INGRID MC Work

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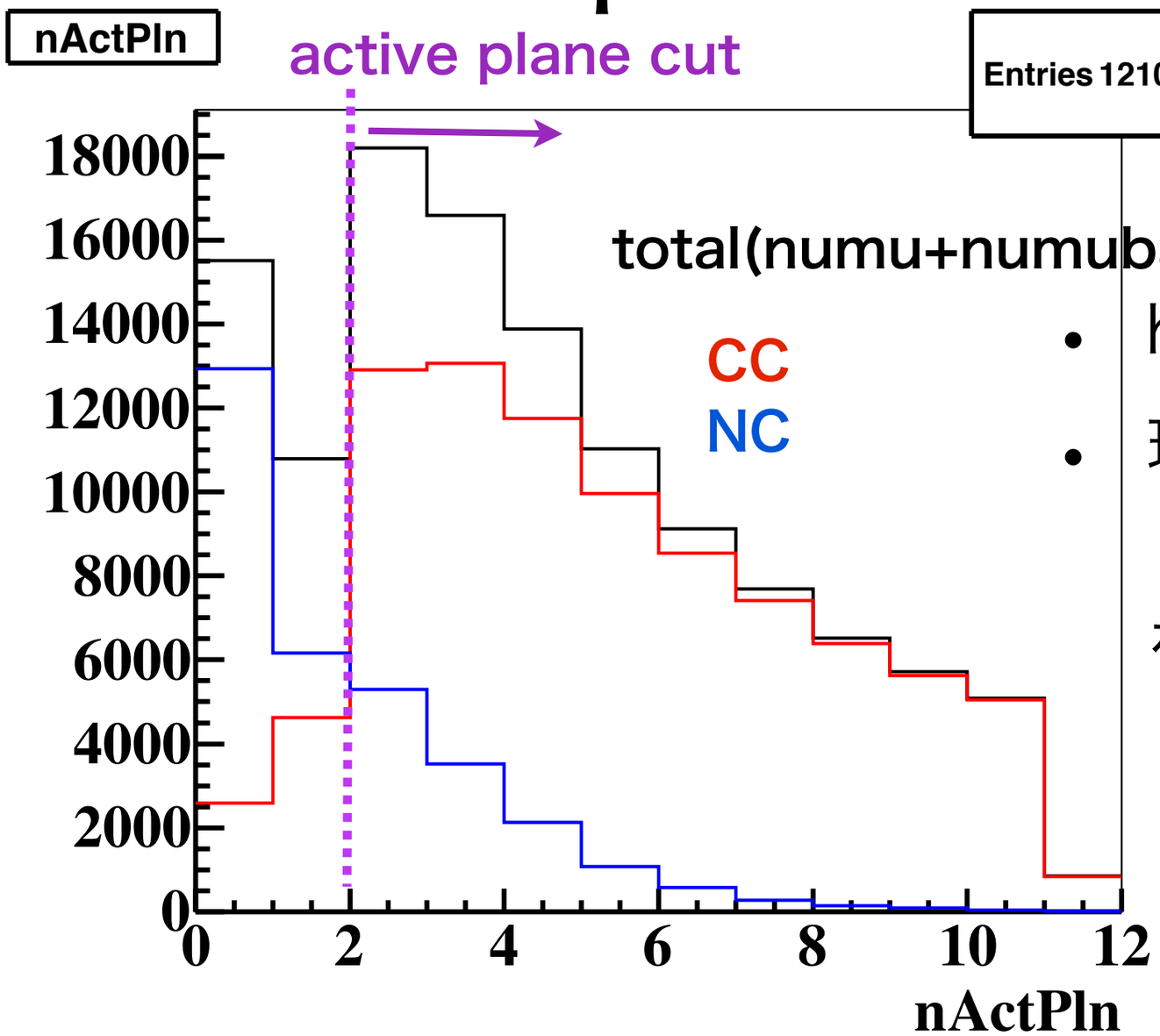
MC setting

- 期待されるニュートリノ反応数(by 南野さん)を元に、events/7modules/10^{19}POT相当の統計量を用いた。

- all horn current = 0kA, jnubeam09c :
  - 4.67×10^4 numu events + 1.29×10^4 numubar events

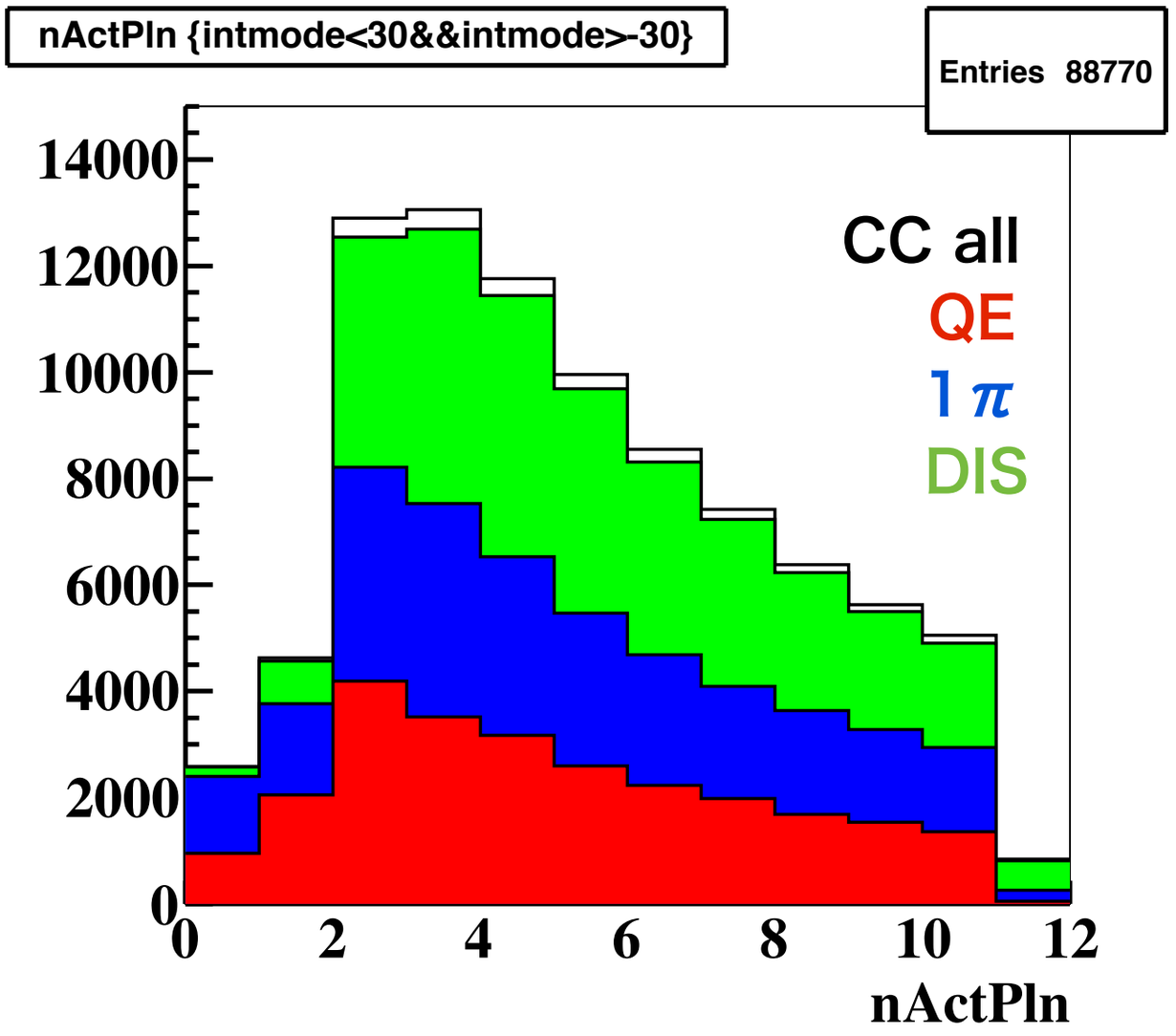
active plane 分布 (w/o horn)

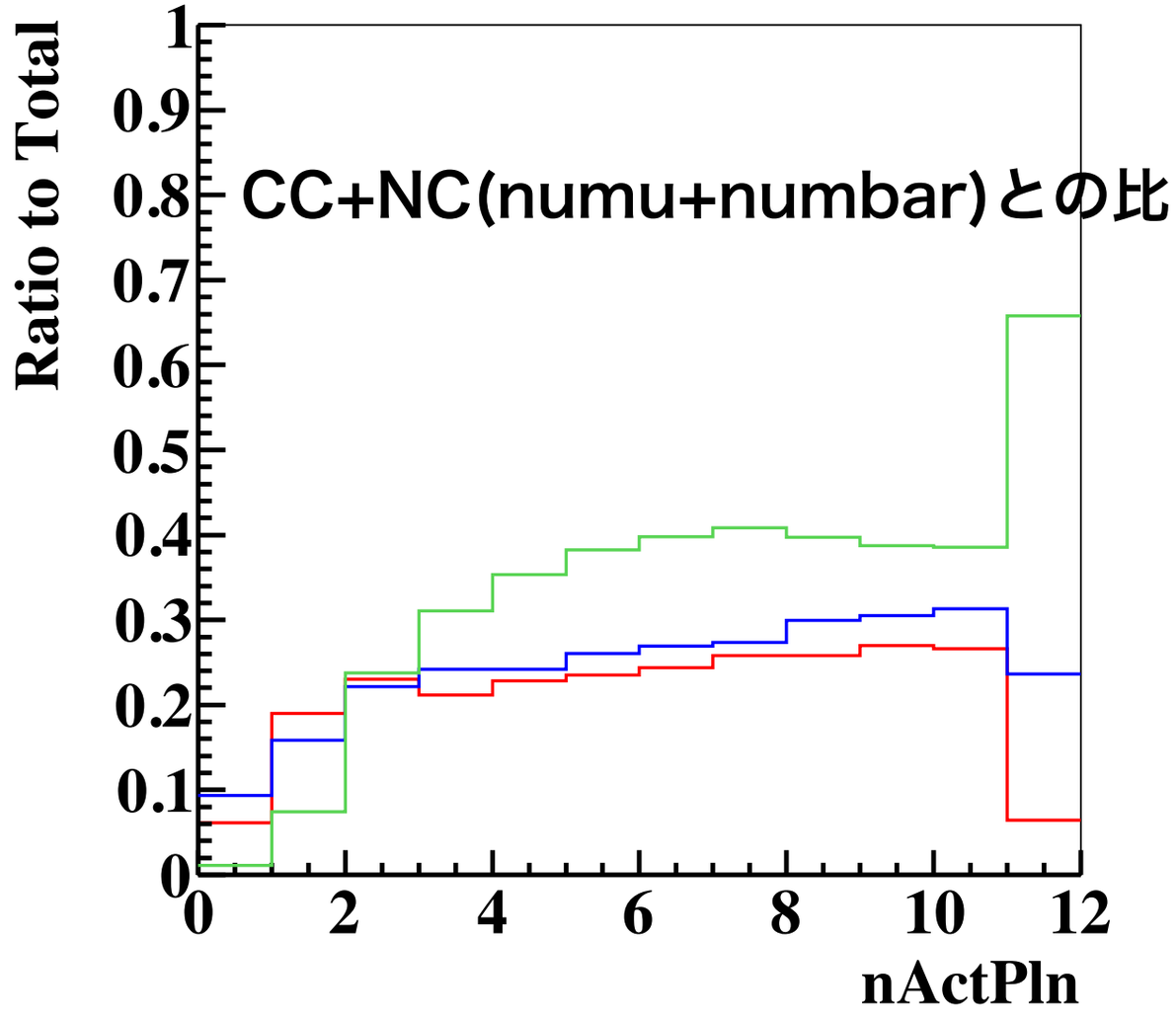


- horizontal & vertical modules
- 現時点でのINGRIDの解析では「アクティブプレーンが２以上」をカット条件にしている

	nocut	active plane > 1	active plane > 2
All	121000	94689(78%)	76496
CC	88770	81557	68654
NC	32230	13132	7842

