

2km proposal for J-PARC PAC

2KM Meeting, Dec.7,2006

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(discussions, comments and corrections during/after
the meeting are shown by blue)

Introduction (Short history)

- At the Nov. T2K meeting, we proposed to submit a proposal for the extension of T2K (2KM detector) for the scientific evaluation of the 2KM detector after the completion of the review processes for the current T2K proposal.
- There was no conclusion for the 2KM proposal at the T2K meeting.
- Then, on Nov.10th, TK had a meeting with Nishikawa-san, Suzuki-san, Aihara-san to discuss the 2km proposal.

Continue ...

- The outcome of the meeting were (as emailed on Nov.13):
 - ➔ In order to submit the proposal to JPARC PAC, 2KM group must finalize the proposal, which includes;
 - 1) the motivation for the 2KM detector (namely, why 2KM is necessary in addition to the 280m detector and NA49),
 - 2) the sensitivity plots with and without 2KM (280m detector should be included).
 - ➔ The proposal must be finalized well before the next T2K meeting so that our colleagues have enough time to read and comment.
 - ➔ In addition, Kajita must present the proposal to the spokesman of T2K, ICRR Kamioka group and T2K IB(R) as soon as possible before the next T2K meeting.
 - ➔ Aihara-san will act as an internal reviewer of the proposal writing.
 - ➔ The final decision will be made at the April 2007 T2K meeting.

Continue ... (2)

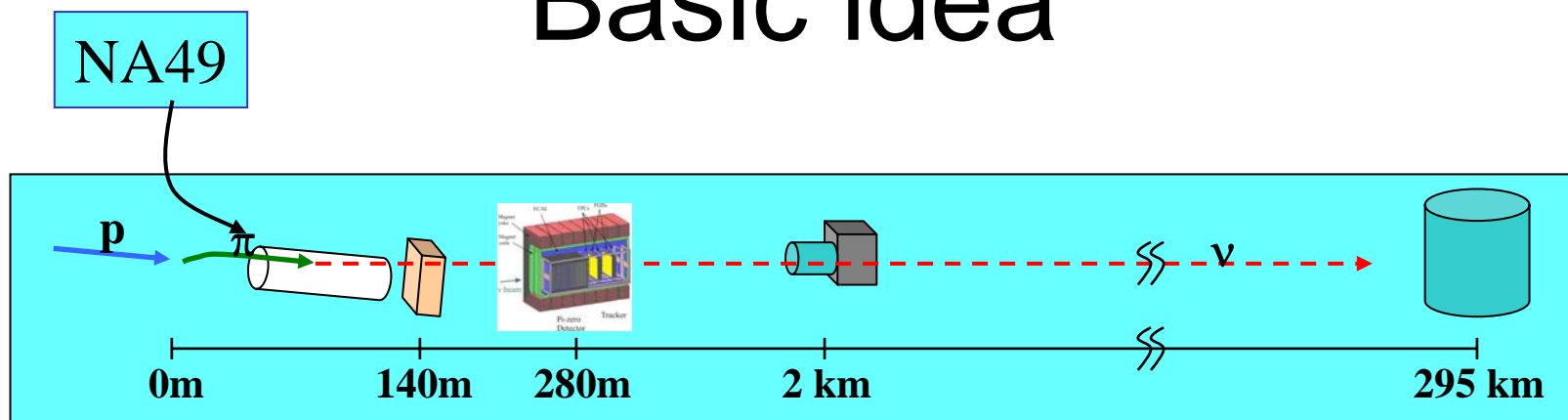
- Soon after the Nov.10 meeting (on Nov.11), some of us and Aihara-san had a meeting to discuss how we should go ahead. We agreed that the **proposal must be ready by the end of Jan. 2007.**
- Then, on Nov.27th, TK had a meeting with Aihara-san to discuss some more details about the strategy and proposal writing.
- In today's meeting, we would like to discuss our strategy and work for the 2km proposal based on the outcome of the Nov.27 meeting.

2km strategy and proposal writing

We have to clarify: Why is 2KM necessary in addition to the 280 m detector ?

