G4 Updates and sensitivity studies

T2K 2km meeting
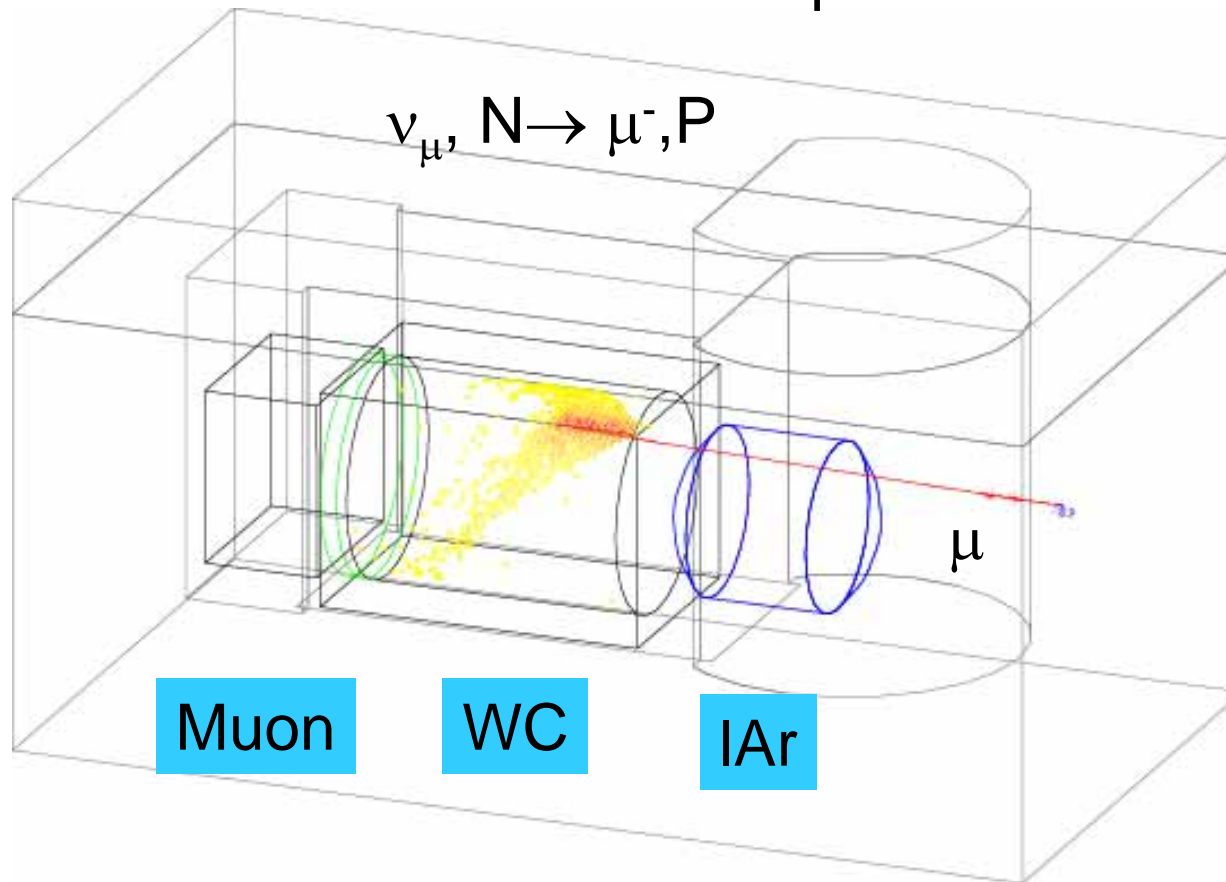
August 29, 2005

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1. Rock walls

Add rock walls in the 2km experimental hall

ν_μ, N$\rightarrow$ μ^-,P

Muon   WC   IAr

μ

We generate wider beam profile to check the event rate of muons coming from rock

Goal : Do full ν_e sensitivity analysis using both the 2km and SK MC with realistic systematic errors