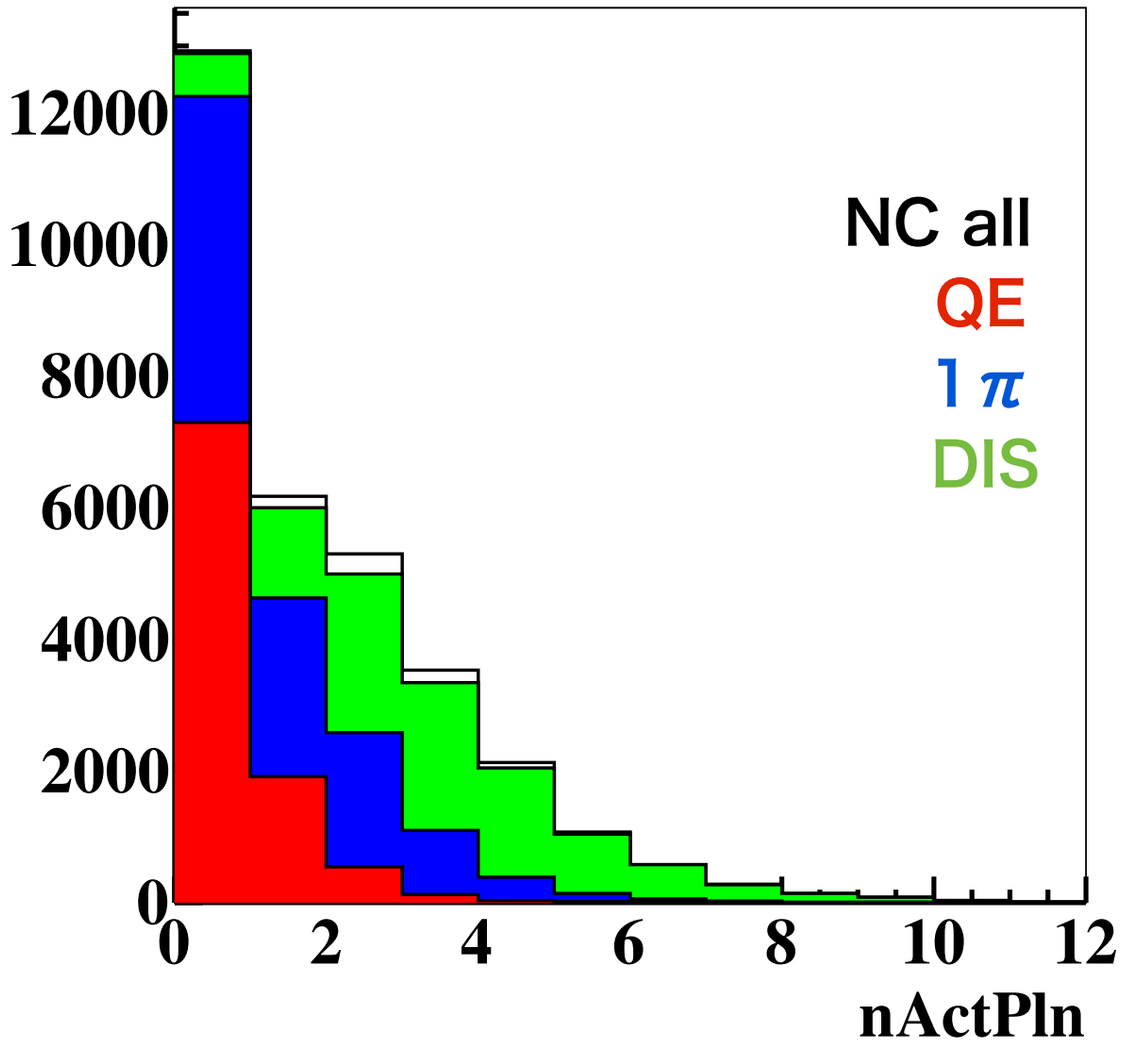
Interaction mode 毎

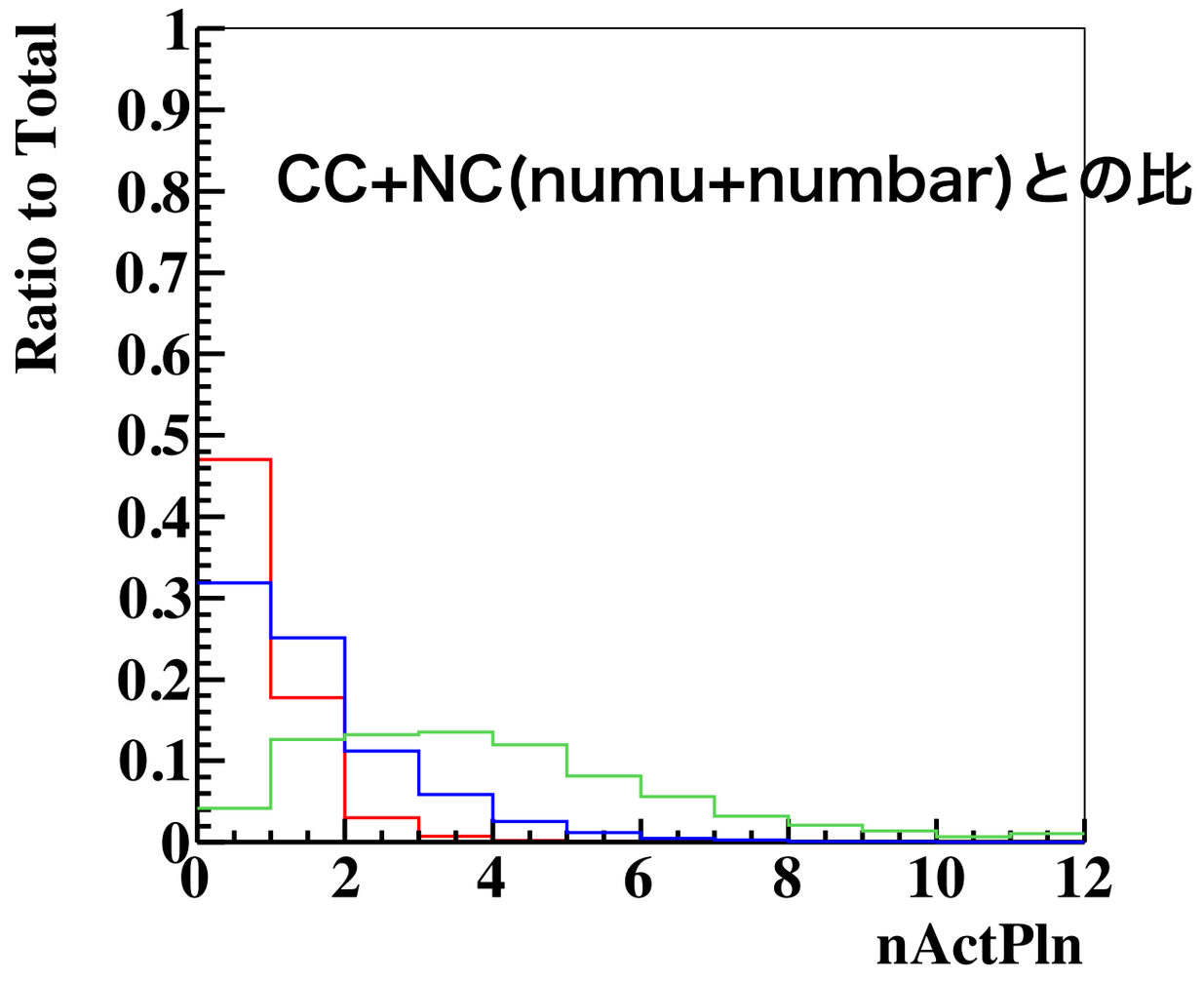




	nocut		active plane > 1		active plane > 2	
CC (numu +numubar)	88770		81557		68654	
QE	25326		22319		18129	
1π	27489		24331		20306	
DIS	33685		32710		28382	

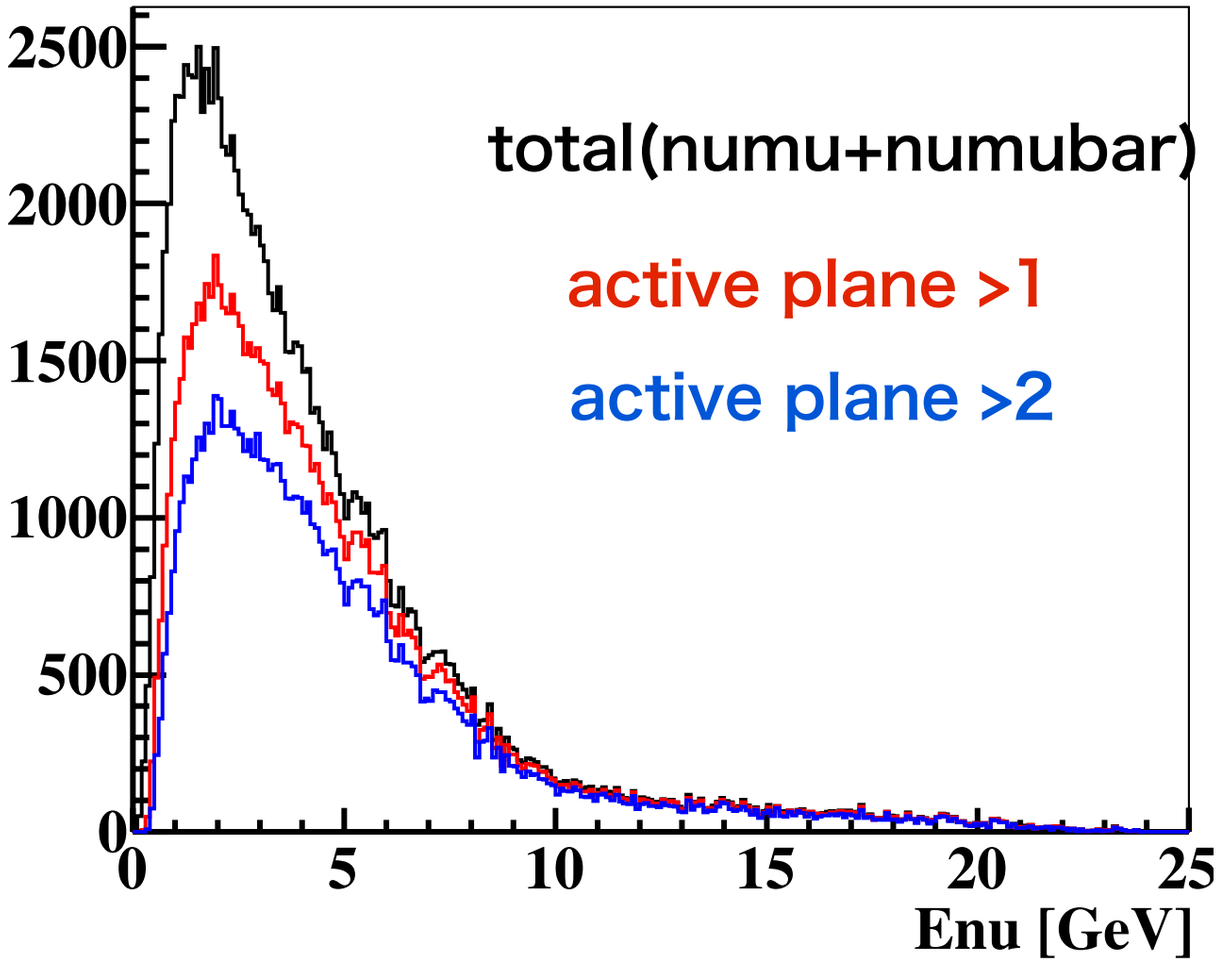
Interaction mode 毎

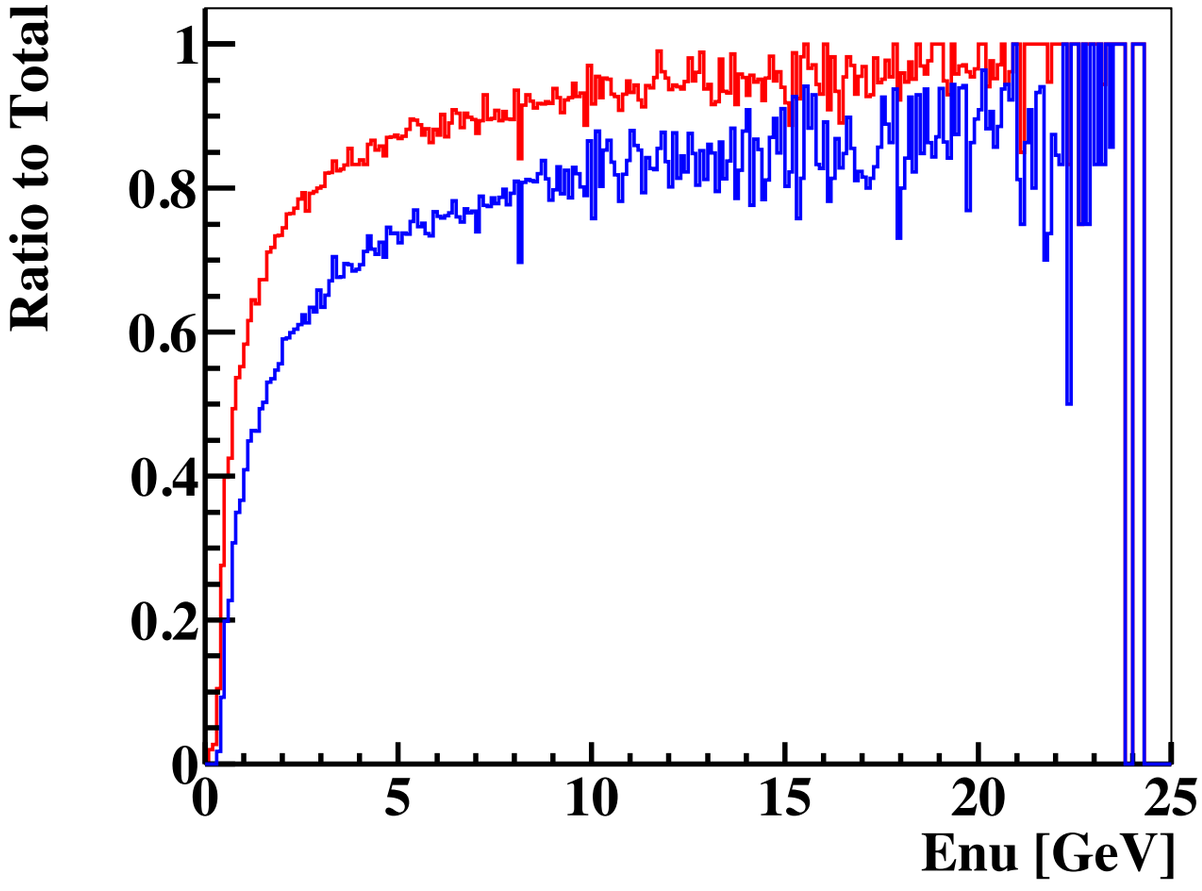




	nocut		active plane > 1		active plane > 2	
NC (numu +numubar)	32230		26264		15684	
Elastic	9923		716		174	
1π	11221		3566		1531	
DIS	10253		8236		5826	

