

NumuOA work

Nsk calculation for comparizon

A.Murakami

Comparison Item

- Comparison Item
 - Nsk with “Nominal MC” (not “BANFF pre-fit”, just nominal SKMC)
 - Nsk with BANFF post-fit center value
 - 1 sigma effect for each systematics (ΔN_{sk})
- Compare for each flavor, each interaction
- Neutrino oscillation : 3 flavor oscillation prob Prob3++
- Comparison not only in NumuOA analyzer ,but also with T2K-SK number (→ next page)

- At first, Nsk comparison between Murakami's and T2K-SK's
- Then the some numbers for comparison in NumuOA analyzer are shown

T2K-SK calculation

- Nsk are calculated by T2K-SK experts for NumuOA with several conditions !
(Thanks for Roger-san and Tobayama-san)
- To compare, I pick up the Nsk with the following condition
 - Oscillation probability : 3 flavor by using Prob3++
 - Oscillation parameters are same as TN118
 - Use no BANFF (= "nominal SKMC applied flux tuning") and BANFF v5 (post-fit)
 - Flux tuning is done by using latest flux (11bv3.1 run1+2+3 full data)
 - Do BANFF weighting each entry of SKMC by using T2KReWeight (v1r15p1)
 - BANFF input : **postfit_banff_v5_osc_marg_POTextrap.root**
- The detail numbers are put on here (in this slide, I show the all flavor numbers)
 - <http://www.t2k.org/asg/oagroup/numu/t2k-sk-nsk-for-comparison/>

Murakami calculation

- SKMC 11c after 10a Numu cut & data reduction
 - smallnt_numu_sk11c_flux11bv31fine_r1-3cfull_10acut.root
 - POT for normalization : 3.01×10^{20}
 - Weighted by latest flux (11b v3.1)
 - sk_tuned11bv3.1_11anom_run1-run3c_full_fine.root
- Neutrino oscillation probability : Prob3++
 - Consider only disappearance for CC interaction neutrino.
 - For the NC interaction neutrino, not consider oscillation
- BANFF : postfit_banff_v5_osc_marg_numu.root
 - not including high energy norm → Now calc by including version.
- Response function estimated with T2KReWeight (v1r15p1)
- Interaction categories → back up

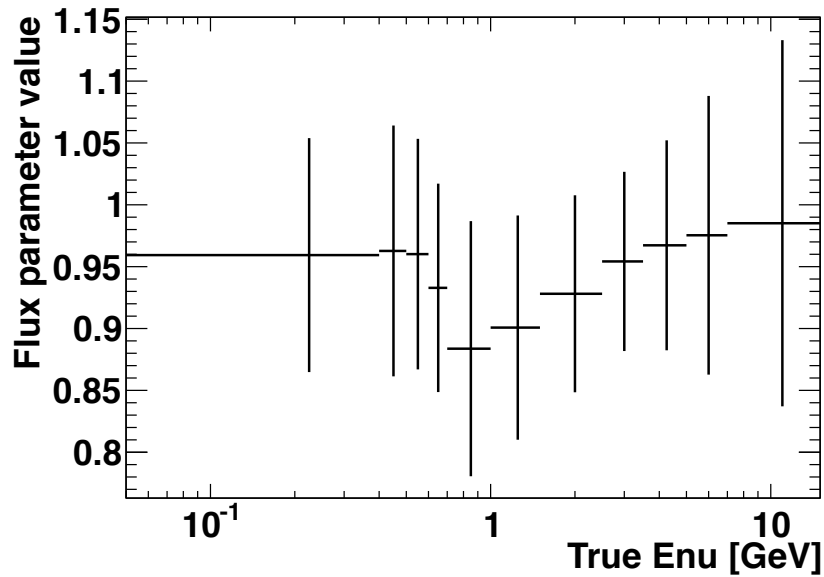
Used oscillation params

Parameter	Value
Δm_{21}^2	$7.6 \times 10^{-5} \text{eV}^2$
Δm_{32}^2	$2.4 \times 10^{-3} \text{eV}^2$
$\sin^2 2\theta_{12}$	0.8704
$\sin^2 2\theta_{23}$	1.0
$\sin^2 2\theta_{13}$	0.1 (or 0)
δ_{CP}	0
Mass hierarchy	Normal
ν travel length	295 km
Earth density	2.6g/cm^3

