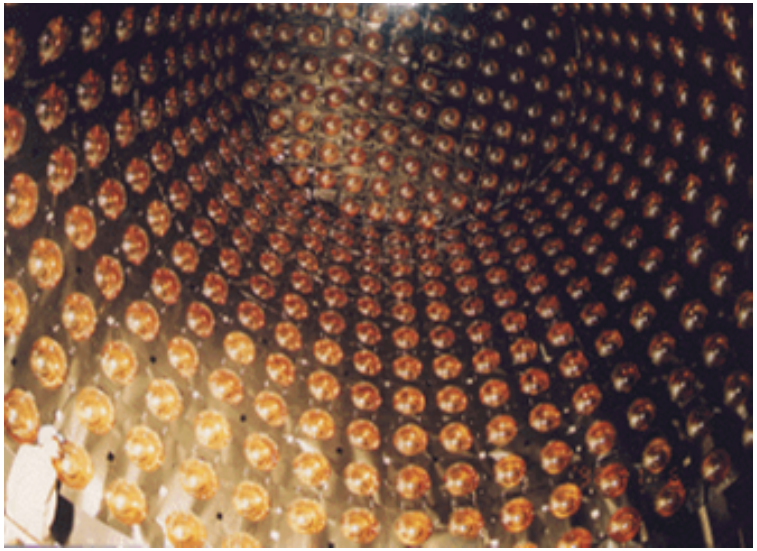
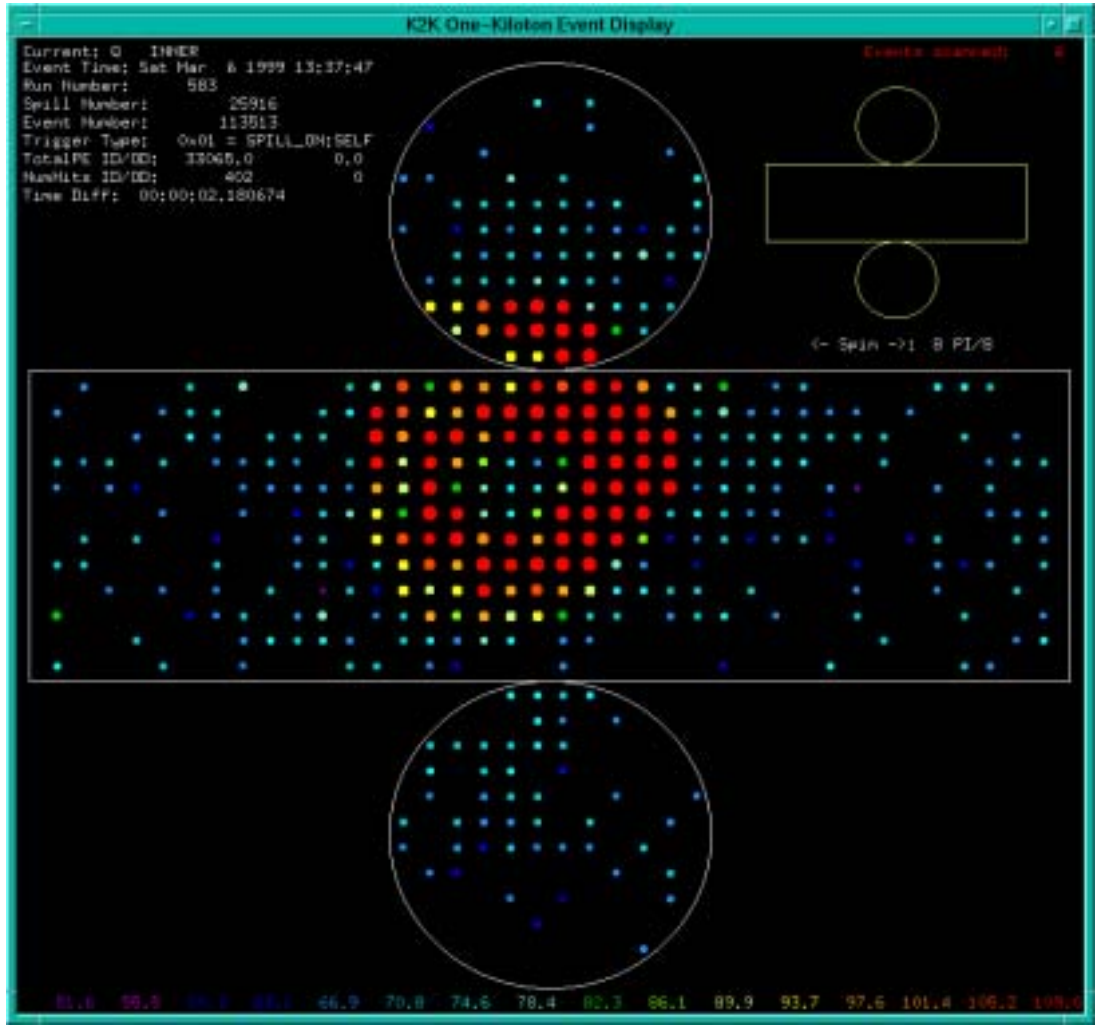
1kt water cherenkov detector K2K 2 T2K 2km (I)

