T2K simulation @ 2KM & SK : status report

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- MC simulation @ 2KM
- MC simulation @ SK
- (brief) report on sensitivity study

Monte Carlo production

2KM:

-> Used the official nue sample

-> Made my own numu vectors using the modified version of Hayato-san's code that I described during a previous 2KM video conference

-> Simulated with latest 2KM destim + G4.7.0

I deactivated muon capture (because of a possible bug posted on the G4 newsgroup)

I used the binary cascade hadronic model (see Jen Raaf's work) to reduce pi0 production from hadronic processes in water (closest model to skdetsim's internal hadronic code)

-> processed the events with latest 2KM software (new AFIT, new PID code, etc.) and polfit5 (for now only version)

-> compare with SK T2K ntuples

Super-Kamiokande:

-> until now only older ntuples were available, from an older T2K spectrum (03a)

-> K. Kaneyuki & J. Raaf have simulated and reconstructed T2K SK events using the latest event spectra (will avoid complicated reweighting in the analysis).

->Polfit2 (official) AND polfit5 (new) were applied and are available in the new ntuples.

Numus are complete ; nues will be available shortly.

Available statistics @ 2KM

In march we generated :
~ 96,500 generated in the 56t FV (~ 0.6 years)
~ 50,600 generated in the 56t FV (~ 14 years)
At the moment :
~ 91,000 numus generated in the 100t FV
~ 80,000 nues generated in the 100t FV (some condor jobs 'froze' -- lost 10,000 events...)

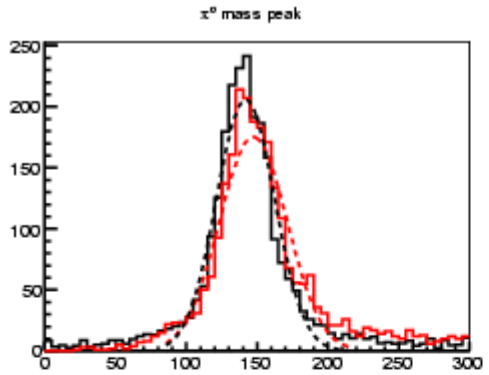
-> is enough for nues (over 10 T2K years).
-> is not enough for numus (~0.3 years)
We want to have about ~ 10 years : ~2.7 million numus in 100t FV.
I am processing more batches of numus as we speak and will keep doing so until the collaboration meeting in january

500,000 events at the NEUT level (64 m^2) --> ~90,000 events in FV100t
~ 0.33 T2K years in FV100t
= ~ 30 minutes CPU time with 10 CPUs @ Kamioka (NEUT) &
~ 12 hours with 100 CPUs @ Kashiwa (GEANT4) &
~ 60 hours with 100 CPUs @ Kashiwa (reconstruction)

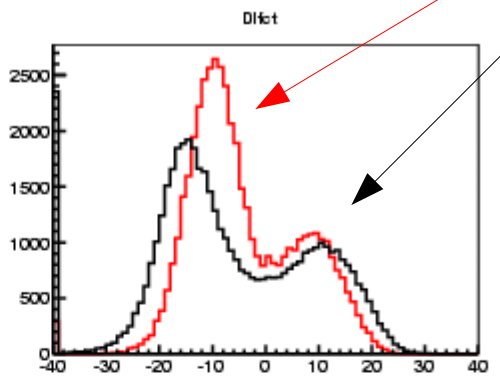
I've simulated 1 T2K year of numus so far.

2KM nov05 vs SK 03a : νμ interactions

Pi0 mass peak

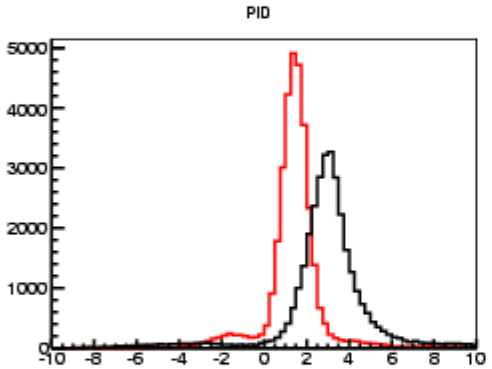


Ring counting likelihood

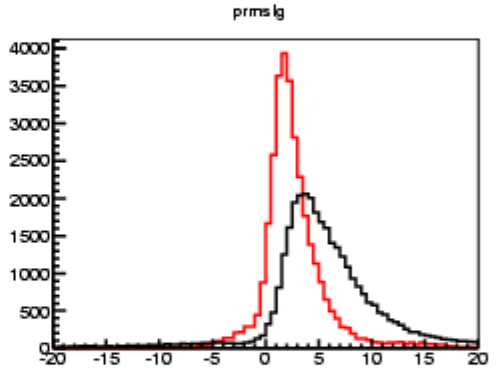


2KM

SK (older ntuples)



PID – 1ring events : total PID,



pattern PID

PID : different patterns so different behaviour...