Want : Use fully reconstructed MC with realistic systematic errors at both the 2km and SK detectors, and <u>fit together</u> to obtain sensitivity
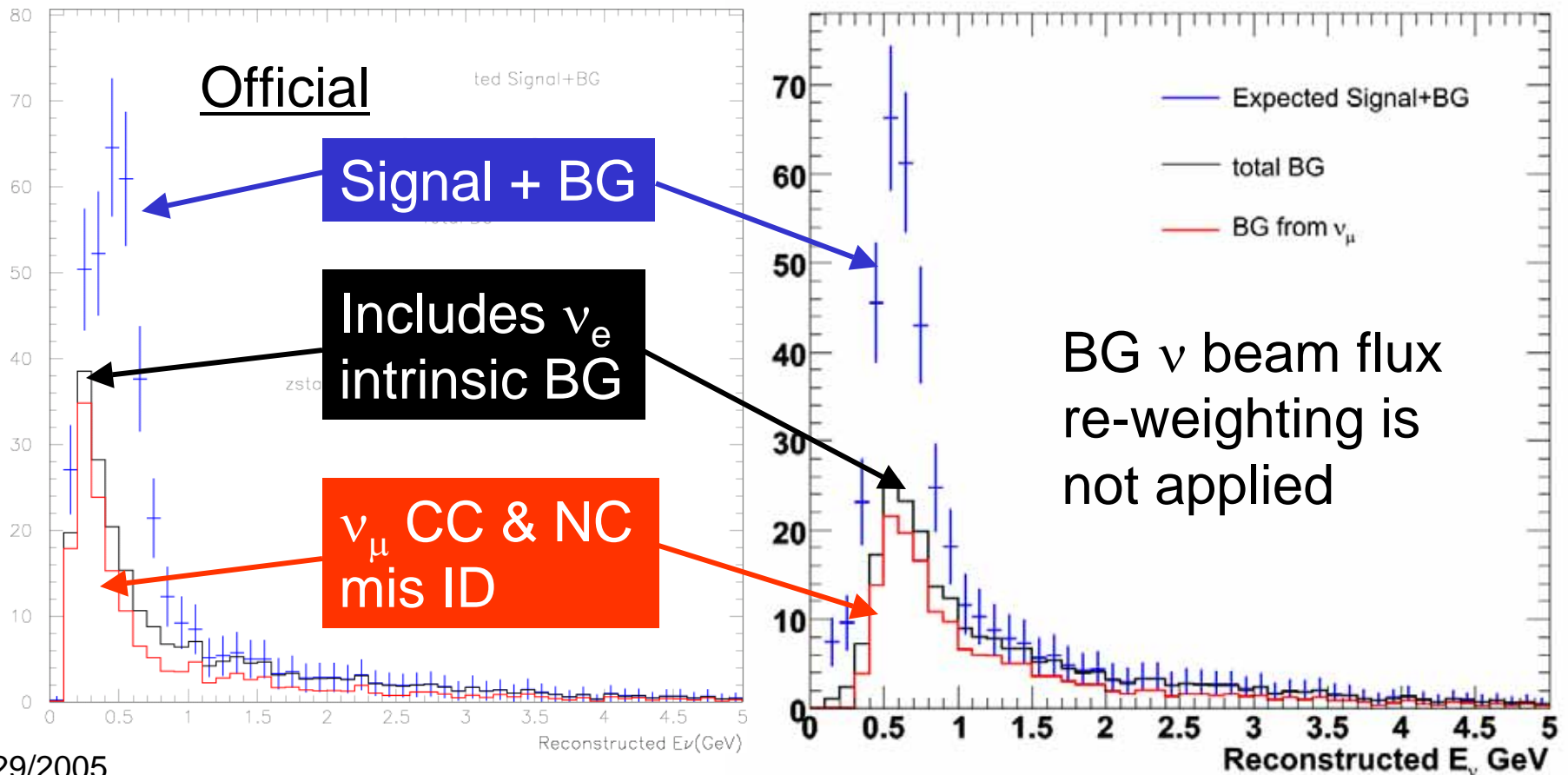
Now

1. Official sensitivity uses SK MC with 5,10,20% syst. uncertainty on BG

2. Maxim measured BG at 2km MC and predicted at SK, and then confirmed with SK MC

Working with Maxim to

1. setup root analysis frame-work with 2km and SK MC available in <u>same program</u>

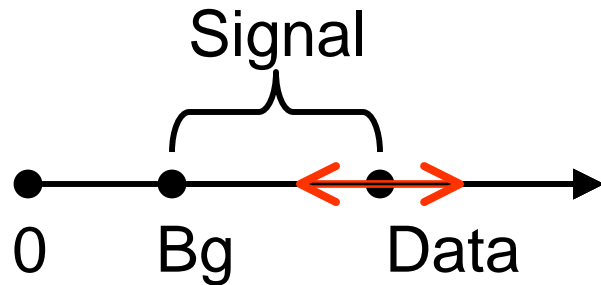2. check we can reproduce official SK / 2km results from proposal