Neutrino Energy 分布

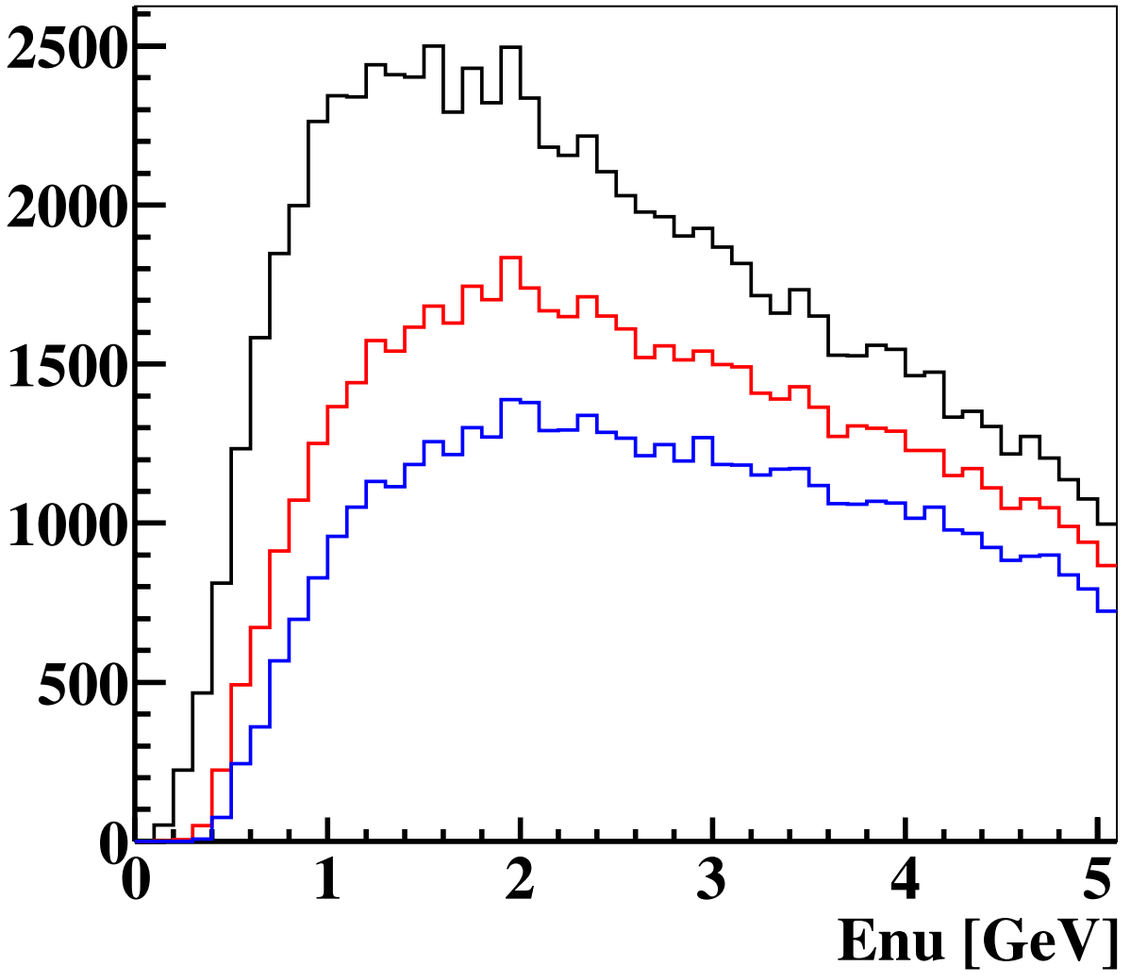


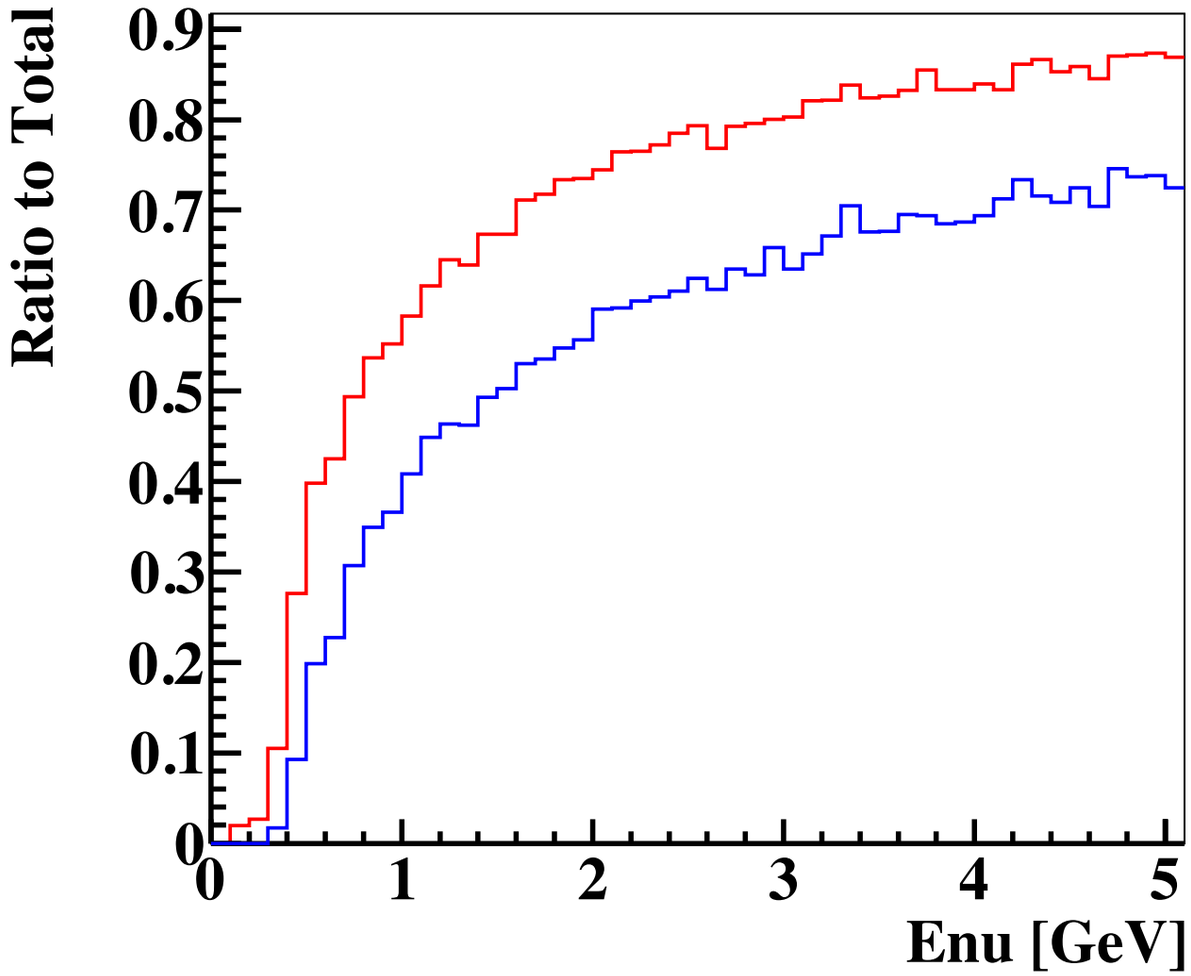


	nocut	active plane > 1	active plane > 2
Total	121000	94689(78%)	76496
Enu < 3 GeV	55249	36977(67%)	27431(50%)

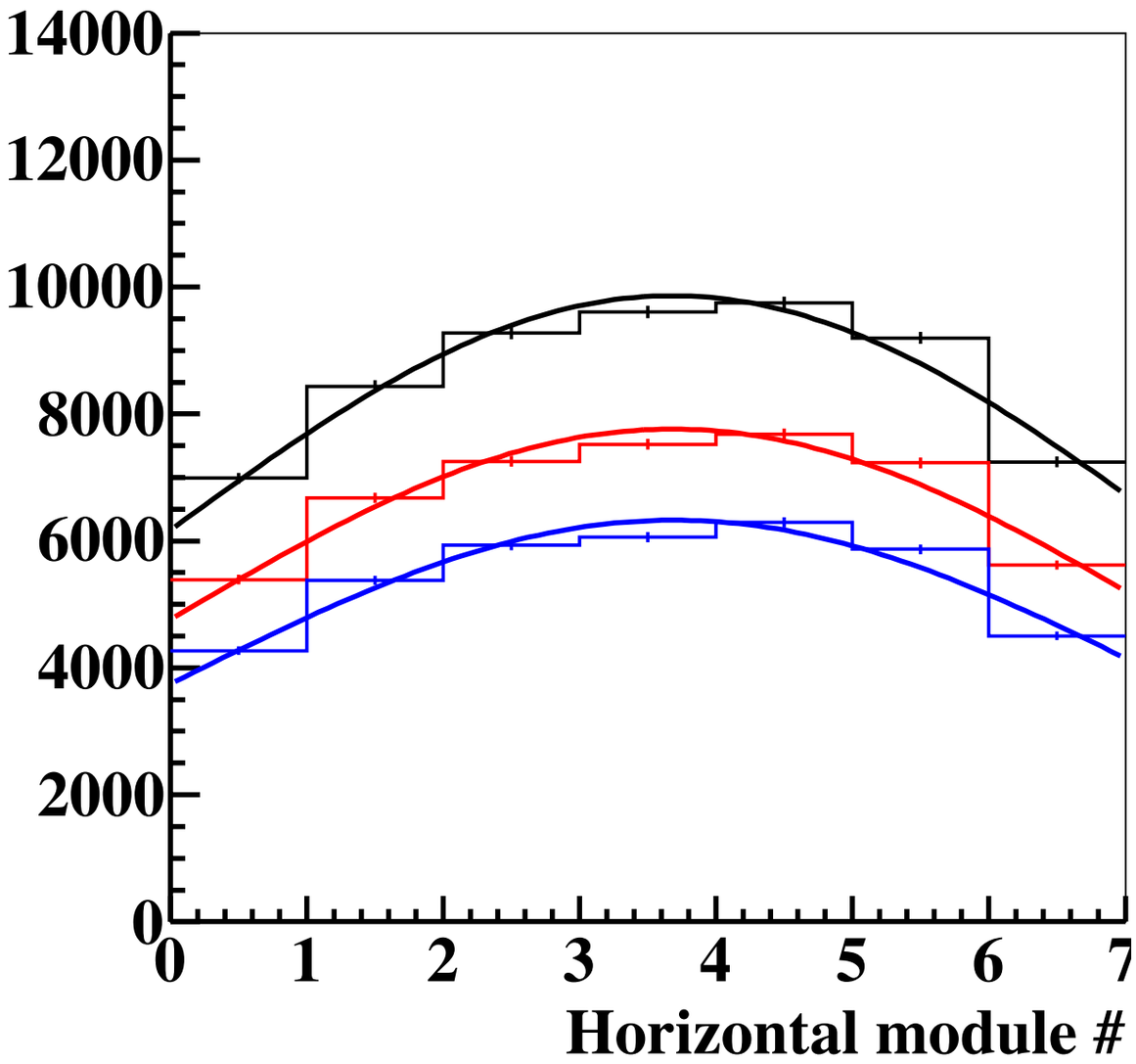
()内は同じEnuの範囲でactive plane カットなしの数との比

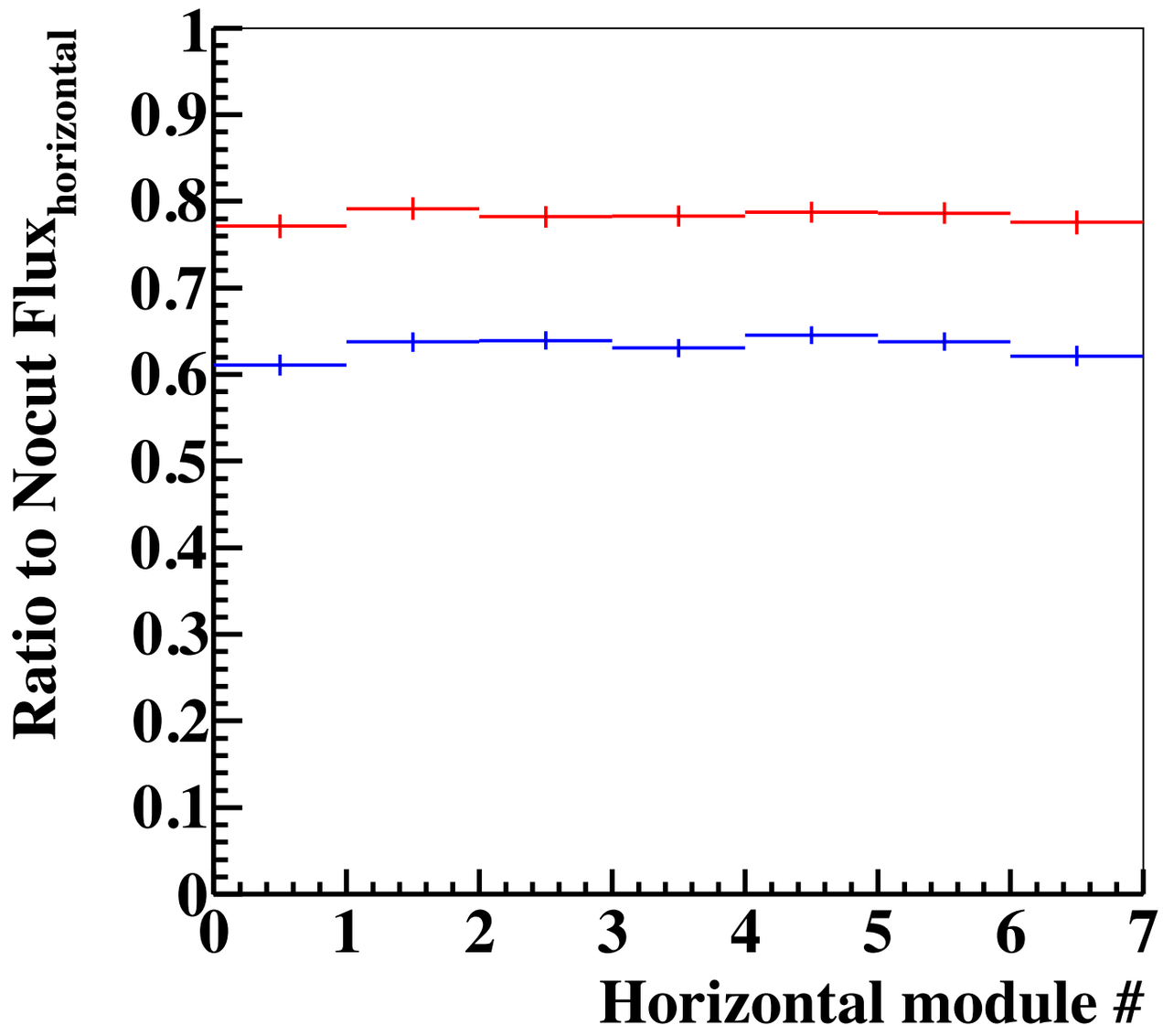
Neutrino E 分布 (low Energy)





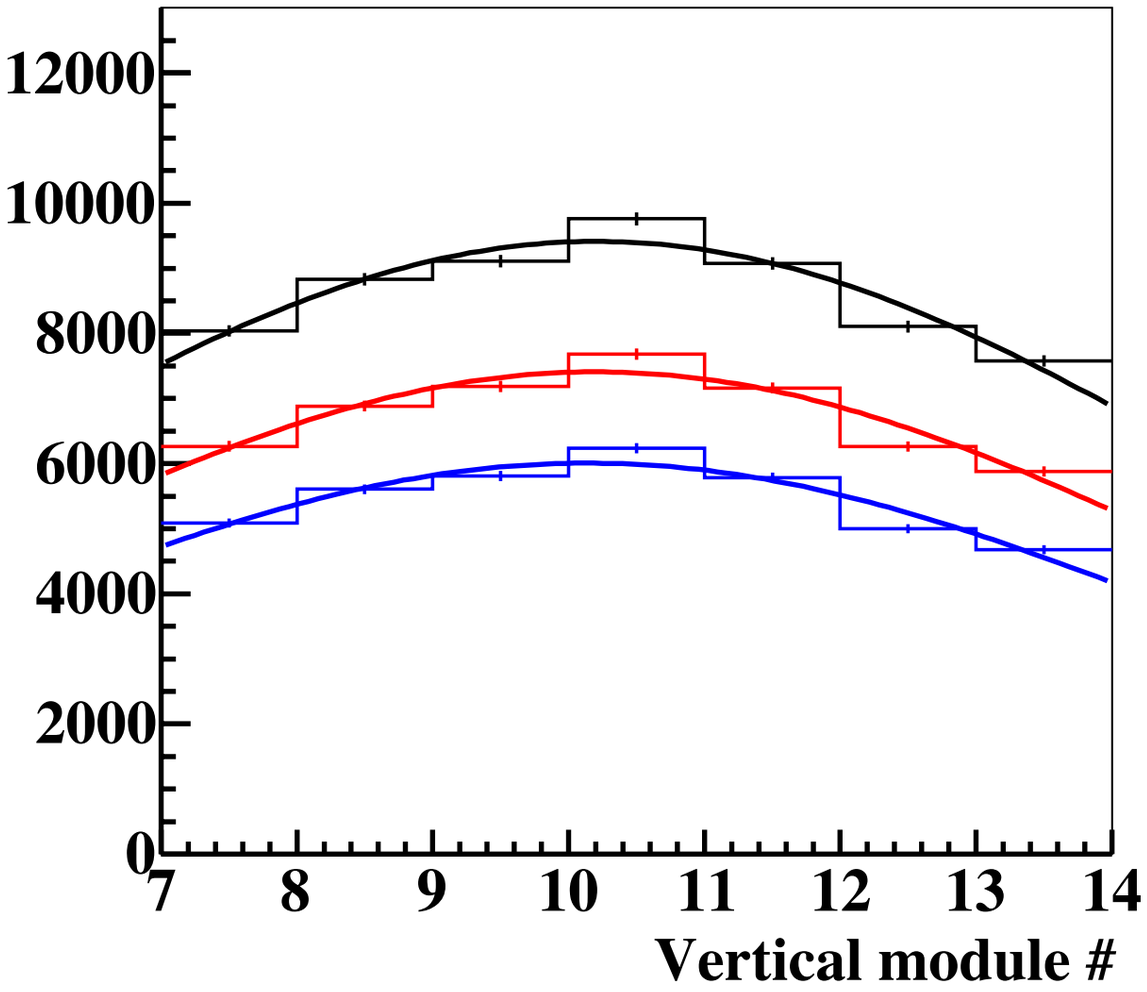
horizontal module

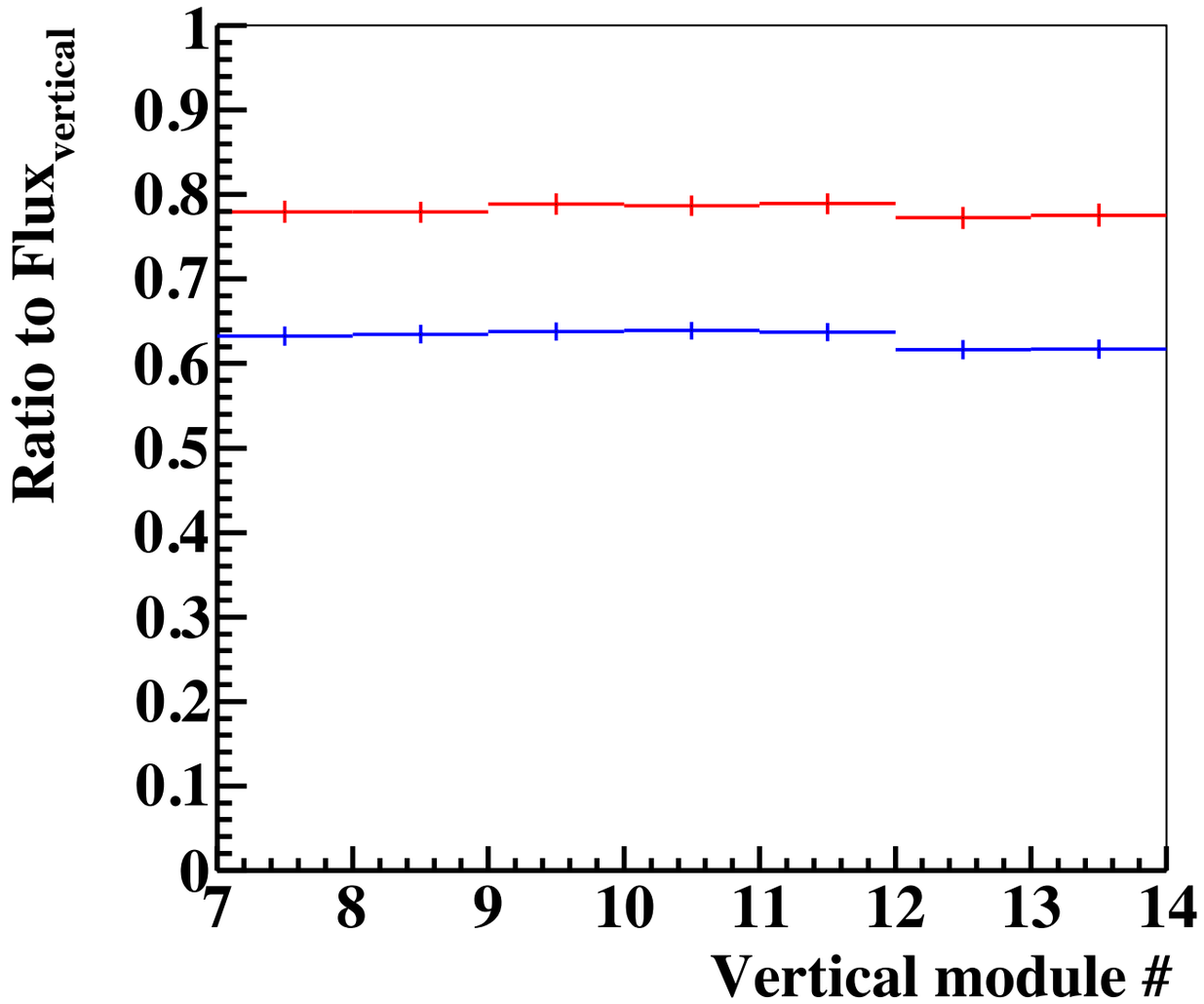




	nocut	active plane > 1	active plane > 2
Constant	9861±58	7761±52	6326±47
Mean	3.68±0.03	3.68±0.03	3.69±0.04
Slgma	3.80±0.07	3.72±0.07	3.61±0.07