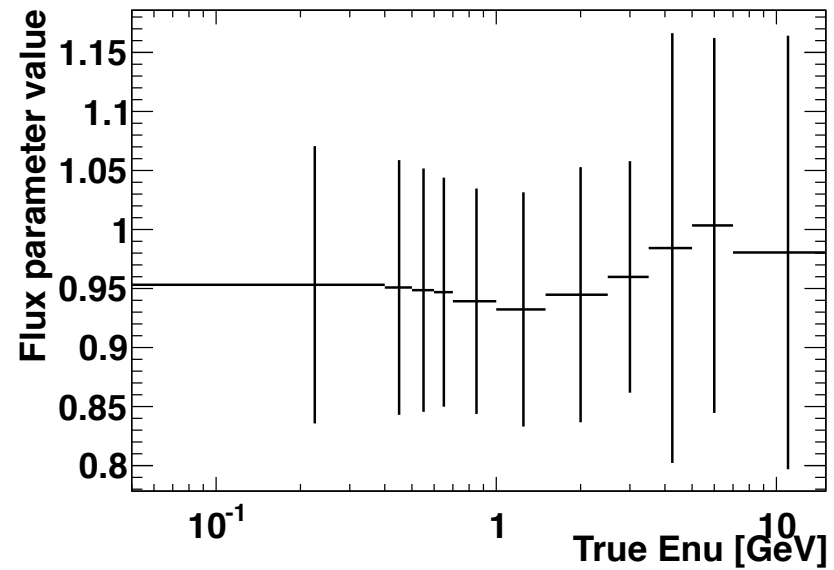
BANFF flux systematics (NumuOA)

Post-fit, Coarse binning

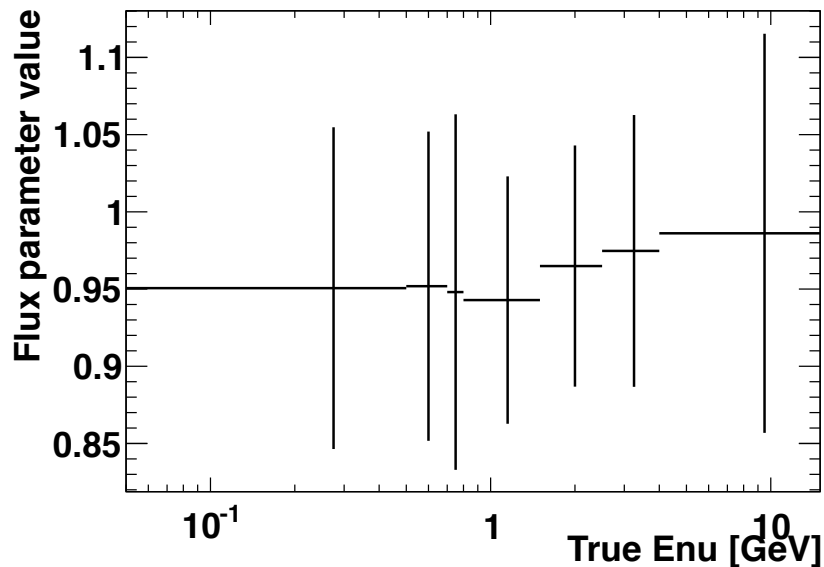
SK Numu



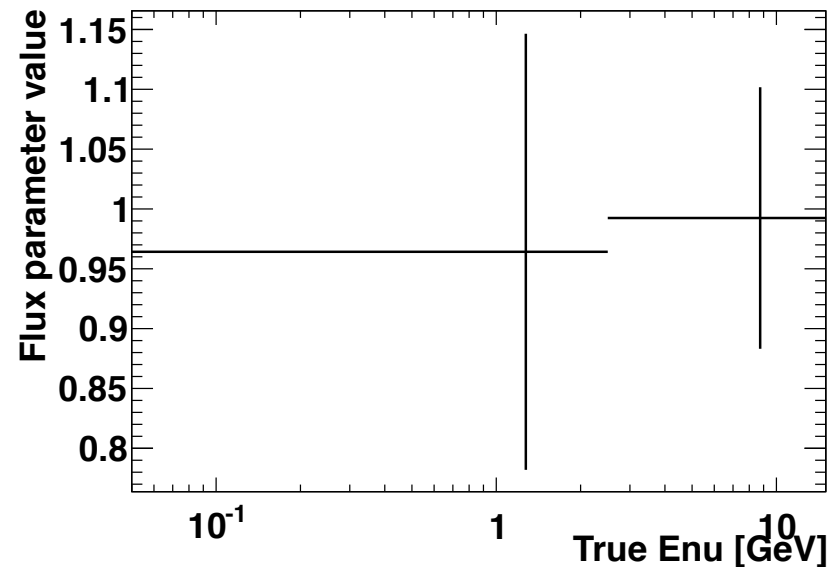
SK Numubar



SK Nue



SK Nuebar



Xsec systematics (NumuOA)

