INGRDI MC Work

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Motivation

- Check the difference of # of neutrino observation at INGRID when I put constant uncertainty on neutrino interaction cross-section.

Data set

- Jnubeam 10b : 1000 file
  - Horn setting : 250kA & 250kA
- NEUT (ver ?) : 80 interaction/file × 1000 file
  - including : numu, numubar, nue, nuebar interaction.
- INGRID MC (Japan orig)
  - Calc # of observation at each module, at each neutrino interaction mode.
  - only horizontal modules in this study.
    - There is no MC sample of vertical modules at numubar, nue, nuebar.

expected # of interaction

only numu : 2.41E+18 pot

module	0	1	2	3	4	5	6	sum
ALL	5844	7490	8791	9175	8957	7559	5929	53745
CCQE	1846	2181	2413	2560	2505	2102	1746	15353
CC1Pi	1367	1849	2269	2368	2266	1879	1410	13408
CC Other	1099	1517	1830	1887	1897	1599	1151	10980
NC	1532	1943	2279	2360	2289	1979	1622	14004

→ by INGRID MC, calc # of observation at each module.

expected # of observation

numu : ~2.41E+18 pot

module	0	1	2	3	4	5	6	sum
ALL	1882	2479	3018	3075	3061	2539	1968	18022
CCQE	789	977	1136	1132	1154	953	800	6941
CC1Pi	514	748	929	977	924	745	541	5378
CC Other	469	610	763	767	776	698	507	4590
NC	110	144	190	199	207	143	120	1113

Put constant uncertainty on each neutrino cross-section
ex) CCQE + 10%
→ # of observation(CCQE) = 6941 × 1.1 = 7635
→ # of observation(ALL) = 7635+5378+4590+1113 = 18716
→ Diff. observation from orig. = (18716/18022 - 1)×100 = 3.8 %

Result (250kA, horizontals)

	CCQE +10%	CCQE +20%	CC1Pi +20%	CC1Pi +30%	CCother +20%	CCother +30%
# of observations [/10^14pot]	0.813	0.842	0.829	0.852	0.829	0.851
diff. from orig [%]	3.7	7.4	5.7	8.6	5.7	8.5

	NC+30%	NC+40%
# of observations [/10^14pot]	0.798	0.803
diff. from orig [%]	1.8	2.4

- Original # of observation : 0.784
- including numu, numubar,nue,nuebar MC sample
- Normalized by 10^14 pot

Next step

- Prepare MC sample of vertical modules at numubar, nue, nuebar.
- Compare each basic plot (# of active plane, etc) when put each uncertainty on cross-section.
- Check beam profile (beam center, beam size) when put each uncertainty on cross-section.

expected # of interaction (ratio)

Calc ratio[%] of each interaction mode to all interaction modes

module	0	1	2	3	4	5	6
CCQE	31.59	29.12	27.45	27.90	27.97	27.81	29.45
CC1Pi	23.39	24.69	25.81	25.81	25.30	24.86	23.78
CC Other	18.81	20.25	20.82	20.57	21.18	21.15	19.41
NC	26.21	25.94	25.92	25.72	25.56	26.18	27.36

expected # of observation (ratio)

Calc ratio[%] of each interaction mode to all interaction modes

module	0	1	2	3	4	5	6
CCQE	41.92	39.41	37.64	36.81	37.70	37.53	40.65
CC1Pi	27.31	30.17	30.78	31.77	30.19	29.34	27.49
CC Other	24.92	24.61	25.28	24.94	25.35	27.49	25.76
NC	5.84	5.81	6.30	6.47	6.76	5.63	6.10