Y.Itow (ICRR)

26Jan,04 T2K 2km meeting

Water Cherenkov Detector (1kt)





- A miniature of Super-Kamiokande detector with 1/50 volume
- 680 20" PMTs with 70cm spacing (same as Super-K)
- Inner Volume : 496 tons(8.6m ✕8.6mϕ)
  Fiducial Volume : 25.1 tons
  (r=2m cylindrical volume along beam)

Typical 1-ring FC μ-like event

For what K2K-1kt detector initially designed was ….

① Absolute Flux normalization with H_2O target

- Essential Requirement

  $\Delta N_{SK} < 10$ % (overall , $\Delta V + \Delta$(near/far))

② Additional information <u>as similar quality as</u> SK

- Spectrum < 1GeV
- $\pi 0$
- ν_e

Current 1kt systematics (for ν_μ disappearance)

overall N_{SK} err

E_ν spectrum err

	Initial design	Current 1kt	T2K 1kt ?
ΔV_{fid}	<10%	4%	<5% (LOI 10%)
$\Delta\Phi_N/\Phi_F$		6%	
E-scale	5% (?)	3% (<1% ΔN_{SK})	?
PID	…		?
Nring	…		?

Q1: How much do we want to reduce for $\nu\mu$ disapp?

Q2: What is effect on νe app ?

Overall normalization error on Nsk for Nov99~

Central Value
76.05evts

KT: dominated
by FV error
SK: also.

Errors

	(Event)	
Stat	0.28	0.37%
KT	3.32	4.37%
SK	2.28	3.00%
Flux	+2.81 -2.59	
F/N	+4.26 -5.55	
NC/CC	+0.15 -0.23	
nQE/QE	+0.38 -0.61	
CT	0.46	0.60%
Total	+6.53 -7.37	

Take errors not considered in matrix

5.34%

(Nishikawa)

Required accuracy

JHF-Phase I

- Discovery of non-zero θ_{13}
- Precise measurement of θ_{23} and Δm^2.

JHF-Phase II
(with Hyper-K)

