Effect of flux uncertainty to Nobs of INGRID

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- MC data set to estimate # of observed neutrino events
  - Jnubeam 10c with nominal beam → NEUT → INGRID MC → Select neutrino events with neutrino selection.
  - including numu, numubar (not including nue,nuebar)
- Weight factors are obtained by the ratio of neutrino energy spectrum.
  - One is the ratio Φ(FLUKA2008 with real beam) / Φ (Jnubeam 10c with nominal beam)
  - One is the ratio Φ(Jnubeam 10c real beam) / Φ(Jnubeam 10c nominal beam)
- The spectrum of FLUKA2008 with real beam is obtained from Jnubeam flux file.
- The spectrum of Jnubeam 10c with real beam is obtained by weighting with proton beam position.

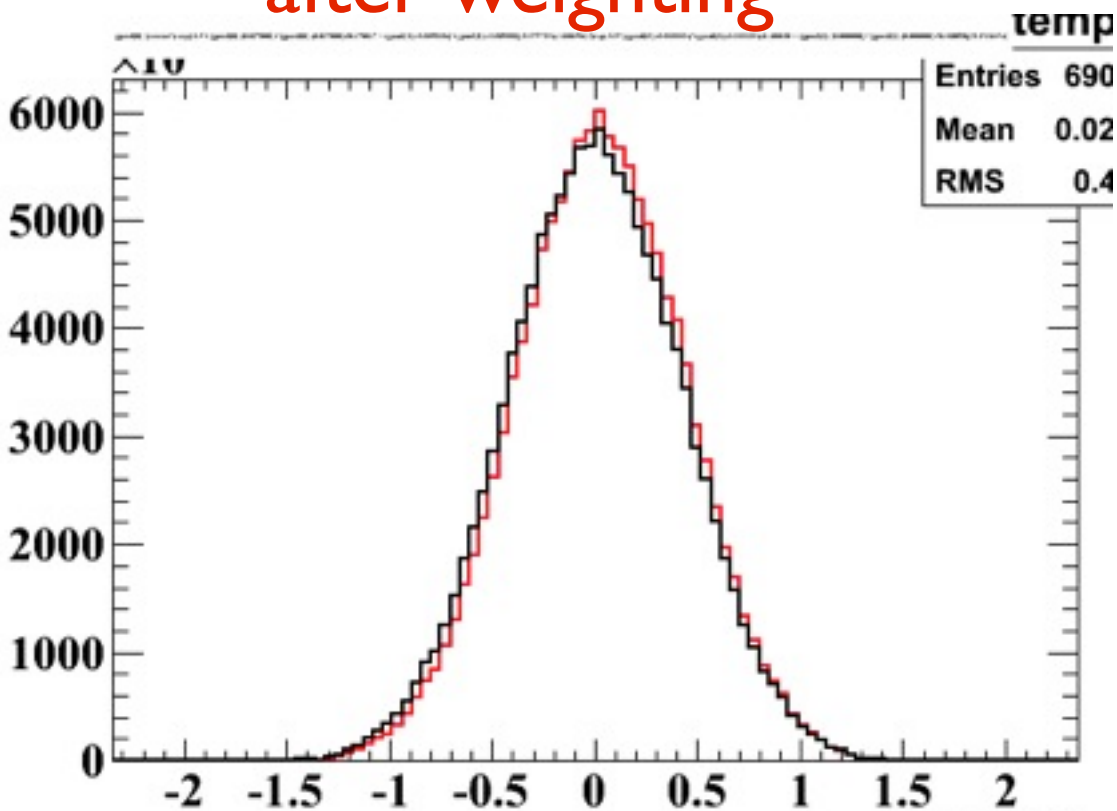
Weighting with primary proton beam position

Nominal beam : Gaussian shape
beam center = (0,0) [mm]
beam size = (4.343,4.343) [mm]

Real beam : calc by Kakuno-san.
(Fitting w/ the single gaussian the accumulated beam profile)
beam center = (0.27, 0.85) [mm]
beam size = (4.133,4.192) [mm]
(detail is the p.9 of http://jnusrv01.kek.jp/Indico/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=250)