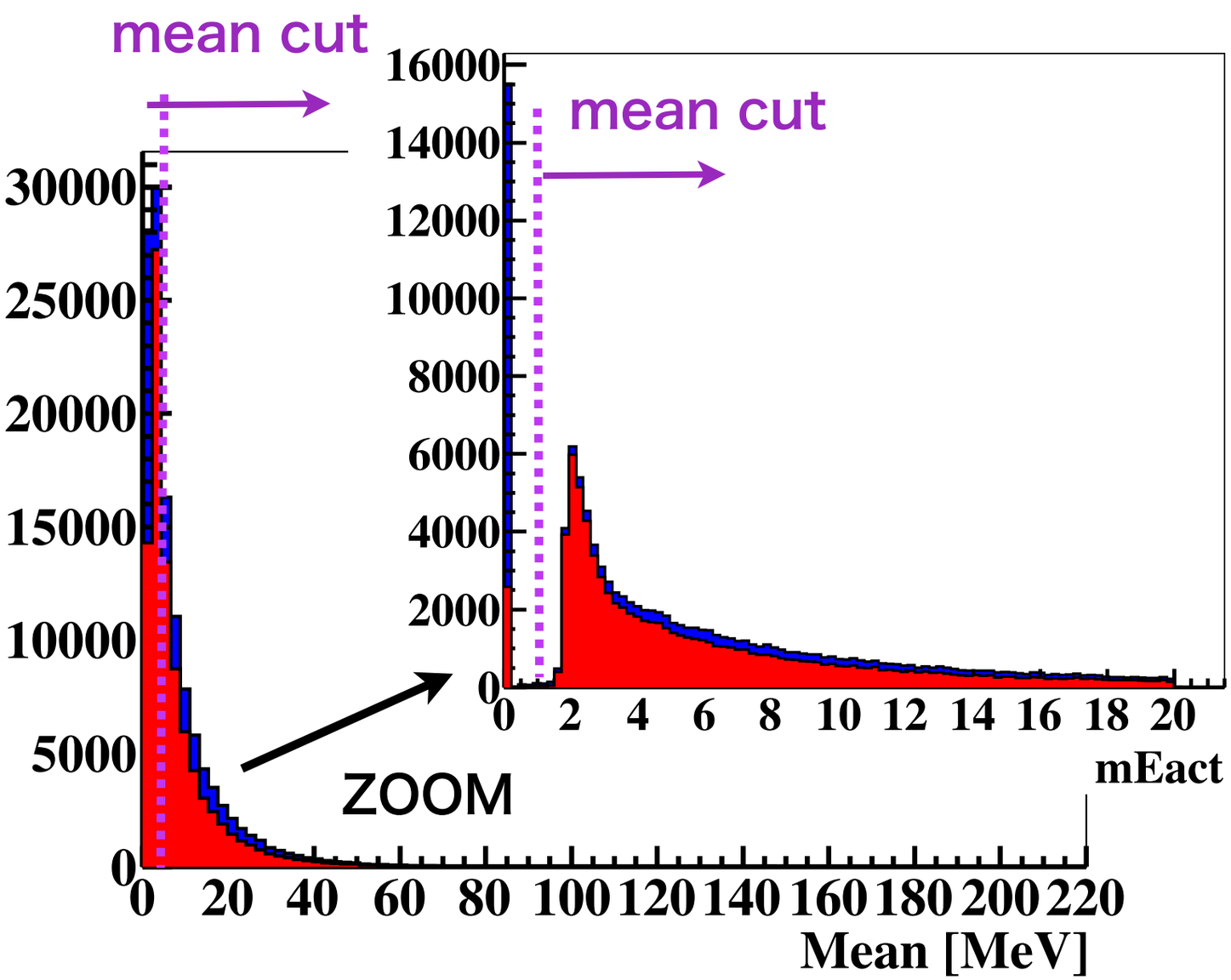
vertical module

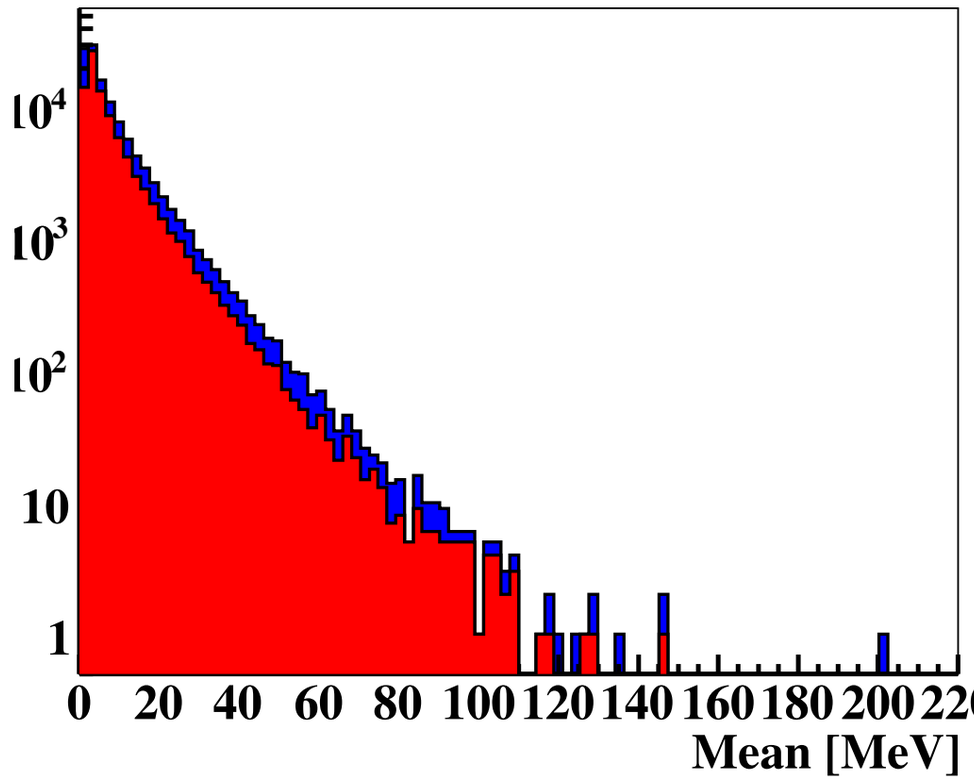




	nocut	active plane > 1	active plane > 2
Constant	9413±57	7409±51	6007±46
Mean	10.2±0.05	10.2±0.1	10.1±0.06
Slgma	4.80±0.13	4.61±0.14	4.52±0.14

Mean energy deposite





- horizontal & vertical modules
- Mean energy deposite (mEact [MeV]) > 8.5 p.e. × (p.e. to energy[MeV] const) → “mean cut”
  - p.e. to energy const = 2MeV / 15p.e. (from cosmic test)

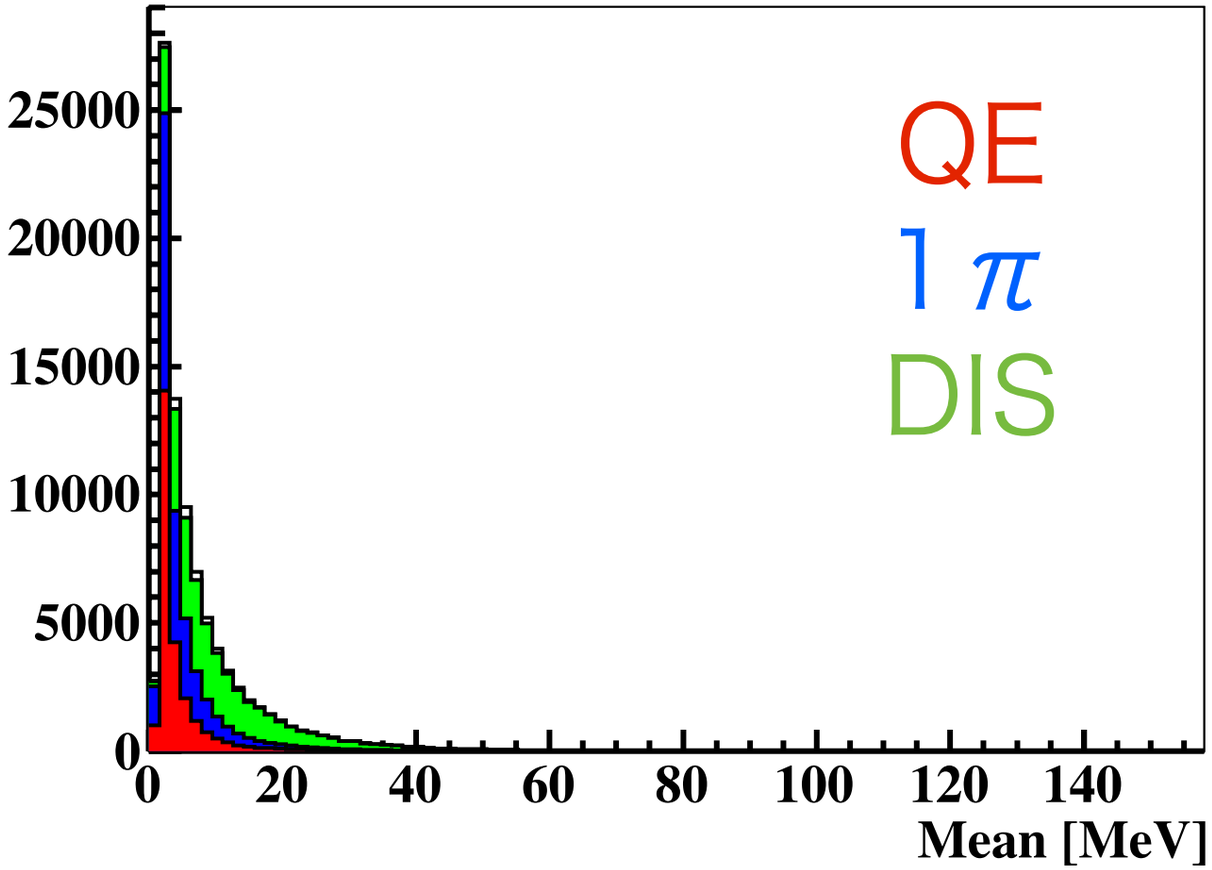
Mean Edep 分布

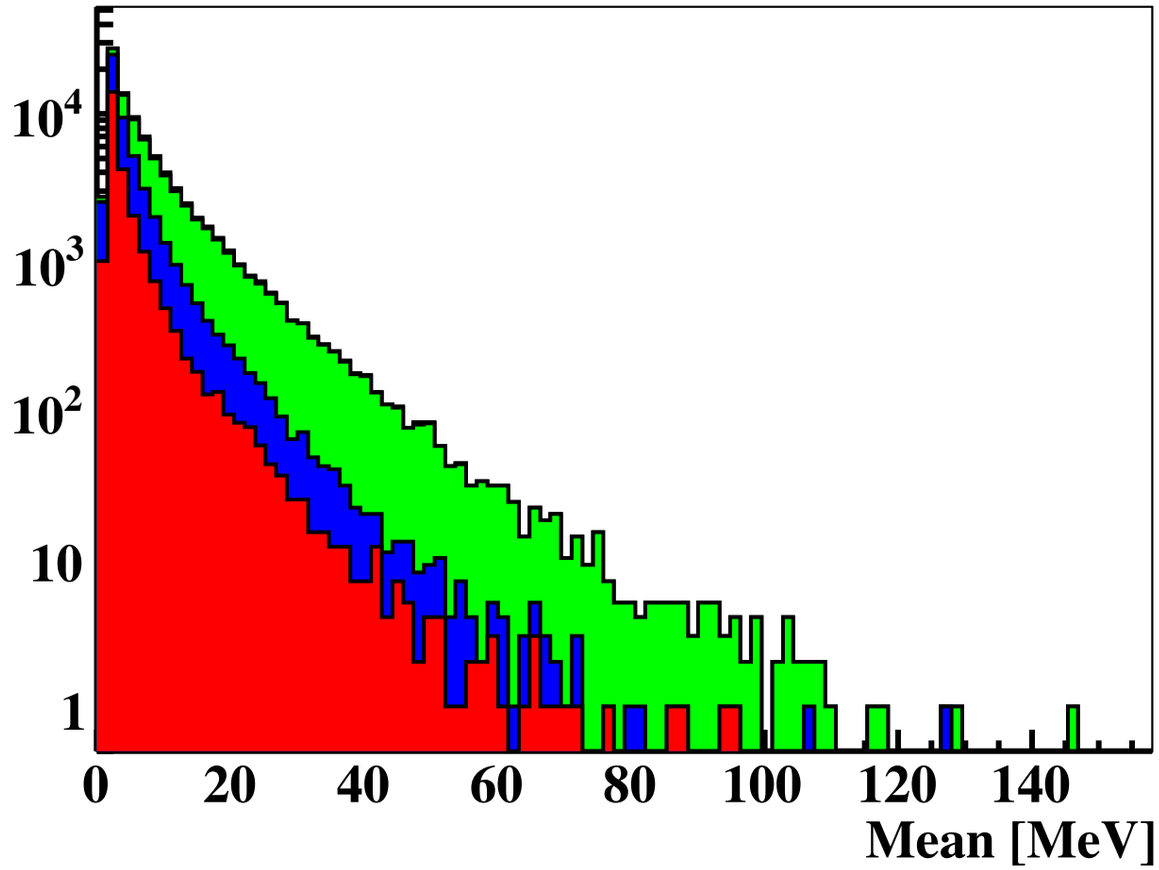
$15 p.e./MIP(2MeV)$

Threshold [p.e.]	0	8.5	9.5	10.5	15	17
Threshold [MeV]	0	1.1333333	1.2666667	1.4	2	2.2666667
# of entry	121000	105201	105139	105058	98605	91130
Efficiency(%)	100	86.9	86.9	86.8	81.5	75.3