	BANFF pre		BANFF post	
Syst name	Center	Frac. Err	Center	Frac. Err
MAQE (B)	1.210	0.372	1.200	0.162
MARES (B)	1.160	0.091	1.140	0.082
CCQE norm E1 (0~1.5 GeV) (A)	1.000	0.110	0.943	0.087
CCIP norm E1 (0 ~2.5 GeV) (A)	1.629	0.434	1.647	0.304

NOTE: "NCPI0 norm" & "NCCOH" not used now

Syst name	Center	Frac. Err
CC other shape (B)	0 (OFF)	0.4
Spec. Func (B)	0 (OFF)	1 (ON)
pF (B)	225	0.133
CCQE norm E2 (1.5~3.5 GeV) (A)	1	0.3
CCQE norm E3 (3.5~30GeV) (A)	1	0.3
CCIP norm E2 (2.5~30 GeV) (A)	1.000	0.300
CC Coherent (A)	1	1
NC other (A)	1	0.3
CC Nue/Numu (A)	1	0.03
W shape (C)	87.7	0.52
Pi-less delta decay (C)	0.2	0.2
IPi Enu shape (C)	0 (OFF)	0.5

(A), (B), (C) mean "NIWG parameter class". Definition is same as NueOA.
(A): uncertainties on the overall normalization, (B):uncertainties that are represented by response functions, (C): uncertainties by $\pm 1\sigma$ variation of the parameter.

SK detector systematics (NumuOA)

syst param name	Center	Frac. Err
Numu/Numb CCQE norm	1	0.018
Numu/Numb CCQE shape1	1	0.017
Numu/Numb CCQE shape2	1	0.035
Numu/Numb CCQE shape3	1	0.093
Numu/Numb CCnQE norm	1	0.200
Nue/Nueb CC norm	1	1.000
NC	1	1.110
Energy scale	1	0.023

*When $N_{exp} < 0$ by shifting syst,
 N_{exp} is set to be 0.*

$$\epsilon_{SK}(E_\nu) \rightarrow \begin{cases} f_{CCQE}^{SK} \cdot f_{shape1}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_\mu \text{ CCQE}, E_\nu^{\text{rec}} < 0.4 \text{ GeV} \\ f_{CCQE}^{SK} \cdot f_{shape2}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_\mu \text{ CCQE}, E_\nu^{\text{rec}} = 0.4 \sim 1.1 \text{ GeV} \\ f_{CCQE}^{SK} \cdot f_{shape3}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_\mu \text{ CCQE}, E_\nu^{\text{rec}} > 1.1 \text{ GeV} \\ f_{CC \text{ other}}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_\mu \text{ CC other interactions} \\ f_{NC}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_\mu \text{ NC} \\ f_{\nu e}^{SK} \cdot \epsilon_{SK}(E_\nu) & I = \nu_e \text{ CC} \end{cases}$$

Comparison btw T2K-SK and Murakami

- Nominal MC case, all flavors

Interaction	Nsk(Murakami)	Nsk(T2K-SK)	(Murakami/T2K-SK) - 1
CCQE	3.559E+01	3.560E+01	-4.2E-04
CCPI	1.570E+01	1.570E+01	1.1E-04
CC Coherent	5.370E-01	5.368E-01	4.7E-04
CC other	4.097E+00	4.097E+00	1.2E-04
NCPI	1.845E+00	1.845E+00	-1.4E-04
NC other	1.667E+00	1.665E+00	1.3E-03
Total	5.944E+01	5.945E+01	-1.8E-04