Weighting factor = the ratio of tho gaussian (real beam parameters)/ (nominal beam parameters)

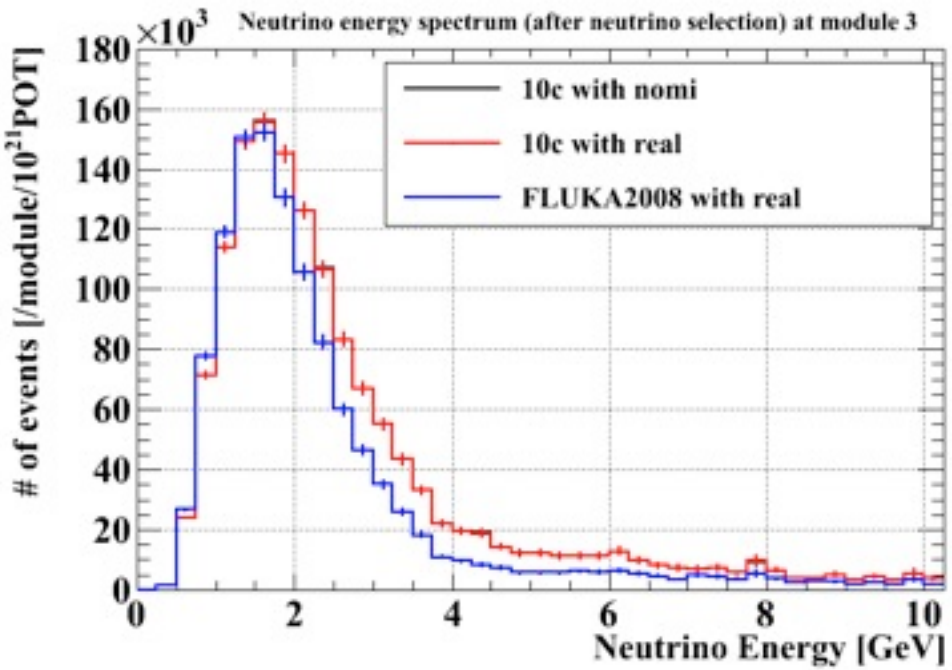
nominal beam
after weighting

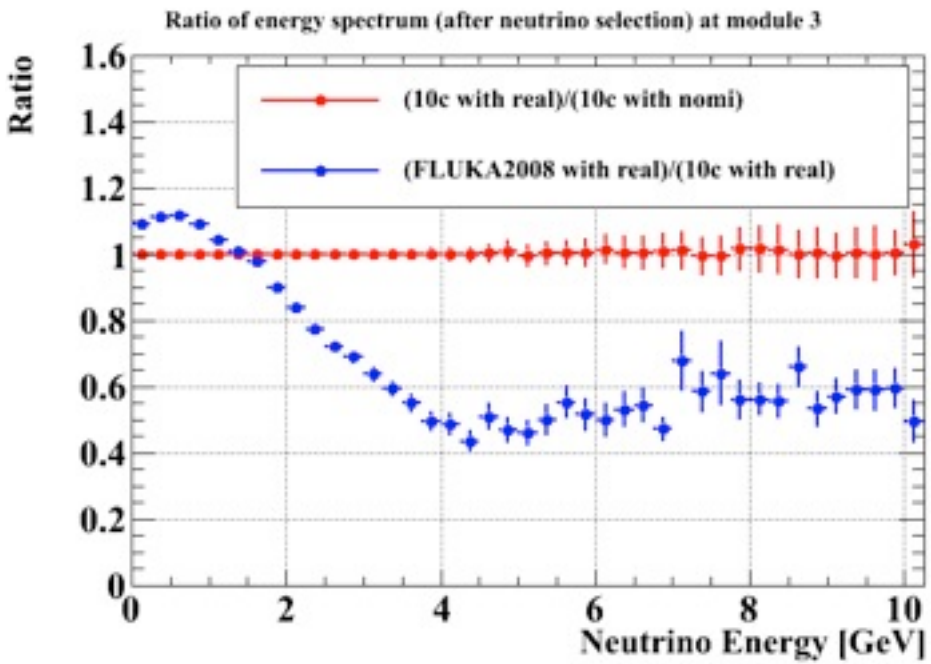


the x-position of proton beam on the target [mm]