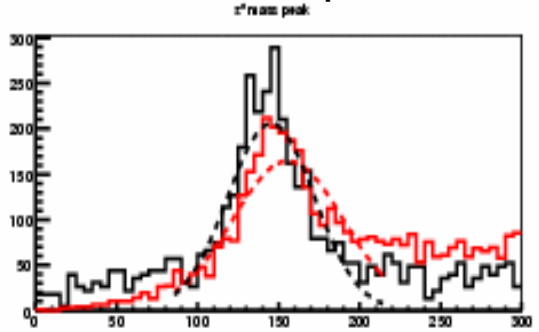
2Ring, e-like, no decay e- :
peak @ 141.9 MeV/c² (SK)
peak @ 147.3 MeV/c² (2KM)
retuning of the energy scale @ 2KM necessary ?

'narrower' DLFCT @ 2KM
but ring counting performance has improved since march (next slide)

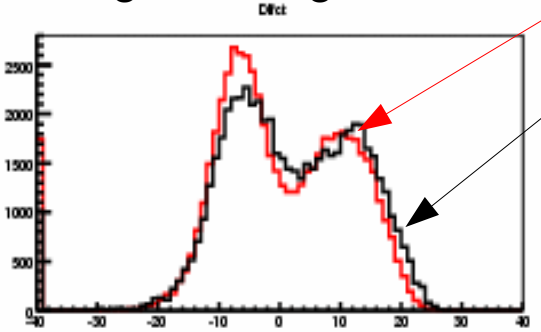
all 2KM histograms are normalized to the same # events as the SK histograms

2KM nov vs SK 03a : νe interactions

Pi0 mass peak

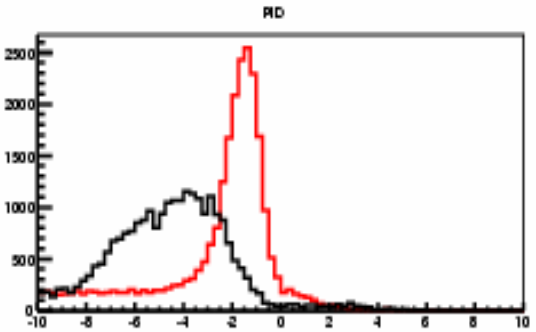


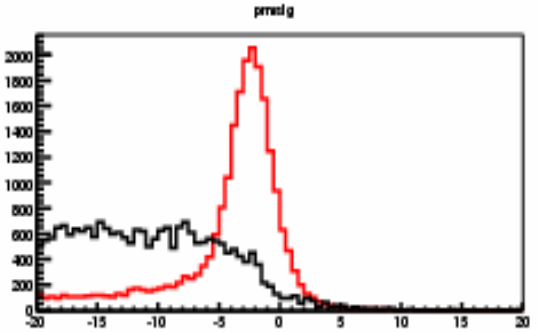
Ring counting likelihood



2KM

SK (older ntuples)