- CP violation

Flux prediction
@far detector

5%

2%

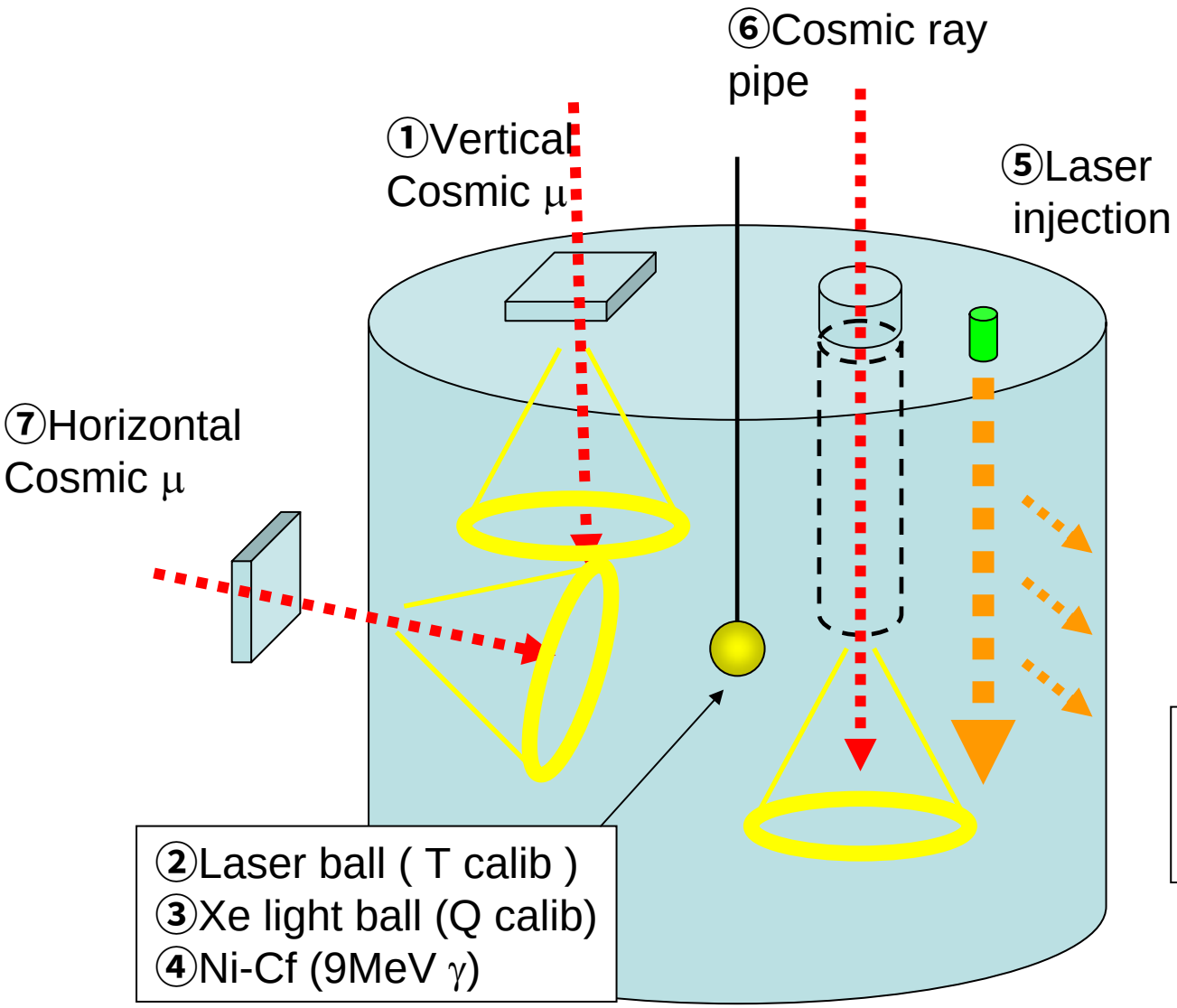
★Main near detector should be water Ch.

★Near detector pos. must be >1.5km.

Improvement of systematic errors needs Good Calibration

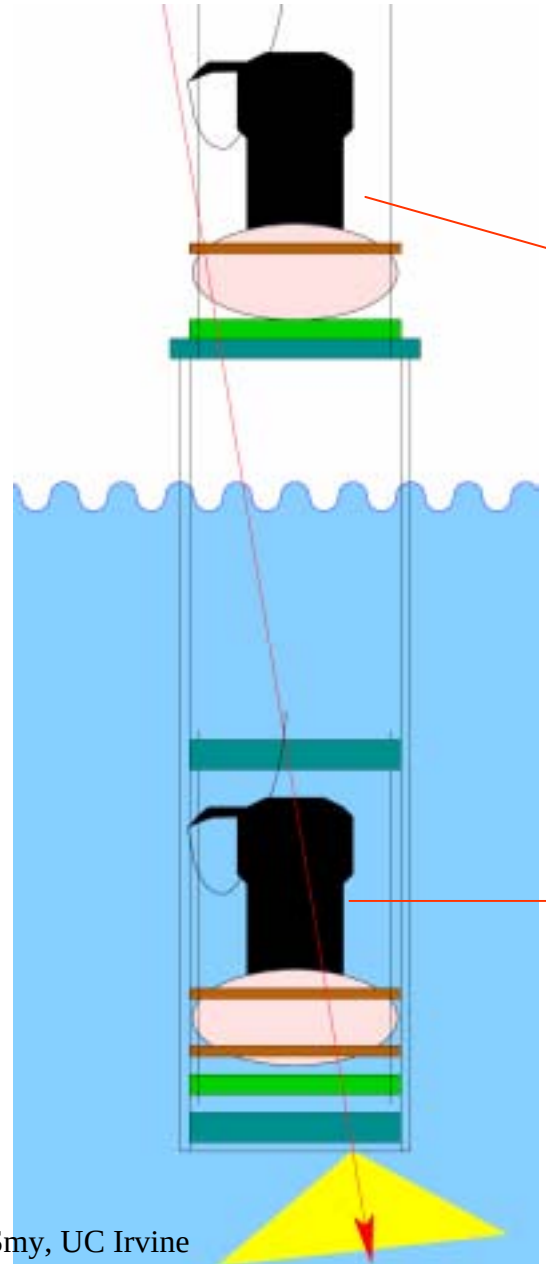
Good Calibration Needs Good Calibration Sources