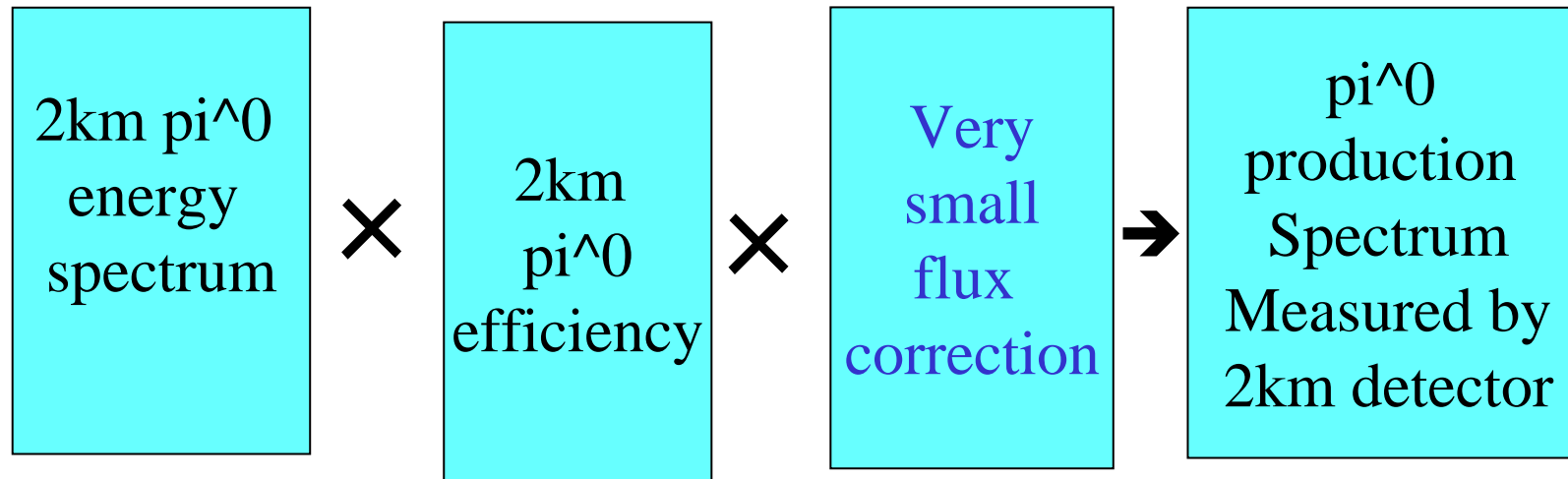
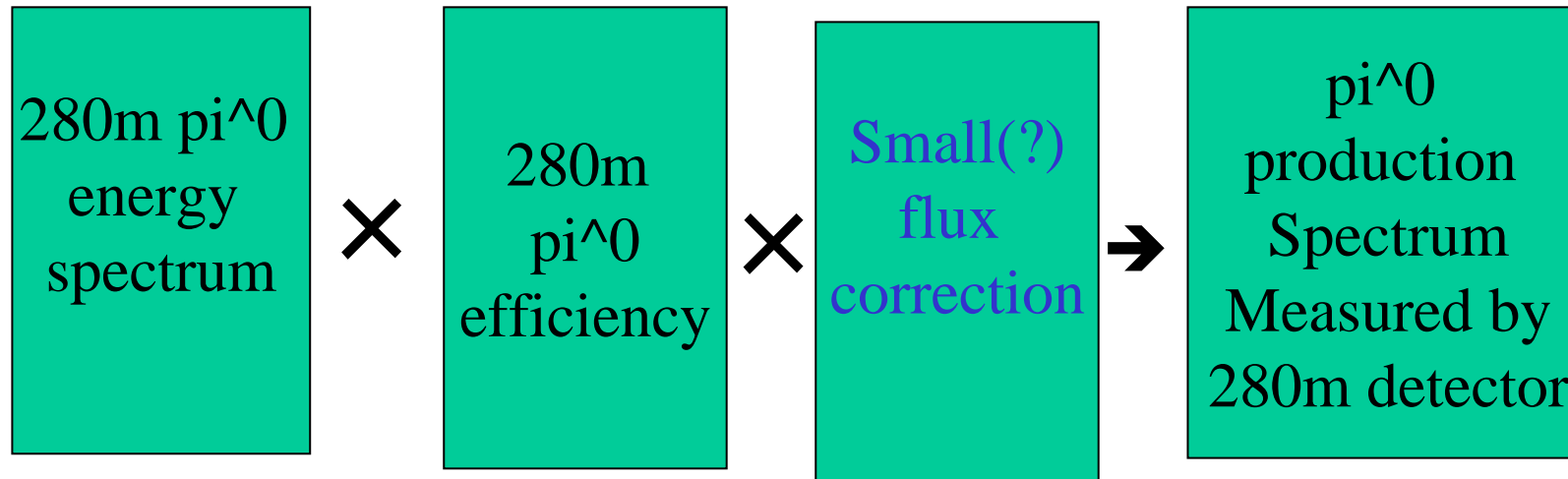
- Basic idea
 - ν_e appearance
 - ν_μ disappearance
- Timeline

Basic idea

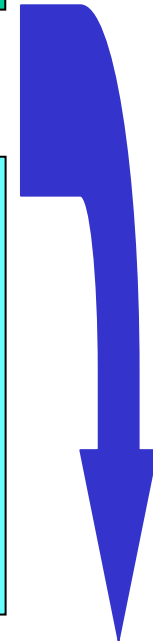


- 280m detector together with NA49 predicts the un-oscillated flux at SK. But the flux observed at SK is oscillated. Therefore, it is **most convincing for the T2K experiment, if the non-oscillated flux prediction (by the 280m detector + NA49) is directly checked with the 2km detector.**
- **Result from various checks between (280m + NA49) and 2KM gives the most convincing prediction for SK.**
- Also, 1) same target material, 2) same detector technology, 3) same spectrum and 4) same reconstruction algorithm should be stressed.