Comparison btw T2K-SK and Murakami

- BANFF post-fit (v5), all flavors

Interaction	Nsk(Murakami)	Nsk(T2K-SK)	(Murakami/T2K-SK) - 1
CCQE	3.138E+01	3.141E+01	-7.7E-04
CCPI	1.851E+01	1.851E+01	-4.0E-04
CC Coherent	5.040E-01	5.043E-01	-6.0E-04
CC other	3.910E+00	3.907E+00	9.9E-04
NCPI	1.593E+00	1.592E+00	4.5E-04
NC other	1.539E+00	1.610E+00	-4.4E-02
Total	5.744E+01	5.754E+01	-1.7E-03

Summary of T2K-SK comparison

- Check the Nsk between T2K-SK experts and Murakami
 - There is no big difference. It seems to be same
 - Looking at Nsk of all flavors&interactions, the difference is 0.018% (at nominal MC), 0.17 % (BANFF v5)
 - For BANFF case, this difference may occur because Murakami not use NCPI0 norma and use spline for BANFF weighting.
- Anyway, need investigate my calculation to check this diff. But, this diff may not urgent problem for me.

Comparison in NumuOA analyzer

- Nsk with nominal MC or BANFF post
- 1σ effect for each syst params

Nsk with nominal MC or BANFF post

Nominal : Nominal MC
 BANFF center : BANFF post-fit

Component	Nominal (NOM)		BANFF center (BNF0)		
	Nsk	Frac(%)	Nsk	Frac(%)	BNF0/NOM
numu ccqe	33.272	55.98	29.267	50.95	0.880
numu ccpi	14.611	24.58	17.178	29.91	1.176
numu cccoh	0.420	0.71	0.393	0.69	0.936
numu ccoth	3.860	6.49	3.682	6.41	0.954
numu ncpi	1.696	2.85	1.463	2.55	0.862
numu ncoth	1.521	2.56	1.401	2.44	0.921
numu all	55.38	0.932	53.38	92.942	0.964
numb ccqe	2.208	3.72	2.022	3.52	0.916
numb ccpi	1.050	1.77	1.274	2.22	1.213
numb cccoh	0.114	0.19	0.108	0.19	0.949
numb ccoth	0.233	0.39	0.225	0.39	0.964
numb ncpi	0.094	0.16	0.081	0.14	0.865
numb ncoth	0.082	0.14	0.077	0.13	0.937
numb all	3.78	0.064	3.79	6.594	1.001
nue ccqe	0.016	0.03	0.014	0.03	0.898
nue ccpi	0.010	0.02	0.013	0.02	1.387
nue cccoh	0.000	0.00	0.000	0.00	0.955
nue ccoth	0.003	0.01	0.003	0.01	0.969
nue ncpi	0.049	0.08	0.044	0.08	0.895
nue ncoth	0.058	0.10	0.055	0.10	0.949
nue all	0.14	0.002	0.13	0.226	0.955
nueb ccqe	0.001	0.00	0.001	0.00	0.959
nueb ccpi	0.001	0.00	0.001	0.00	1.247
nueb cccoh	0.000	0.00	0.000	0.00	0.975
nueb ccoth	0.000	0.00	0.000	0.00	0.982
nueb ncpi	0.006	0.01	0.005	0.01	0.880
nueb ncoth	0.006	0.01	0.006	0.01	0.954
nueb all	0.01	0.000	0.01	0.022	0.935
signue ccqe	0.092	0.15	0.080	0.14	0.871
signue ccpi	0.028	0.05	0.041	0.07	1.465
signue cccoh	0.002	0.00	0.002	0.00	0.927
signue ccoth	0.001	0.00	0.001	0.00	0.911
signue ncpi	0.000	0.00	0.000	0.00	nan
signue ncoth	0.000	0.00	0.000	0.00	nan
signue all	0.12	0.002	0.12	0.215	1.008
all ccqe	35.59	0.599	31.38	54.641	0.882
all ccpi	15.70	0.264	18.51	32.220	1.179
all cccoh	0.54	0.009	0.50	0.877	0.939
all ccoth	4.10	0.069	3.91	6.808	0.954
all ncpi	1.85	0.031	1.59	2.773	0.863
all ncoth	1.67	0.028	1.54	2.680	0.923
total	59.44	1.000	57.44	100.000	0.966
numu+numub ccqe	35.48	59.696	31.29	54.475	0.882
numu+numub ccpi	15.66	26.350	18.45	32.124	1.178
numu+numub cccoh	0.53	0.899	0.50	0.873	0.939
numu+numub ccoth	4.09	6.887	3.91	6.802	0.954
nue+nueb cc	0.15	0.258	0.16	0.273	1.020
all ncpi	1.85	3.104	1.59	2.773	0.863
all ncoth	1.67	2.805	1.54	2.680	0.923

