ν_μ spectra

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Explanations

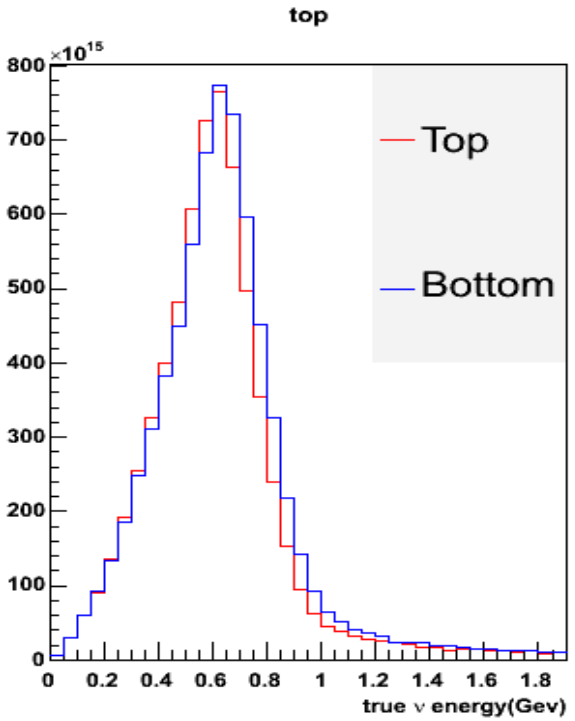
- How similar are the spectra @ 2KM and SK ?
- T2K events simulation is done in three stages :
  beam simulation (JNUBEAM) ->fluxes
(ie ν 4-vectors with weights),
  vectors (NEUT)(convolution with cross-sections)
  detector simulation (G4,skdetsim,...)
- At SK we only have older '03a' fluxes -> need to reweight to be compatible with 2KM ntuples : check that the reweighting technique does not introduce strange effects

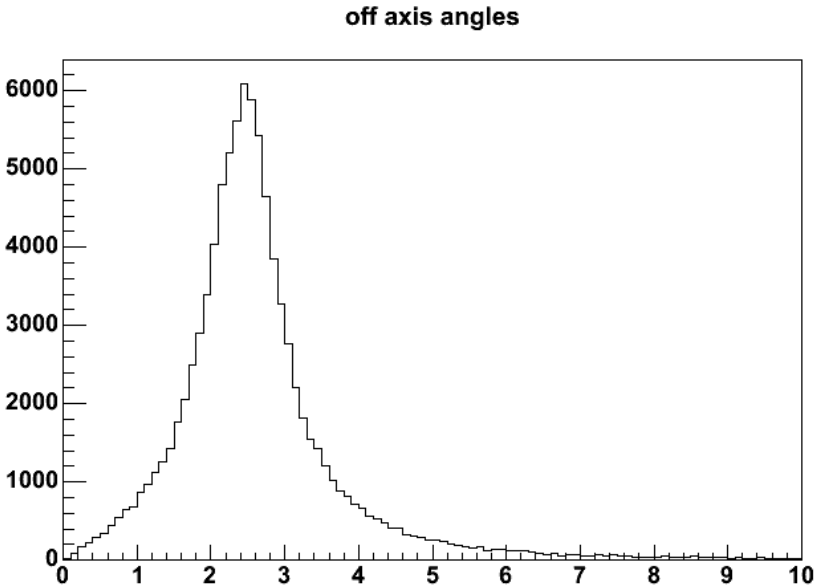
Remark : I use F/N ratios to compare differences between SK & 2KM. That does not mean I recommend to use the F/N as the extrapolation method in my final analyses.

