INGRID MC Work
Flux10d tuning effect

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Motivation

- Check the effect of flux tuning (tuned-v1) on INGIRD observation.
  - numu and anti-numu MC sample.
- Comparison of 10d (no tune) to 10d tuned flux (histogram).
- Use tuning version 1, 2
  - version 1 : from kubo-san
  - version 2 : from slavic-san
- Consider only MC Stat error

10d flux (no tune & tuning)

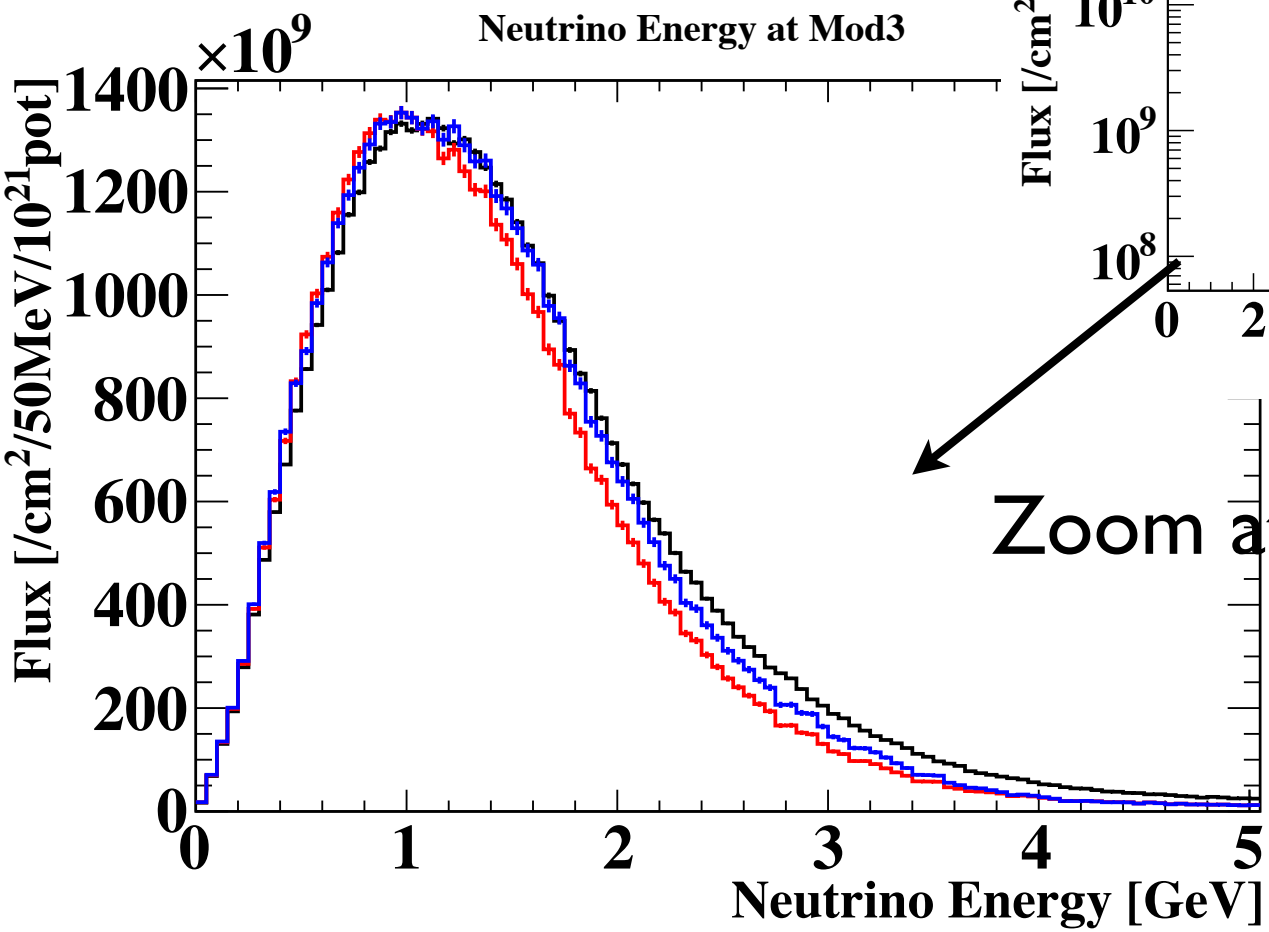
- The slavic's report of 10d flux (no tuned) is here : http://www.t2k.org/beam/NuFlux/FluxRelease/10d/sumplot10d/view.
  - Use FLUKA hadron production input and has the history of hadrons.
- 10d tuned-v1 was reported slavic-san : http://www.t2k.org/beam/NuFlux/FluxRelease/10d/10dtunev1/sumplots/view
  - Tuning many parameters of pion, kaon production.
- 10d tuned-v2 was reported at plenary meeting at Dec collabo. meeting.
  - Only pion tuning.

