Muon Flux

Paolo, ICRC 2003

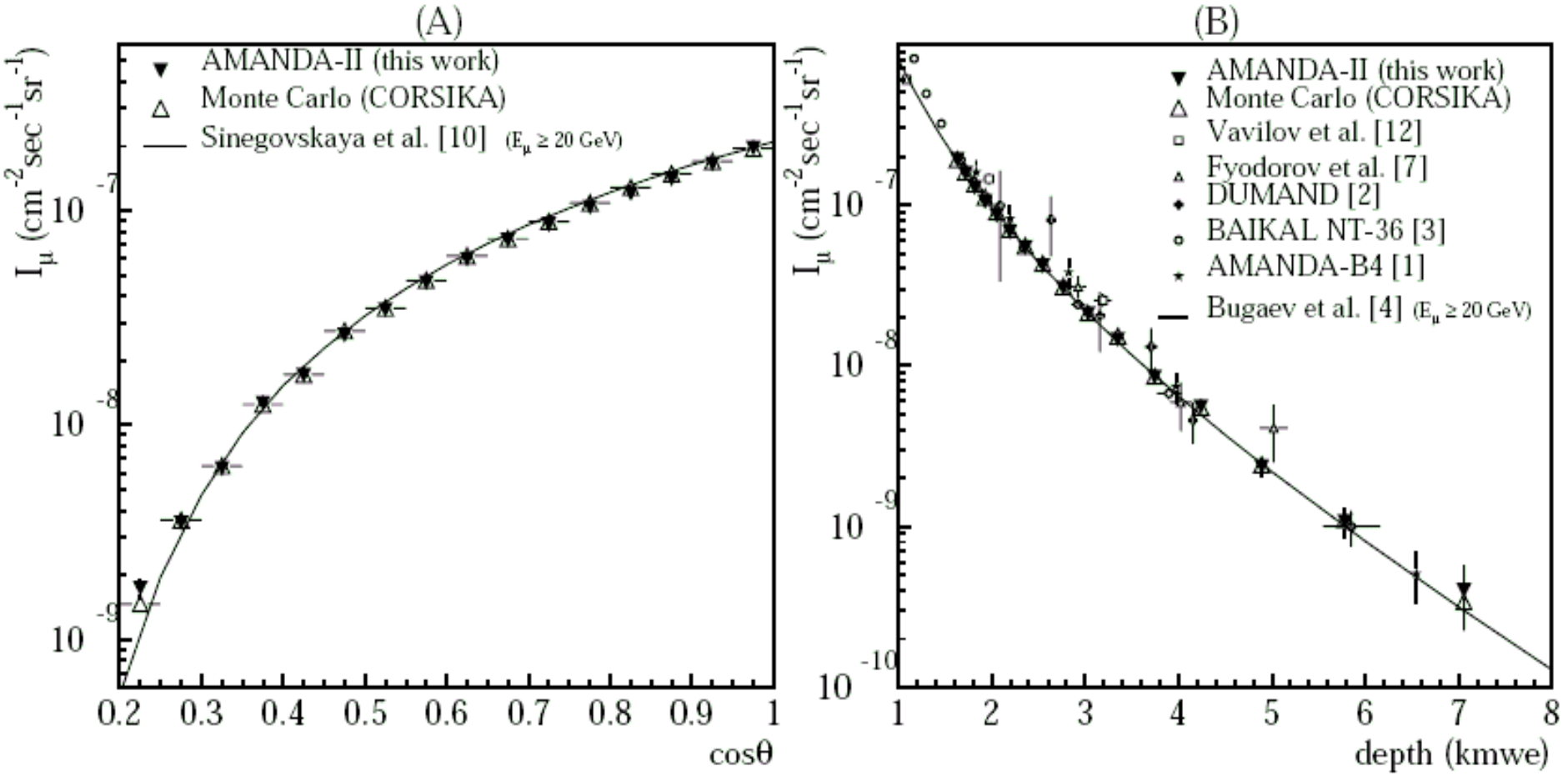


Fig. 1. Preliminary muon angular (A) and vertical depth intensity (B). AMANDA-II unfolded data are normalized to the vertical Monte Carlo point. See text for details.

MACRO

Suupaakamiokande

IceCube

small

big

MACRO

Suupaakamiokande

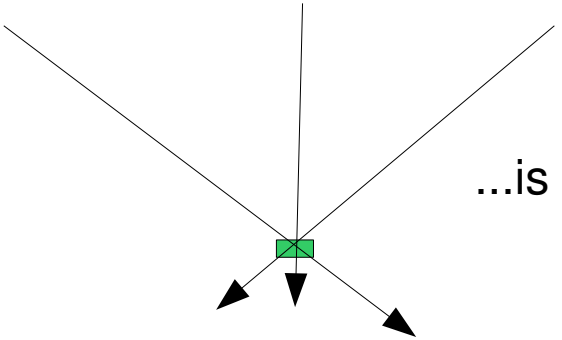
IceCube

What is a muon?

