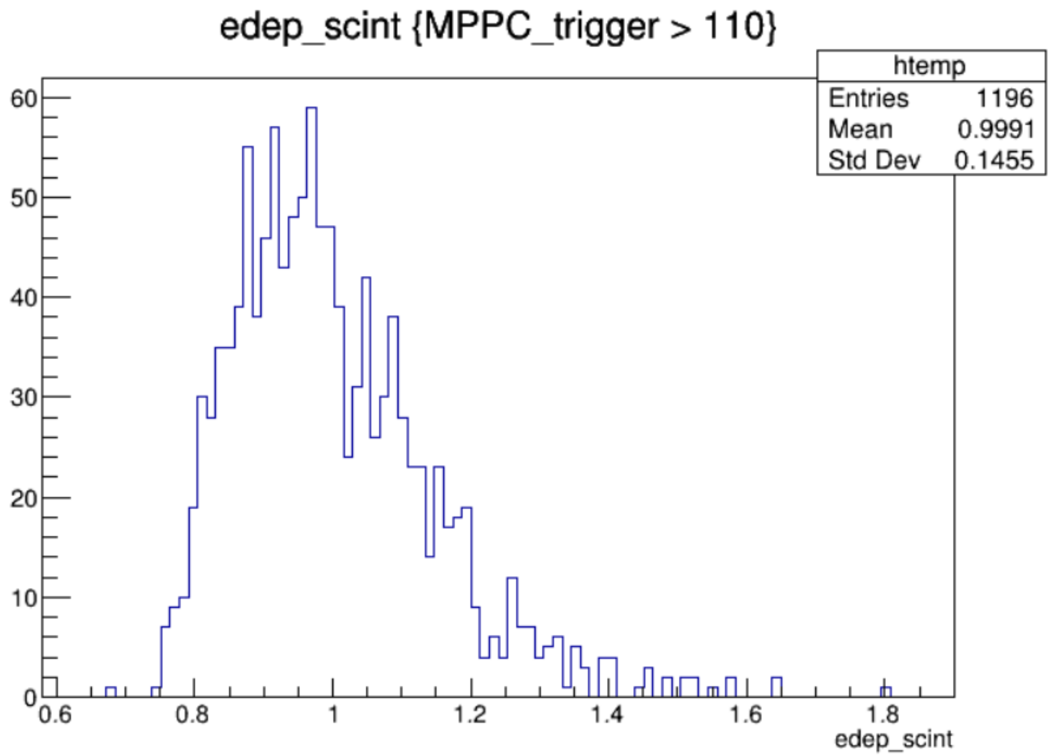




Trigger 조건이 변함에도 Mean 값은 거의 변하지 않음.