Current 1kt calibration tools



T2K 1kt needs at least same or much better tools

Trigger Counters for Cosmic Ray Pipe



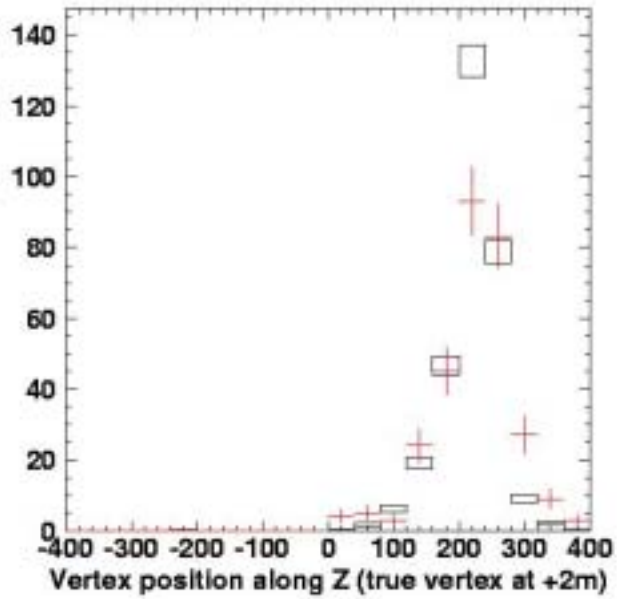
Position with *apos*

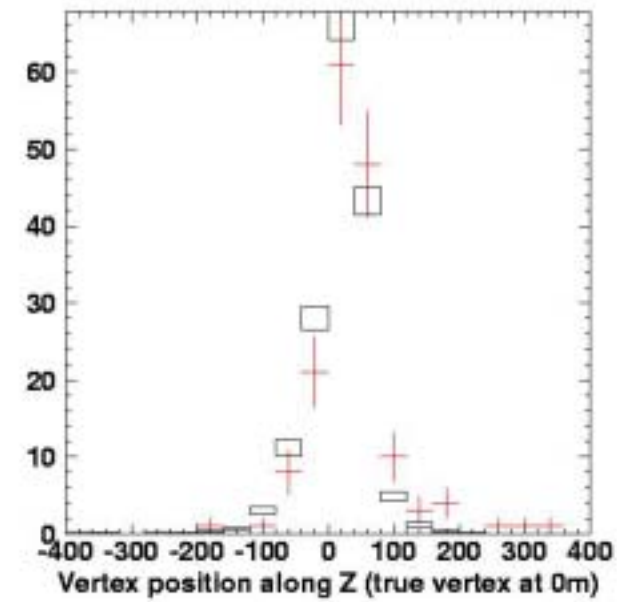
apos = vertex position obtained by *AFIT*

(fitter using timing and charge information, assuming 1 ring e-like event)

MC

Data





Calibration of Vertex of FC event by CRP

(Jeremy Argyriades)

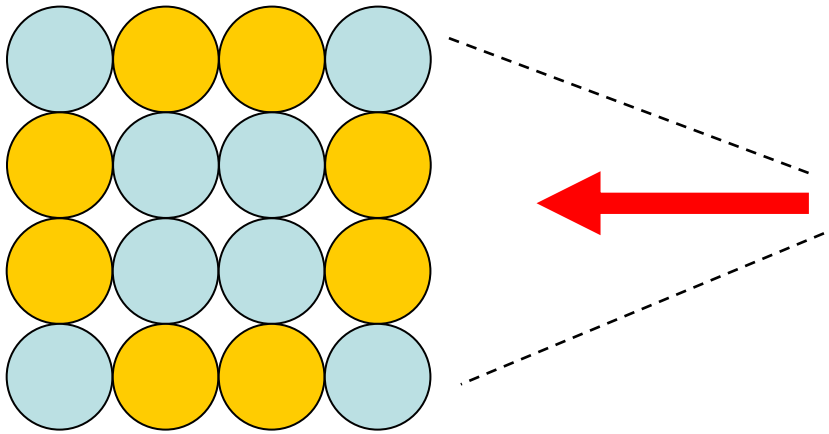
Possible improvement of calibration tools