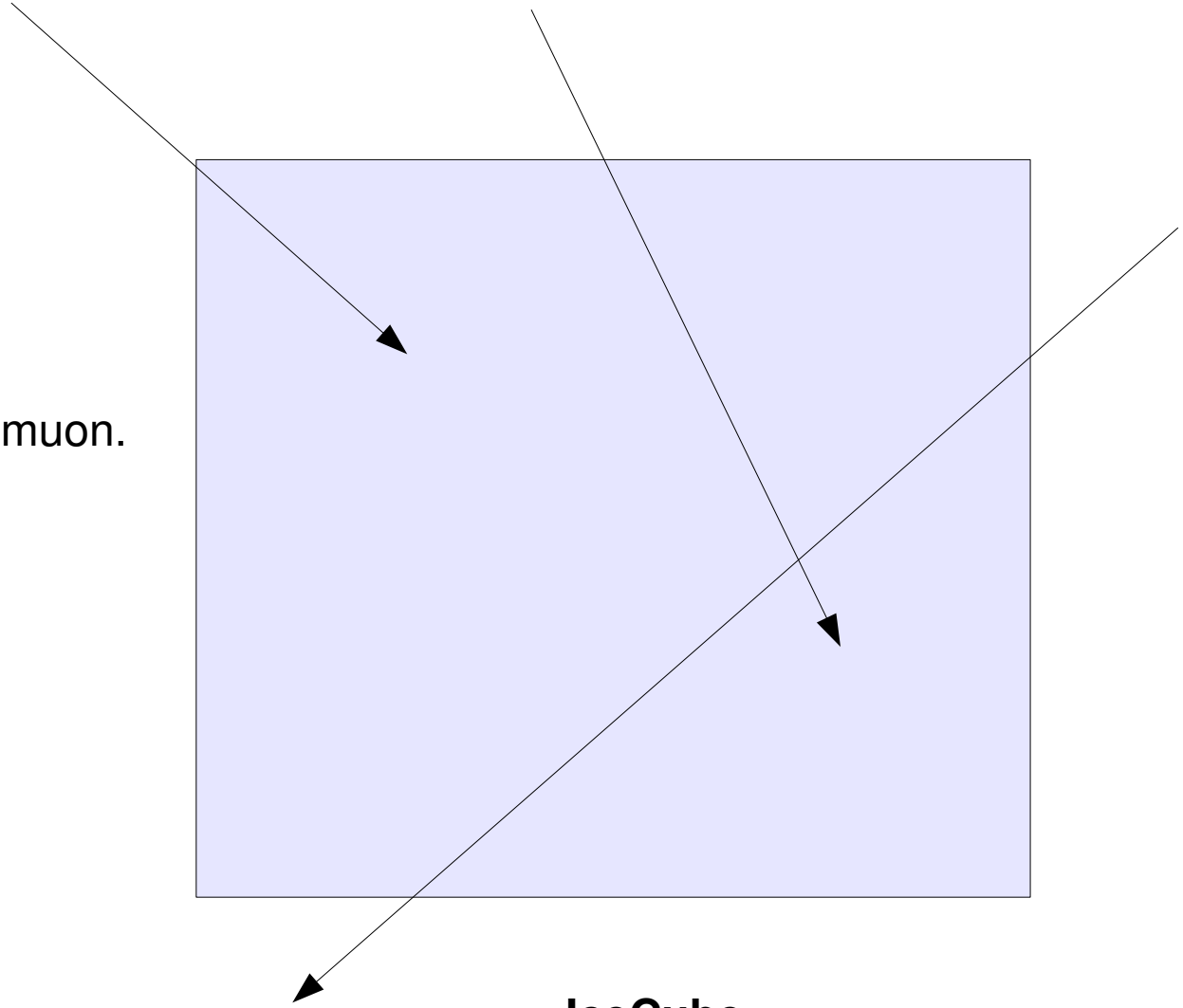
A muon...

...is a muon...

...is a muon.

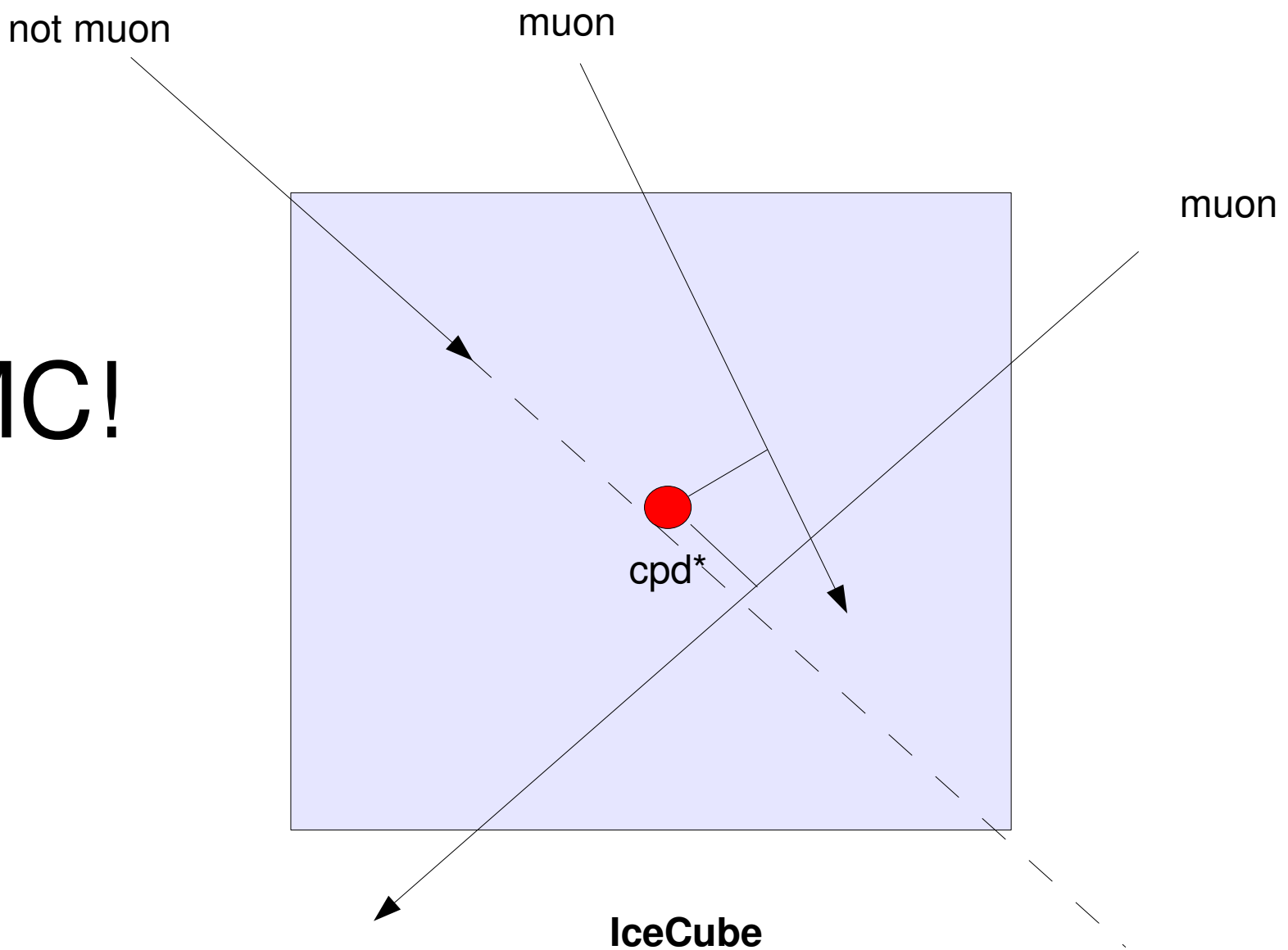


MACRO



IceCube

MMC!