アクティブプレーンあたりの平均エネルギー損失の閾値を2MeV以上にすると
徐々にefficiencyが落ちてくる。それまではほとんど変化なし。

interaction mode (CC)





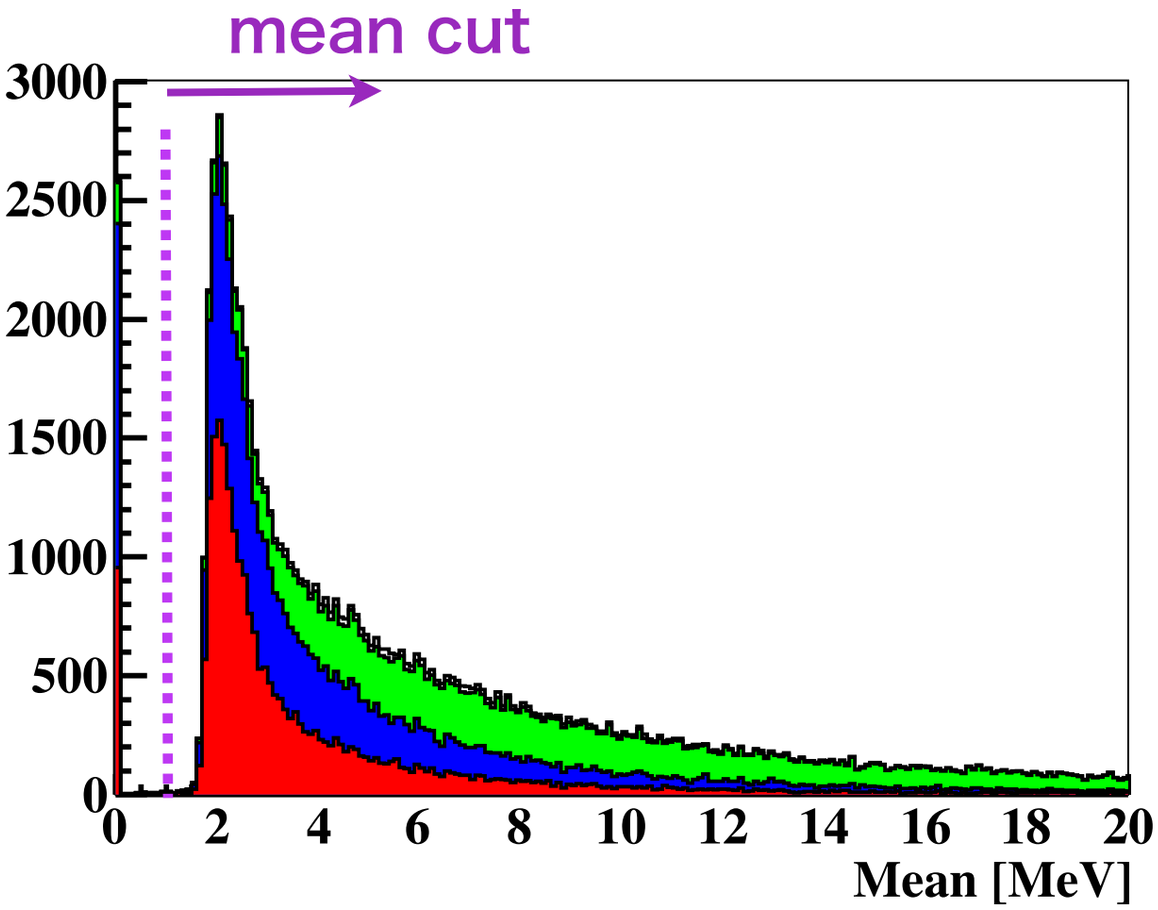
CC反応のみを描写

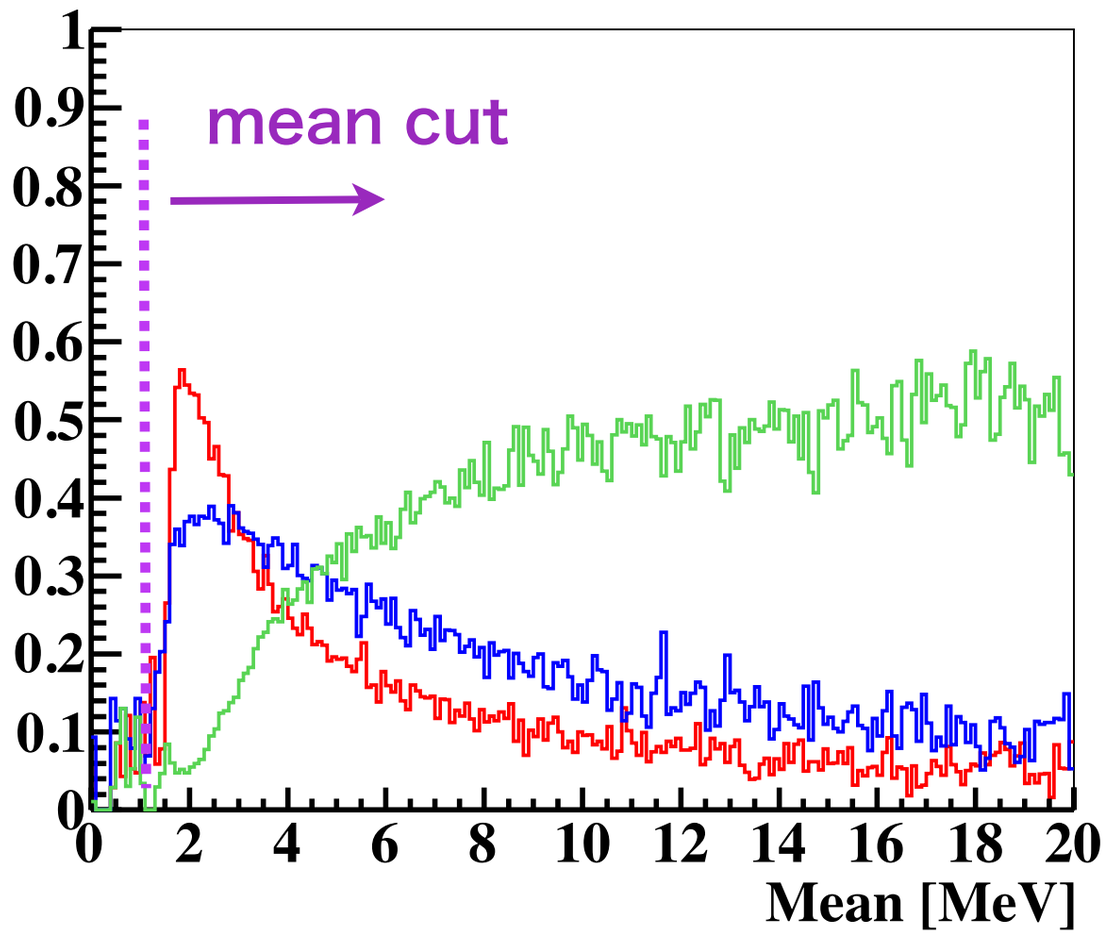
低エネルギー領域を細かく見てみる →

interaction mode (CC)

アクティブプレーンあたりの平均エネルギー損失

< 20MeV 以下を細かく見てみる



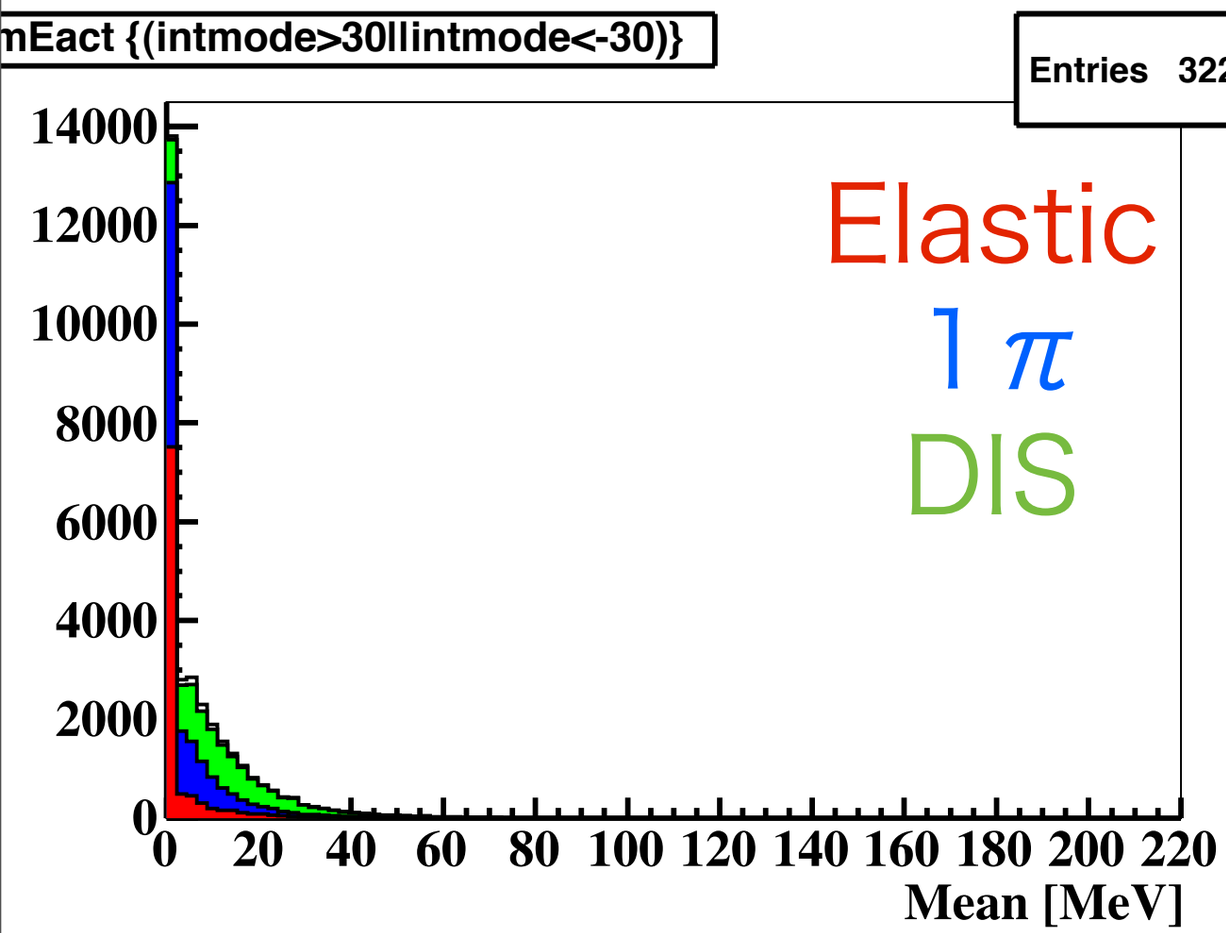


2MeV付近にピーク

interaction mode (CC)

	nocut	Mean > 8.5	Mean > 15
CC all	88770	86118	79980
QE	25326	24351	20865
1π	27489	26014	23715
DIS	33685	33494	33167