ν_e appearance: 1st year

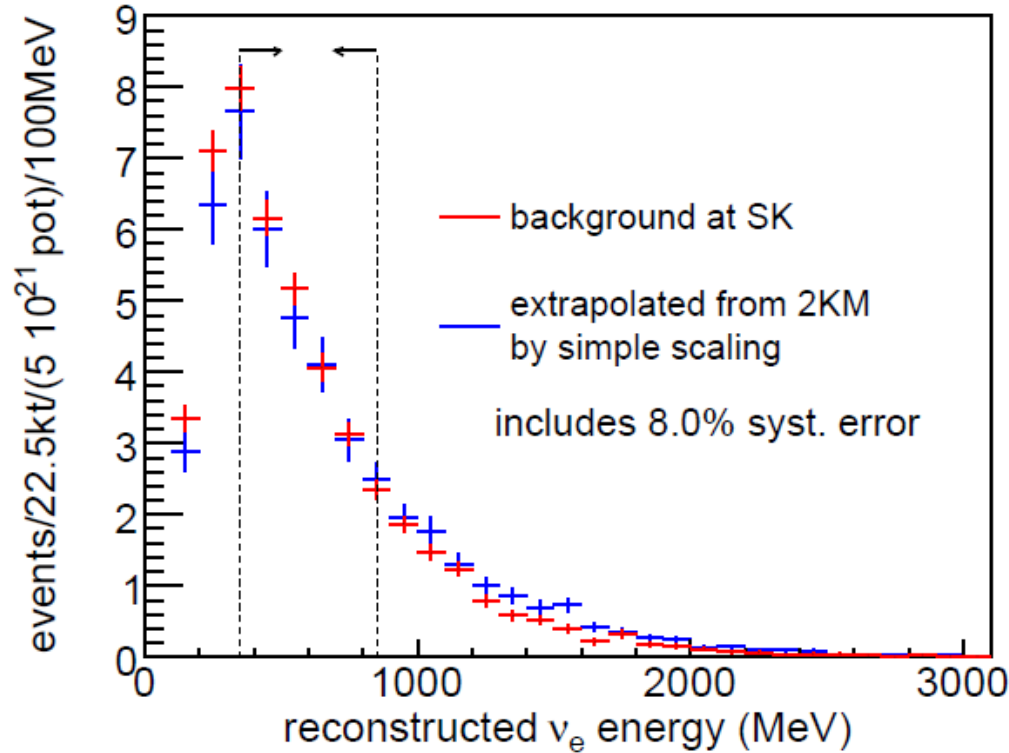


\updownarrow compare



Convincing prediction for the π^0 BG spectrum

ν_e appearance: after 5 years



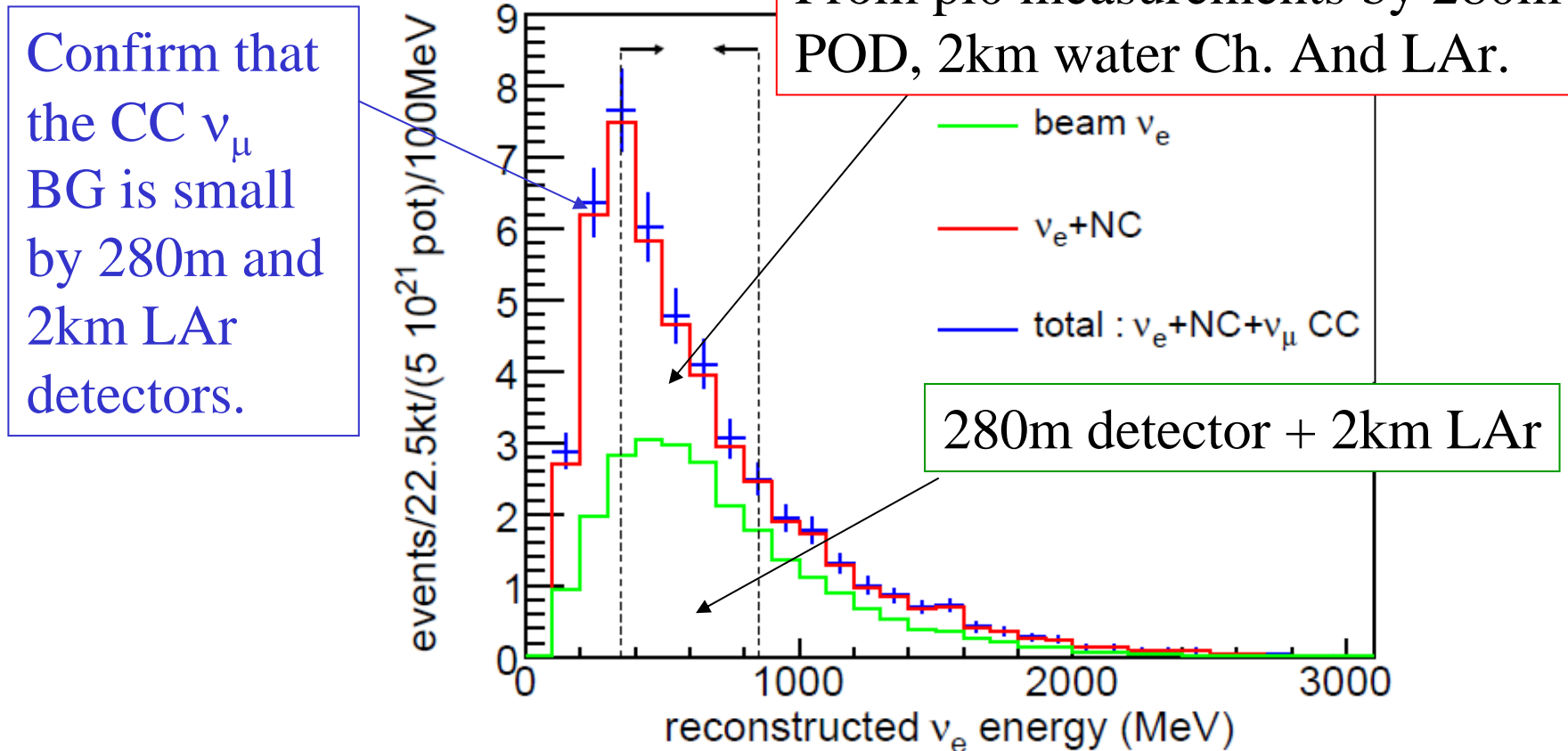
Background prediction
Systematic uncertainties:

Total 7.5%
(or could be 5%)

(We already have these information.)

ν_e appearance: after 5 years(2)

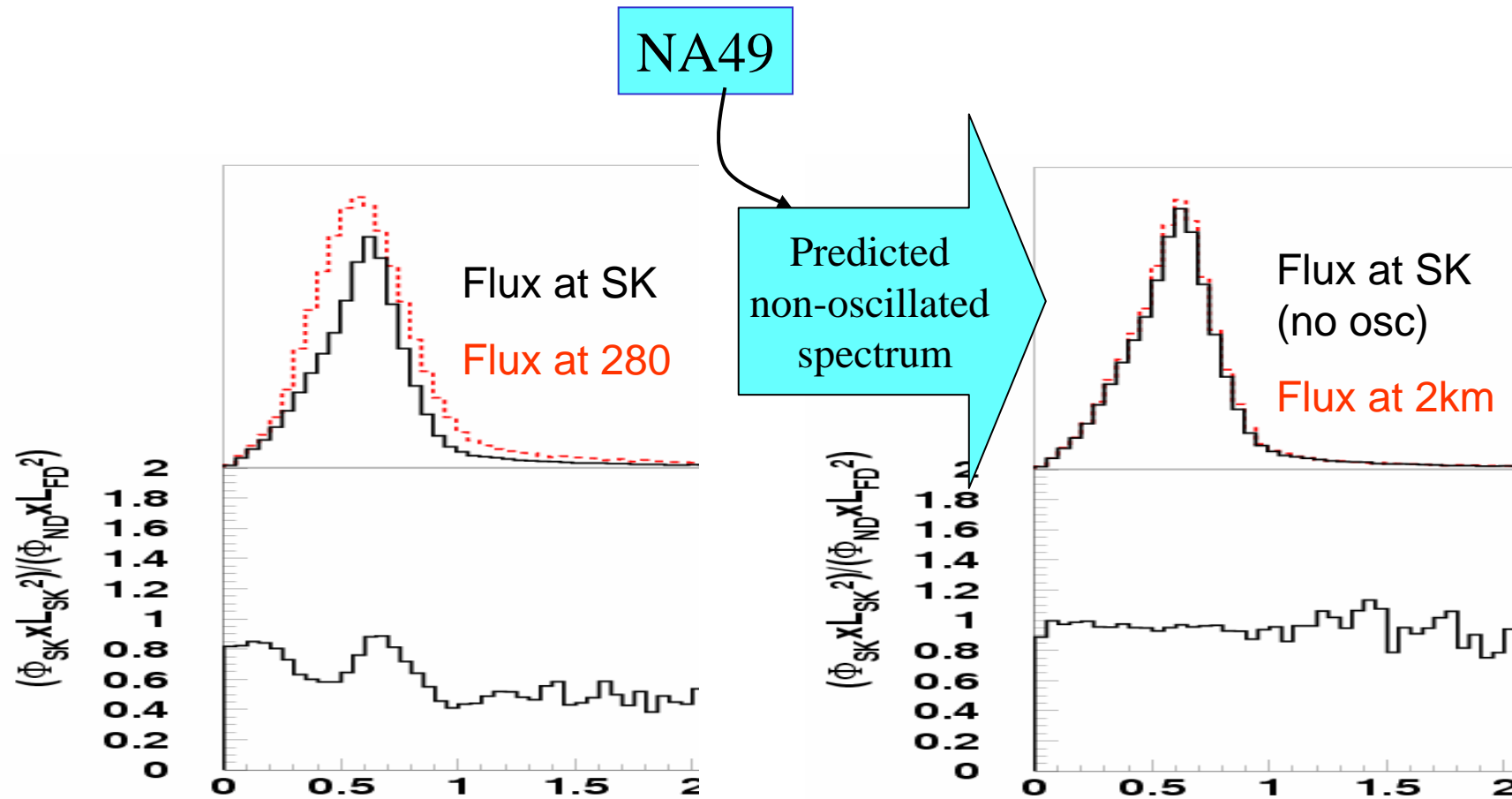
- Understanding the electron background -



→ Goal: Consistency between the total BG measurement by 2km water Ch. and measurements of individual BG components.