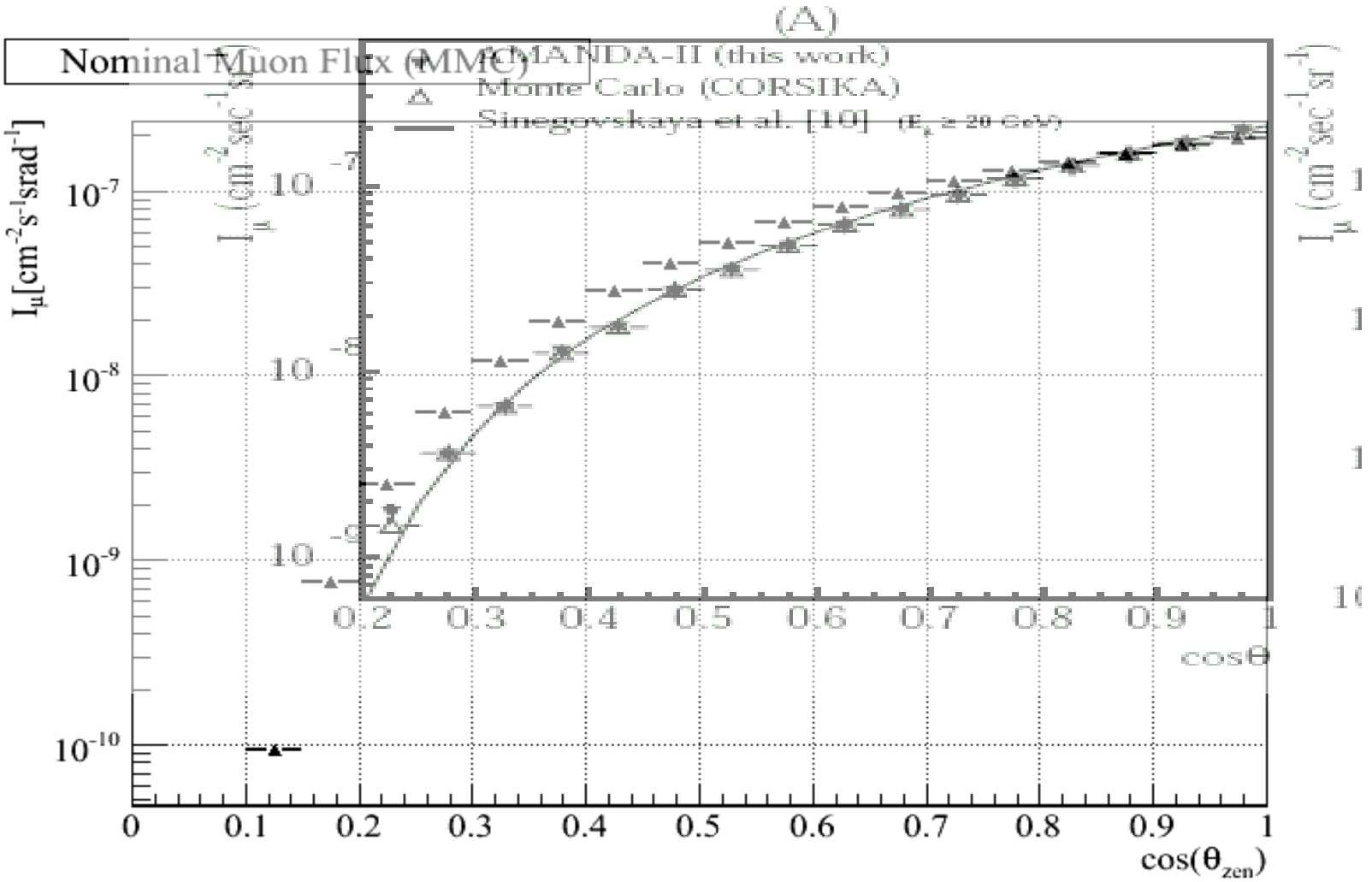
*__c__enter of our __p__recious __d__etector

$$\Phi_{\mu,MMC}(\theta) = \frac{N_{\mu}(\theta)}{livetime \cdot bin\ space\ angle \cdot A_{gen}(\theta)}$$

$$A_{gen}(\theta) = \left(\frac{d}{2}\right)^2 \pi \left(\cos\theta + \frac{4}{\pi}\frac{l}{d}\sin\theta\right)$$

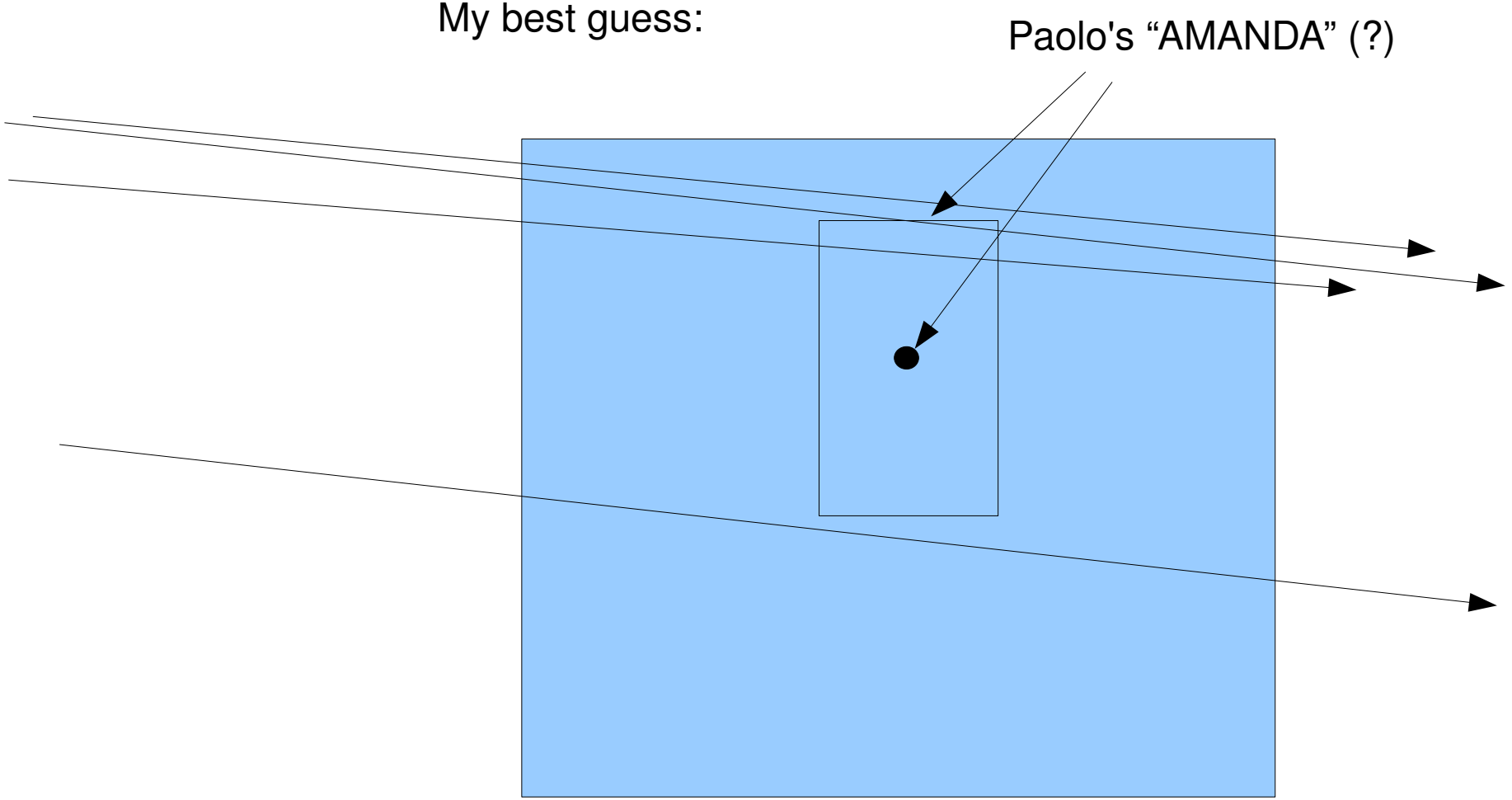
$$\Phi_{\mu,MMC} = \frac{N_{\mu}}{N_{files}} \cdot \frac{N_{bins}}{2} \cdot \frac{1.24 \cdot 10^{-11}}{\pi\cos\theta + 4\sin\theta}\, cm^{-2}\, s^{-1}\, srad^{-1}$$