Diff. of numu energy spectrum

Diff. of numu observed in FV energy spectrum at module 3





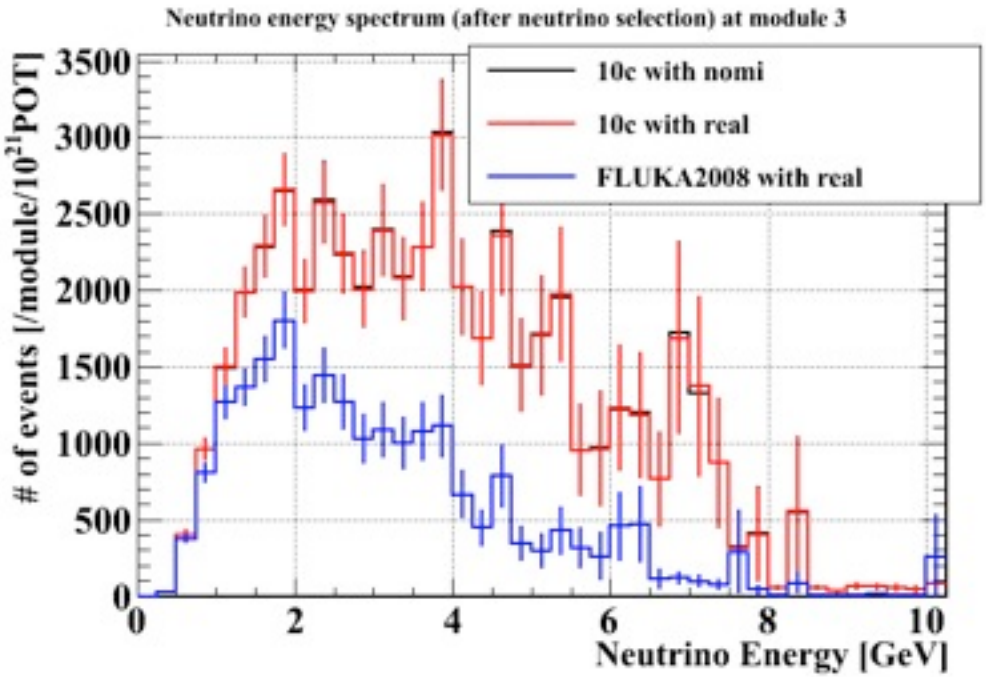
Calc diff. of Nobs of INGRID.