- Check if we can reproduce Mine-san's ν_e official sensitivity curve
- Using SK MC only, ν_e analysis cuts applied
- ν_e energy at SK for 5 yr with $\sin^2 2\theta_{13}=0.1$ and $\Delta m^2=0.0025$
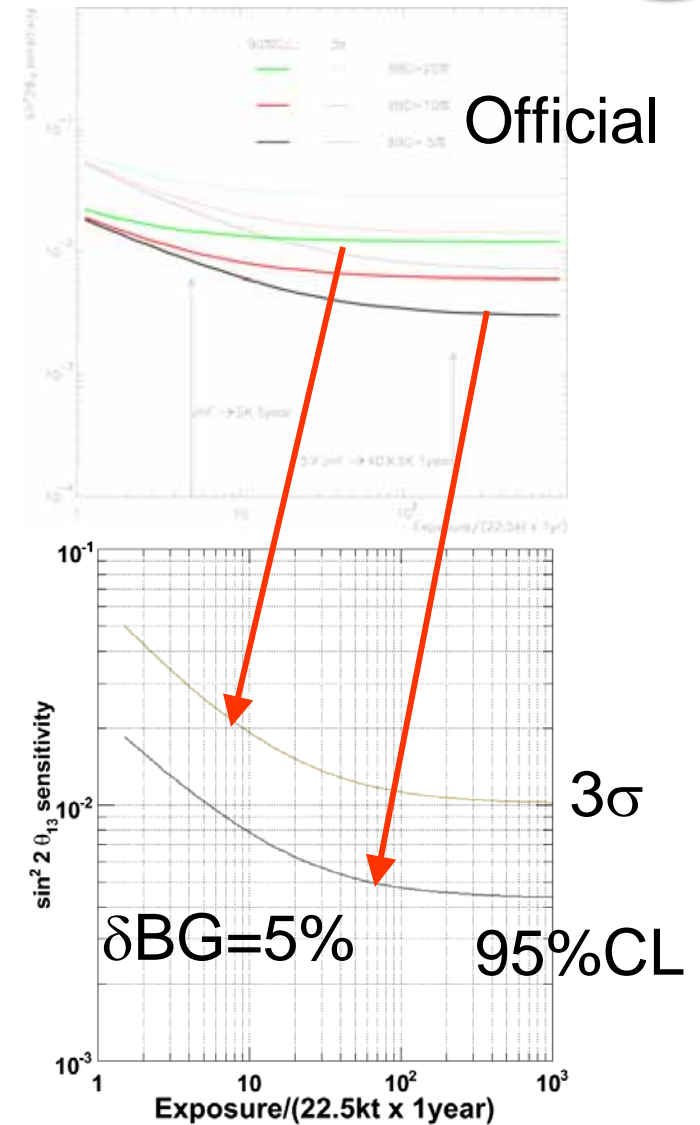

Official

Signal + BG

Includes ν_e intrinsic BG

ν_μ CC & NC mis ID

Reconstructed Eν(GeV)

Expected Signal+BG
total BG
BG from ν_μ

BG ν beam flux re-weighting is not applied

Reconstructed E$_\nu$ GeV

4. Sensitivity curve vs Exposure

Official systematic error treatment

Signal

0   Bg   Data

Official

- If I assume Data=S+B,

$$\delta_{stat}(\text{Data}) = \sqrt{S+B}$$

- Ratio of δ(Data) to Signal is `Significance',

$$\text{significance} = \frac{S}{\sqrt{S+B}}$$

- Here, if we assume 0.1B as syst. error (B±0.1B), quadratic sum is

$$\sqrt{S+B+(0.1B)^2} \quad \text{and}$$

$$\text{sensitivity} = \frac{S}{\sqrt{S+B+(0.1B)^2}}$$

3σ

δBG=5%   95%CL

Program basically reproduces official result at SK

Maxim estimated 1) at 2km and predicted 2) at SK

	NC	beam ν_e	CC-ν_μ
1) Monte Carlo estimate	8.4	14.1	0.4
2) Extrapolated from 2KM	$9.6 \pm 0.4 \pm 0.8$	$13.2 \pm 0.5 \pm 1.0$	$0.6 \pm 0.04 \pm 0.03$