How accurate can we understand each component? (We have to work)

ν_μ disappearance



- Directly prove the (280m + NA49) prediction.
- Inter-checks (280m+NA49) ↔ 2KM: most convincing non-oscillated spectrum (smallest syst)

Expected n_m spectrum after 1 year of 2KM@T2K

Need a figure that shows ν_μ spectrum after 1 year (MRD included, Up to 2GeV?)

Expected systematic errors (after 1 year):

Absolute flux:

Spectrum shape

Peak position

Expected n_m spectrum after 5 year of 2KM@T2K

Need a figure that shows ν_μ spectrum after 5 yrs

Expected systematic errors (after 5 years):

Absolute flux:

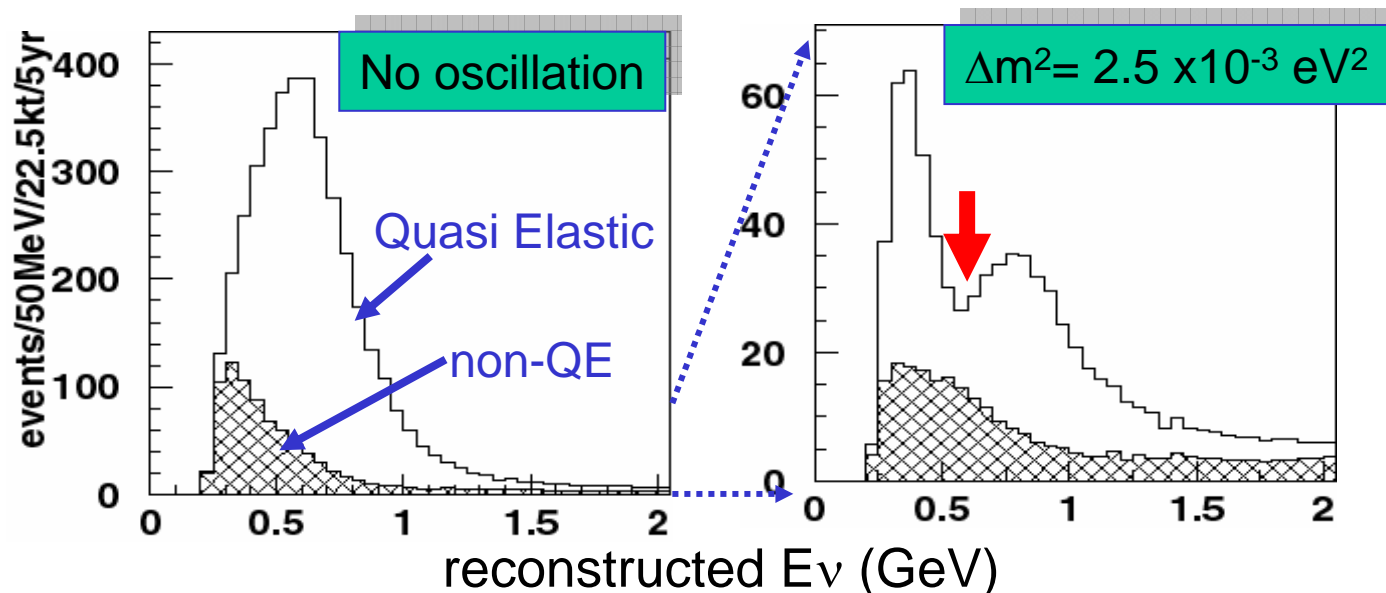
Spectrum shape

Peak position

Do we have anything that makes the syst better with 280m+ 2km ? If we have, we should stress. (Probably, the near/far extrapolation from 280 to 2km makes the 2km to SK extrapolation much more reliable.)