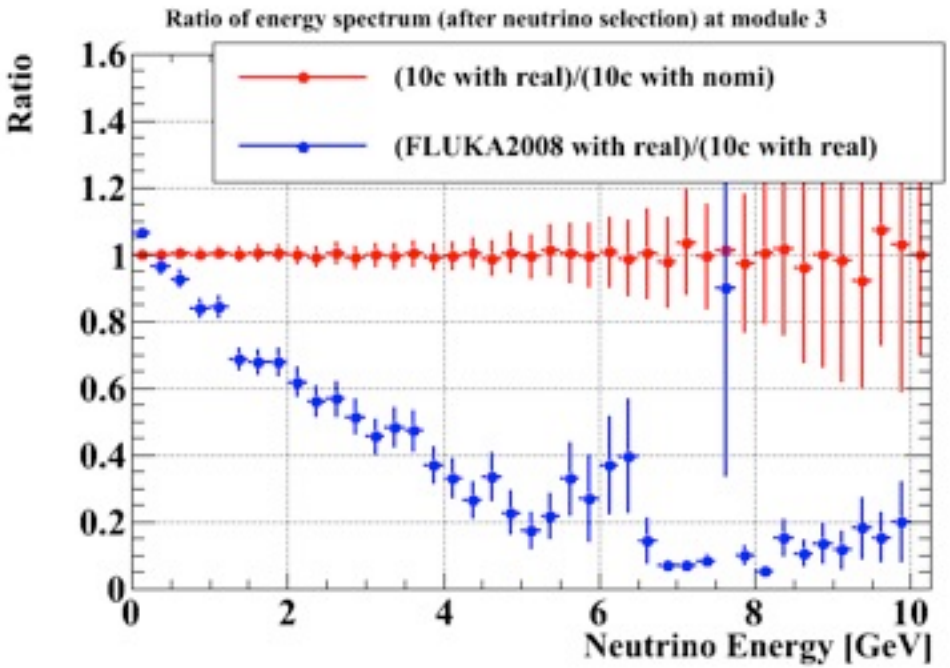
Diff. of A from B = (A-B)/B

Diff. of 10c(real) from 10c(nomi)	+ 2.4e-2 %
Diff. of FLUKA2008(real) from 10c(real)	- 19.6 %
Diff. of FLUKA2008(real) from 10c(nomi)	- 19.6 %

Diff. of numubar energy spectrum

Diff. of numubar observed in FV energy spectrum at module 3





Calc diff. of Nobs of INGRID.

Diff. of A from B = (A-B)/B

Diff. of 10c(real) from 10c(nomi)	+ 0.11 %
Diff. of FLUKA2008(real) from 10c(real)	- 56.5%
Diff. of FLUKA2008(real) from 10c(nomi)	- 56.4 %

Summary of Nobs.

	Nobs(numu) [/10^{14}POT]	Nobs(numubar) [/10^{14}POT]	(numu+numubar) [/10^{14}POT]
10c nomi	1.72	0.063	1.78(1.)
10c real	1.72	0.0604	1.78(1.)
FLUKA2008 real	1.38	0.0263	1.41(0.79)

Nobs(Data:Run29-34) = 1.51 /10^{14}POT

- To estimate Diff . due to beam size :
  - Diff. of (10c real) from (10c nomi) ~ 0.0 %
- To estimate Diff. due to hadron producion :
  - Diff. of (FLUKA2008 real) from (10c real) ~ - 20.8%

Back up

Diff. of Nobs at all modules (numu)

Diff1.	Diff. of 10c(real) from 10c(nomi)
Diff.2	Diff. of FLUKA2008(real) from 10c(real)
Diff.3	Diff. of FLUKA2008(real) from 10c(nomi)

Diff	mod0	1	2	3	4	5	6
1	0.31	0.26	0.08	0.02	-0.07	-0.09	-0.3
2	-18.5	-20.0	-20.1	-19.6	20.6	-21.4	-17.7
3	-18.2	-19.8	-20.0	-19.6	-20.6	-21.5	-18.0

Diff	mod7	8	9	10	11	12	13
1	1.3	0.64	0.31	0.04	-0.29	-0.62	-1.2
2	-18.4	-19.8	-19.3	-18.5	-19.7	-20.8	-18.9
3	-17.3	-19.3	-19.1	-18.5	-19.9	-21.3	-19.8

Diff. of Nobs at all modules (numubar)

Diff1.	Diff. of 10c(real) from 10c(nomi)
Diff.2	Diff. of FLUKA2008(real) from 10c(real)
Diff.3	Diff. of FLUKA2008(real) from 10c(nomi)

Diff[%]	mod0	1	2	3	4	5	6
1	-0.06	-0.28	0.17	0.69	-0.20	0.13	-0.14
2	-51.8	-56.5	-58.0	-57.4	-57.1	-55.4	-50.0
3	-51.9	-56.7	-57.9	-57.1	-57.2	-55.4	-50.1

Diff[%]	mod7	8	9	10	11	12	13
1	0.0	-0.49	0.65	-0.05	-0.05	0.64	0.19
2	-56.0	-55.1	-60.0	-62.1	-57.5	-55.2	-50.5
3	-56.0	-55.3	-59.8	-62.1	-57.5	-54.9	-50.4