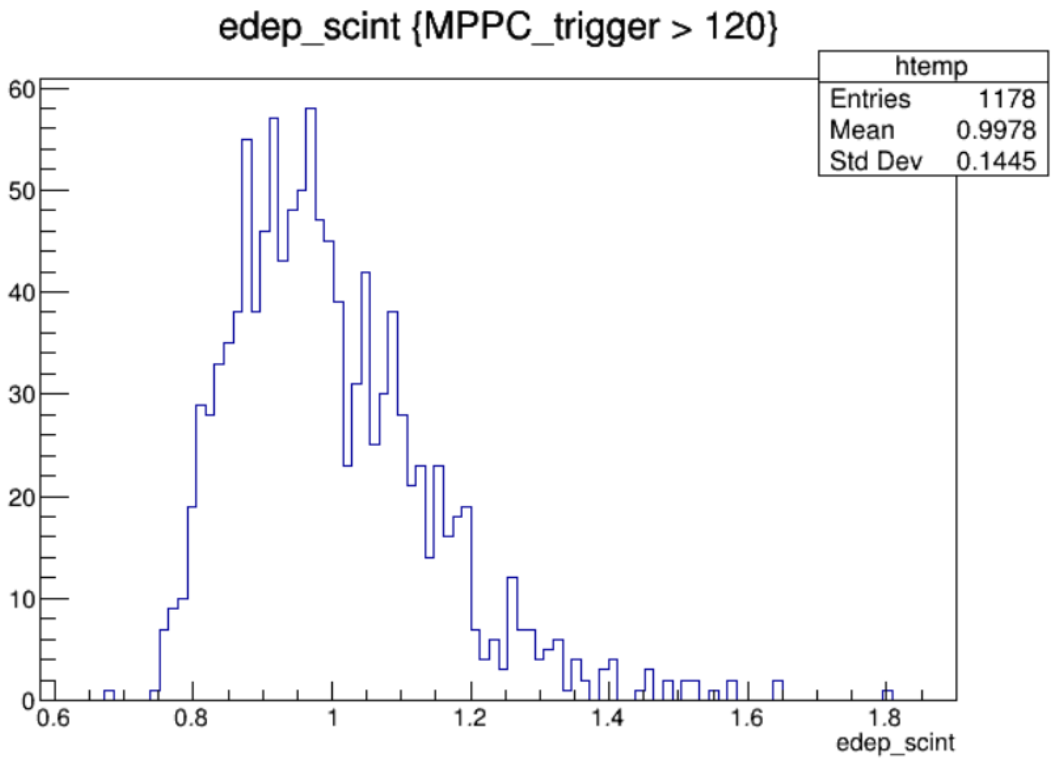
Energy deposit depending on trigger

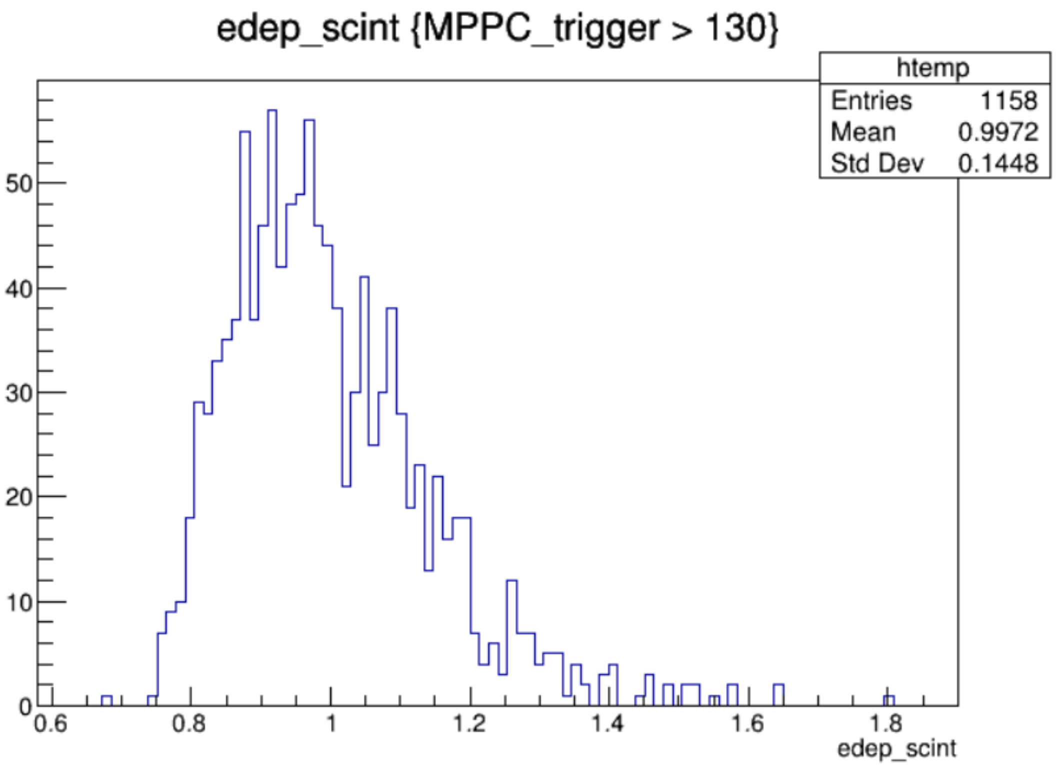