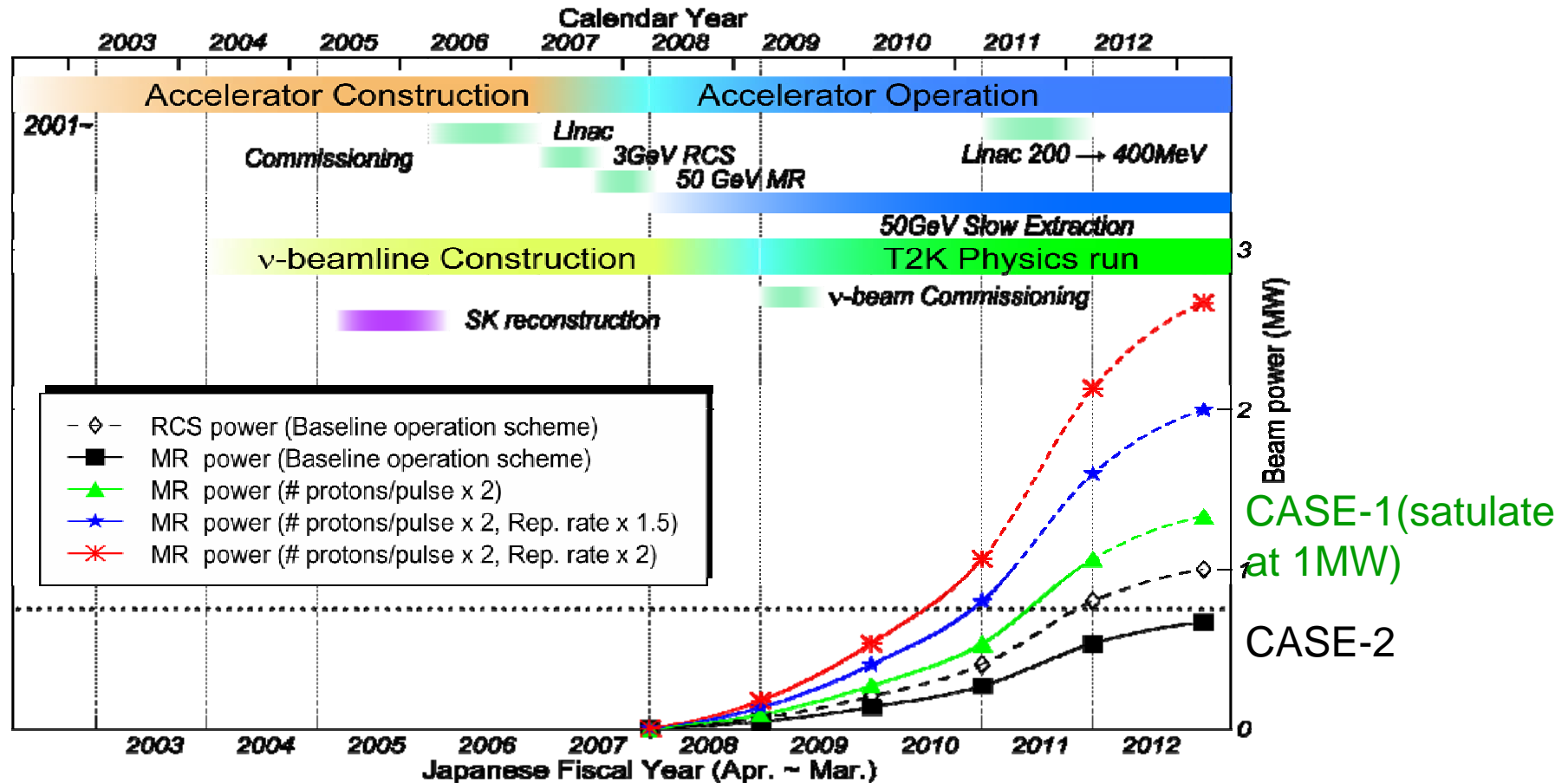
Prediction of the non-QE/QE ratio (after 5 years?)

- Non-QE/QE must be measured by detectors other than water Ch.
- The target material could either be C, O or Ar.
- In case of C (Ar), the predicted 1-ring non-QE/QE μ -like ratio should be smaller (larger) than that of O due to the nuclear effects.



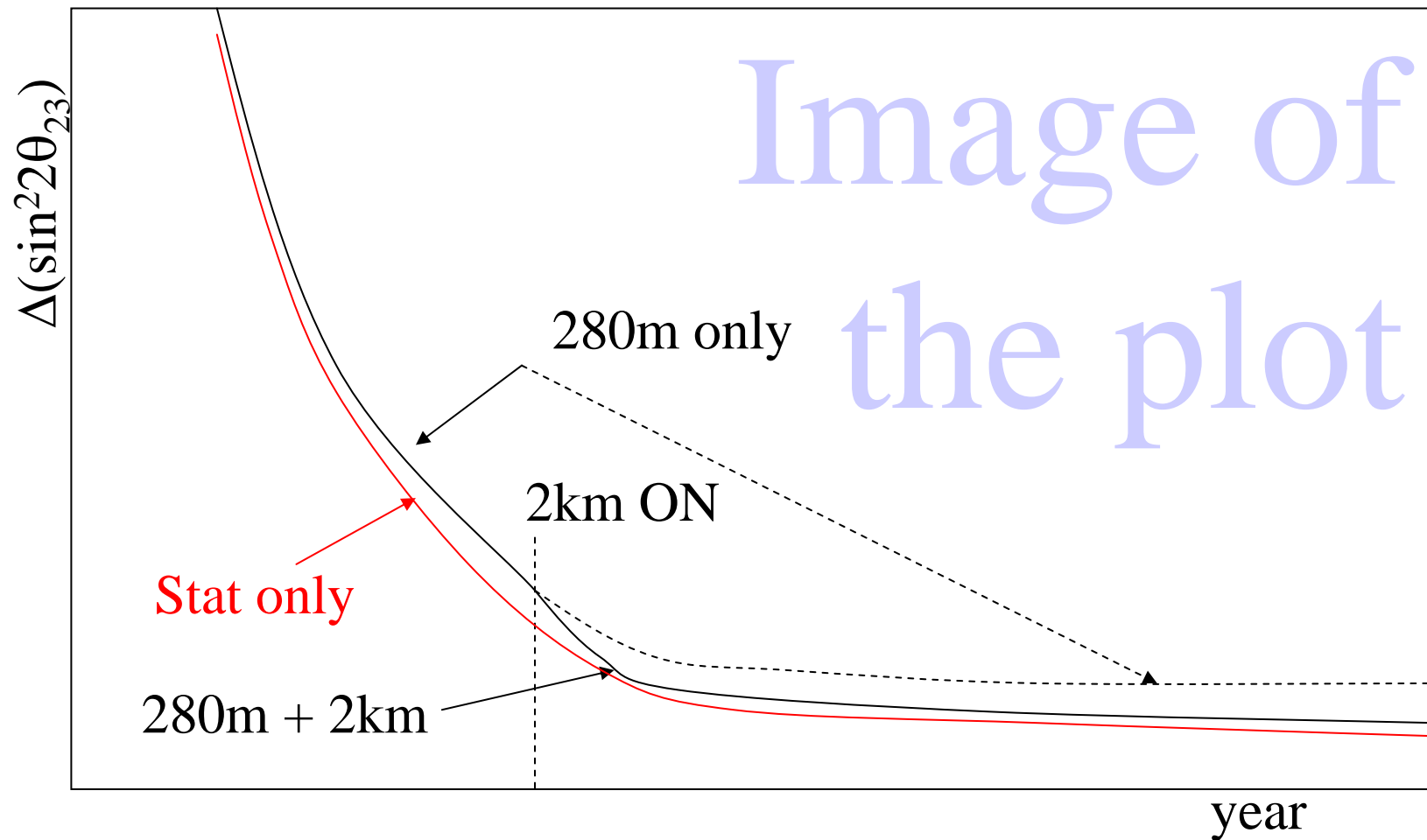
Request at the Nov. collaboration
meeting:
time line plots