Spectra at 2KM

The $\nu\mu$ spectra at 2KM and SK are different because :

- The ν source is not point-like (seen from the 2KM)
- The π beam has a non zero divergence
- The 2KM is not point-like

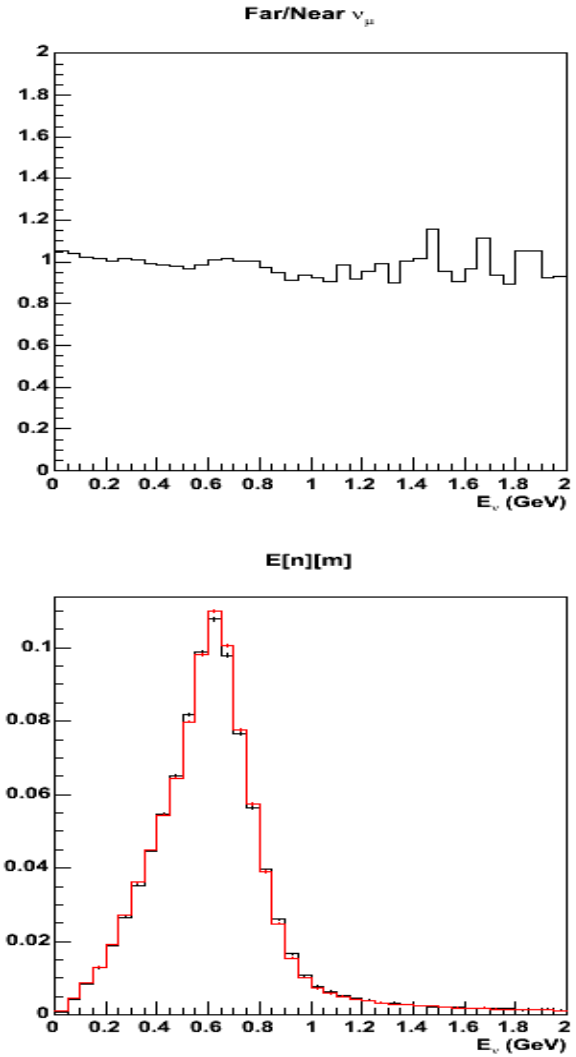




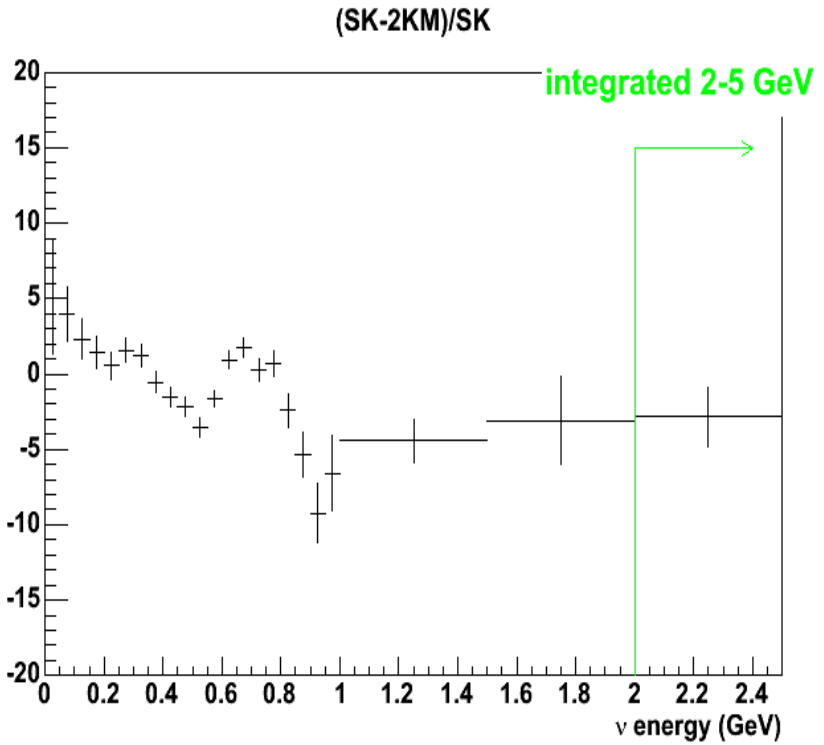
'Off axis angle' (deg) for ν_μ from π decays