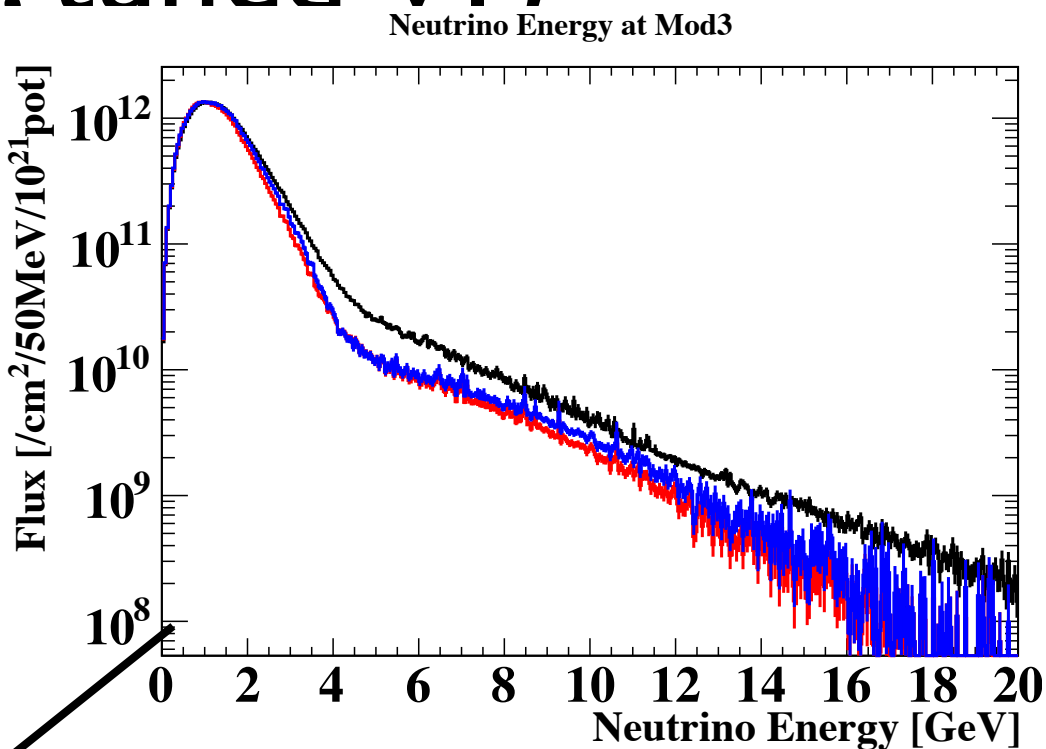
νμ Flux at module 3 (no tune. tuned-v1)

10c nominal (GFLUKA)

10d no tune (FLUKA)