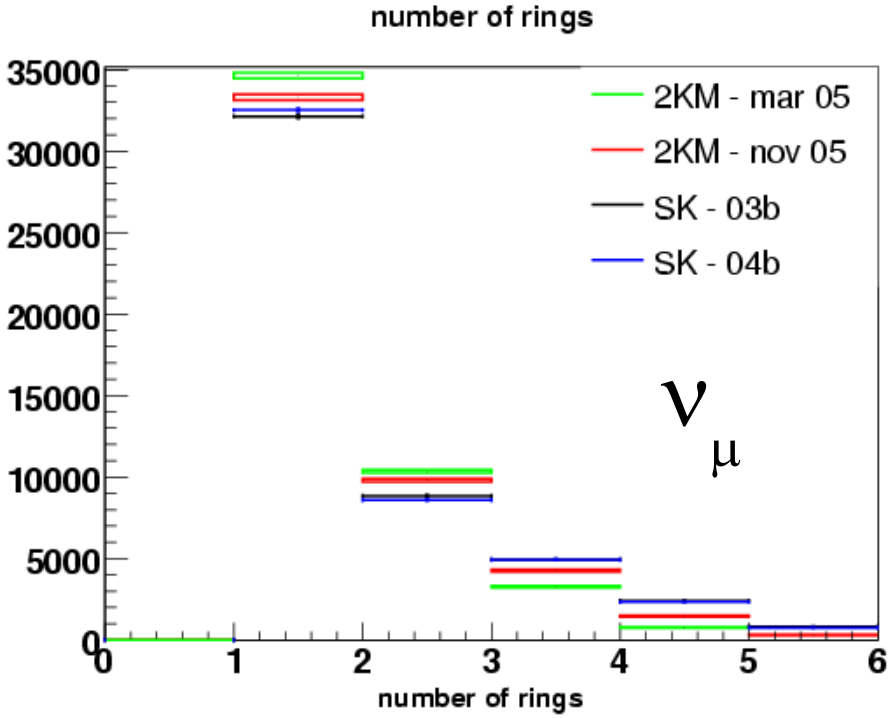


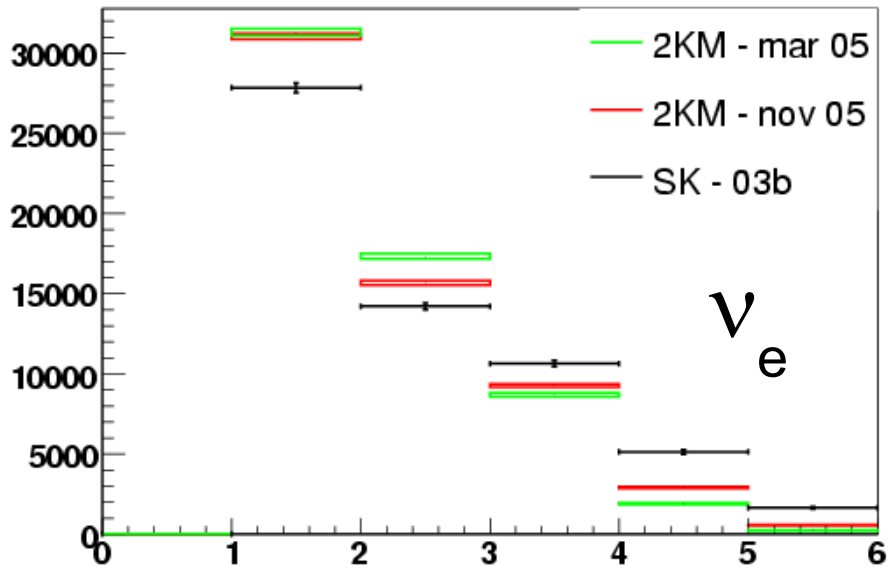
PID – 1ring events : total PID, pattern PID

Same comment on PID

higher 1 ring efficiency @ 2KM for nue events : under investigation.

nring





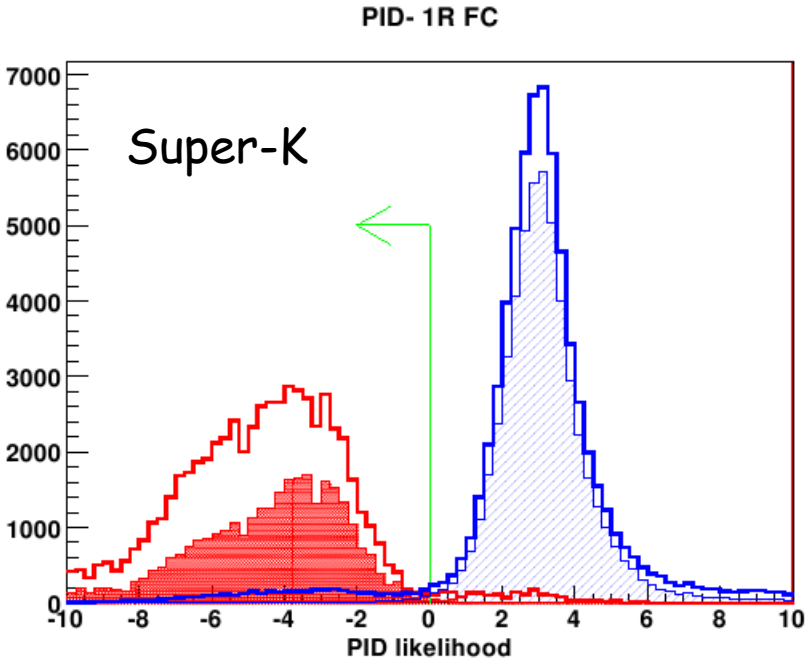
$\nu\mu$ events: Nring for FC,FV,evis>100 events