Usual plots : flux F/N

JNUBEAM produces flux ntuples ie ν 4-vectors with weights



Using all events
(det. = 800cm*800cm square)

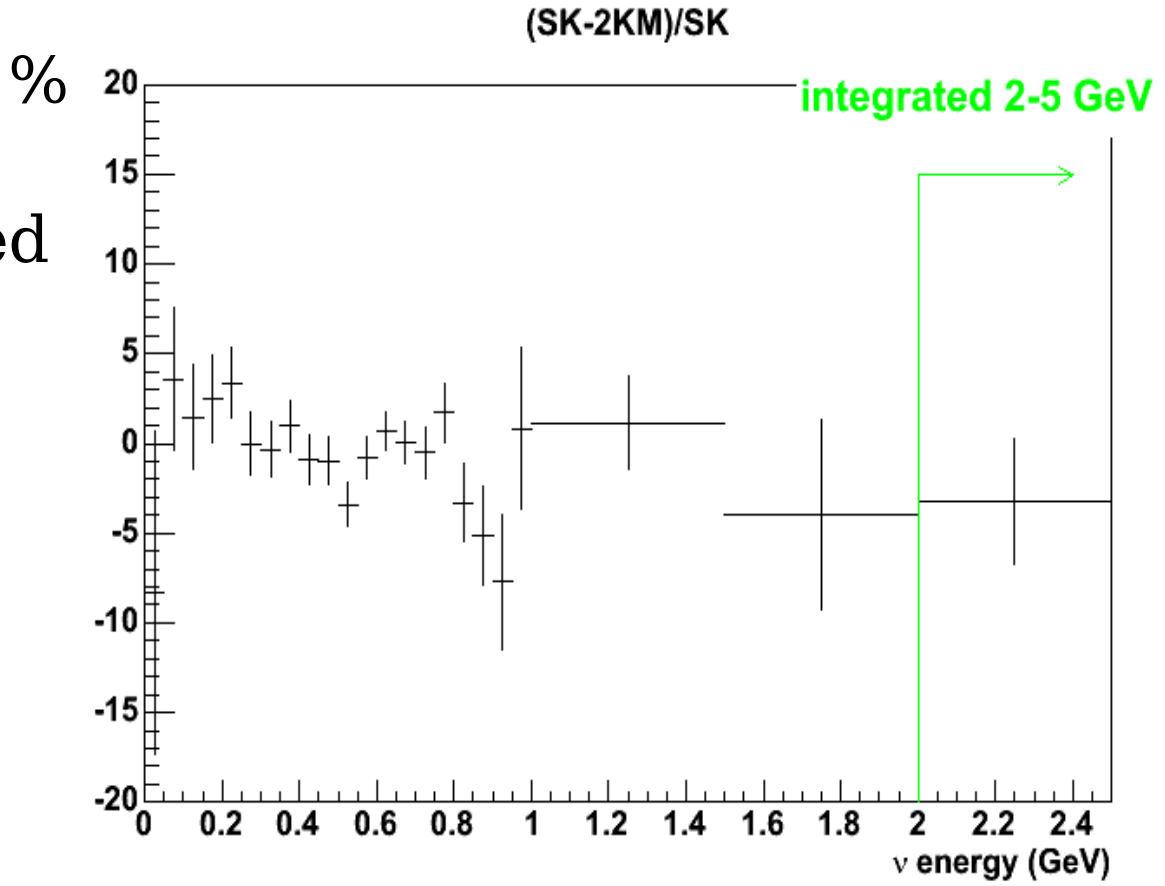


(SK-2KM)/SK*100 as a function of true neutrino energy

Flux F/N

Select events roughly in the FV (r<200cm)