10d tune-v1



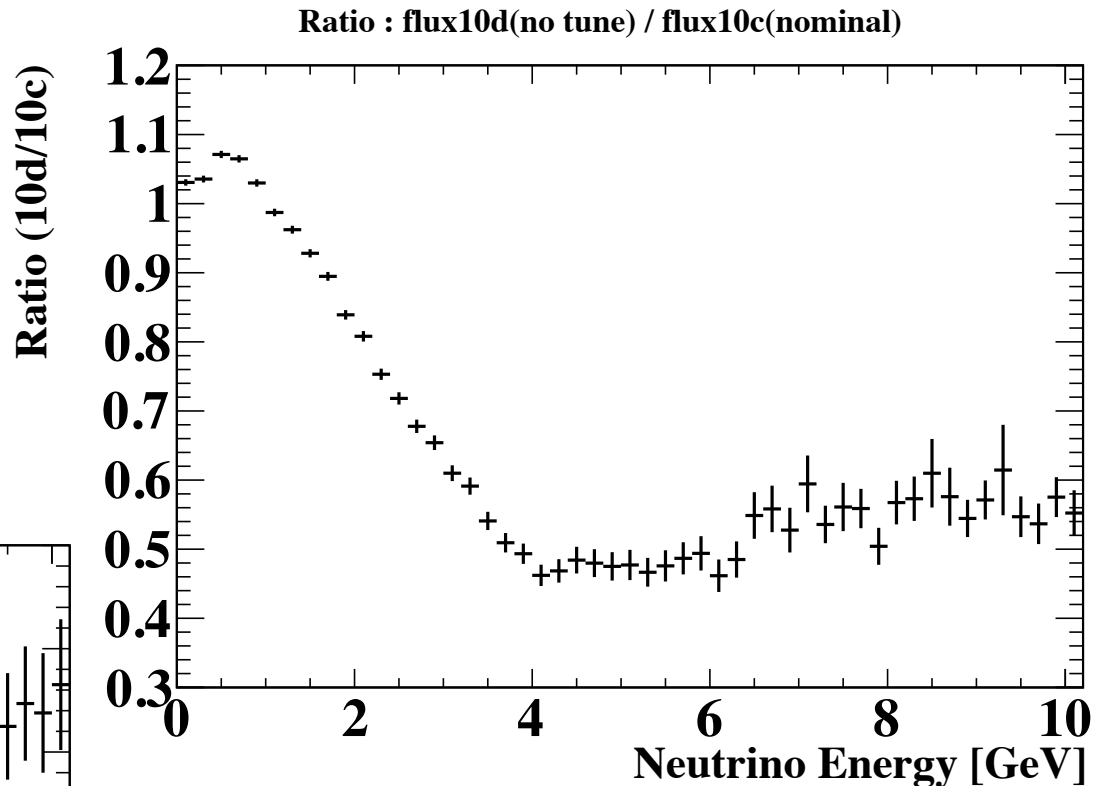


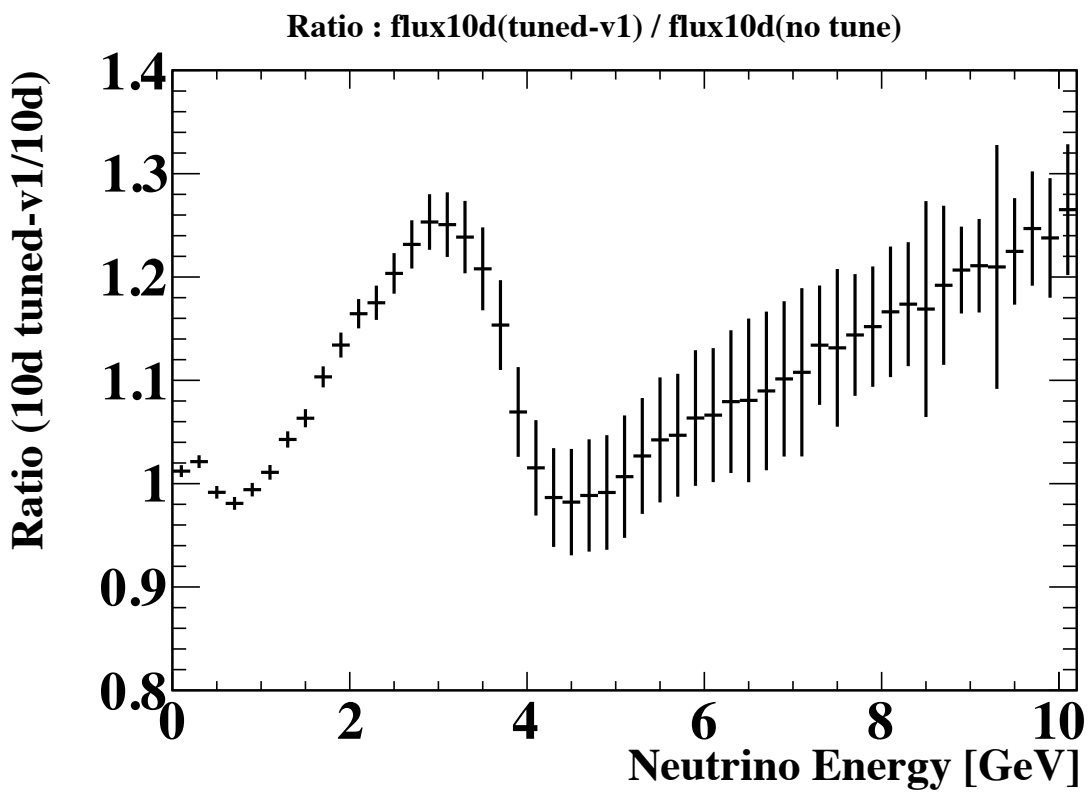
Zoom at low energy ration

(Only MC stat error)

The ratio of νμ Flux at module 3 (no tune, tuned-v1)