- Better light sources (Xe, Laser, Ni)
  - Uniform and point-like light source
  - Not only at center
  - Similar to Cherenkov spectrum (as for QE)
- Better entering track sources
  - Better external tracking
  - More pure well-control sample
  - Horizontal track (same as ν)
  - More statistics

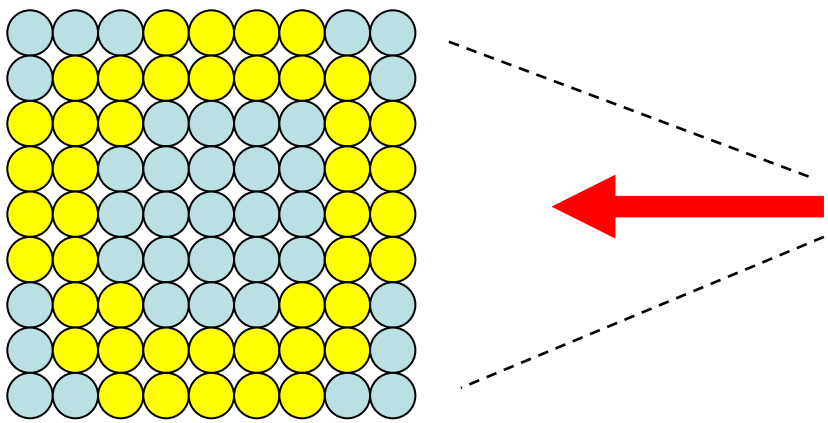
Consider T2K 1kt is underground !

- Better laser injection
  - various position, direction, wave length (same as SK)
- Automated
- New ideas ?
  - Cherenkov ring simulator? Check ring counting , timing separation