Remark : 2KM is rescaled by a factor of (1800/295000)^2



Selecting events near the center 'flattens' the distribution

Using vectors

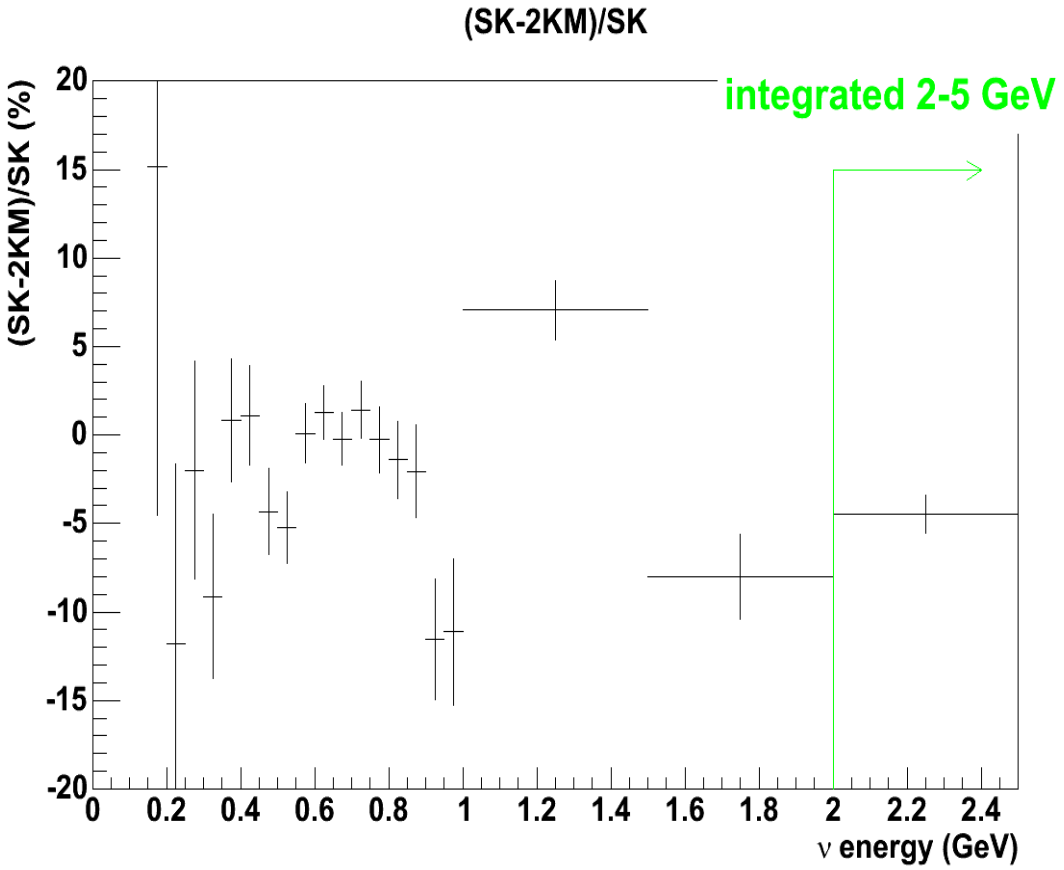
Output of JNUBEAM piped into NEUT to generate neutrino interaction vectors

