disappearance studies and non-QE/QE ratio

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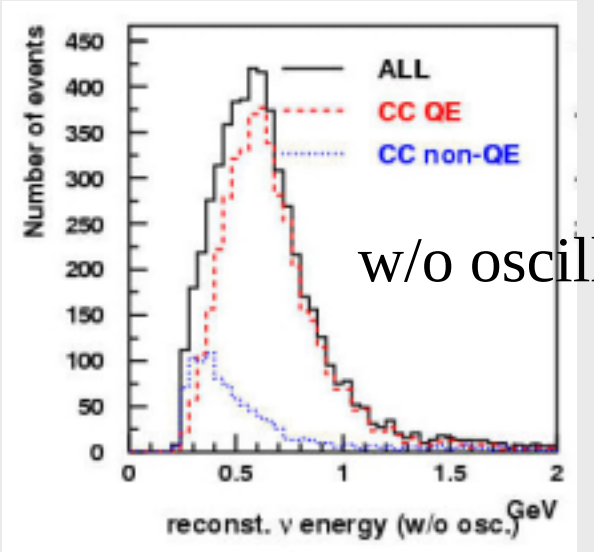
Introduction

- non-Q.E. events are main B.G. for disappearance measurement
- In this study, contributions of non-Q.E. events to observed events and systematic error in parameter sensitivity will be investigated for some Δm^2 parameters and ν beam configurations

OA 2.5 degree



w/o oscillation

Expected νμ energy spectrum @SK

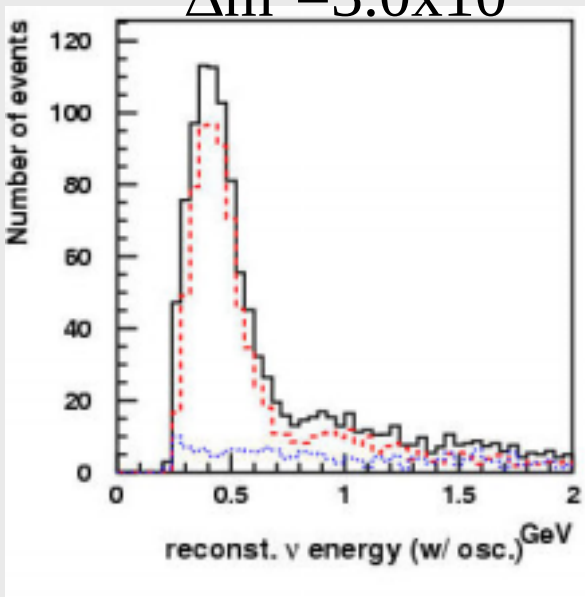
(5yr, 22.5kton, $\sin^2 2\theta_{\mu\tau}=1$)