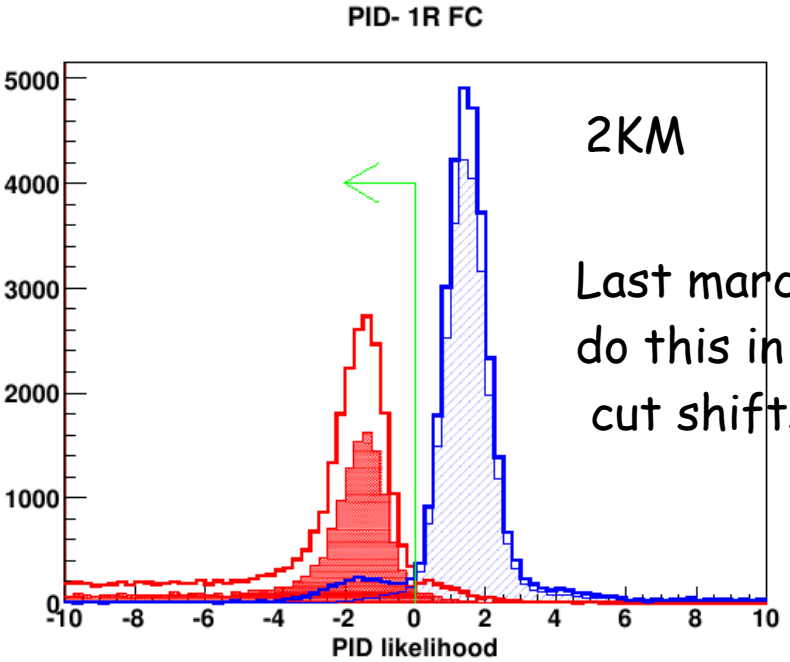
Distribution @ 2KM (red) closer to SK (black) than it used to be (green) :

Still different for nue events

Possible reason for the changes :
latest 2KM detsim uses:
-> smaller scattering lengths (more scattering)
-> less reflections
-> different hadronic model