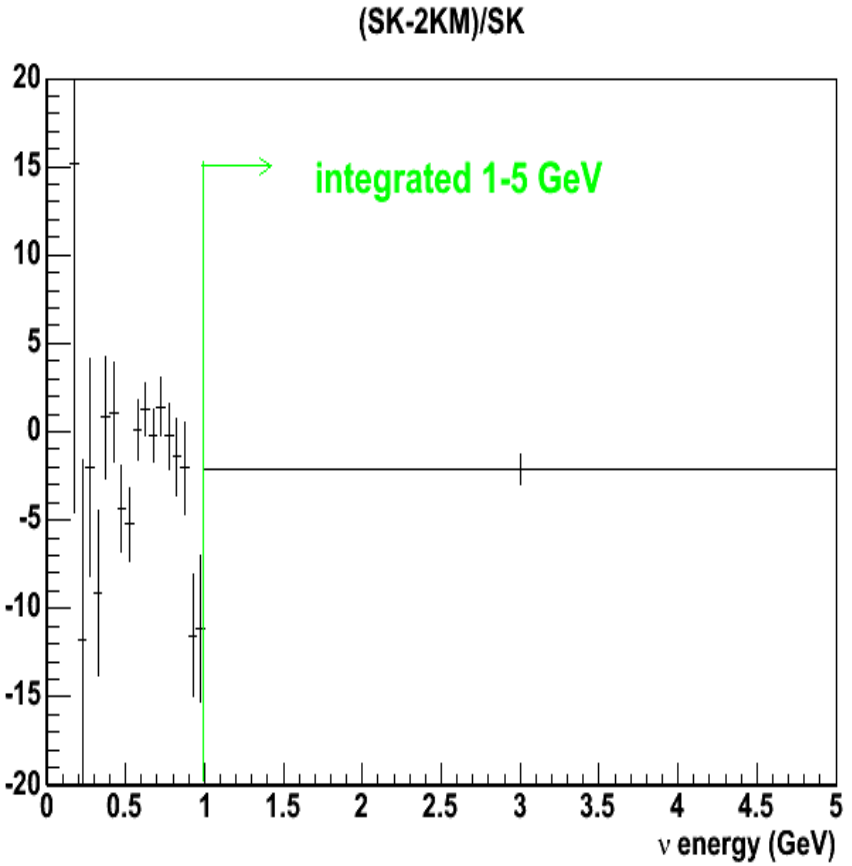
It is unclear to me how this is done : Use the same 4-vectors several times ? Generate new ones ?

Use the flux histograms from JNUBEAM as a sampling distribution --> Need to properly propagate the statistical errors on the flux into the vector files. I haven't done this yet --> the error bars are probably underestimated (at 2KM).