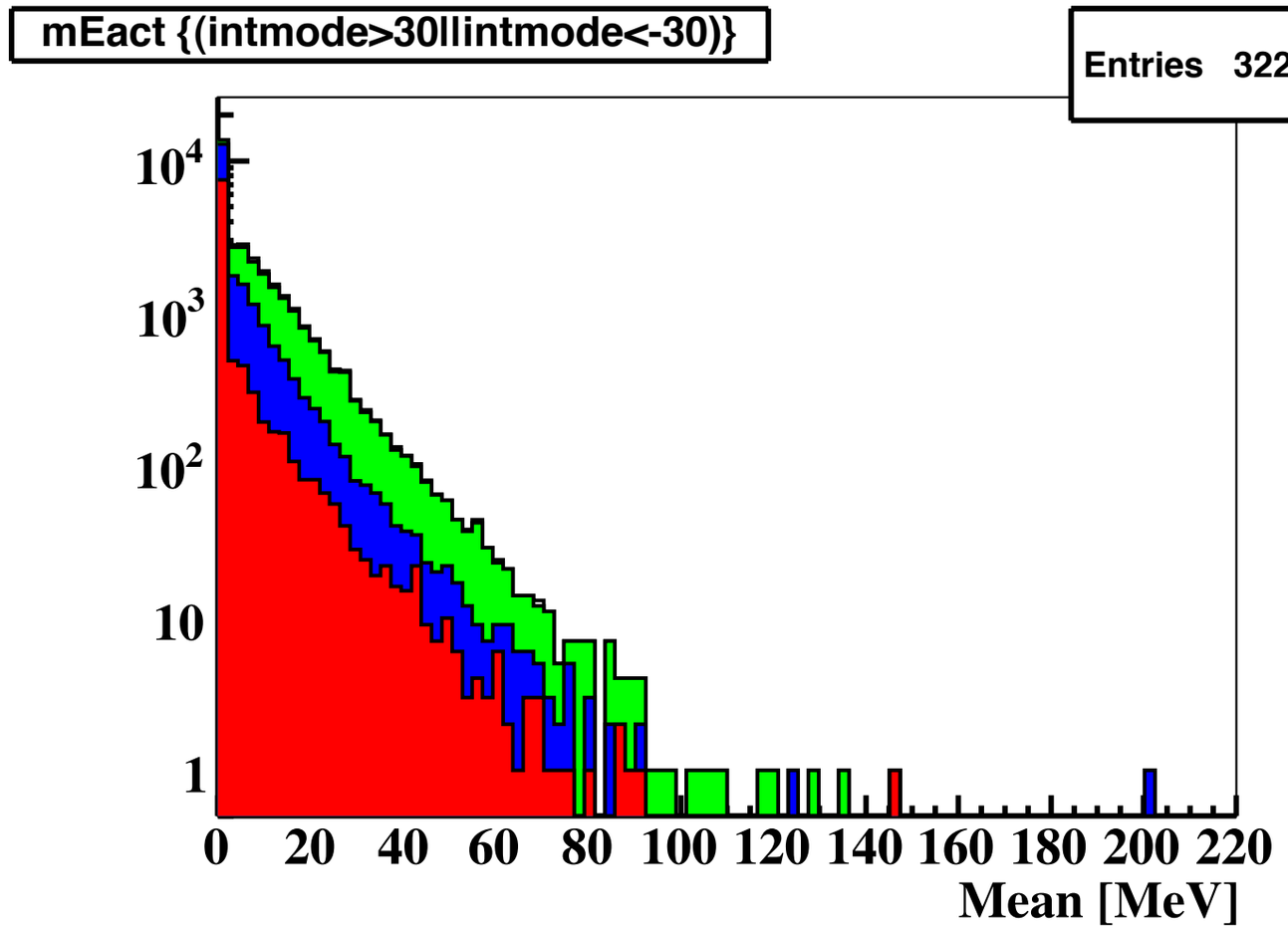
interaction mode NC



Elastic

1 π

DIS

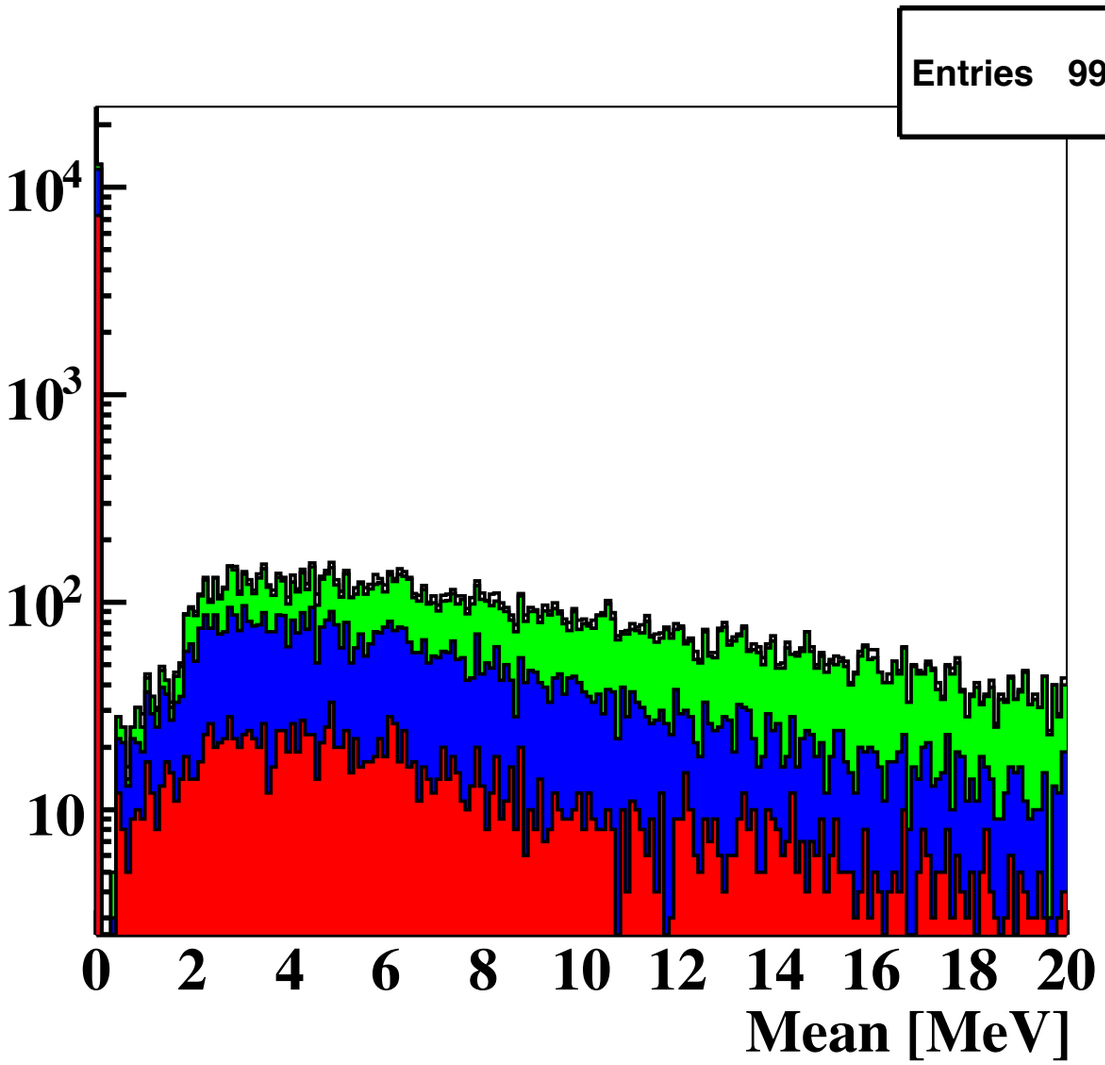


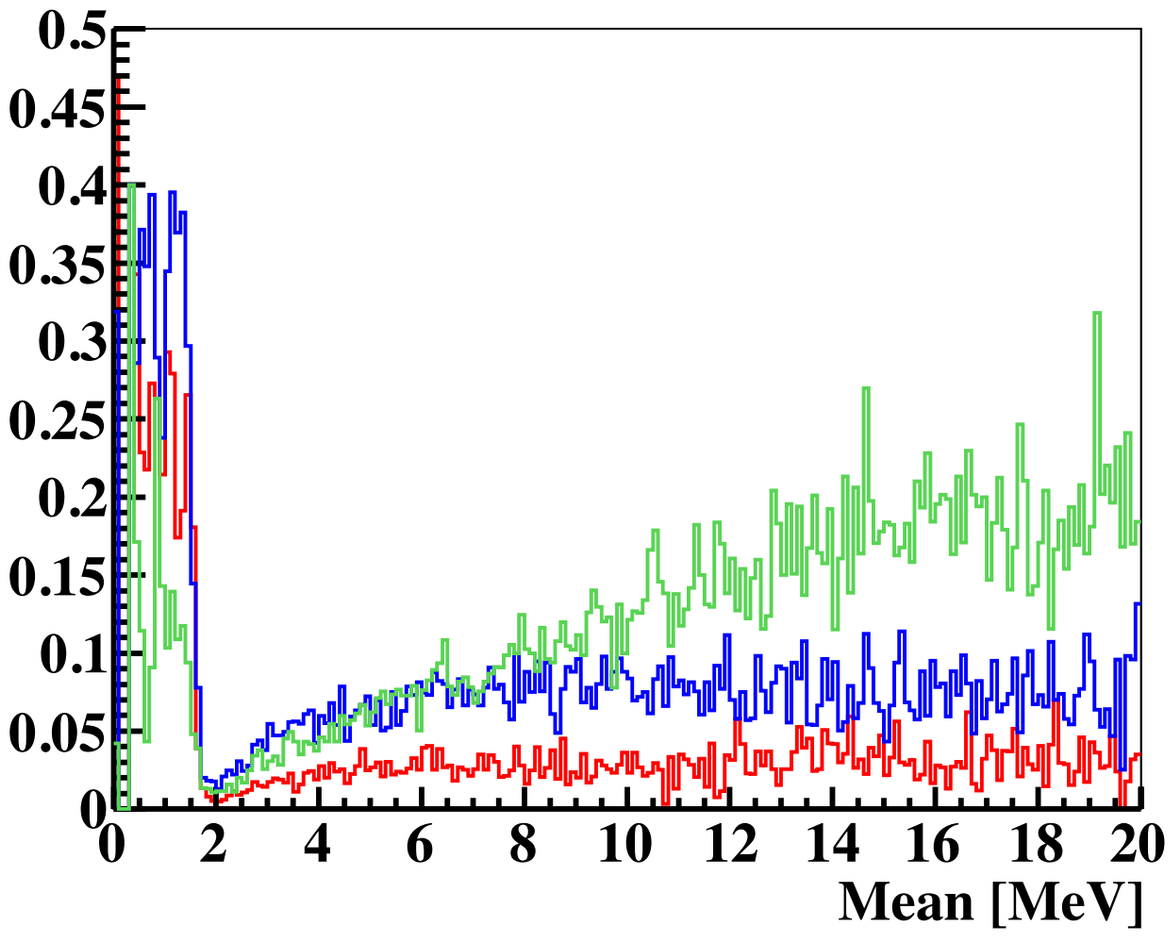
NC反応のみを描写

Mean Edep = 0MeVにピーク。

低エネルギー領域を細かく見る →

interaction mode NC



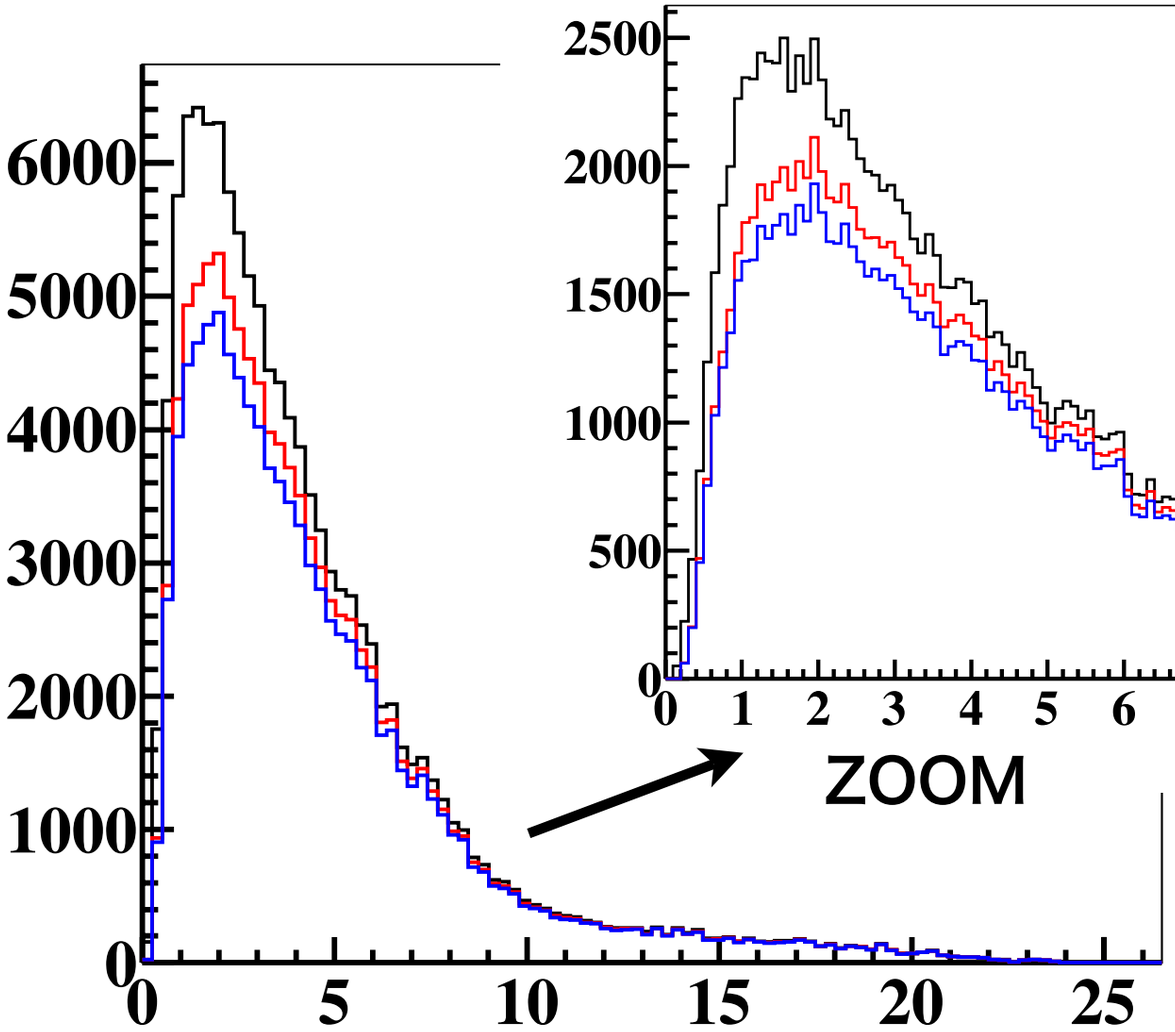


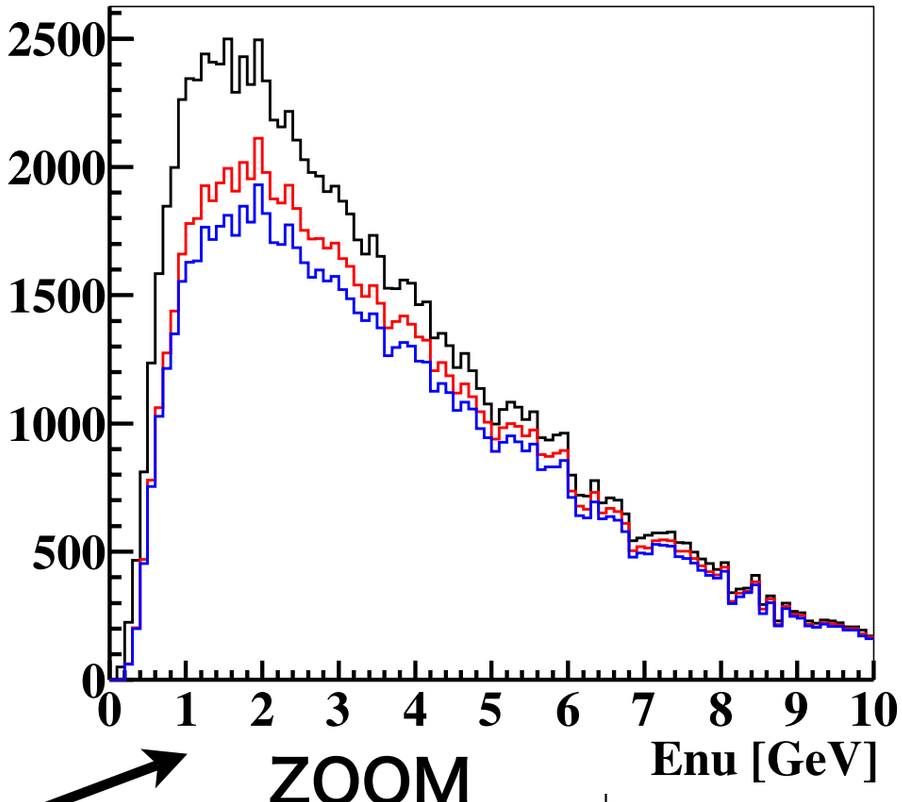
CCとは違い、2MeV付近で最小に

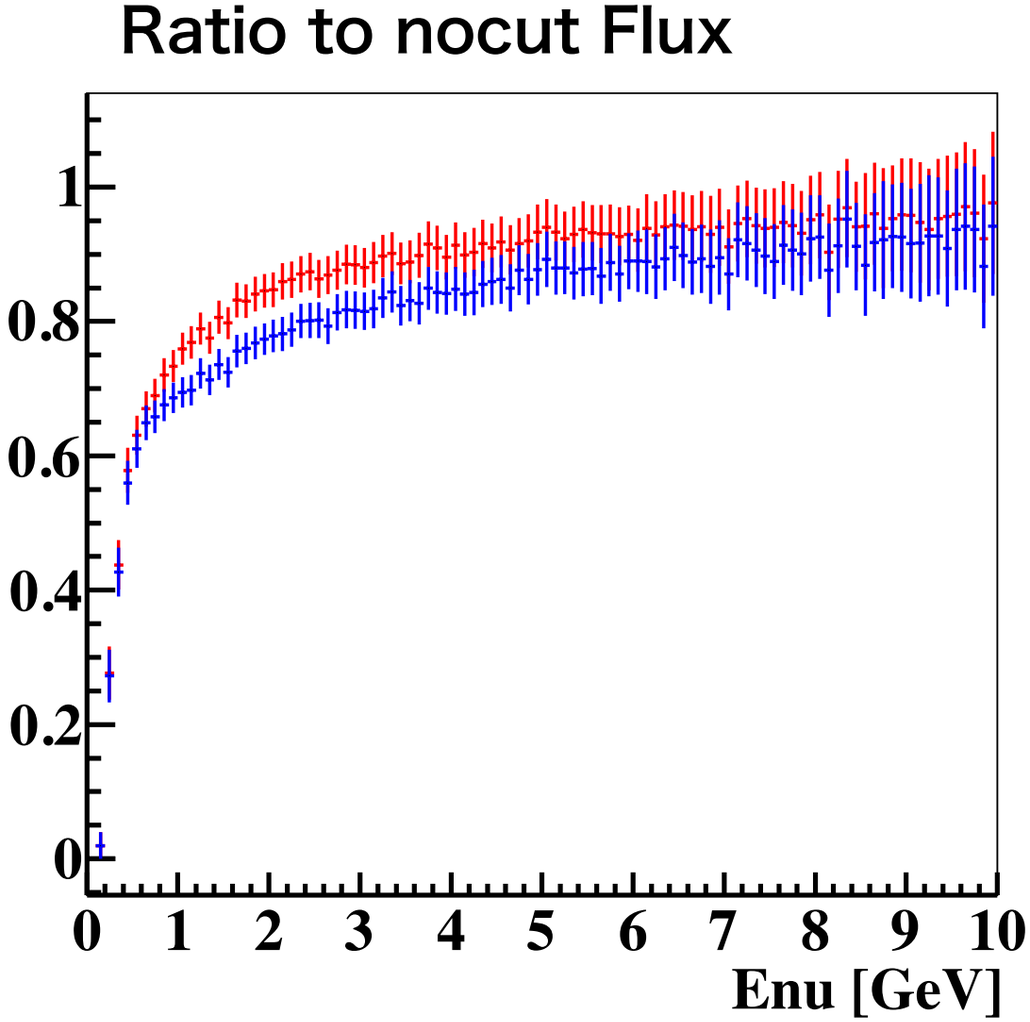
interaction mode 分布

	nocut	Mean Edep>1	Mean Edep>1.13
NC all	32300	19083	18625
Elastic	9923	2556	2438
1π	11221	6181	5966
DIS	10253	9564	9451