(standard IC22 Corsika files, 10M primaries, 2.621sec livetime, 0<coszen<1)



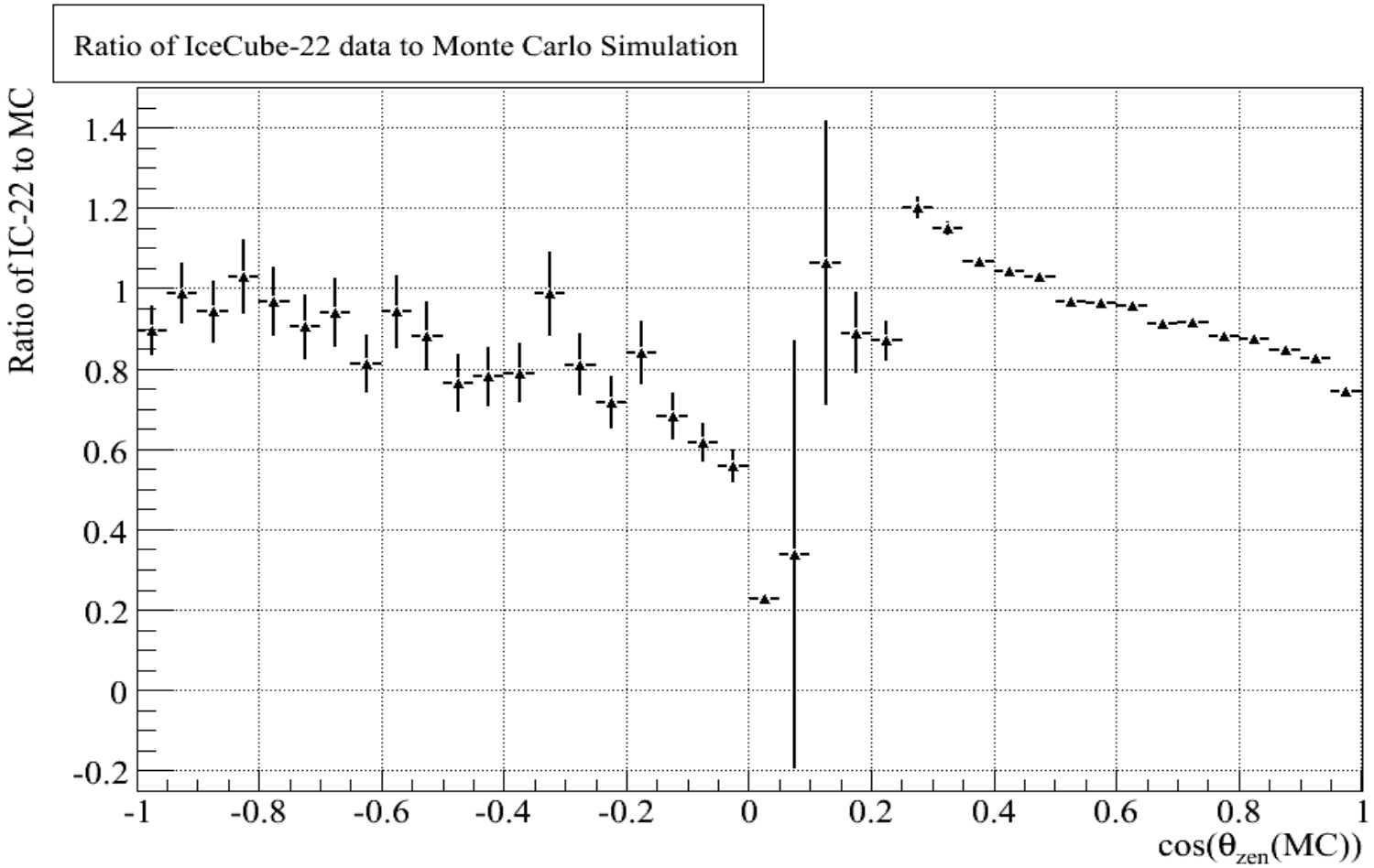
? IceCube flux is higher than AMANDA... ?

My best guess:

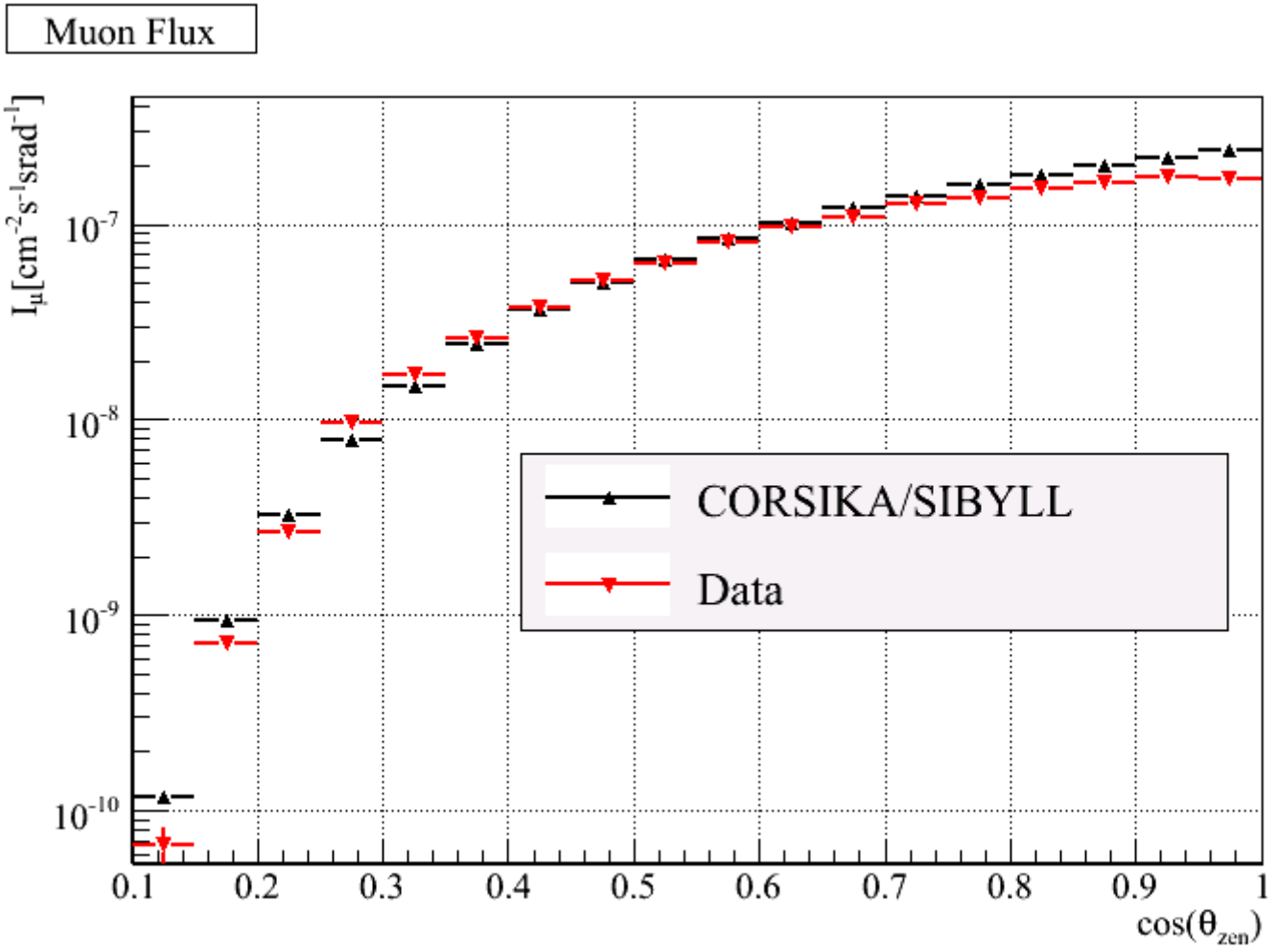


At flat angles, average z increases more & more

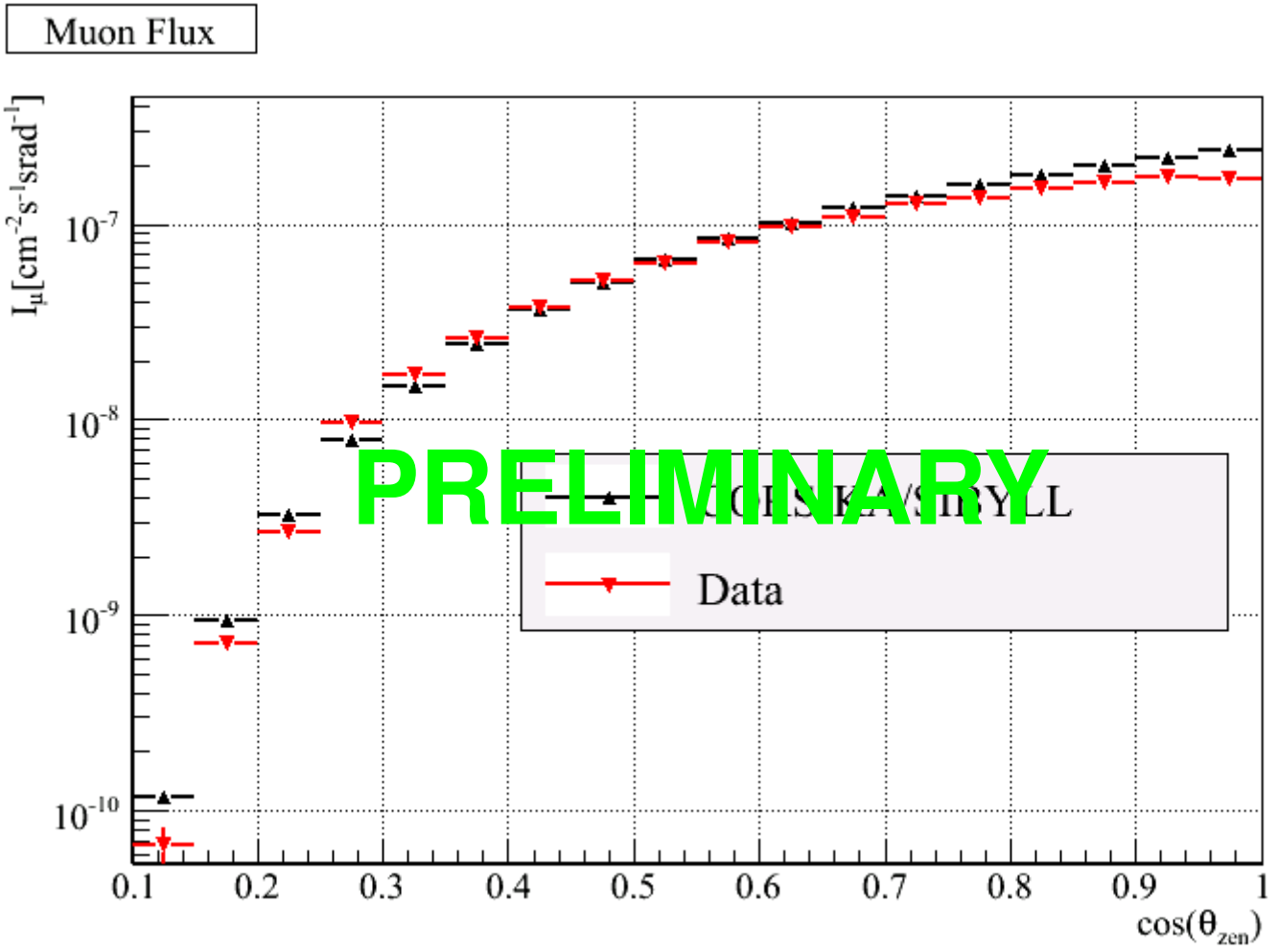
Then we just take the ratio data/MC at final cut level,
hope that all efficiencies cancel out....



...and pretend that we have measured something deeply meaningful



Just to be on the safe side...



Depth: A true nightmare!

All done with tiny detectors!