Time line (1): Assumption on the beam intensity upgrade

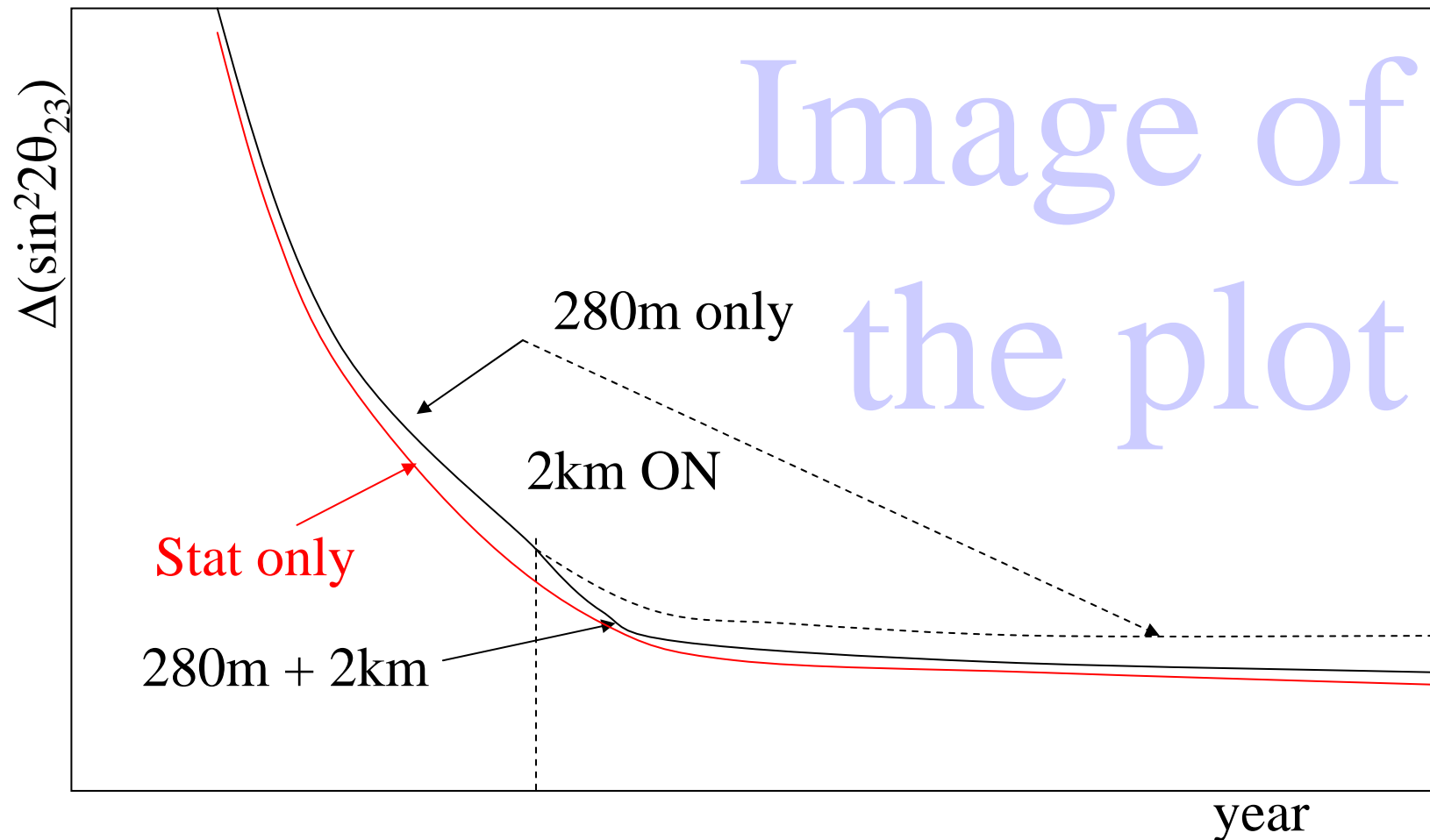


We assume 2 cases

Time line (2-1): accuracy of $\sin^2 2\theta_{23}$ (assume true $\sin^2 2\theta_{23}=0.97$?) with CASE-1 (beam) + 280m (from 2009) + 2km (from 2012?) (syst errors are the “goal values”)