Granularity and smearing



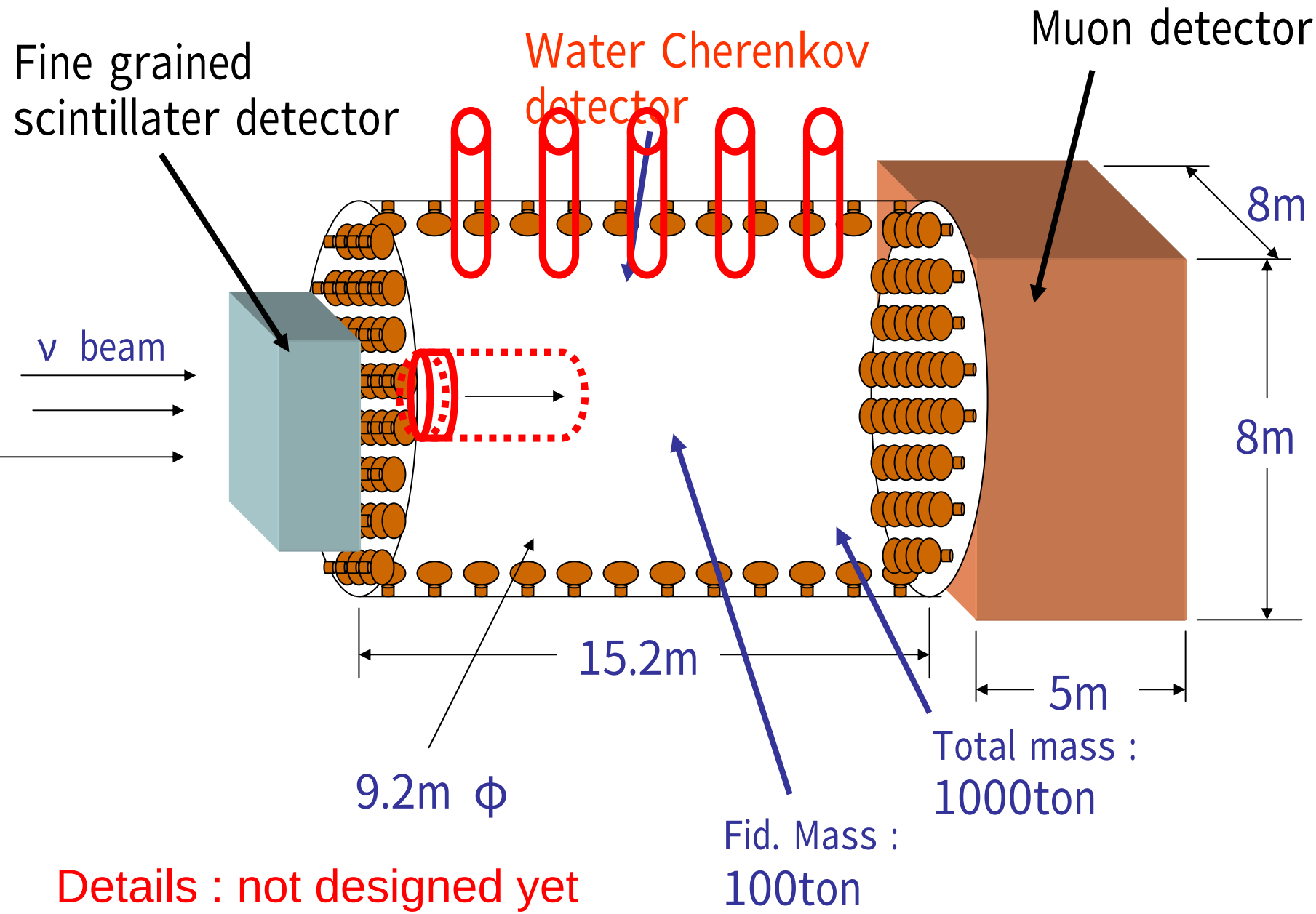
Number of PMT in a ring is small
PMT by PMT characteristics
Is important