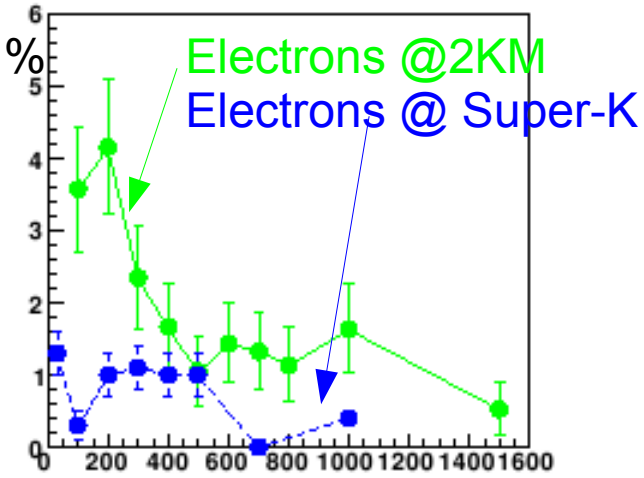
PID

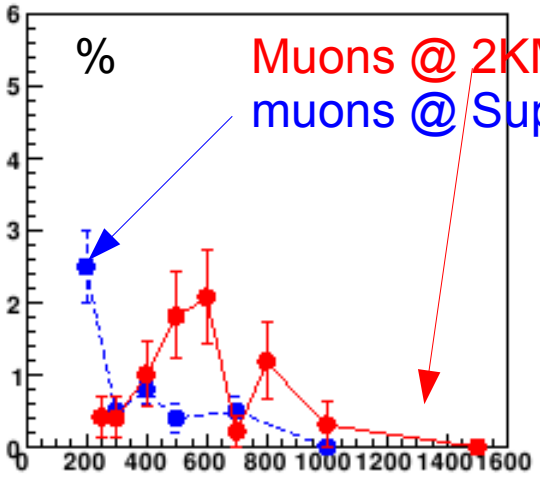




Last march we could not do this in the full FV + cut shifts were necessary

Mis ID (%) as a function of momentum from monochromatic events

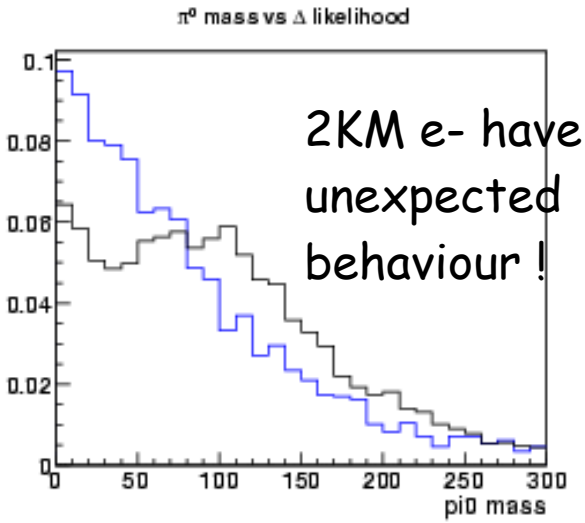


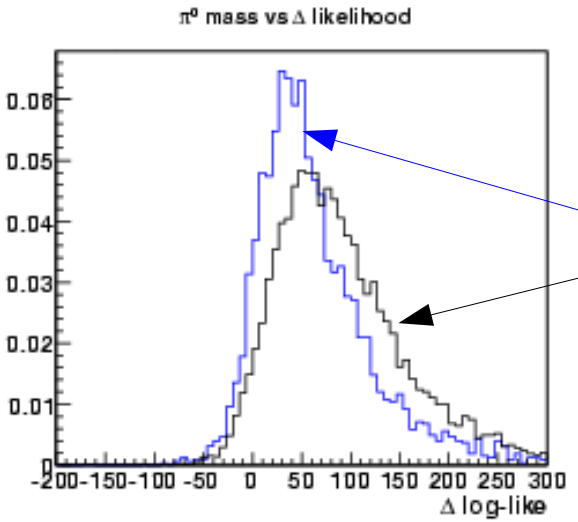


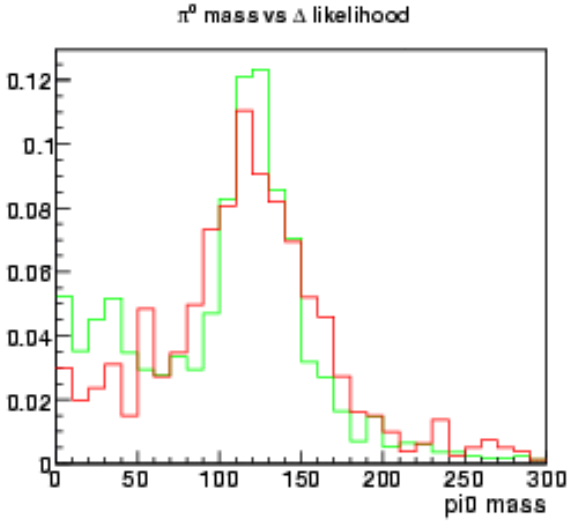
Momentum (MeV/c)