ALL

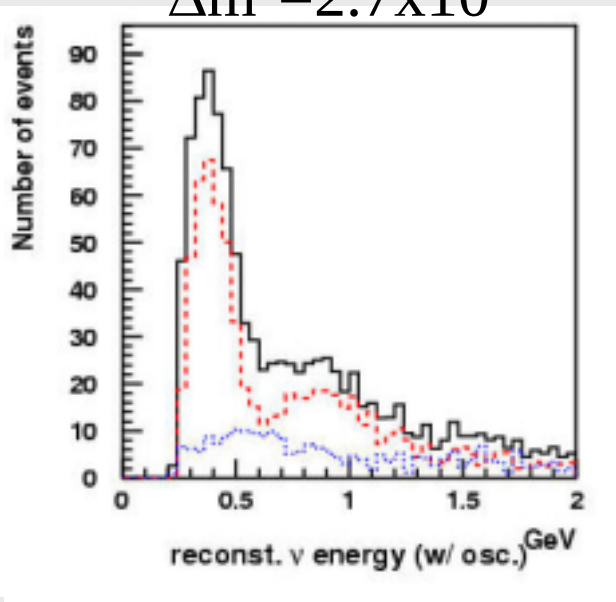
CC QE

CC non-QE

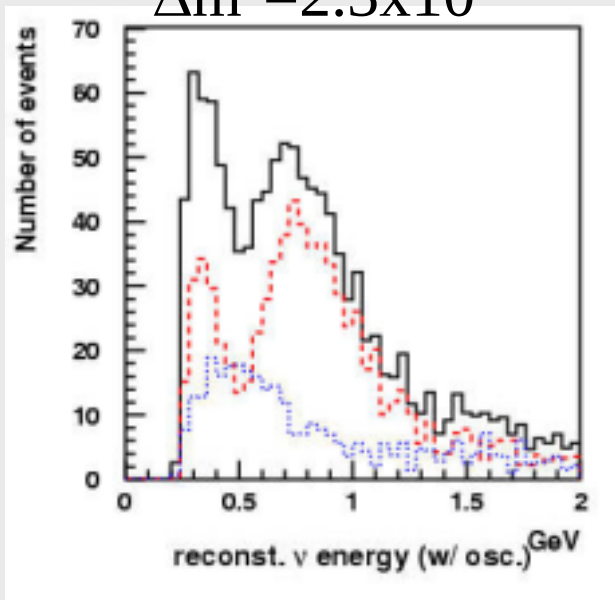
$\Delta m^2=3.0\times10^{-3}$



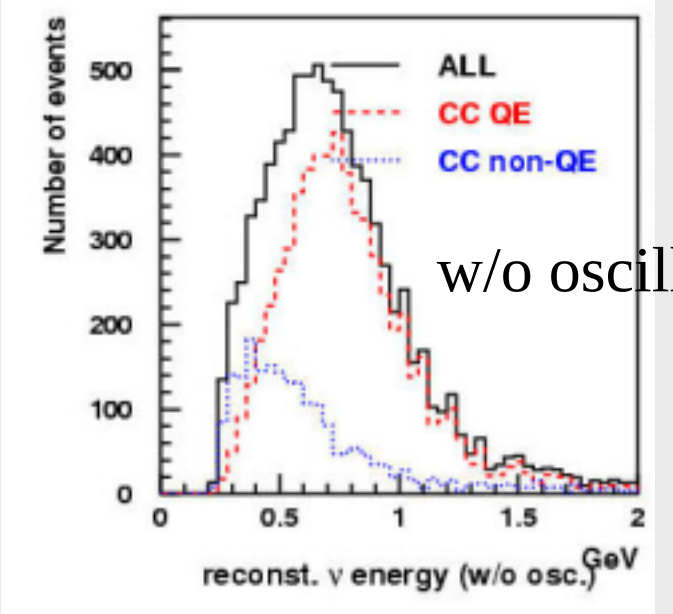
$\Delta m^2=2.7\times10^{-3}$



$\Delta m^2=2.3\times10^{-3}$

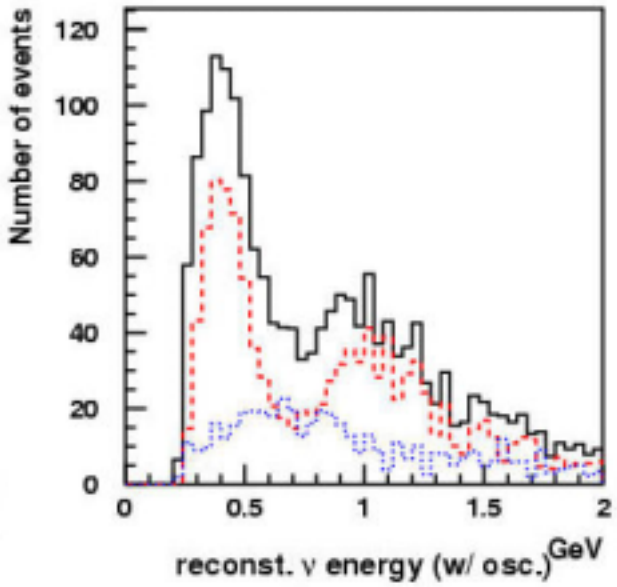


OA 2.0 degree

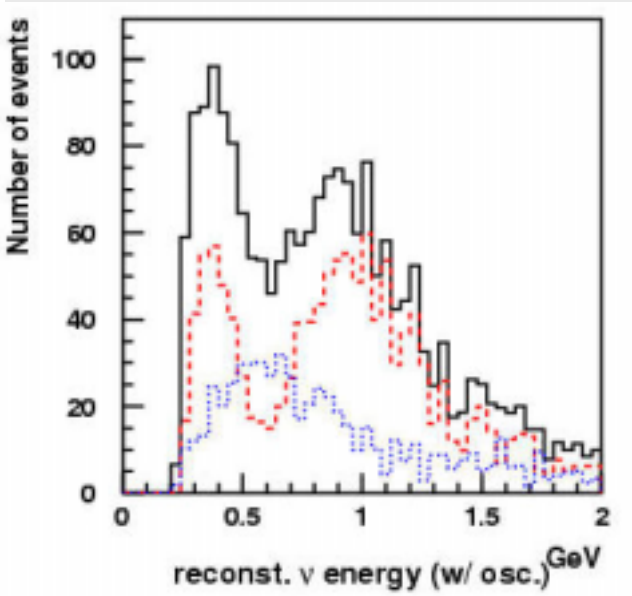


w/o oscillation

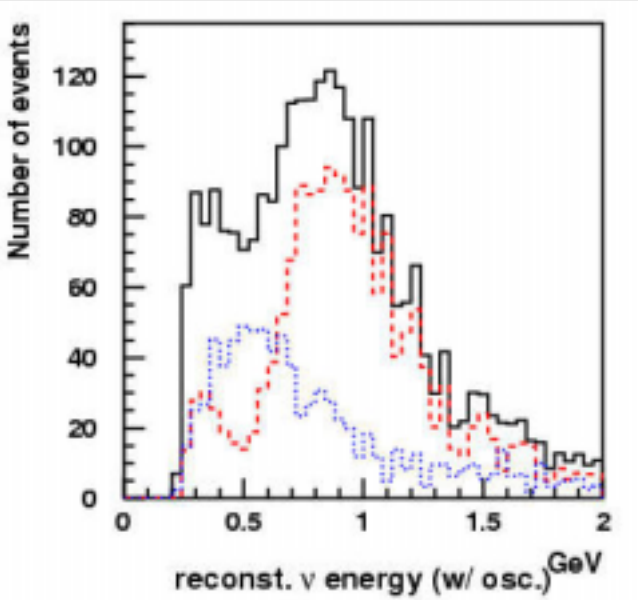
$\Delta m^2=3.0\times10^{-3}$



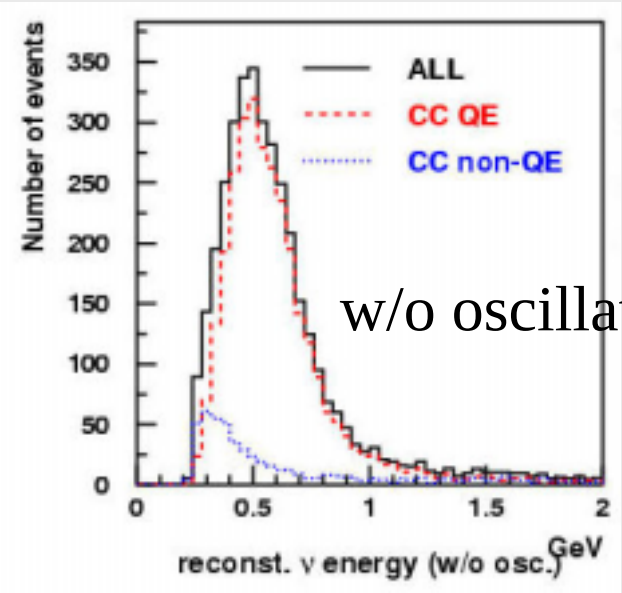
$\Delta m^2=2.7\times10^{-3}$



$\Delta m^2=2.3\times10^{-3}$

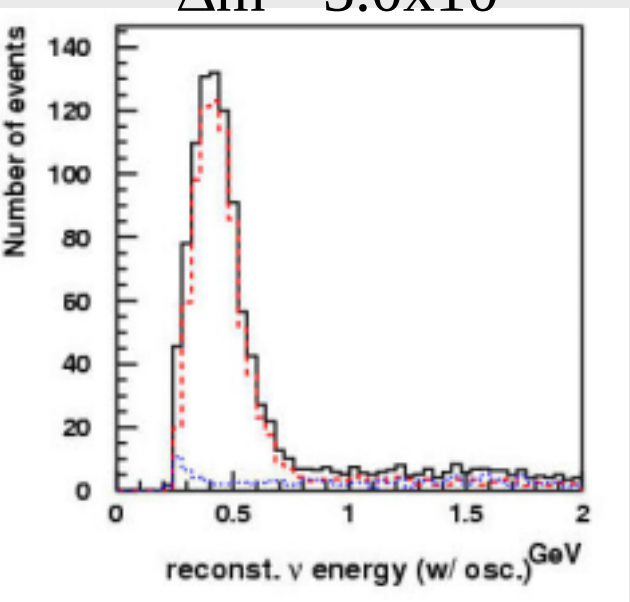