Number of PMT in a ring is large
PMT by PMT characteristics
Is smeared out

PMT by PMT pre-calibration
is also important

Near detector @2km

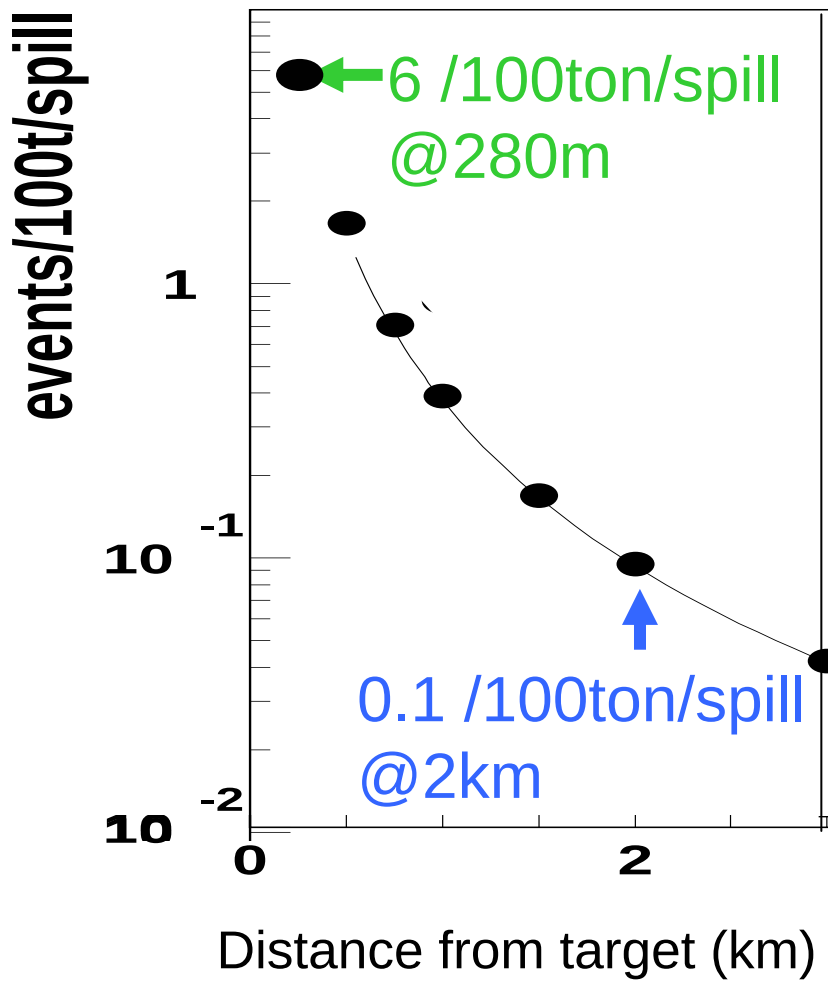


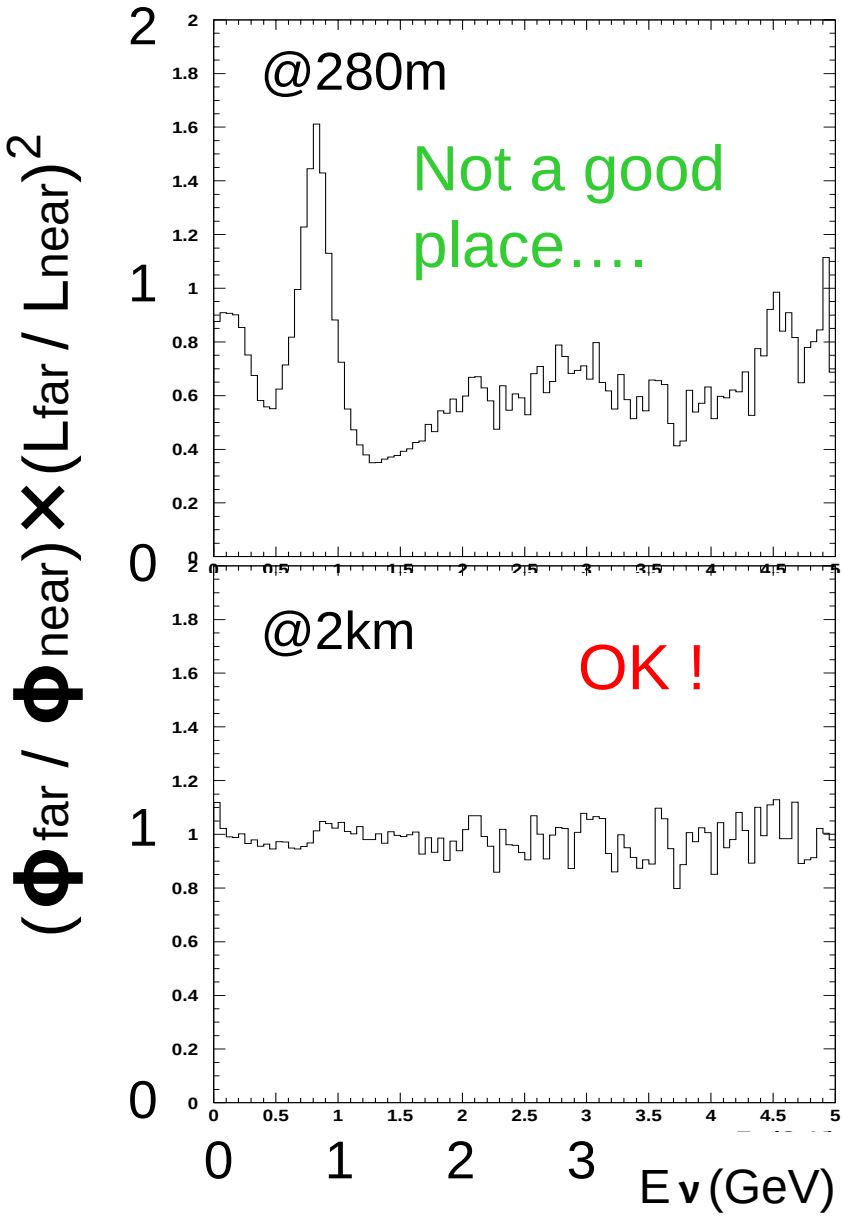
Details : not designed yet

Summary

- Good systematic control of T2K 1kt detector needs good calibration
- Good calibration needs good calibration source
- Should understand PMT by PMT base
- Statistics is important (cosmic mu??)

Event rate & Far/near ratio





Water Cherenkov :
Impossible @280m
(Total mass > 100 tons)