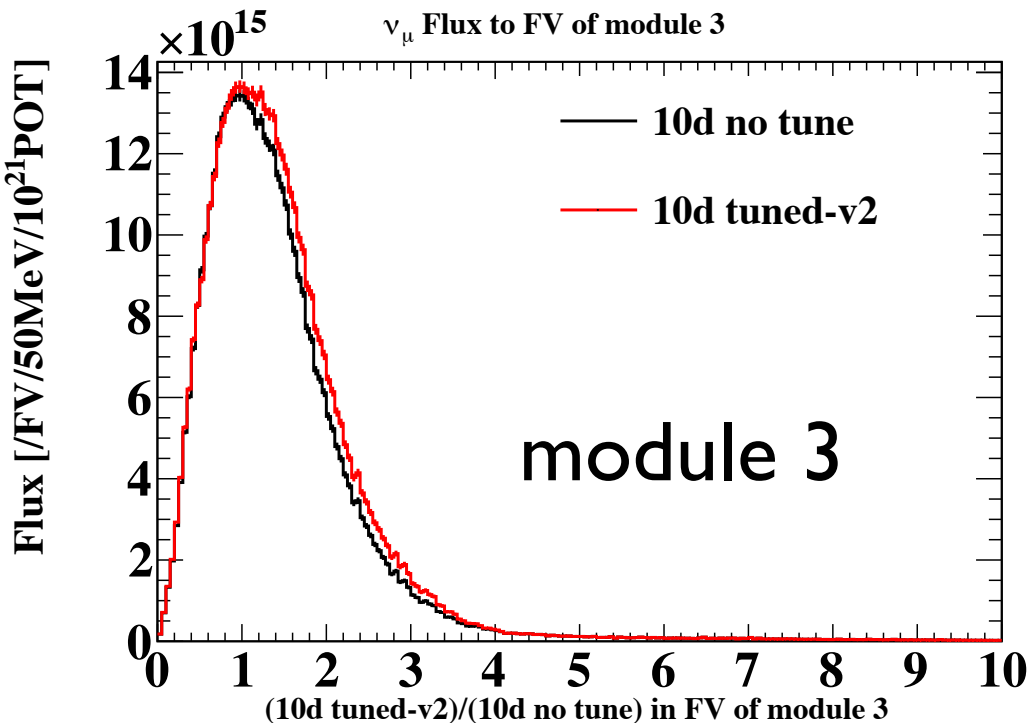
flux10d no tune / flux10c nominal →

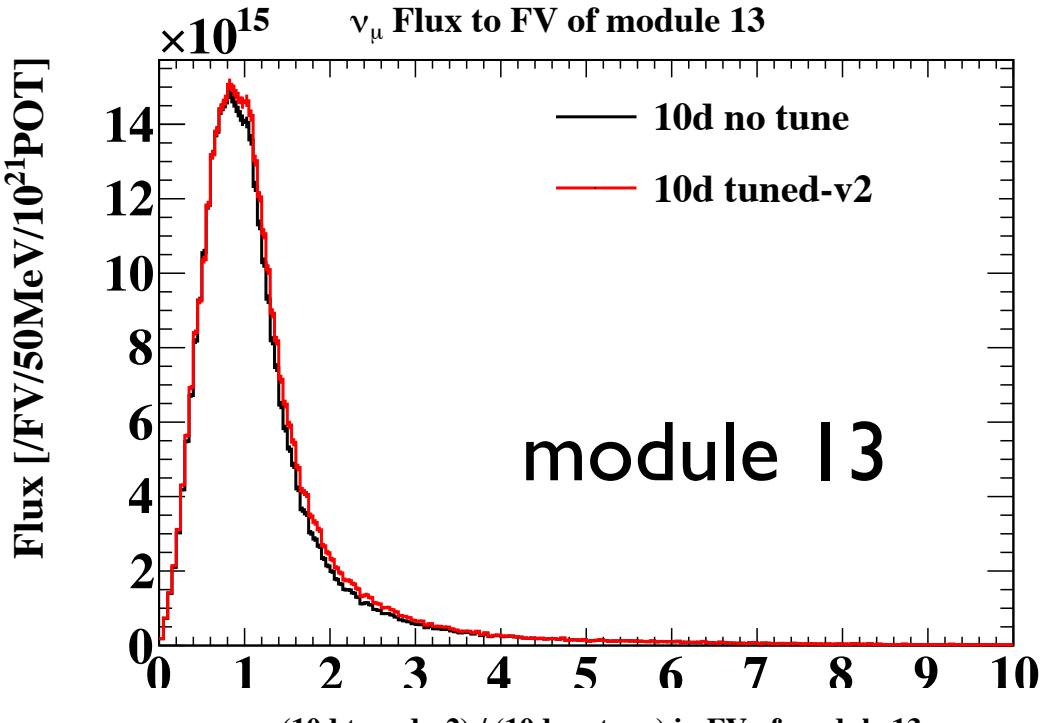


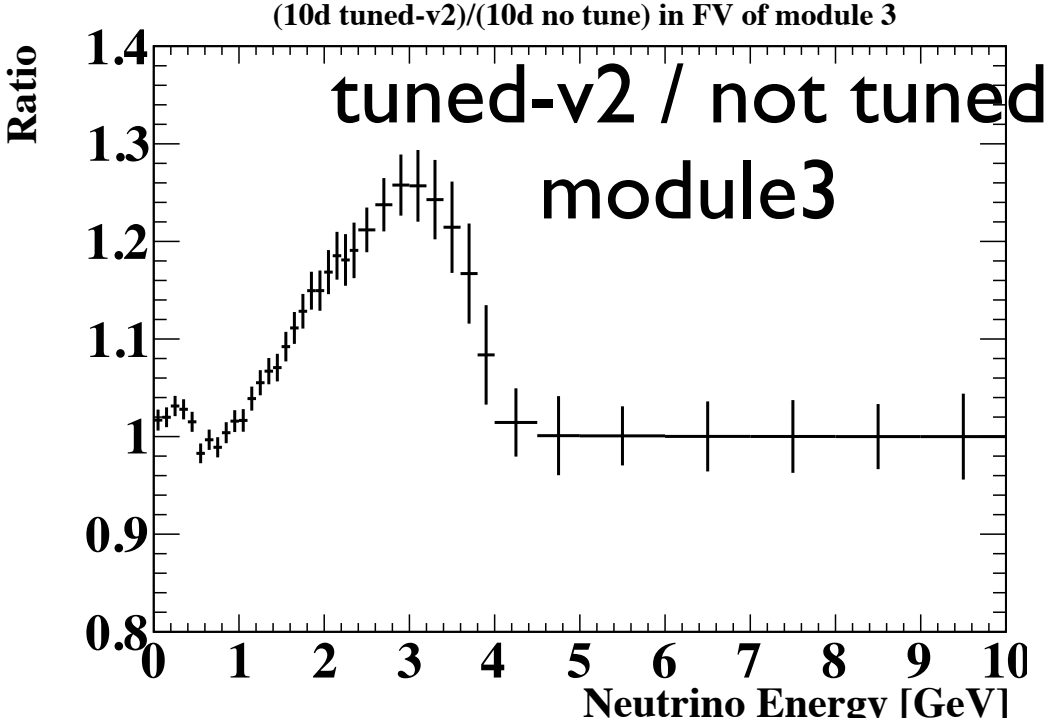


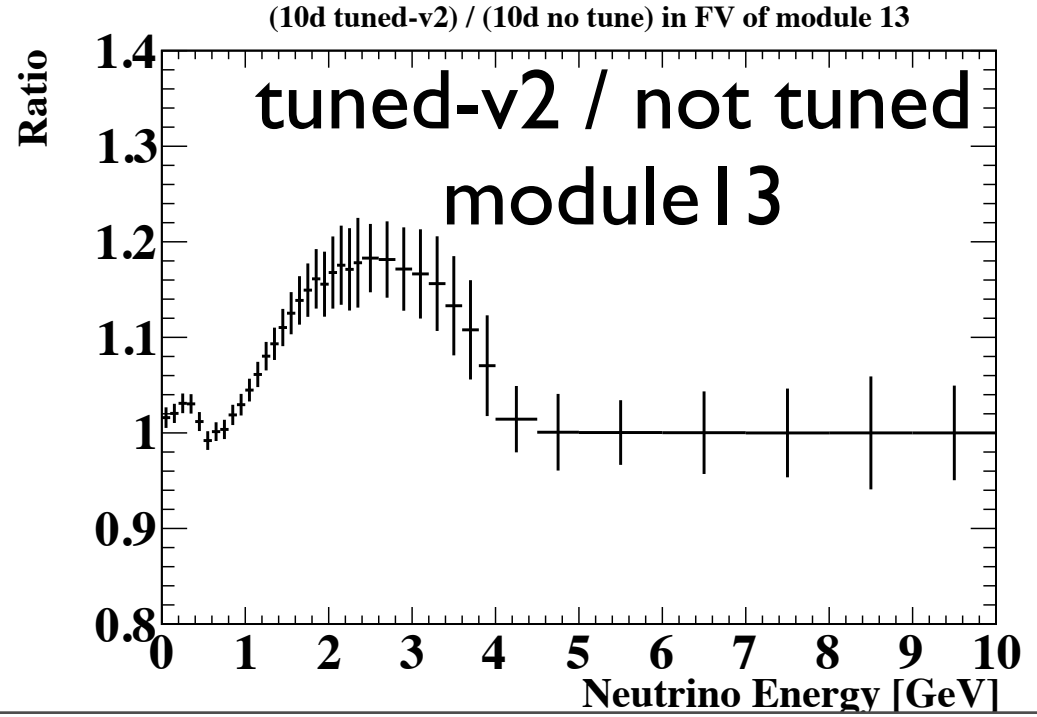
← flux10d tune-v1 / flux10d no tune

νμ flux10d (no tune, tuned-v2)