1 sigma effect for each syst params

Nsk change by shifting each
syst by +/- 1 sigma

***At this time, please check the
“BANFF post” line***

Unit : [%]

syst param	BANFF pre				BANFF post			
	Non-Osc		Osc		Non-Osc		Osc	
	+1 σ	-1 σ	+1 σ	-1 σ	+1 σ	-1 σ	+1 σ	-1 σ
fFlux-SKNumu00	0.342	-0.342	0.813	-0.813	0.290	-0.290	0.676	-0.676
fFlux-SKNumu01	1.008	-1.008	0.671	-0.671	0.844	-0.844	0.551	-0.551
fFlux-SKNumu02	1.880	-1.880	0.122	-0.122	1.551	-1.551	0.099	-0.099
fFlux-SKNumu03	2.235	-2.235	0.296	-0.296	1.788	-1.788	0.234	-0.234
fFlux-SKNumu04	3.816	-3.816	2.509	-2.509	3.036	-3.036	1.961	-1.961
fFlux-SKNumu05	1.104	-1.104	2.042	-2.042	0.904	-0.904	1.640	-1.640
fFlux-SKNumu06	0.683	-0.683	1.883	-1.883	0.598	-0.598	1.615	-1.615
fFlux-SKNumu07	0.278	-0.278	0.886	-0.886	0.242	-0.242	0.757	-0.757
fFlux-SKNumu08	0.338	-0.338	1.129	-1.129	0.290	-0.290	0.949	-0.949
fFlux-SKNumu09	0.163	-0.163	0.555	-0.555	0.134	-0.134	0.449	-0.449
fFlux-SKNumu10	0.043	-0.043	0.150	-0.150	0.038	-0.038	0.128	-0.128
fFlux-SKNumb00	0.009	-0.009	0.024	-0.024	0.009	-0.009	0.021	-0.021
fFlux-SKNumb01	0.012	-0.012	0.008	-0.008	0.011	-0.011	0.007	-0.007
fFlux-SKNumb02	0.017	-0.017	0.001	-0.001	0.015	-0.015	0.001	-0.001
fFlux-SKNumb03	0.019	-0.019	0.002	-0.002	0.017	-0.017	0.002	-0.002
fFlux-SKNumb04	0.061	-0.061	0.050	-0.050	0.054	-0.054	0.044	-0.044
fFlux-SKNumb05	0.088	-0.088	0.167	-0.167	0.080	-0.080	0.149	-0.149
fFlux-SKNumb06	0.105	-0.105	0.290	-0.290	0.105	-0.105	0.285	-0.285
fFlux-SKNumb07	0.034	-0.034	0.108	-0.108	0.034	-0.034	0.107	-0.107
fFlux-SKNumb08	0.035	-0.035	0.118	-0.118	0.038	-0.038	0.124	-0.124
fFlux-SKNumb09	0.011	-0.011	0.039	-0.039	0.012	-0.012	0.039	-0.039
fFlux-SKNumb10	0.003	-0.003	0.010	-0.010	0.003	-0.003	0.010	-0.010
fFlux-SKNue00	0.000	-0.000	0.001	-0.001	0.000	-0.000	0.001	-0.001
fFlux-SKNue01	0.000	-0.000	0.001	-0.001	0.000	-0.000	0.001	-0.001
fFlux-SKNue02	0.000	-0.000	0.001	-0.001	0.000	-0.000	0.001	-0.001
fFlux-SKNue03	0.001	-0.001	0.005	-0.005	0.001	-0.001	0.004	-0.004