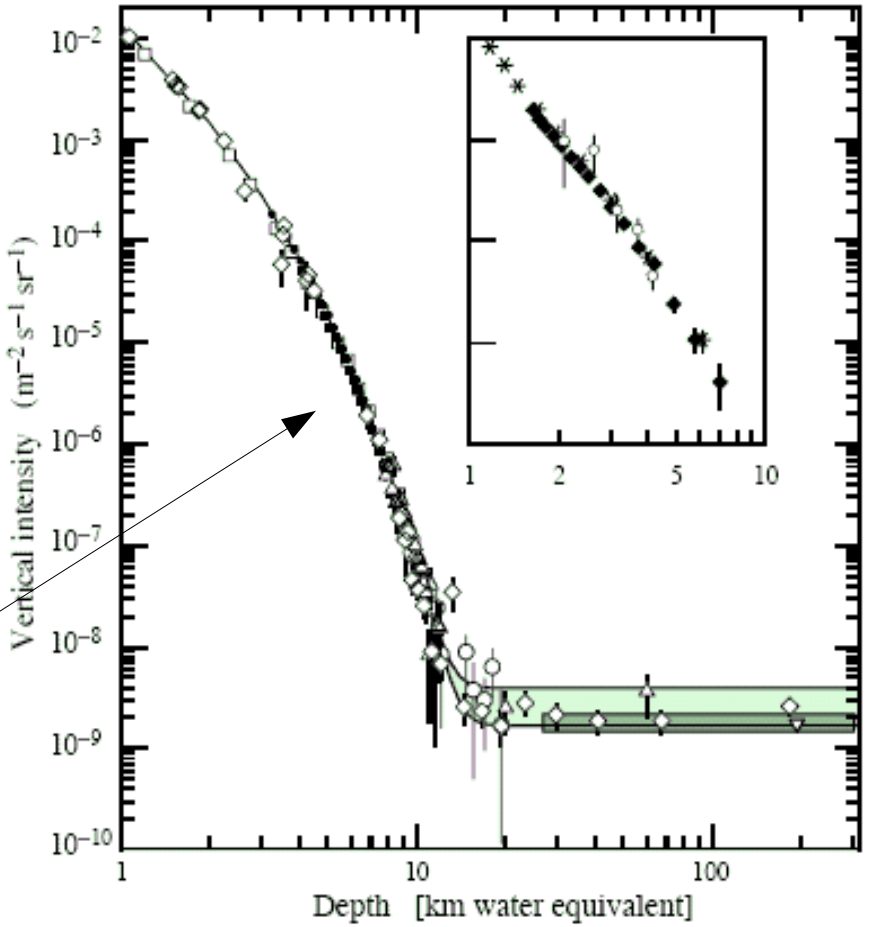


Figure 24.6: Vertical muon intensity vs depth (1 km.w.e. = 10^5 g cm^{-2} of standard rock). The experimental data are from: ◊: the compilations of Crouch [55], □: Baksan [59], ○: LVD [60], •: MACRO [61], ■: Frejus [62], and △SNO [63]. The shaded area at large depths represents neutrino-induced muons of energy above 2 GeV. The upper line is for horizontal neutrino-induced muons, the lower one for vertically upward muons.

We need to disregard that:

- mwe_rock.ne.mwe_water

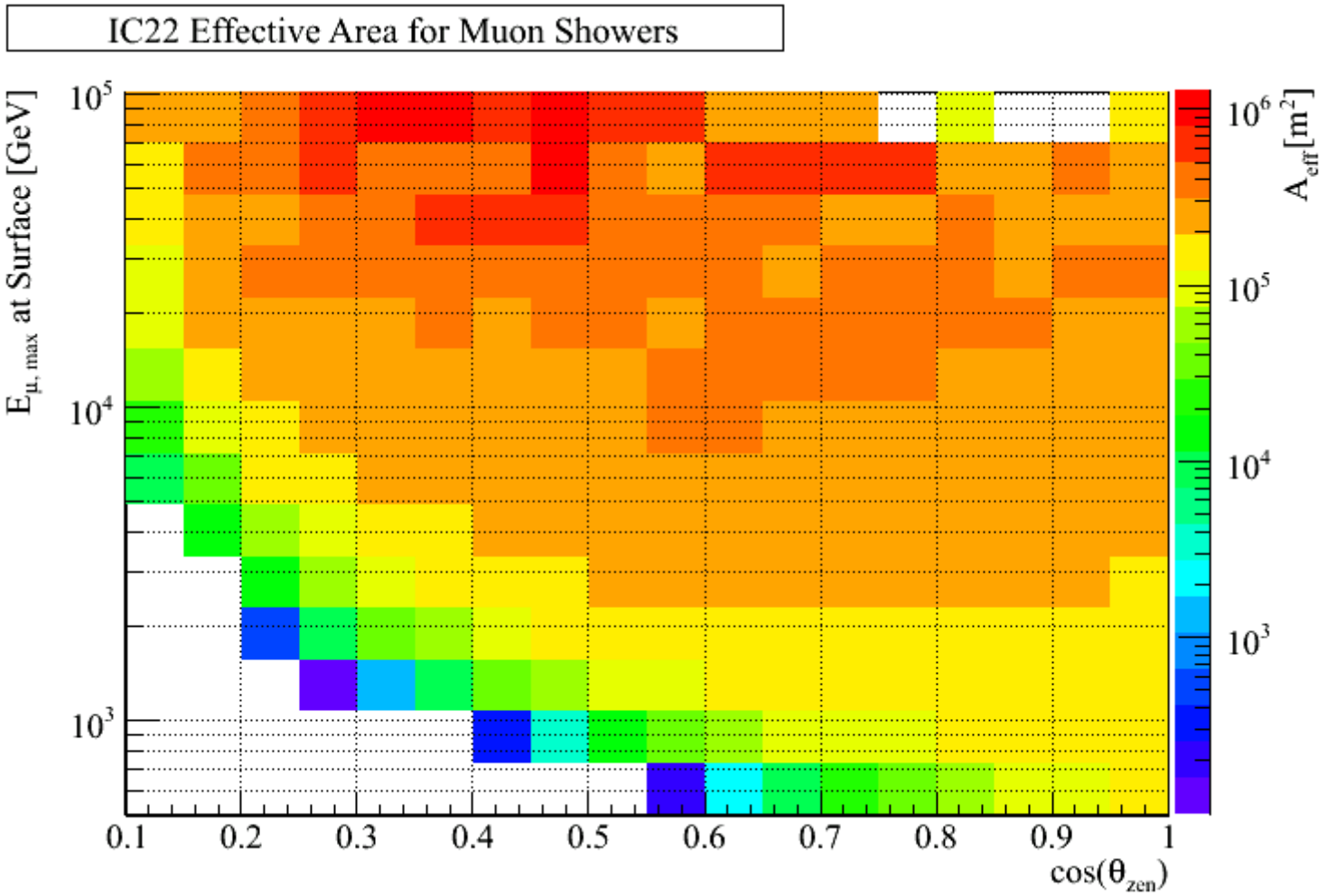
- atm_US.ne.atm_SP

- phi(theta)/phi(theta=vert)=f(whatever model/MC generator one uses)

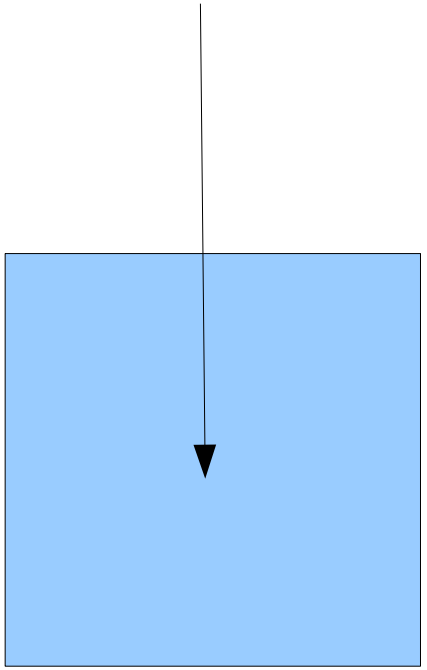
- depth(theta).ne.simply some fn(theta, depth(cpd))

- Our detector wasn't made for stuff like this

Our detector response is not trivial.