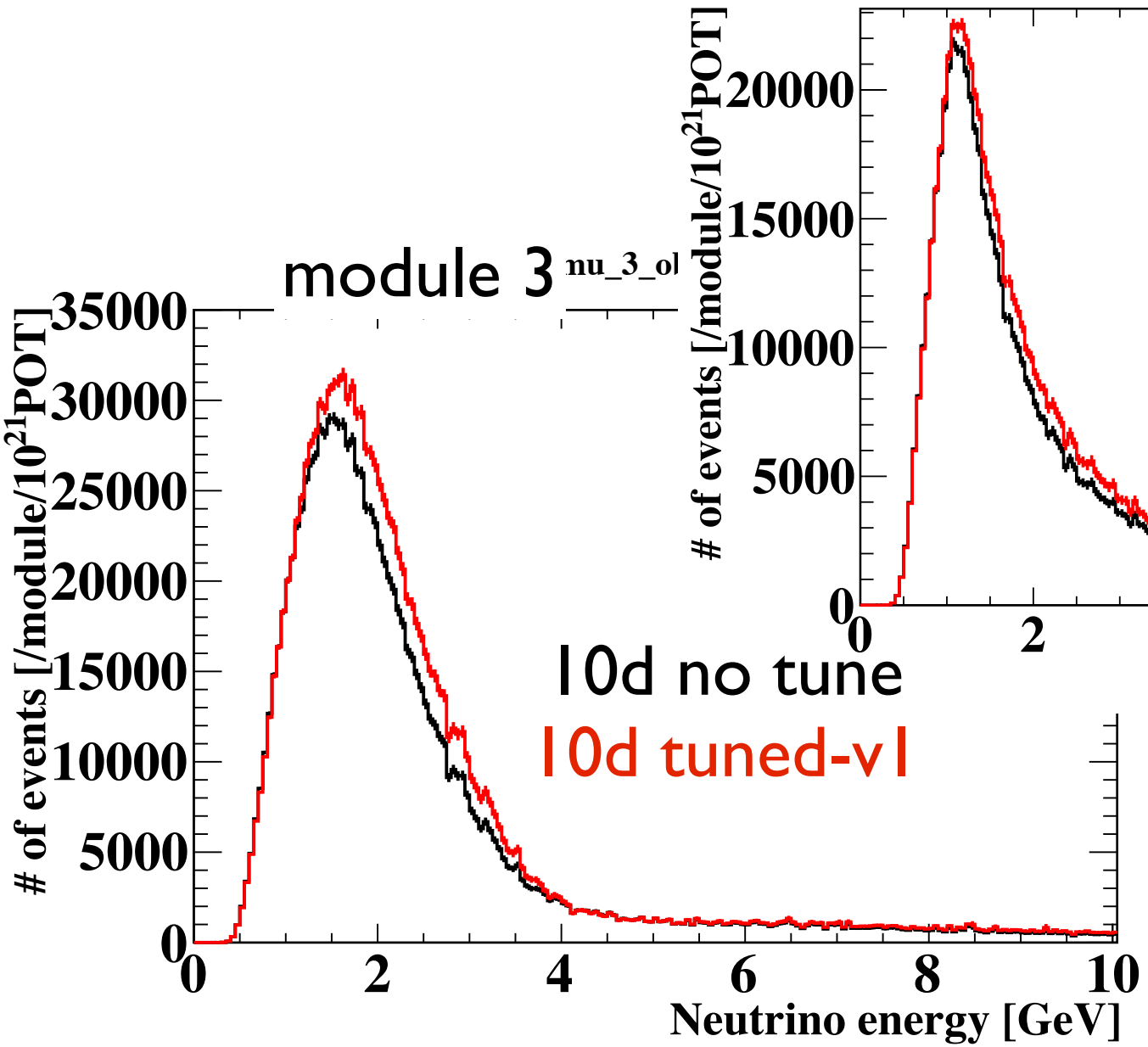


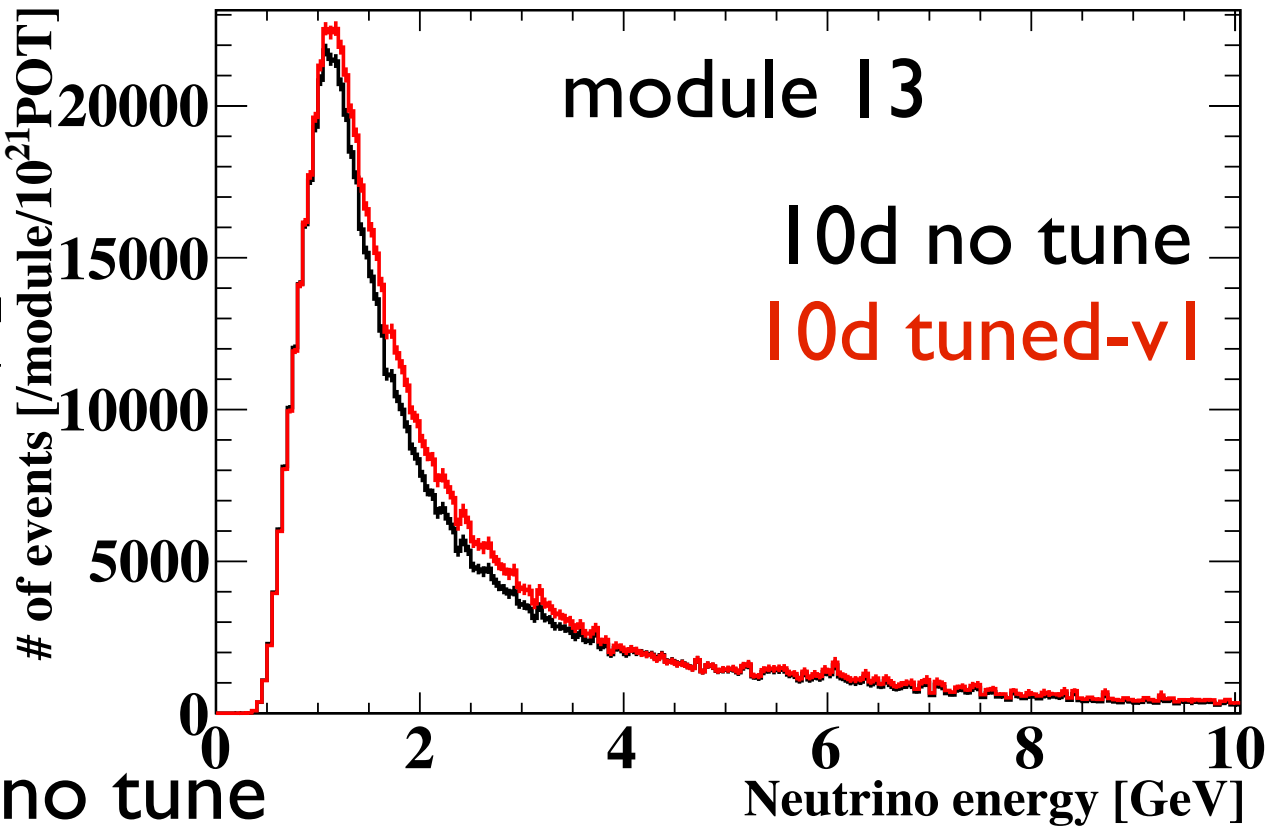


The expect # of observation

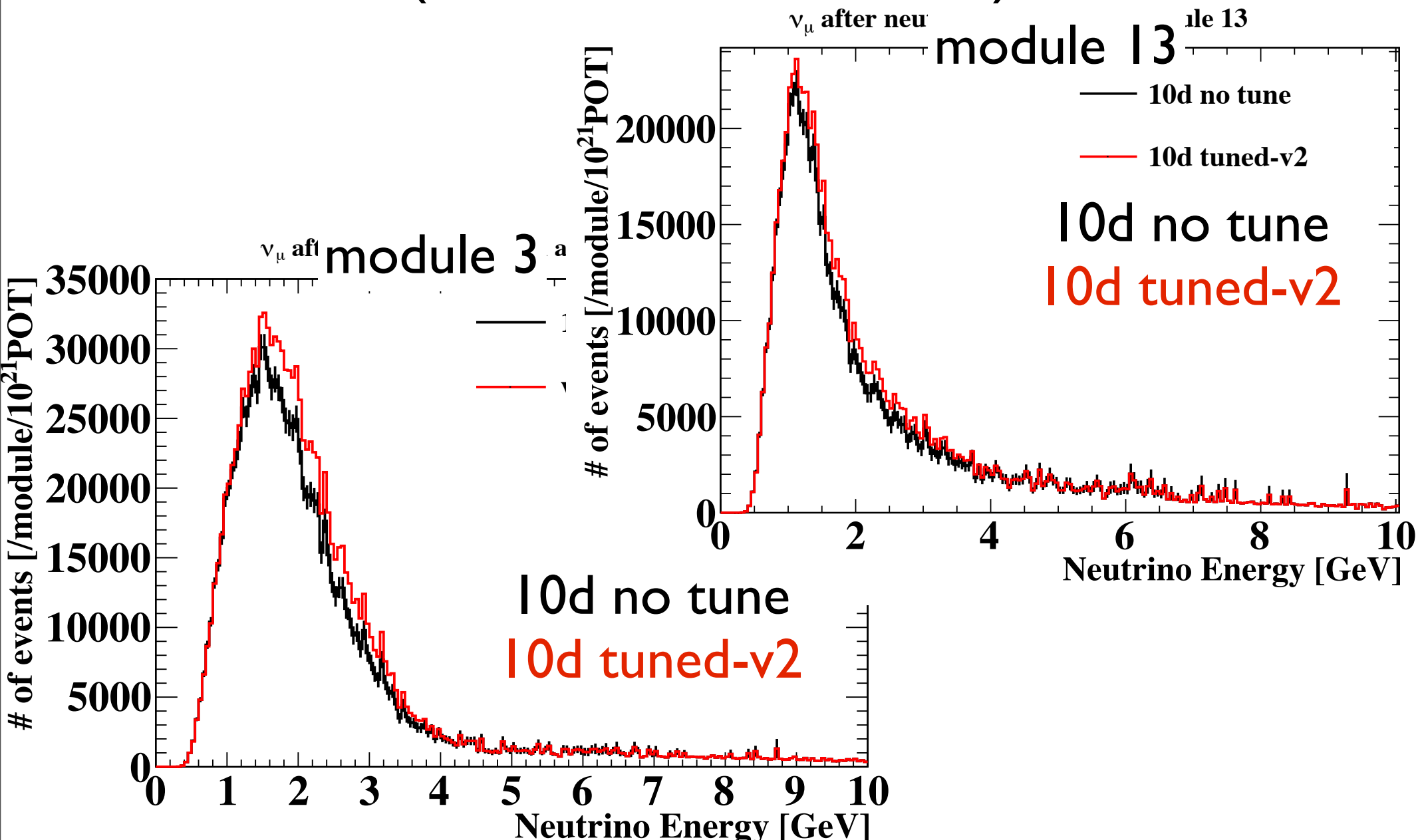
- Calculate the expect # of observations.
  - INGRID MC : input flux 10d no tune (fluka-input)
  - Neutrino energy weighting with flux ratio.
  - Integrate the energy spectrum after neutrino selection in whole energy region.
    - The energy region of tuned-v2 flux : 0 ~ 10GeV.
      → Weighting factor at high energy (>10GeV) is assumed to be 1.
  - νμ and anti-νμ MC sample.

νμ Energy spectrum after selection (no tune, tuned-v1)