For vectors the rescaling factor is (1800/295000)^2*22.5kt/56t

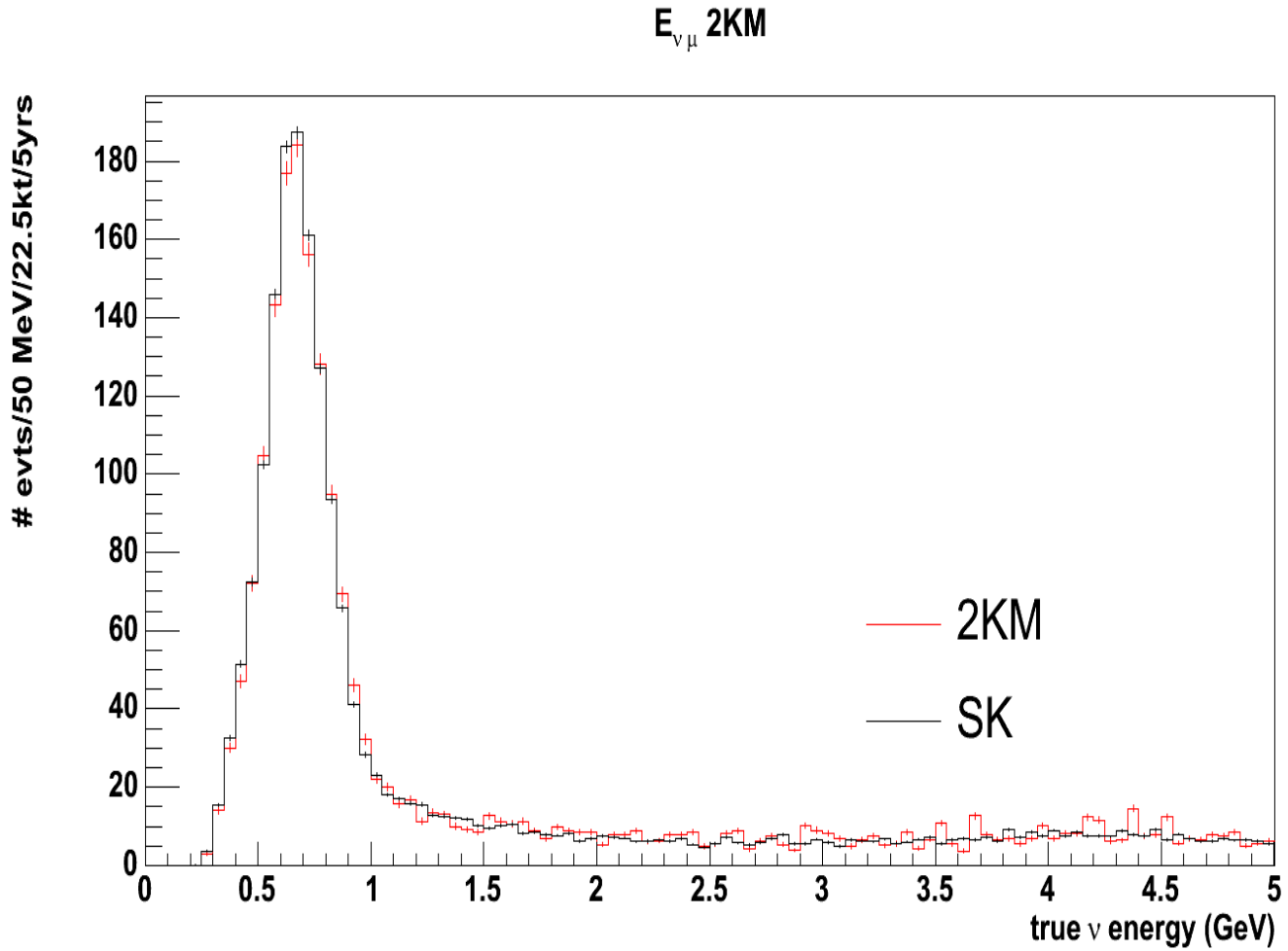
(SK-2KM)/SK





Using 55.8t FV (radius<175cm)

Large fluctuations at high energy with too small error bars



Statistics is quite limited in the 2KM vector files

In part due to JNUBEAM --> we need high statistics at 2KM (see my next talk).

Summary

Need to summarize these distributions (and quote a 'flatness number' in the proposal)

Compute weighted sample mean and weighted sample variance (with weight_i = 1/sigma_i^2)

Fluxes : mean{(SK-2KM)/SK} = 1.2% , RMS = 1.9%

Vectors : mean{(SK-2KM)/SK} = -1.7%, RMS = 2.8%

Using reconstructed ntuples

For SK only 03a , NEUT 4.5 vectors are available--> we reweight the events after reconstruction to 04b, NEUT 4.5.2