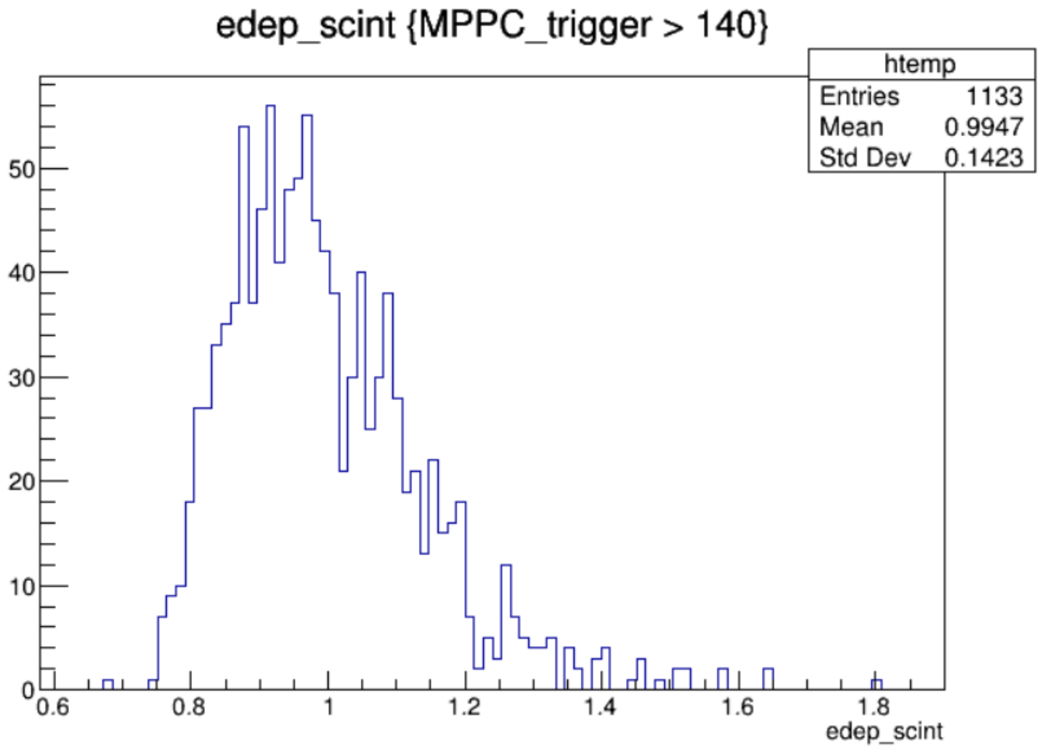
Trigger 조건이 증가함에 따라 Energy deposit이 감소함
이는 Trigger 쪽에 에너지를 더 많이 남기기 위해서는 Scintillator에 에너지를 덜 남겨야 하기 때문이다.