Enu 分布





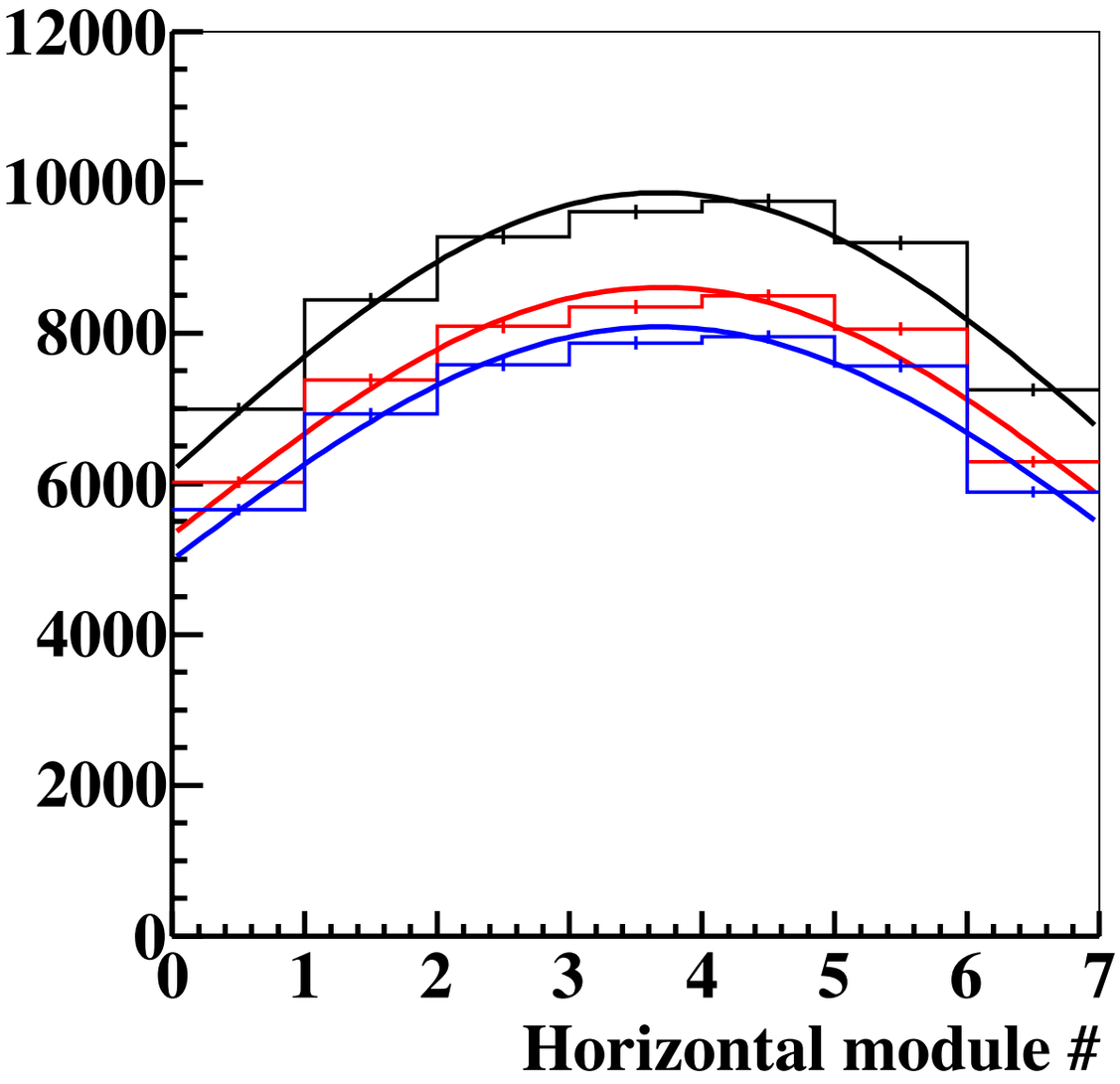


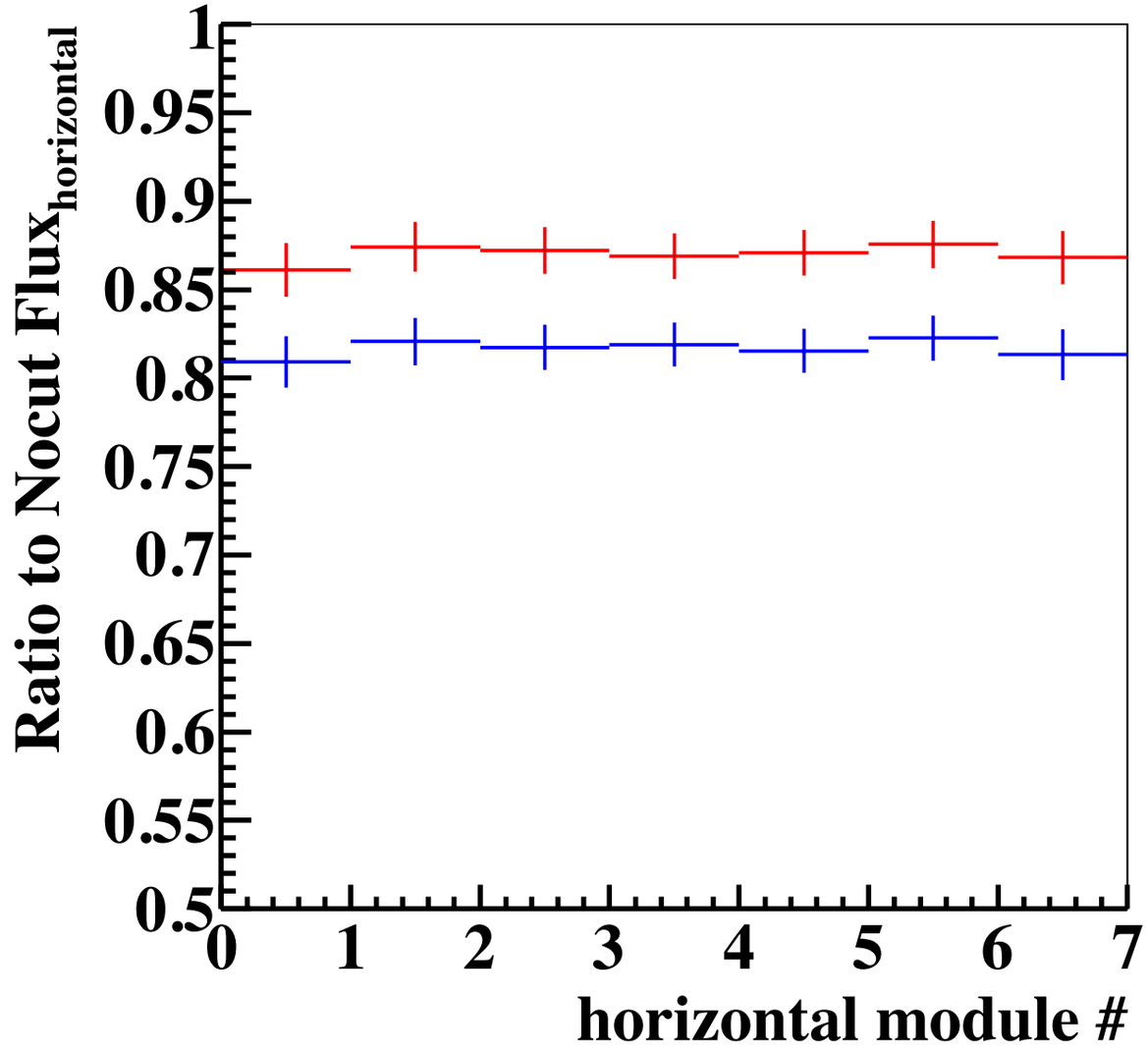
total(numu+numubar)

Mean > 8.5 p.e.

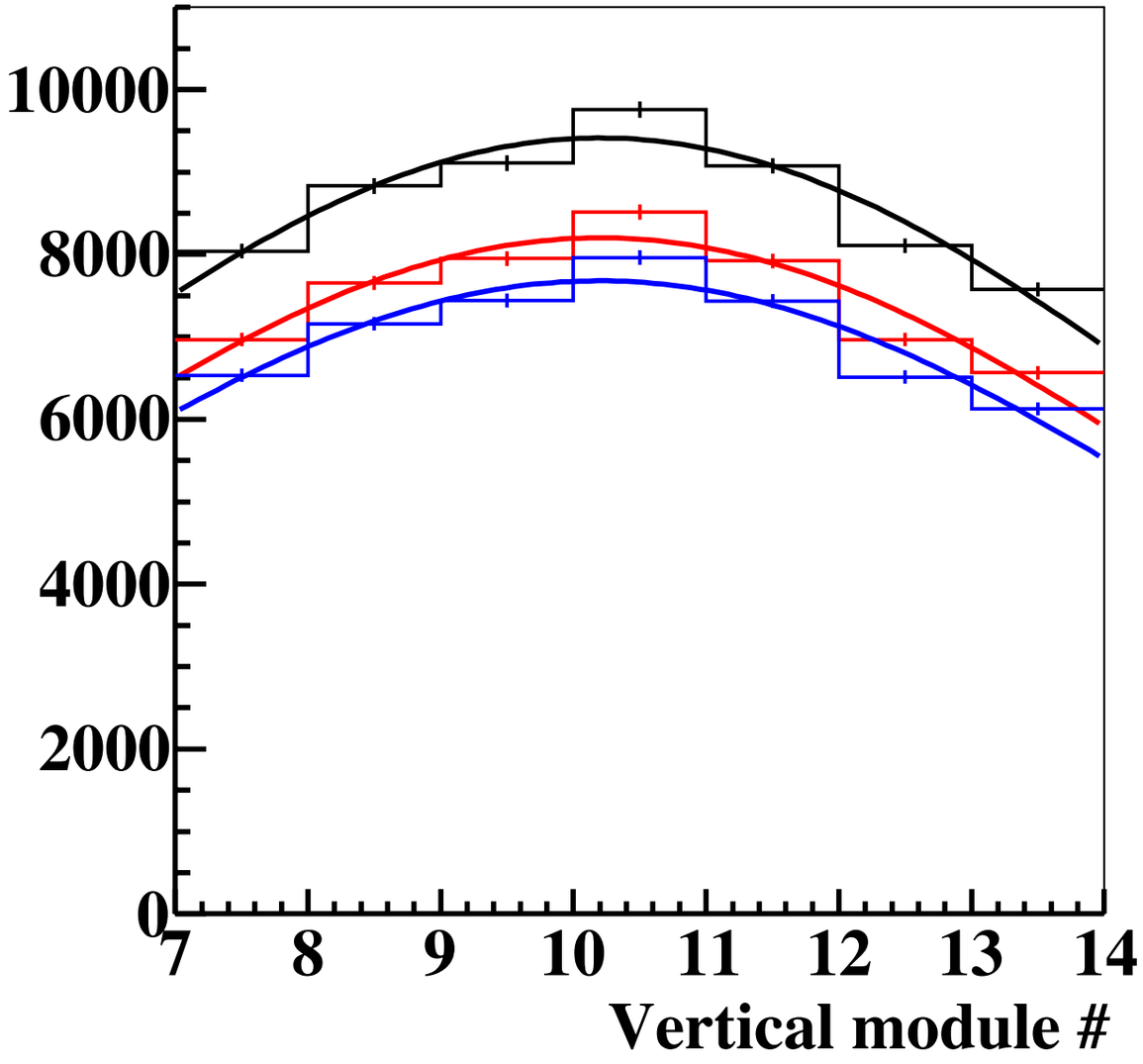
Mean > 15 p.e.

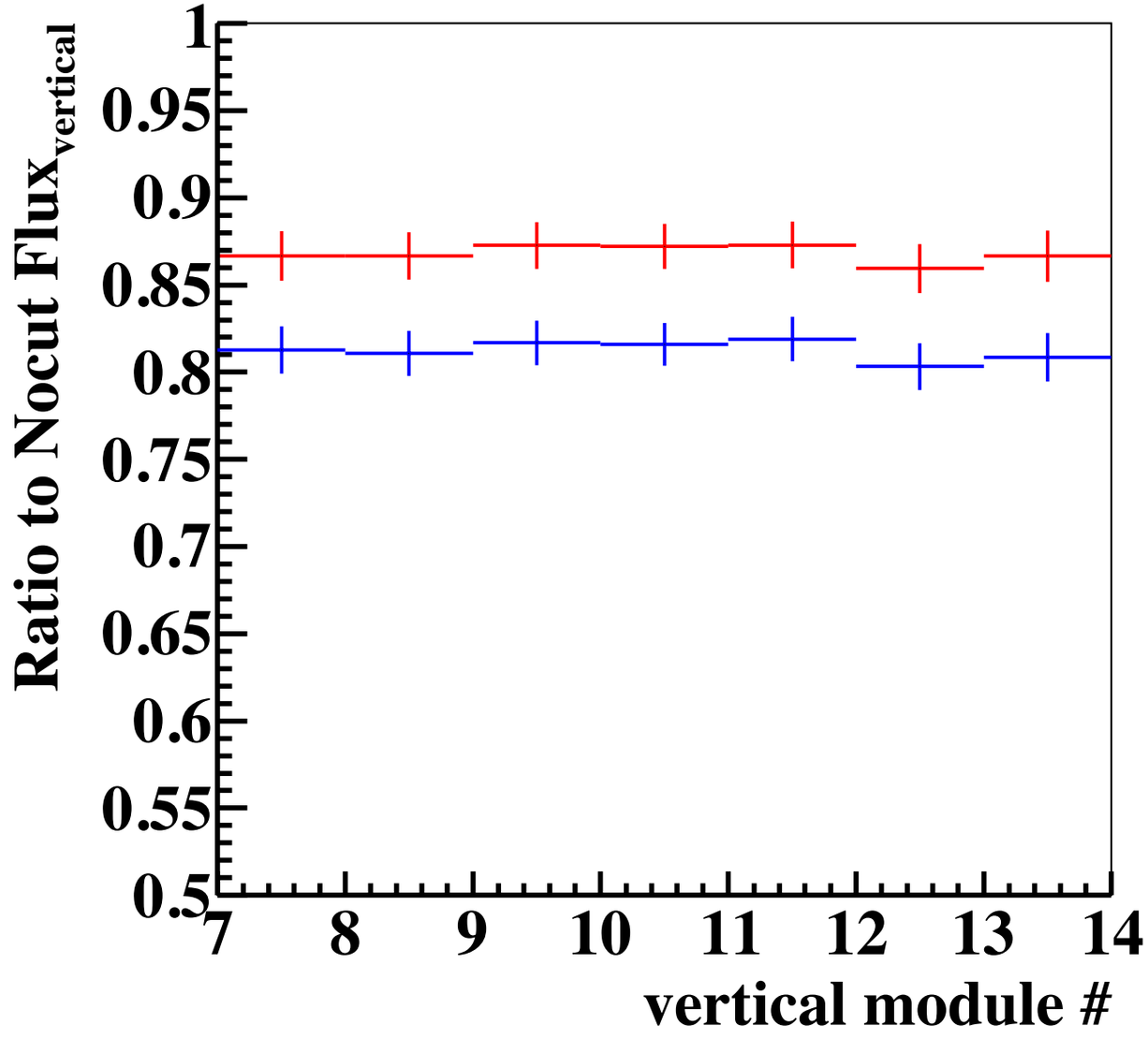
	No cut	Mean > 8.5 p.e.
All	121000	105201(87%)
Enu<3GeV	55249	44302(80%)