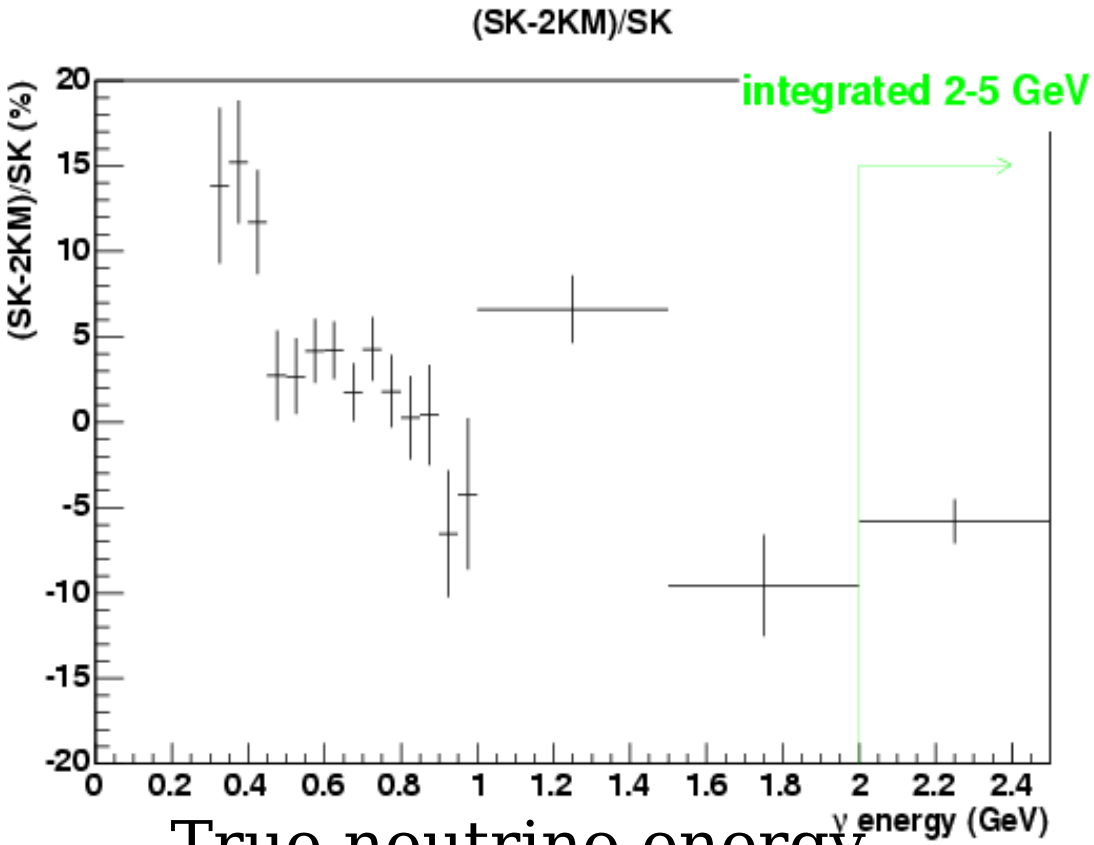
->Check that the reweighting method works correctly

During reconstruction some events (presumably low energy) are lost

-> may change the low energy behaviour of the F/N ratio

It would be useful to be able to study SK 03a vectors& ntuples BEFORE reconstruction, and check which events were lost.

Here SK = reconstructed SK 03a ntuples reweighted to 04b
2KM = reconstructed 04b FV56t ntuples



True neutrino energy

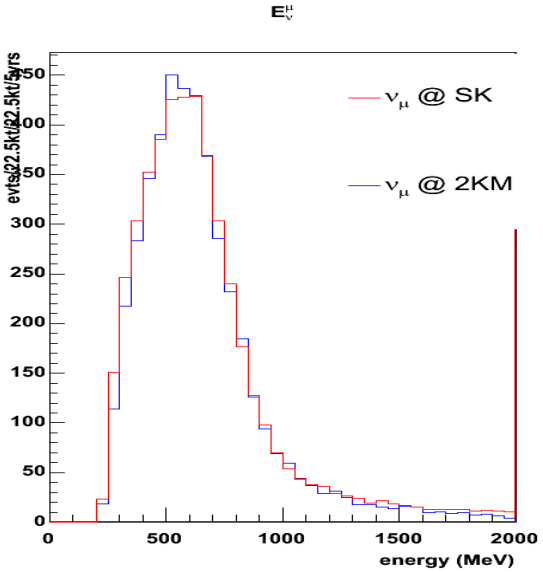
In each case I use the true neutrino energy, with no cuts (MC true vertex generated inside the FV).