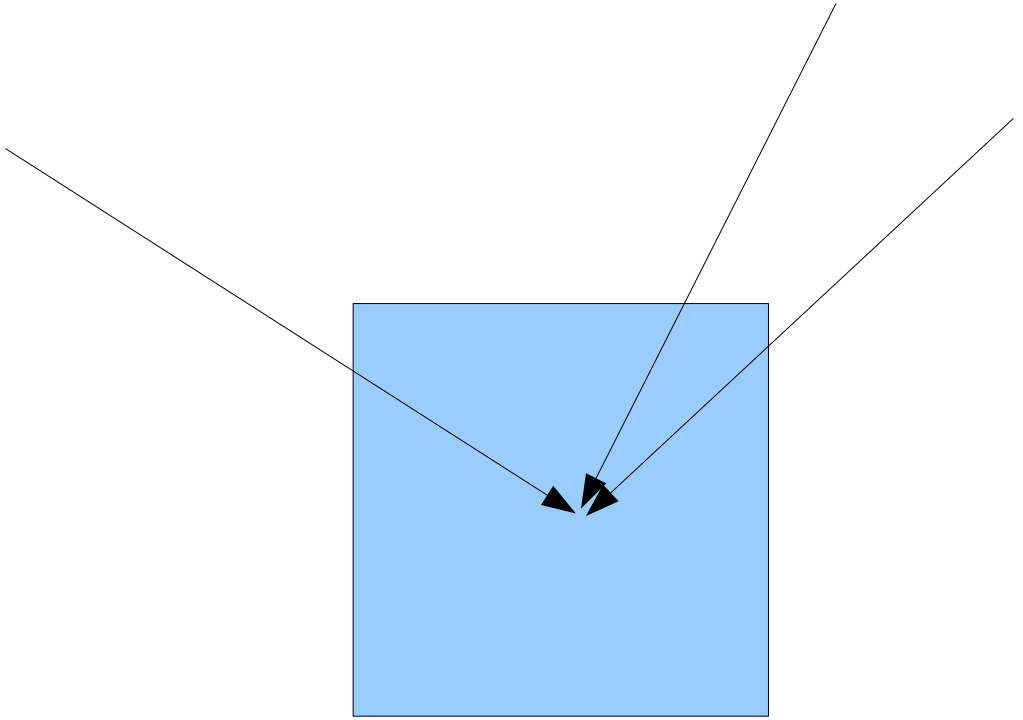


Here's how I would do it:



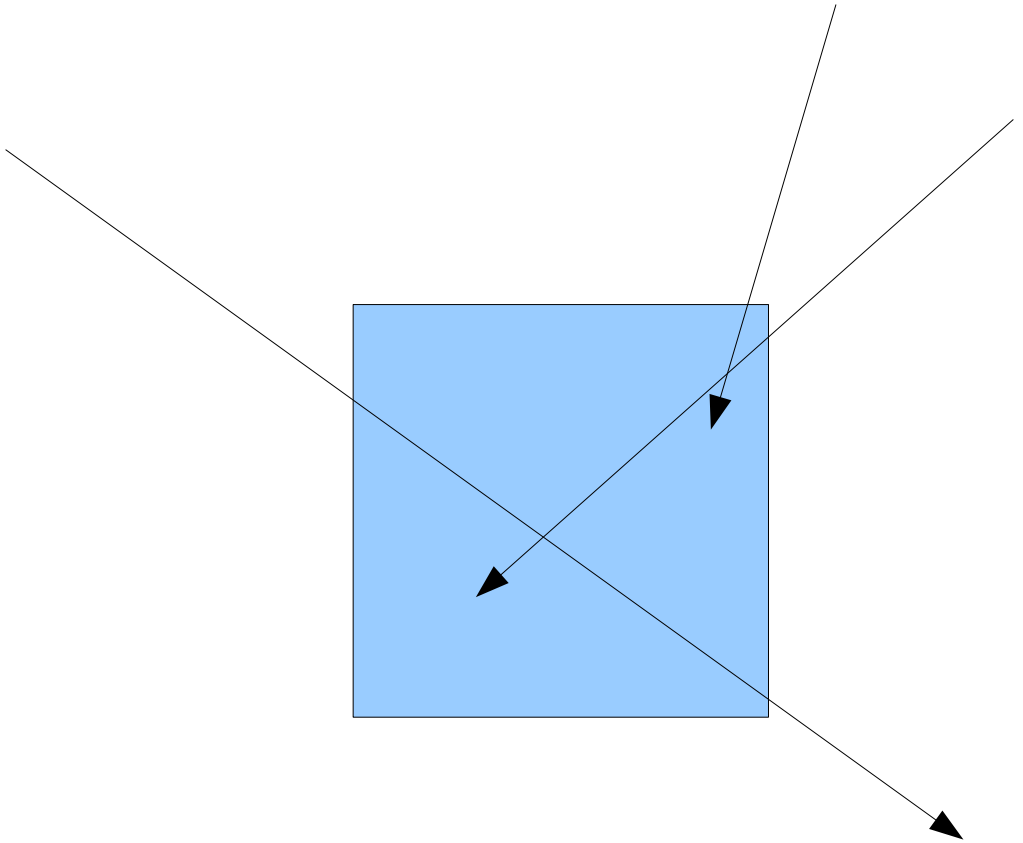
1. Generate CORSIKA F2K-File with only vertical events.