fFlux-SKNue04	0.002	-0.002	0.006	-0.006	0.002	-0.002	0.005	-0.005
fFlux-SKNue05	0.002	-0.002	0.007	-0.007	0.002	-0.002	0.005	-0.005
fFlux-SKNue06	0.001	-0.001	0.005	-0.005	0.001	-0.001	0.004	-0.004
fFlux-SKNueb00	0.000	-0.000	0.002	-0.002	0.000	-0.000	0.002	-0.002
fFlux-SKNueb01	0.000	-0.000	0.002	-0.002	0.000	-0.000	0.001	-0.001
fXsec-MAQE	16.993	-24.635	14.968	-18.090	8.344	-9.861	6.976	-7.572
fXsec-MARES	1.753	-1.807	3.868	-3.812	1.677	-1.719	3.623	-3.564
fXsec-CCQEnorm00	7.777	-7.777	4.240	-4.240	6.443	-6.443	3.411	-3.411
fXsec-CCRESnorm00	4.320	-4.320	5.718	-5.718	3.060	-3.060	3.973	-3.973
fXsec-DISshape	0.267	-0.267	0.774	-0.774	0.286	-0.286	0.816	-0.816
fXsec-spec	-2.522	5.015	-0.718	2.044	-2.455	4.906	-0.688	1.971
fXsec-pF	0.126	-0.152	0.036	0.088	0.100	-0.128	0.023	0.099
fXsec-CCQEnorm01	1.389	-1.389	3.944	-3.944	1.460	-1.460	4.065	-4.065
fXsec-CCQEnorm02	0.363	-0.363	1.210	-1.210	0.394	-0.394	1.288	-1.288
fXsec-CCRESnorm01	1.255	-1.255	4.106	-4.106	1.331	-1.331	4.265	-4.265
fXsec-CCCOHnorm	0.546	-0.546	0.841	-0.841	0.575	-0.575	0.877	-0.877
fXsec-NCOTHERnorm	0.220	-0.220	0.771	-0.771	0.235	-0.235	0.804	-0.804
fXsec-CCnuenumu	0.001	-0.001	0.008	-0.008	0.001	-0.001	0.008	-0.008
fXsec-MdeltaWidth	-1.139	0.804	-0.797	-0.281	-1.166	0.819	-0.785	-0.318
fXsec-pionlessdcy	3.844	-3.844	6.329	-6.329	3.953	-3.953	6.421	-6.421
fXsec-1piEnushape	-0.094	-1.379	3.000	-9.061	-0.077	-1.533	3.101	-9.468
fSK-NumuCCQE	1.378	-1.378	1.000	-1.000	1.362	-1.362	0.981	-0.981
fSK-Shape-NumuCCQE00	0.021	-0.021	0.051	-0.051	0.021	-0.021	0.051	-0.051
fSK-Shape-NumuCCQE01	2.258	-2.258	0.953	-0.953	2.224	-2.224	0.910	-0.910
fSK-Shape-NumuCCQE02	1.004	-1.004	2.359	-2.359	1.014	-1.014	2.371	-2.371
fSK-NumuCCnQE	4.386	-4.386	7.771	-7.771	4.542	-4.542	7.960	-7.960
fSK-NueCC	0.017	-0.017	0.055	-0.055	0.018	-0.018	0.057	-0.057
fSK-AllNC	1.690	-1.522	5.906	-5.321	1.768	-1.593	6.053	-5.453
fSK-Escale	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000