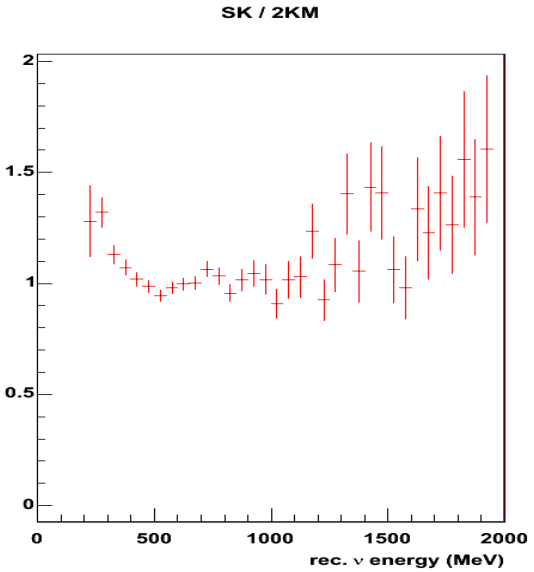
Above 500 MeV very similar to 04b vector files before reconstruction

Below ? Effect of the reconstruction ?

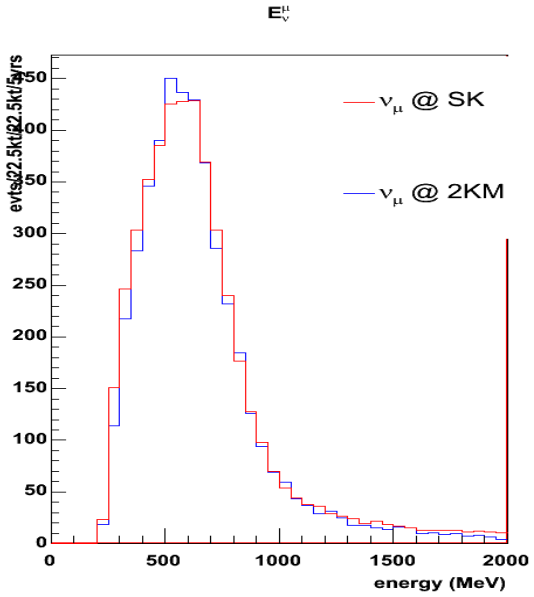
After reconstruction

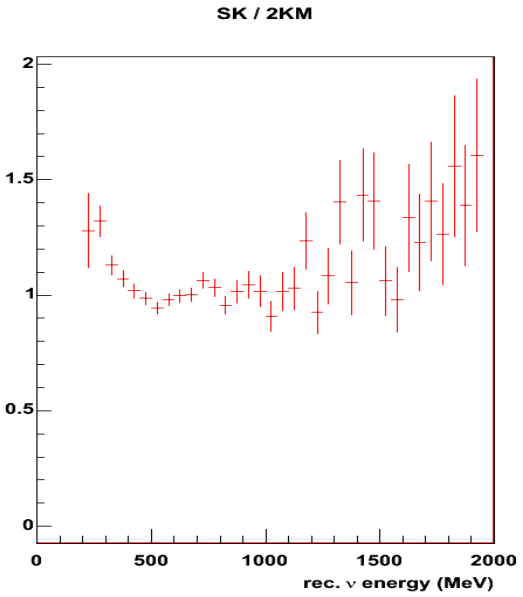
Select FCFV 1ring μ-like events at 2KM and SK





CCQE only





All events

Conclusions

- 'flatness numbers' (SK-2KM)/SK ~ -1.7%, RMS~2.8%
- It would be nice to have 04b SK ntuples to avoid the extra complication of reweighting ; would require processing existing 04b vectors with skdetsim+apfit+polfit5. How long would it take ?
- I still need to check the reduction at low energy induced by reconstruction --> need SK 03a vectors & zbs files
- We need 5*10^6 numu events at 2KM in order to have enough statistics (ie 10 yrs in FV56t+1m)-->start JNUBEAM + NEUT + G4 simulation ASAP

We presently have ~0.3 yrs for numus...