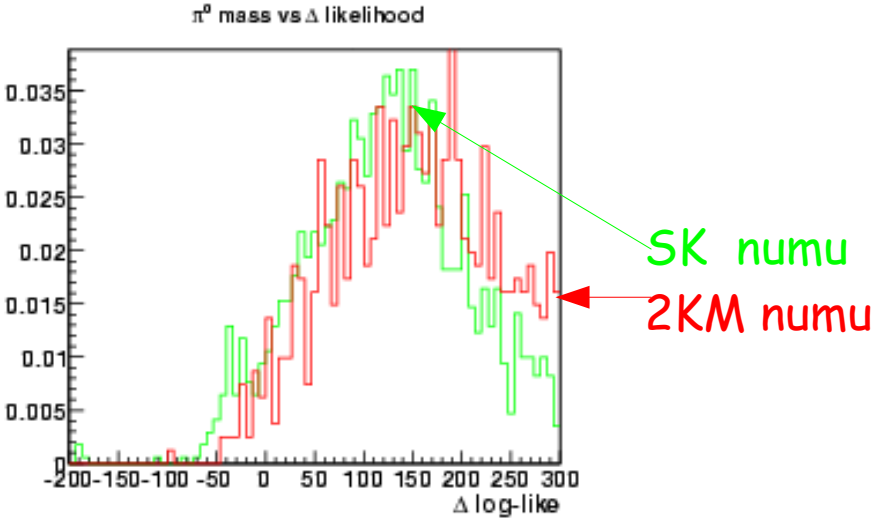
POLfit

FC,FV,1R,e-like,no decay e-,cos(θ)<0.9

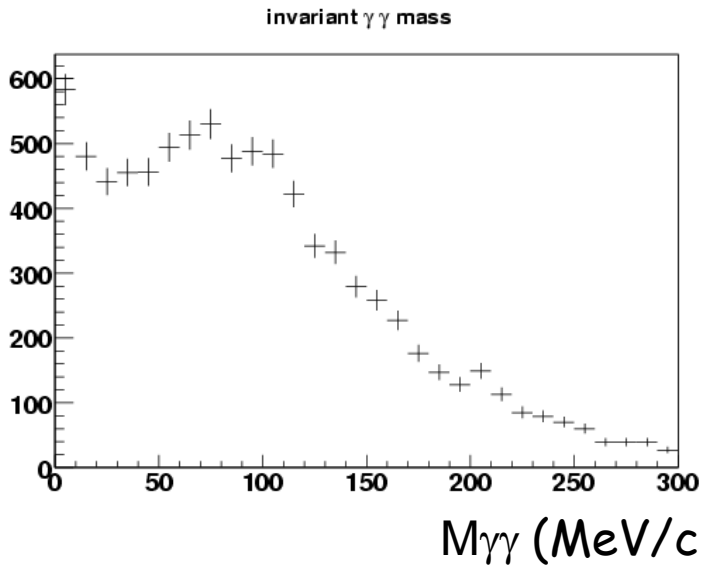




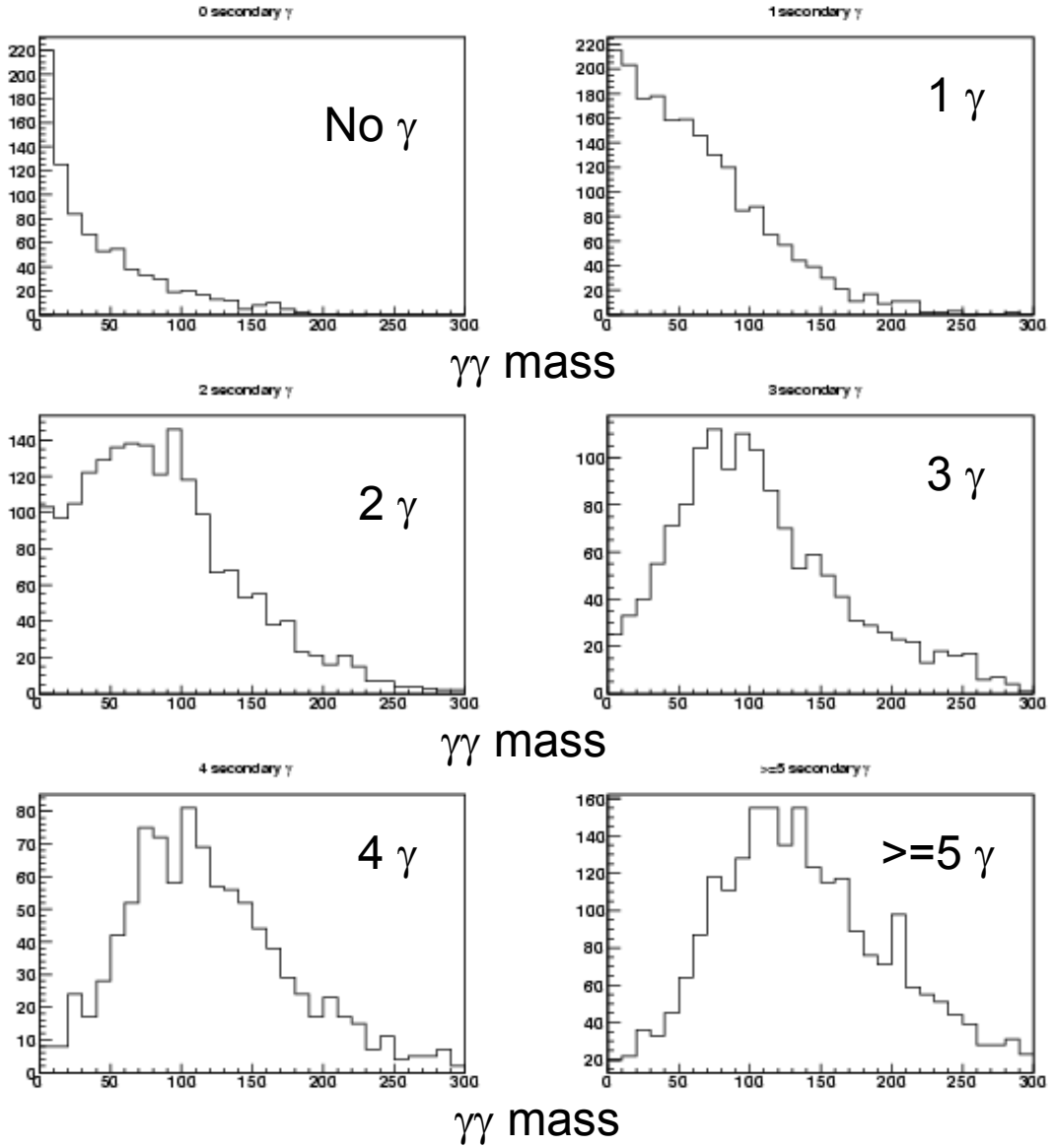




- Shape of the invariant mass plot still the same even with CCQE nues
- The electron expected light patterns seems to agree reasonably with the MC
- The shape of the invariant mass peak seems to be correlated with the number of high energy (>50 MeV) γ generated in the event. Seems to be absent at SK.