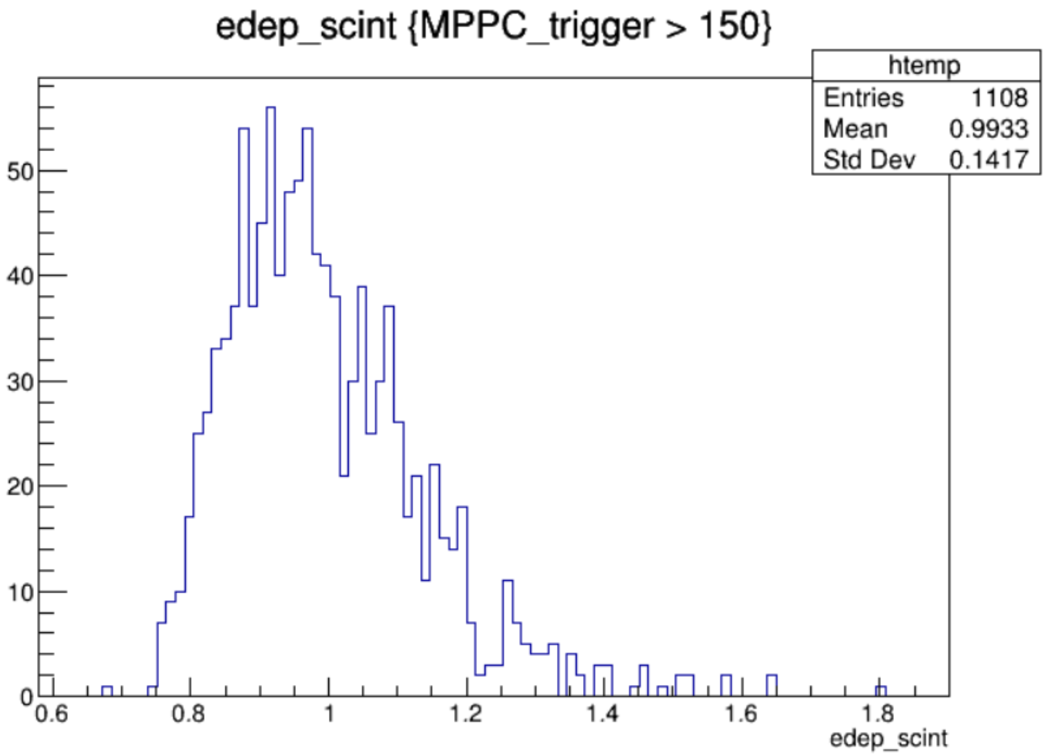
Energy deposit depending on trigger



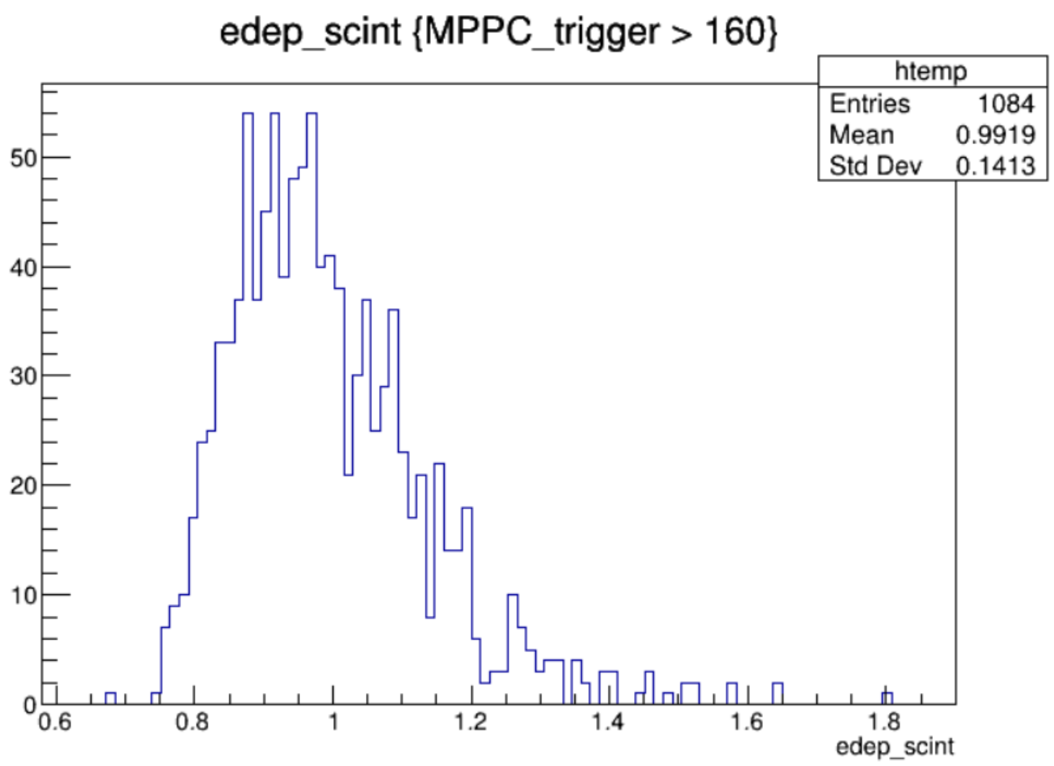


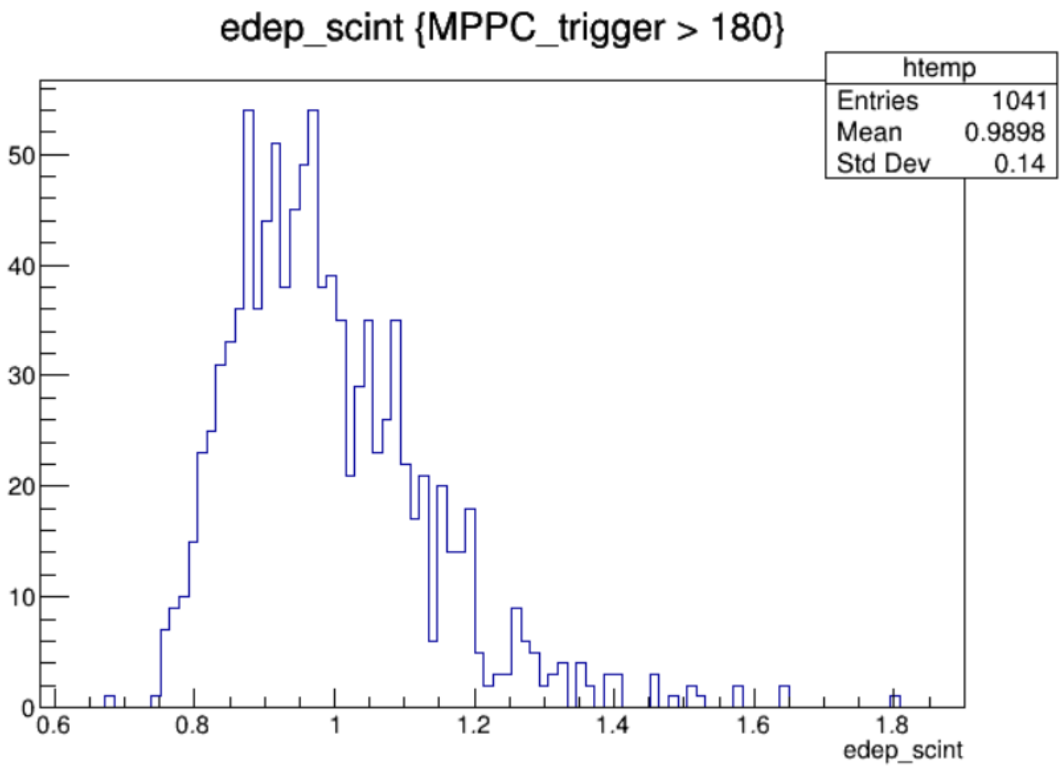
Energy deposit depending on trigger





Energy deposit depending on trigger





Energy deposit depending on trigger