Here's how I would do it:

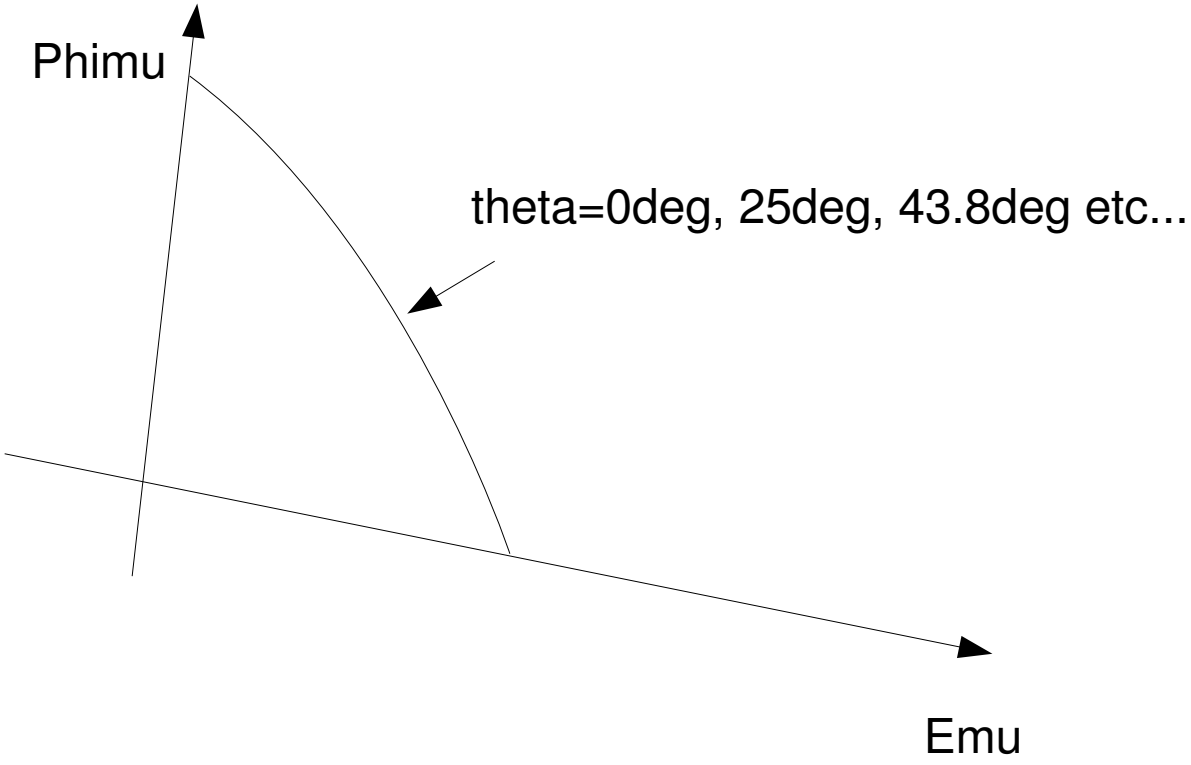


2. Use a perl script to randomize theta according to the correct distribution.
   And that includes curvature effects :((

Here's how I would do it:

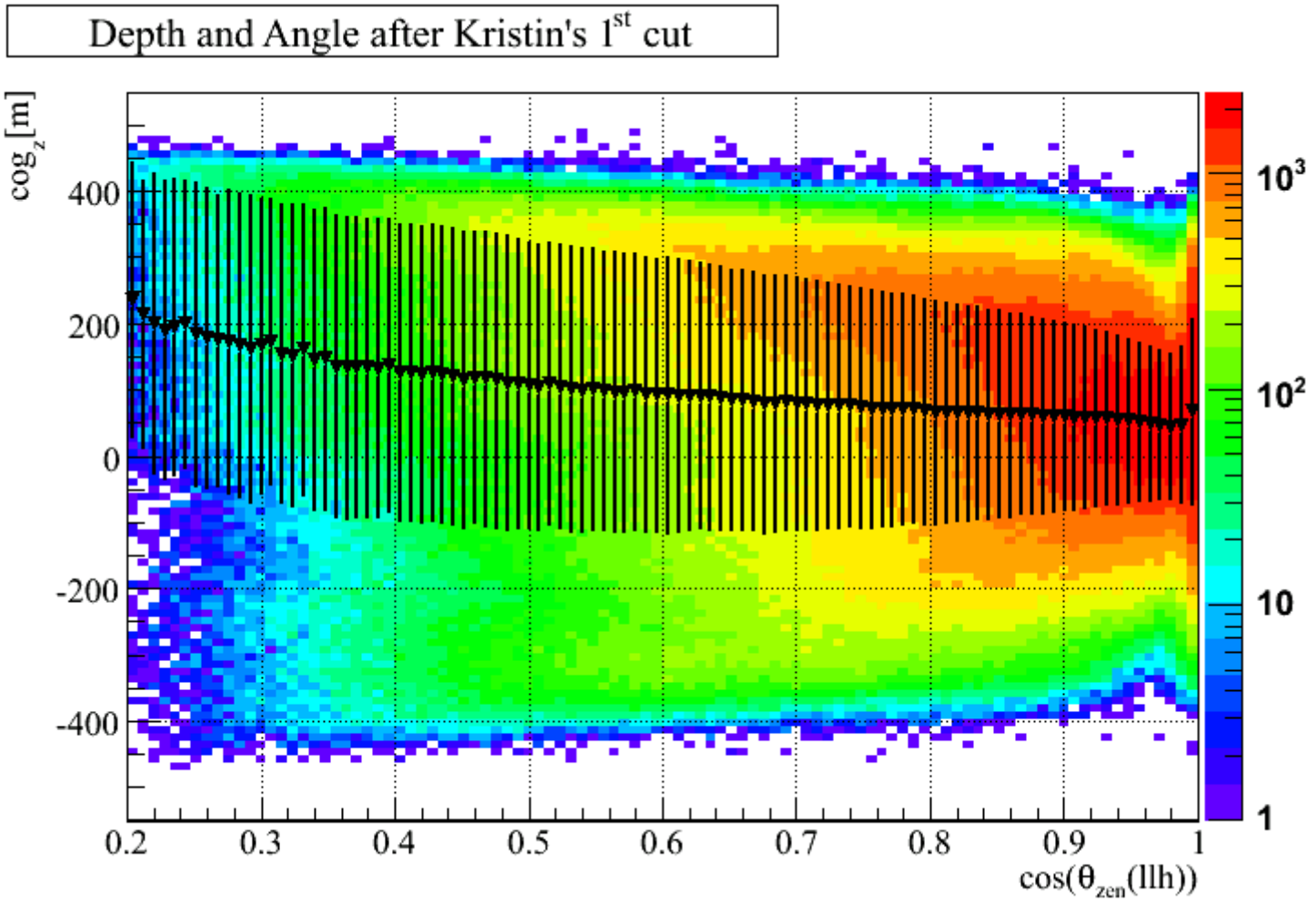


3. ucr,mmc



4. Calculate again flux(theta), but this time we pretend all flux is like vertical flux!

And then assume depth(theta) = bar{depth(theta)}



Otherwise I see no good solution.

Ceterum censeo Sieglindem esse resuscitandam.