We can make $E(\nu_e)$ plots together with the same program using the separate MC's

at 2km

Expected Signal+BG
total BG
BG from ν_μ

Reconstructed E_ν GeV

at SK

Expected Signal+BG
total BG
BG from ν_μ

Reconstructed E_ν GeV
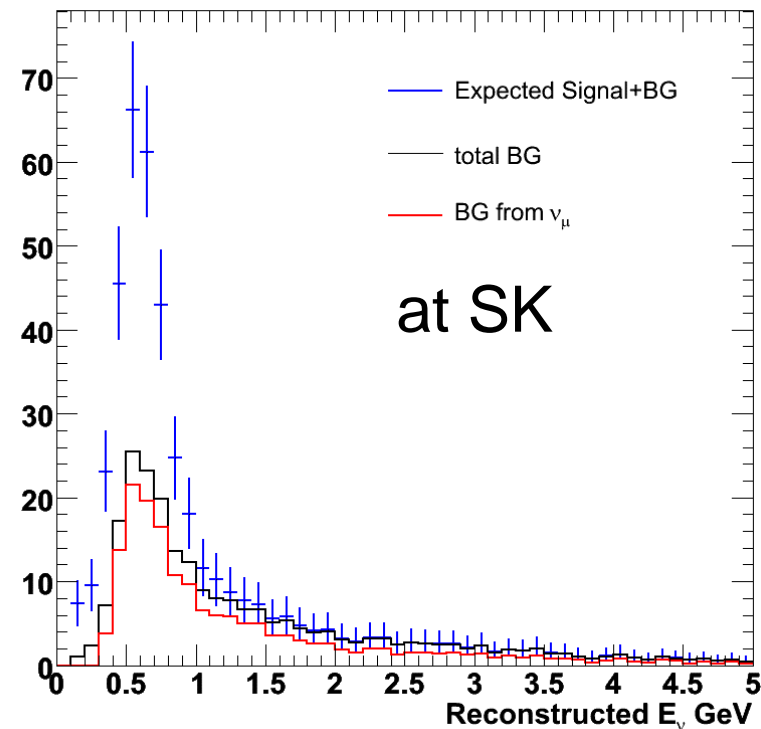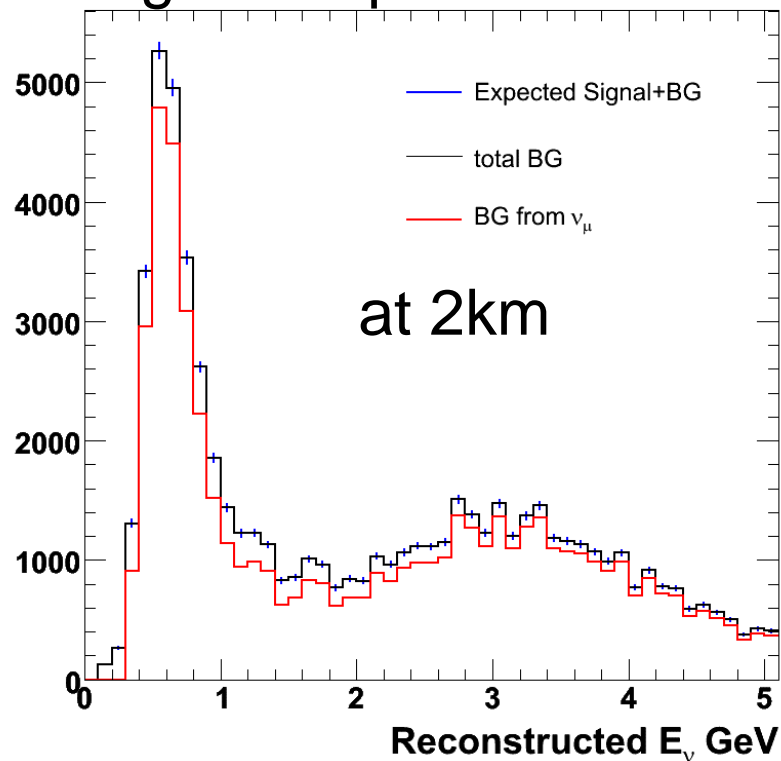
Conclusions

- Set up root based analysis framework
- Can reproduce official SK only sensitivity
- Can make plots at 2km and SK together

Future plans

- Use realistic beam intensity
- Work with Maxim to fit SK MC together with 2km MC using both :
  - Atmpd fit technique
  - Feldman-Cousins with systematic errors