Effect on Nsk from 1 sigma shift of MAQE

Component	Nominal (NOM)		BANFF center (BNF0)			BANFF + 1 σ (BNF+1)			BANFF - 1 σ (BNF-1)		
	Nsk	Frac(%)	Nsk	Frac(%)	BNF0/NOM	Nsk	Frac(%)	BNF+1/BNF0	Nsk	Frac(%)	BNF-1/BNF0
numu ccqe	33.272	55.98	29.267	50.95	0.880	32.988	53.69	1.127	25.169	47.41	0.860
numu ccpi	14.611	24.58	17.178	29.91	1.176	17.178	27.96	1.000	17.178	32.36	1.000
numu cccoh	0.420	0.71	0.393	0.69	0.936	0.393	0.64	1.000	0.393	0.74	1.000
numu ccoth	3.860	6.49	3.682	6.41	0.954	3.682	5.99	1.000	3.682	6.93	1.000
numu ncpi	1.696	2.85	1.463	2.55	0.862	1.463	2.38	1.000	1.463	2.76	1.000
numu ncoth	1.521	2.56	1.401	2.44	0.921	1.401	2.28	1.000	1.401	2.64	1.000
numu all	55.38	0.932	53.38	92.942	0.964	57.11	92.939	1.070	49.29	92.838	0.923
numb ccqe	2.208	3.72	2.022	3.52	0.916	2.296	3.74	1.135	1.784	3.36	0.882
numb ccpi	1.050	1.77	1.274	2.22	1.213	1.274	2.07	1.000	1.274	2.40	1.000
numb cccoh	0.114	0.19	0.108	0.19	0.949	0.108	0.18	1.000	0.108	0.20	1.000
numb ccoth	0.233	0.39	0.225	0.39	0.964	0.225	0.37	1.000	0.225	0.42	1.000
numb ncpi	0.094	0.16	0.081	0.14	0.865	0.081	0.13	1.000	0.081	0.15	1.000
numb ncoth	0.082	0.14	0.077	0.13	0.937	0.077	0.13	1.000	0.077	0.15	1.000
numb all	3.78	0.064	3.79	6.594	1.001	4.06	6.610	1.072	3.55	6.686	0.937
nue ccqe	0.016	0.03	0.014	0.03	0.898	0.016	0.03	1.130	0.012	0.02	0.854
nue ccpi	0.010	0.02	0.013	0.02	1.387	0.013	0.02	1.000	0.013	0.03	1.000
nue cccoh	0.000	0.00	0.000	0.00	0.955	0.000	0.00	1.000	0.000	0.00	1.000
nue ccoth	0.003	0.01	0.003	0.01	0.969	0.003	0.00	1.000	0.003	0.01	1.000
nue ncpi	0.049	0.08	0.044	0.08	0.895	0.044	0.07	1.000	0.044	0.08	1.000
nue ncoth	0.058	0.10	0.055	0.10	0.949	0.055	0.09	1.000	0.055	0.10	1.000
nue all	0.14	0.002	0.13	0.226	0.955	0.13	0.214	1.014	0.13	0.240	0.984
nueb ccqe	0.001	0.00	0.001	0.00	0.959	0.001	0.00	1.141	0.001	0.00	0.875
nueb ccpi	0.001	0.00	0.001	0.00	1.247	0.001	0.00	1.000	0.001	0.00	1.000
nueb cccoh	0.000	0.00	0.000	0.00	0.975	0.000	0.00	1.000	0.000	0.00	1.000
nueb ccoth	0.000	0.00	0.000	0.00	0.982	0.000	0.00	1.000	0.000	0.00	1.000
nueb ncpi	0.006	0.01	0.005	0.01	0.880	0.005	0.01	1.000	0.005	0.01	1.000
nueb ncoth	0.006	0.01	0.006	0.01	0.954	0.006	0.01	1.000	0.006	0.01	1.000
nueb all	0.01	0.000	0.01	0.022	0.935	0.01	0.021	1.008	0.01	0.024	0.993
signue ccqe	0.092	0.15	0.080	0.14	0.871	0.089	0.15	1.115	0.069	0.13	0.861
signue ccpi	0.028	0.05	0.041	0.07	1.465	0.041	0.07	1.000	0.041	0.08	1.000
signue cccoh	0.002	0.00	0.002	0.00	0.927	0.002	0.00	1.000	0.002	0.00	1.000
signue ccoth	0.001	0.00	0.001	0.00	0.911	0.001	0.00	1.000	0.001	0.00	1.000
signue ncpi	0.000	0.00	0.000	0.00	nan	0.000	0.00	nan	0.000	0.00	nan
signue ncoth	0.000	0.00	0.000	0.00	nan	0.000	0.00	nan	0.000	0.00	nan
signue all	0.12	0.002	0.12	0.215	1.008	0.13	0.216	1.075	0.11	0.212	0.910
all ccqe	35.59	0.599	31.38	54.641	0.882	35.39	57.599	1.128	27.03	50.925	0.861
all ccpi	15.70	0.264	18.51	32.220	1.179	18.51	30.119	1.000	18.51	34.860	1.000
all cccoh	0.54	0.009	0.50	0.877	0.939	0.50	0.820	1.000	0.50	0.949	1.000
all ccoth	4.10	0.069	3.91	6.808	0.954	3.91	6.364	1.000	3.91	7.366	1.000
all ncpi	1.85	0.031	1.59	2.773	0.863	1.59	2.593	1.000	1.59	3.001	1.000
all ncoth	1.67	0.028	1.54	2.680	0.923	1.54	2.505	1.000	1.54	2.899	1.000
total	59.44	1.000	57.44	100.000	0.966	61.44	100.000	1.070	53.09	100.000	0.924
numu+numub ccqe	35.48	59.696	31.29	54.475	0.882	35.28	57.426	1.128	26.95	50.770	0.861
numu+numub ccpi	15.66	26.350	18.45	32.124	1.178	18.45	30.029	1.000	18.45	34.756	1.000
numu+numub cccoh	0.53	0.899	0.50	0.873	0.939	0.50	0.816	1.000	0.50	0.945	1.000
numu+numub ccoth	4.09	6.887	3.91	6.802	0.954	3.91	6.358	1.000	3.91	7.359	1.000
nue+nueb cc	0.15	0.258	0.16	0.273	1.020	0.17	0.273	1.072	0.14	0.270	0.915
all ncpi	1.85	3.104	1.59	2.773	0.863	1.59	2.593	1.000	1.59	3.001	1.000
all ncoth	1.67	2.805	1.54	2.680	0.923	1.54	2.505	1.000	1.54	2.899	1.000