Are those γ coming from π^0 from hadronic interactions in the water ?
Not clear yet why we see this.

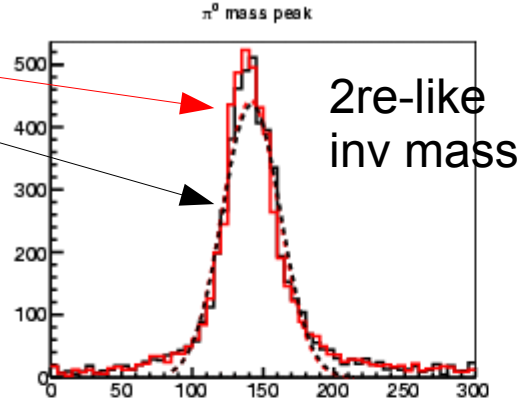


New SK ntuples

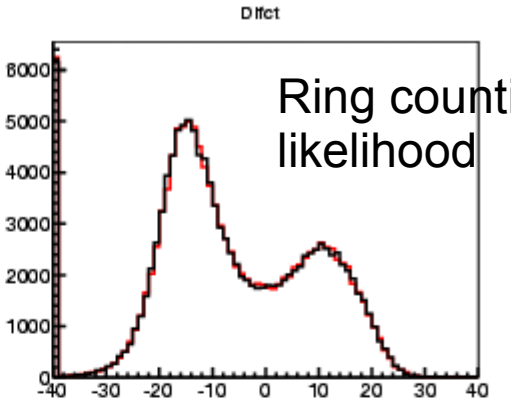
SK new
SK 03b

Simple comparison of the two versions
(only difference is in the beam MC)

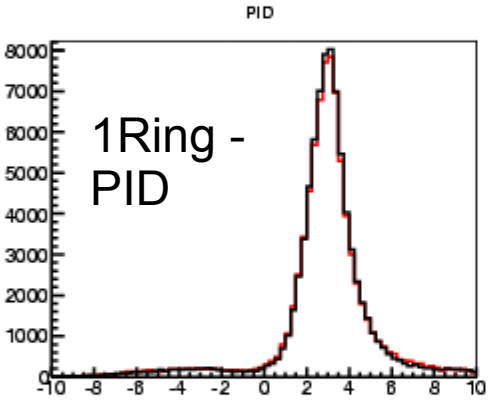
The results are almost identical.