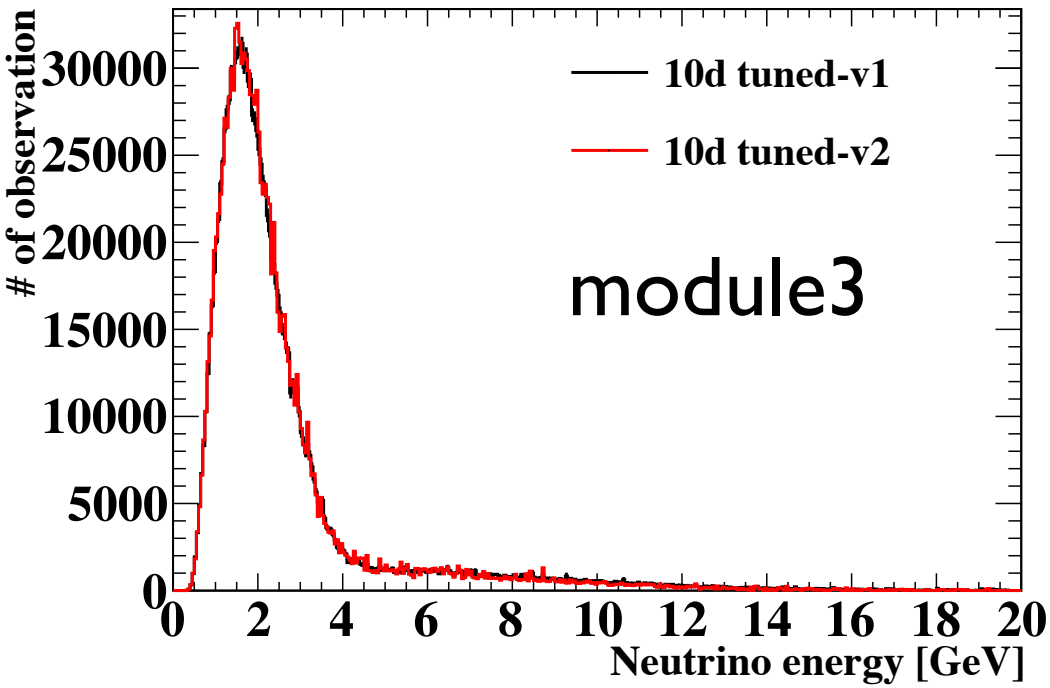


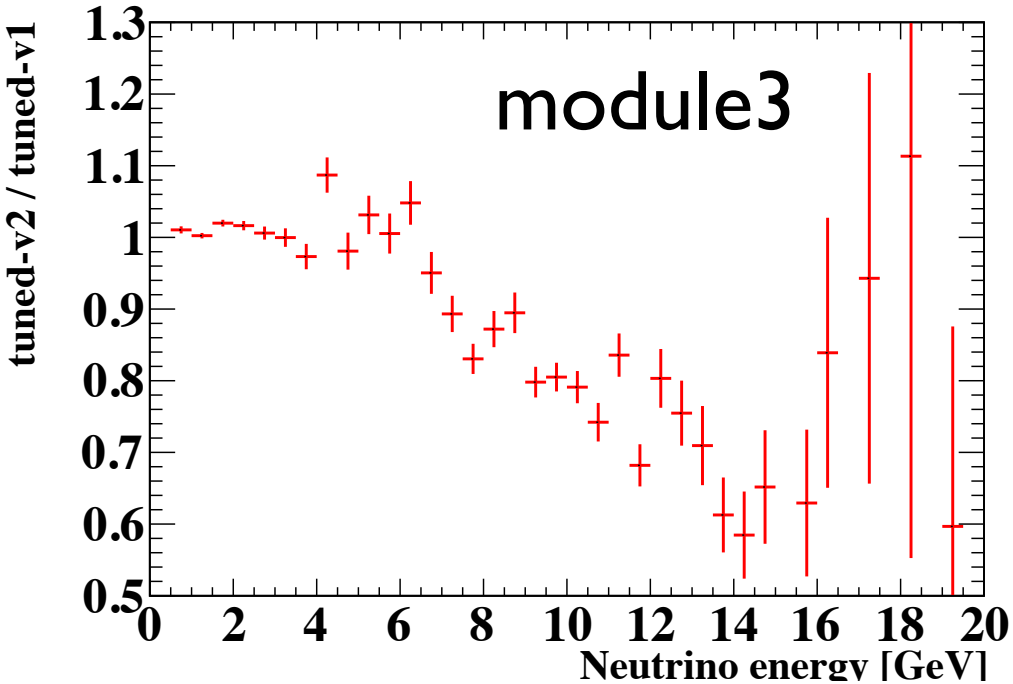


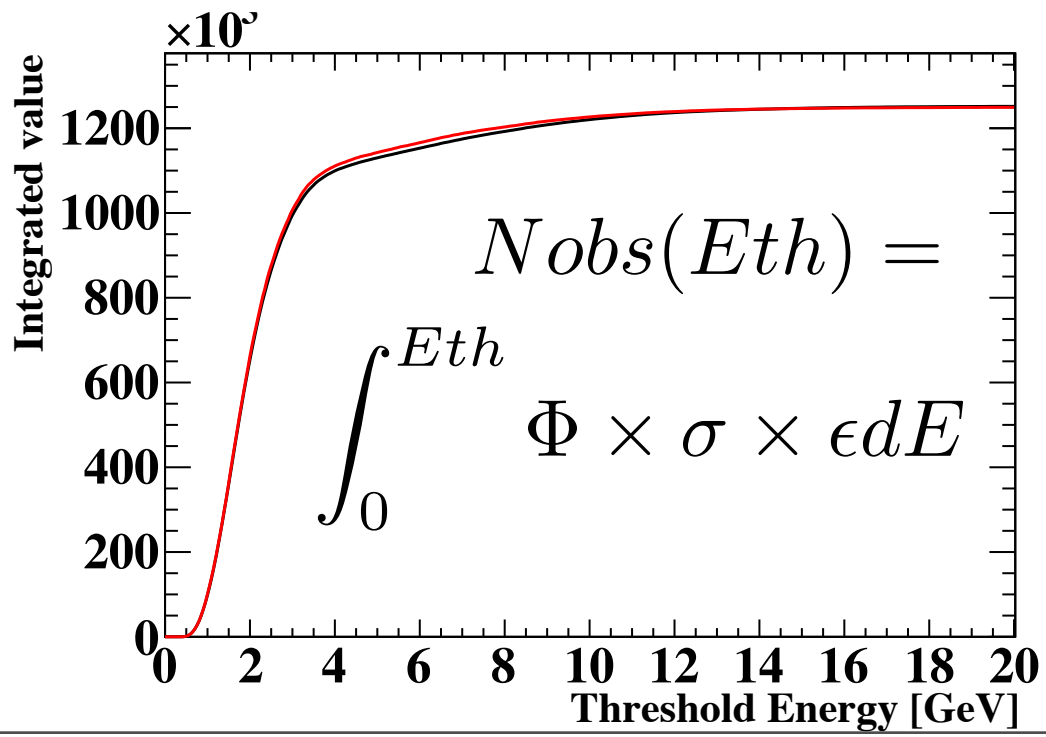
νμ Energy spectrum after selection (no tune, tune-v2)