Time line (2-2): accuracy of $\sin^2 2\theta_{23}$ with CASE-2 (beam) + 280m (from 2009) + 2km (from 2012?)
(syst errors are 150% of the “goal values” ?)



Time line (2-3): accuracy of $\sin^2 2\theta_{23}$ with CASE-1 (beam) + 280m (from 2009) + 2km (from 2012?) (syst errors are 150% of the “goal values”)

Time line (2-4): accuracy of $\sin^2 2\theta_{23}$ with CASE-2 (beam) + 280m (from 2009) + 2km (from 2012?) (syst errors are the “goal values”)

→ Instead of (or in addition to ?) $\Delta(\sin^2 2\theta_{23})$, one should use $\Delta\chi^2$ or $\Delta\sigma$ for the non-maximality of $\sin^2 2\theta_{23}$ to make sure the importance of 2km is properly expressed.

(All these 4 cases needed? Maybe these are just back-ups.)

Time line (3-(1-4)): accuracy of Δm_{23}^2 (true =
0.0025eV?) with
the beam and detectors same as “Time line (2-(1-4))”

Time line (4-(1-4)): sensitivity on $\sin^2 2\theta_{13}$ with
the beam and detectors same as “Time line (2-(1-4))”
(we assume that true $\sin^2 2\theta_{13}=0$)

Also, we **should** assume that true $\sin^2 2\theta_{13}=0.10$ and show

$\Delta(\text{prob}(v_\mu \rightarrow v_e))$ as a function of year ???

→ Instead of $\Delta(\text{prob}(v_\mu \rightarrow v_e))$, one should use $\Delta\chi^2$, or $\Delta\sigma$ from
 $\sin^2 2\theta_{13}=0$ to make sure the importance of 2km is properly expressed.

We need to discuss with Nakaya-san about the 280 numbers.

Proposal writing

Note: The present draft is just an update of the document for NuSAG. Therefore, the draft must be improved, following the above discussion.

One note:

For the LAr, (as requested at the T2K meeting by the T2K collab,) the proposal should write that the technology decision (taking various factors into account) should be made later. Instead, the proposal should clarify the specification for the fine grain detector. Then, LAr should be described as an example.

Also, how do we write the day-1 fine-grain detector for the 2km?

→ Do we write that we need the fine grain detector at day-1? Or are we more flexible?

We should very clearly define the role and specification of the fine grain detector. And we should write the LAr detector as a concrete example of the detector that satisfies the above requirements.

Proposal improvements

- Include 280m (NA49 as well?) description at Introduction
- Rewrite “Motivation” with 280m detector and NA49
- Argue that fine grain detector at 2km is necessary
- In “Physics with the intermediate detector”, write
 - ➔ the global strategy (280m + 2km)
 - ➔ time line (280 + 2km later, and the sensitivities.)
 - (➔ update the ν_μ discussion)
- Define (hoped) day-1 for 2km: Day-1 assumed for the timeline figure is 2012. But, in general, we do not mention the day-1 too precisely.
- Stress that 2km is needed independent of the value of θ_{13} .

Job lists(1) (By Dec.20)

(Initial list of people who will work on these items are listed)

We should;

- Re-write Introduction with 280 detector **together with NA49** (K.Scholberg,M.Fechner)
- Re-write Motivation with 280 detector **(+NA49)** (K.Scholberg)
- Re-write “Physics with the intermediate detector”, especially, “the global strategy (280m + 2km)” (C.Walter)
- Add why fine grain detector @2km is necessary (ETHZ+Bern+ α ?)
- Add MRD test results (1 page?) (K.Kaneyuki,C.Ishihara)
- Modify NEUT to include C and Ar interactions and confirm the performance (G.Mitsuka) ---- By the end of Dec.
- Meet Nakaya-san to get information on 280 detector (T.Kajita,K.Kaneyuki)
- Finish the ν_{μ} analysis with the present MC (M.Fechner)
- Describe the π^0 rejection and ν_e component measurement in LAr more quantitatively. (ETHZ+Bern)

Job lists(2) (Dec.21-Jan.10)

We should;

- Produce some figures (v_μ spectrum, π^0 , ..)
- Re-write the LAr part (with words such as “final decision open”, “as an example”, etc...)

Job lists(3) (Jan.11-21)

We should;

- Finalize all the figures and numbers;
 - ➔time line figures
 - ➔Non-QE/QE figure
- Finish the proposal writing

Job lists(4) (Jan.22-31)

- We should;
- Check additional figures and the writings.

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- We should have meetings to discuss the progress. (Probably next meeting around Dec.20.)