- Nominal : Nominal SKMC (not use BANFF weighting)
- BANFF center : BANFF fit center
- BANFF + 1 σ : BANFF fit center + 1 σ error
- BANFF - 1 σ : BANFF fit center - 1 σ error

Component

- Nsk : # of expected events
- Frac (%) : Fraction of this component in all

For all sysys

http://www-he.scphys.kyoto-u.ac.jp/~akira.m/nuosc/work/nsk_comparison/nsk_summary_osc_bnfpst.pdf

Back up

Interaction categories (based on NEUT)

NEUTRINO MODE

**** CHARGED CURRENT ****

-- ELASTIC --
1 : NEU,N --> LEPTON-,P

ccqe

-- SINGLE PI FROM DELTA RESONANCE --
11 : NEU,P --> LEPTON-,P,PI+
12 : NEU,N --> LEPTON-,P,PI0
13 : NEU,N --> LEPTON-,N,PI+

ccpi

16 : NEU,O(16) --> LEPTON-,O(16),PI+

cccoh

-- SINGLE GAMMA FROM DELTA RESONANCE --
17 : NEU,N --> LEPTON-,P,GAMMA

-- MULTI PI ($1.3 < W < 2.0$ GeV) --
21 : NEU,(N OR P) --> LEPTON-, (N OR P), MULTI PI

-- SINGLE ETA FROM DELTA RESONANCE --
(added 97/12/01 J.Kameda)
22 : NEU,N --> LEPTON-,P,ETA0

-- SINGLE K FROM DELTA RESONANCE --
(added 98/02/25 J.Kameda)
23 : NEU,N --> LEPTON-,LAMBDA,K+

-- DEEP INELASTIC ($2.0 \text{ GeV} < W$, JET set) --
26 : NEU,(N OR P) --> LEPTON-, (N OR P), MESONS

ccoth

**** NEUTAL CURRENT ****

-- SINGLE PI FROM DELTA RESONANCE --

31 : NEU,N --> NEU,N,PI0
32 : NEU,P --> NEU,P,PI0

ncoth

33 : NEU,N --> NEU,P,PI-
34 : NEU,P --> NEU,N,PI+

ncpi

36 : NEU,O(16) --> NEU,O(16),PI0

-- SINGLE GAMMA FROM DELTA RESONANCE -
38 : NEU,N --> NEU,N,GAMMA
39 : NEU,P --> NEU,P,GAMMA

-- MULTI PI ($1.3 \text{ GeV} < W < 2.0 \text{ GeV}$) --
41 : NEU,(N OR P) --> NEU,(N OR P), MULTI PI

-- SINGLE ETA FROM DELTA RESONANCE --
(added 97/12/01 J.Kameda)
42 : NEU,N --> NEU,N,ETA0
43 : NEU,P --> NEU,P,ETA0

52 : NEU,N --> NEU,N
-- SINGLE K FROM DELTA RESONANCE --
(added 98/02/20 J.Kameda)

44 : NEU,N --> NEU,LAMBDA,K0
45 : NEU,P --> NEU,LAMBDA,K+

-- DEEP INELASTIC ($2.0 \text{ GeV} < W$, JET set) --
46 : NEU,(N OR P) --> NEU,(N OR P), MESONS

-- ELASTIC --
51 : NEU,P --> NEU,P

Xsec param vs Affected Int. Cate.

○: affected

int. cate. param#	0 CCQE	1 CCPI	2 CCCoh	3 CCOth	4 NCPI	5 NCOth
0 MAQE	○					
1 MARES		○		○	○	○
2 CC other Shape				○		
3 Spec Function	○					
4 EB						
5 pF	○					
6 WV-shape		○		○	○	○
7 Pi-less delta decay		○			○	○
8 MB IPi shape		○				○