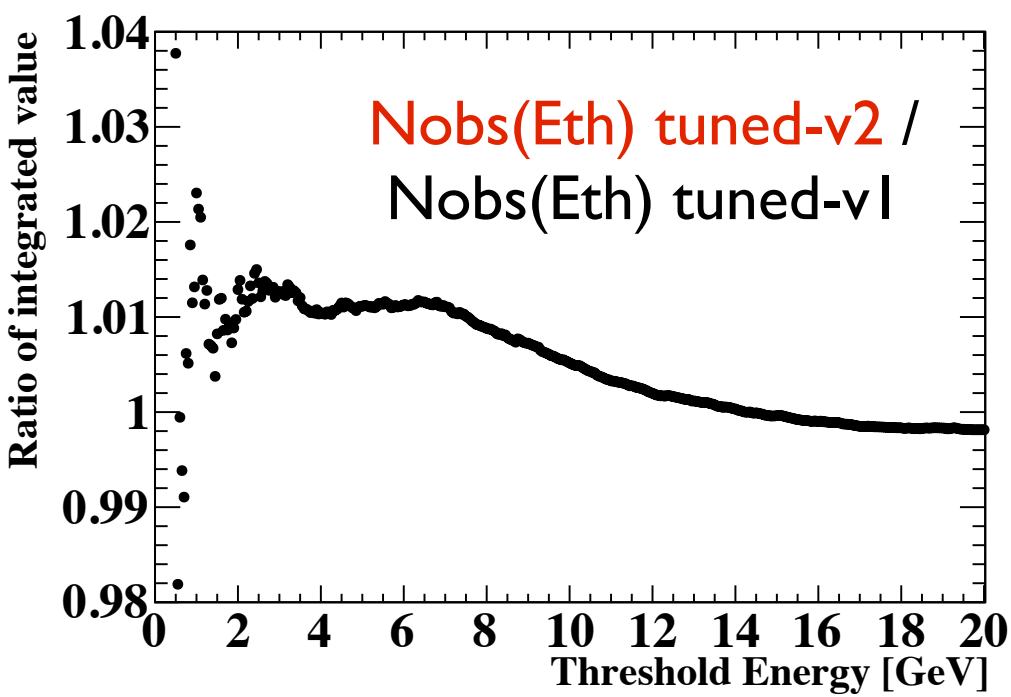


Diff. btw tuned-v1 and tuned-v2









Nobs of all modules

	νμ [/10^{14}pot]	anti-νμ [/10^{14}pot]	νμ+anti-νμ [/10^{14}pot]
10d	1.296	0.02515	**1.321**
10d tune-v1	1.430	0.02635	**1.456**
10d tune-v2	1.427	0.02660	**1.454**
10d tune-v1 / 10d	1.103	1.048	**1.102**
10d tuned-v2 /10d	1.101	1.058	**1.100**

Tuned effect to Nobs of INGRID : **+10%**

Tuned-v1, -v2 effect to Nobs is almost same.

Back up

of observed νμ [/10^{21}POT]

module#	0	1	2	3	4	5	6
10d	6.587E+05	8.783E+05	1.051E+06	1.125E+06	1.060E+06	8.876E+05	6.666E+05
10d tune v1	7.182E+05	9.668E+05	1.165E+06	1.252E+06	1.177E+06	9.775E+05	7.270E+05
10d tune/10d	1.090	1.101	1.109	1.113	1.110	1.101	1.091

module#	7	8	9	10	11	12	13
10d	7.204E+05	9.304E+05	1.101E+06	1.162E+06	1.089E+06	9.219E+05	7.076E+05
10d tune v1	7.867E+05	1.025E+06	1.222E+06	1.294E+06	1.206E+06	1.015E+06	7.716E+05
10d tune / 10d	1.092	1.102	1.110	1.113	1.108	1.101	1.090

of observed νμ [/10^{21}POT]

module#	0	1	2	3	4	5	6
10d	6.587E+05	8.783E+05	1.051E+06	1.125E+06	1.060E+06	8.876E+05	6.666E+05
10d tune v2	7.126E+05	9.500E+05	1.172E+06	1.249E+06	1.170E+06	9.766E+05	7.195E+05
10d tune/10d	1.082	1.082	1.116	1.111	1.104	1.100	1.079

module#	7	8	9	10	11	12	13
10d	7.204E+05	9.304E+05	1.101E+06	1.162E+06	1.089E+06	9.219E+05	7.076E+05
10d tune v2	7.797E+05	1.023E+06	1.230E+06	1.287E+06	1.212E+06	1.011E+06	7.760E+05
10d tune / 10d	1.082	1.099	1.117	1.108	1.114	1.097	1.097

of observed anti-νμ [/10^{21}POT]

module#	0	1	2	3	4	5	6
10d	1.363E+04	1.602E+04	1.995E+04	2.183E+04	2.000E+04	1.749E+04	1.504E+04
10d tune v1	1.447E+04	1.760E+04	2.055E+04	2.202E+04	2.057E+04	1.810E+04	1.441E+04
10d tune/10d	1.062	1.099	1.030	1.009	1.029	1.034	0.958

module#	7	8	9	10	11	12	13
10d	1.490E+04	1.756E+04	2.050E+04	2.243E+04	1.986E+04	1.798E+04	1.604E+04
10d tune v1	1.633E+04	1.877E+04	2.150E+04	2.241E+04	2.114E+04	1.927E+04	1.640E+04
10d tune / 10d	1.096	1.069	1.049	0.999	1.064	1.072	1.023

of observed anti-νμ [/10^{21}POT]

module#	0	1	2	3	4	5	6
10d	1.363E+04	1.602E+04	1.995E+04	2.183E+04	2.000E+04	1.749E+04	1.504E+04
10d tune v2	1.435E+04	1.685E+04	2.101E+04	2.298E+04	2.101E+04	1.836E+04	1.583E+04
10d tune/10d	1.053	1.052	1.053	1.053	1.051	1.049	1.052

module#	7	8	9	10	11	12	13
10d	1.490E+04	1.756E+04	2.050E+04	2.243E+04	1.986E+04	1.798E+04	1.604E+04
10d tune v2	1.567E+04	1.850E+04	2.162E+04	2.356E+04	2.082E+04	1.880E+04	1.678E+04
10d tune / 10d	1.051	1.053	1.055	1.051	1.048	1.045	1.046