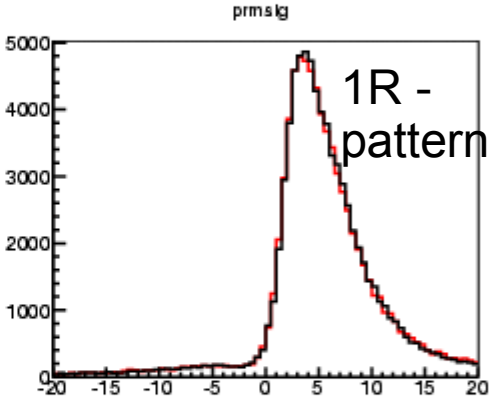
2re-like inv mass



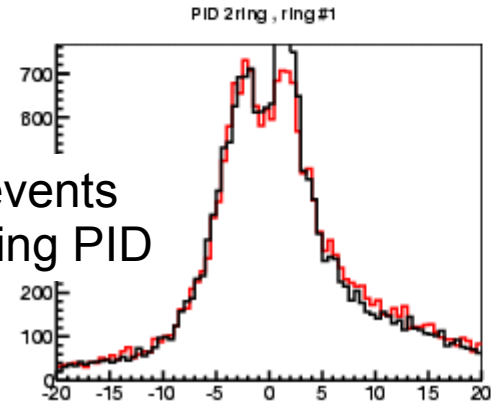
Ring counting likelihood



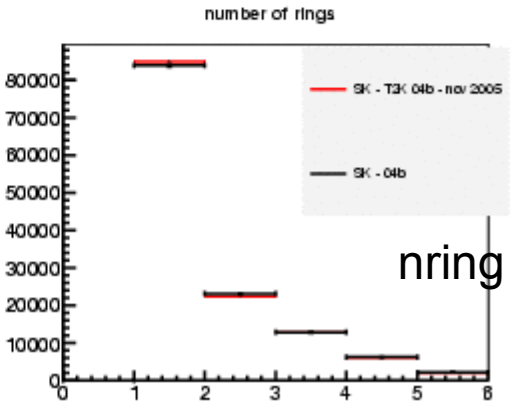
1Ring - PID



1R - pattern PID



2 R events first ring PID



nring

Selection efficiencies : νμ

SK / 2KMnov / 2KM mar	CC SK/2KMnov/2KMmar	NC SK/2KMnov/2KMmar
FC,FV, evis>100 MeV	111559 / 42406	16764 / 6684
1 ring	72.1% / 74.17% /76.9%	27.15% /27.54% /32.9%
e-like	1.62% / 3.15% /3.2%	21.12% /21.95% /19.2%
No decay electrons	0.46% / 0.31% /0.55%	18.7% /21.7% /18.0%
0.35<Enu<0.85 GeV	0.11% / 0.078% /0.17%	6.3% /7.96% / 5.7%
cos(θ ν-lepton)<0.9	0.083%/ 0.071% /0.12%	4.45% /4.95% /4.15%
POLfit cuts	0.03% / 0.02% /0.06%	0.95% /0.075% /1.3%

This is **PRELIMINARY**

Largest differences :

- *CC* νμ PID cut
- decay e- cuts -> use MC true info @ 2KM because the decay e- finder can't work @ 2KM (decay e- trigger not implemented in the G4 MC) seems ineffective on NC events
- Polfit cuts should not be considered yet

Selection efficiencies : νe

SK03b /2KMnov/ 2KM old	CC SK03b/2KMnov/2KMmar	NC SK03b/2KMnov/2KMmarch
FC,FV, evis>100 MeV	15831 / 48915	2724 / 9599
1 ring	50.7% / 56.7% /56.0%	24.2% / 28.8% /34.5%
e-like	50.4% / 55.6% /55.2%	17.2% / 22.4% /19.0%
No decay electrons	41.1% / 55.5% /45.9%	14.8% / 22.3% /17.2%
0.35<Enu<0.85 GeV	11.3% / 15.04% /14.1%	4.9% / 7.6% /5.7%
cos(θ ν-lepton)<0.9	9.78% / 12.9% /12.2%	3.6% / 5.3% /3.7%
POLfit cuts	8.12% / 7.8% /10.0%	0.84% / 0.65% /0.85%

The spectra are slightly different @ 2KM & SK
New νe SK ntuples are not available yet.

This is **PRELIMINARY**

Largest differences :

- Ring counting
- CC νe PID cut
- decay e- cut seems to be ineffective for νμ NC & all νe --> UNDER STUDY
- PiO cuts -> should not be considered for the moment

Sensitivity studies

- As explained in N. Tanimoto's talk during the previous meeting, we are developing a combined fitter for SK & 2KM that includes all reconstruction systematics (ring counting, PID, POLfit etc.). The techniques are similar to those used for SK atmospheric neutrino analysis.

We are presently working on :

- Method 1: reweight event samples according to all systematic terms and fit using MINUIT
- Method 2: use linear method with matrix like SK combined paper (Naho)

- Both will be ready for the next meeting

Conclusions

- Simulation of 2KM water Cherenkov T2K events in progress

nues are complete ; I will keep generating numus until the collaboration meeting

- Reconstruction : ring counting & PID performance are closer to SK this time
- POLfit : unexpected effect for electrons --> under investigation
- Other efficiency differences will be investigated (esp. decay e- cut)
- Super-K : simulation of numu T2K events is complete and works as expected ;

nues are being processed.

- Sensitivity studies : we are presently incorporating reconstruction systematics (PID, ring counting, etc.) in our fitter using both SK methods (minimizer & matrix).

Will be ready for the next meeting.