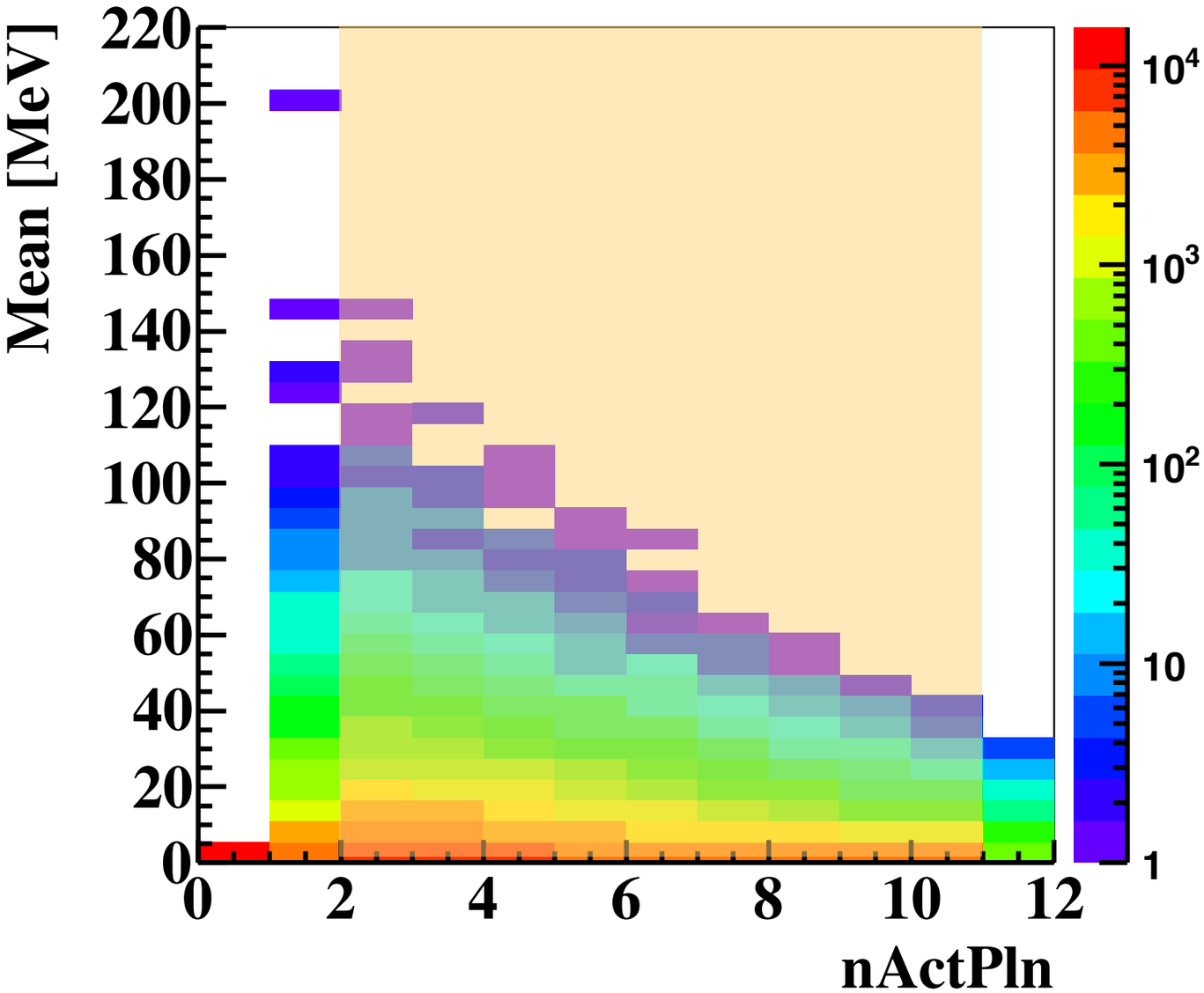
	nocut	Mean > 8.5 p.e.	Mean > 15 p.e.
Mean	3.68±0.03	3.69±0.03	3.68±0.03
SIgma	3.80±0.07	3.76±0.07	3.75±0.07

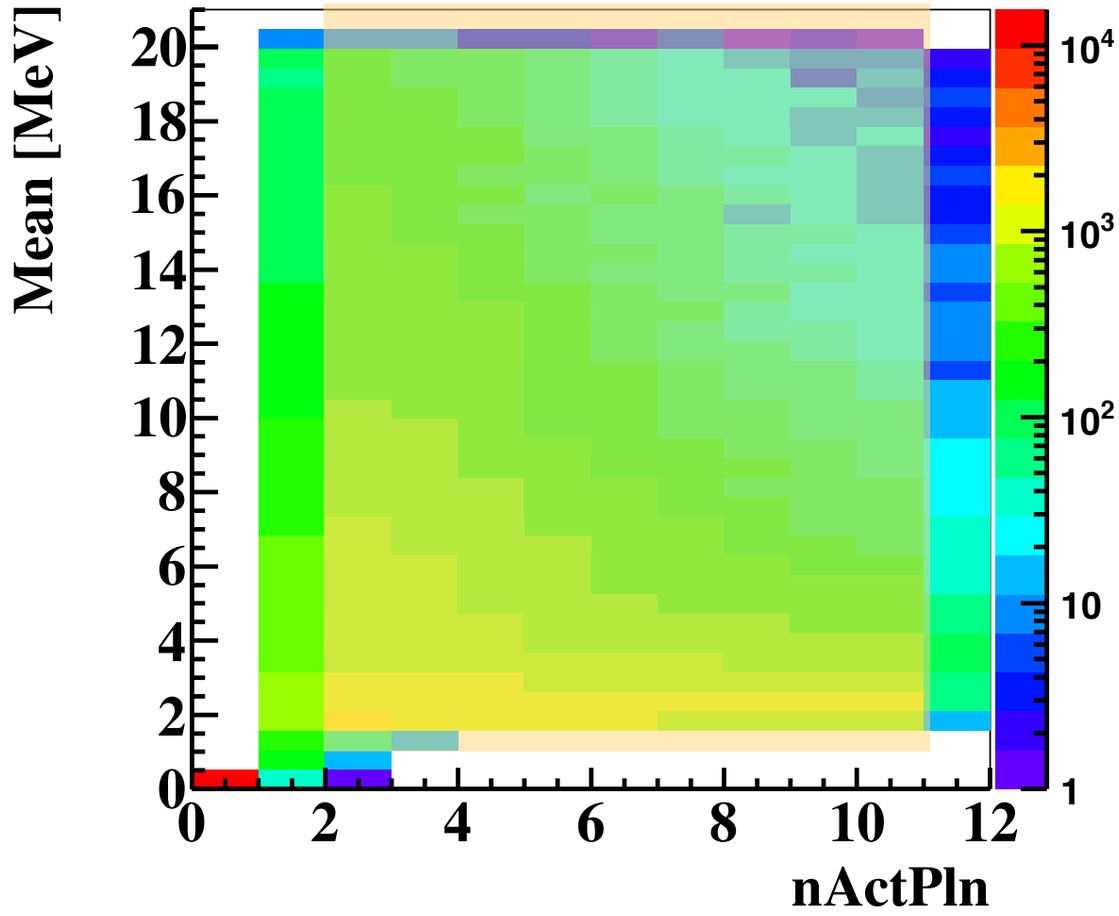




	nocut	Mean > 8.5 p.e.	Mean > 15 p.e.
Mean	10.2±0.05	10.2±0.05	10.2±0.05
SIgma	4.79±0.13	4.70±0.14	4.68±0.14

シグナル領域





- シグナル条件
- active plane > 1
- Mean energy deposite per active plane > 8.5 p.e.
- upstream veto cut

HornなしEfficiency まとめ

誤差＝√N

	All	Efficiency
no cut	121000±348	
active plane > 1	94689±308	78.3±0.3%
Mean p.e. > 8.5 p.e.	105201±324	86.9±0.4%
upstream veto	114141±338	94.3±0.3%
All cut	88622±298	73.2±0.2%

14module(Fe 7.11ton/module×14)で期待されるニュートリノ反応数に検出効率をかけて

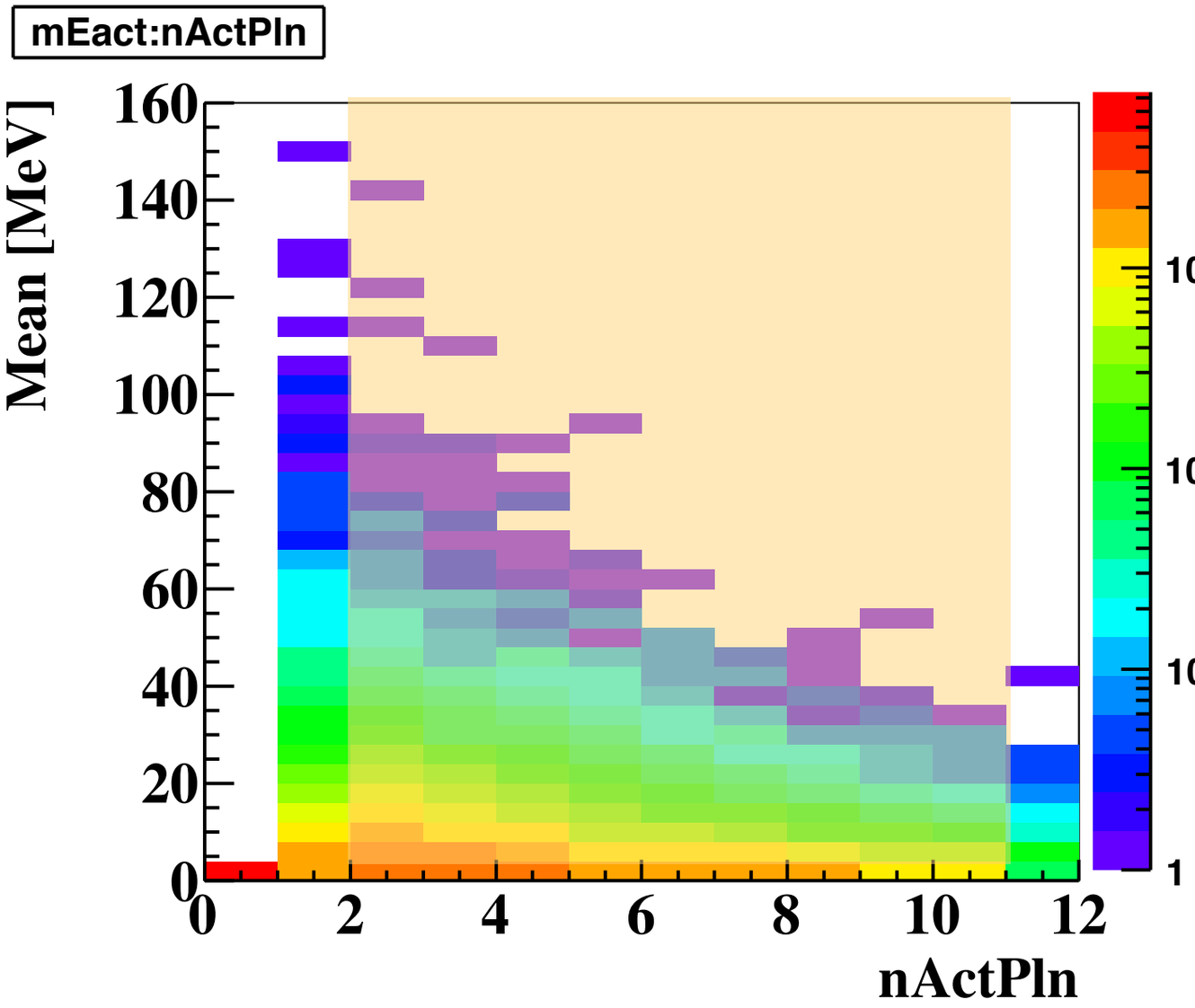
0.900±0.02 events/14modules/10^{14}POT

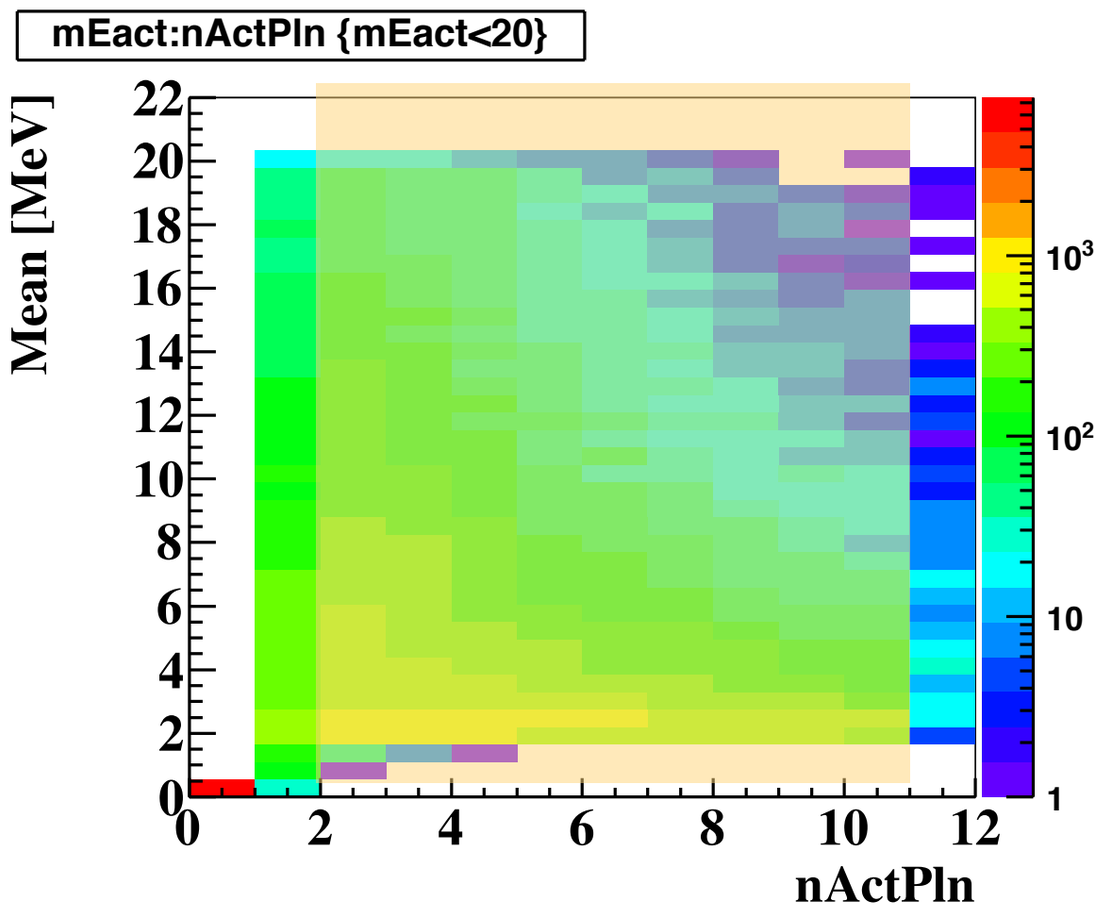
1st horn のみ

MC setting 1stホーンのみ

- とりあえず１０Neutファイル分の統計＝3 × 10^5 events (in 11m × 11m target)
  - 1st horn current = 320kA, 2nd,3rd horn current = 320kA,
  - jnubeam09c
    - 26045 numu events / horizontal modules
    - 26308 numu events / vertical modules

シグナル領域





- シグナル条件
- active plane > 1
- Mean energy deposite per active plane > 8.5 p.e.
- upstream veto cut

1st Horn のみEfficiency まとめ

誤差＝√N

	All	Efficiency
no cut	52353±229	
active plane > 1	38582±196	73.7±0.5%
Mean p.e. > 8.5 p.e.	44715±211	85.4±0.5%
upstream veto	49684±223	94.9±0.6%
All cut	36348±191	69.4±0.5%