OA 3.0 degree

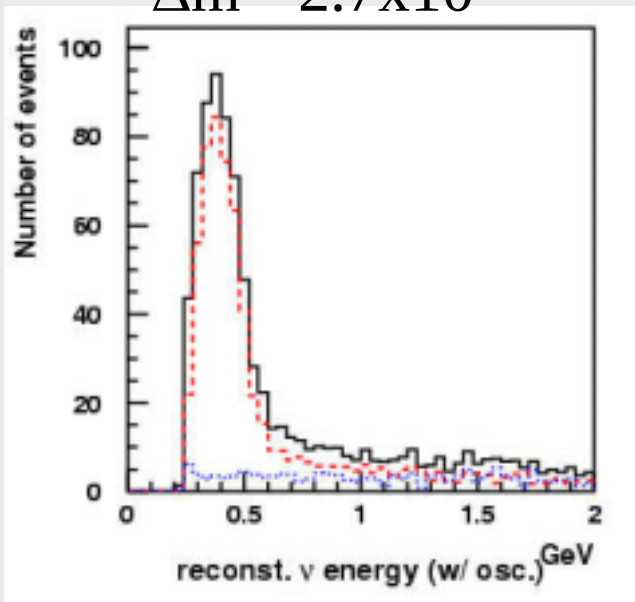


w/o oscillation

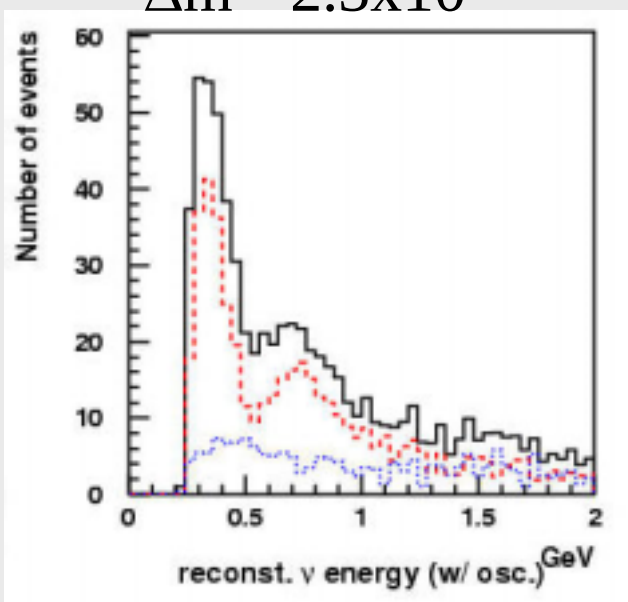
$\Delta m^2=3.0\times10^{-3}$



$\Delta m^2=2.7\times10^{-3}$



$\Delta m^2=2.3\times10^{-3}$



Nevents of Q.E. and non-QE. process

$E\nu\mu^{recon} < 2GeV$

5yr, 22.5kton

$\sin^2 2\theta\mu\tau = 1$

OA2.5°

	CC Q.E	CC non-Q.E
w/o osc.	4267	987
$\Delta m^2 = 3.0 \times 10^{-3}$	823	190
$\Delta m^2 = 2.7 \times 10^{-3}$	682	227
$\Delta m^2 = 2.3 \times 10^{-3}$	737	319

19~30%

OA2.0°

	CC Q.E	CC non-Q.E
w/o osc.	6162	2081
$\Delta m^2 = 3.0 \times 10^{-3}$	1104	457
$\Delta m^2 = 2.7 \times 10^{-3}$	1204	586
$\Delta m^2 = 2.3 \times 10^{-3}$	1605	821

29~34%

OA3.0°

	CC Q.E	CC non-Q.E
w/o osc.	3015	515
$\Delta m^2 = 3.0 \times 10^{-3}$	858	134
$\Delta m^2 = 2.7 \times 10^{-3}$	609	142
$\Delta m^2 = 2.3 \times 10^{-3}$	444	176

16~28%

Systematic errors

	this study	K2K
abs. flux α	±10%	±8%
CC non-QE/QE β	±30%	±30%
NC/CC γ	±30%	±30%
ν spectrum shape ε	20%	~<20%
energy scale δ	±5%	±2.5%

$$\chi^2 = \sum_i [2(E^i_{\exp} - E^i_{obs}) + 2E^i_{obs} \log \frac{E^i_{obs}}{E^i_{\exp}}] + \frac{\alpha^2}{\sigma^2_\alpha} + \frac{\beta^2}{\sigma^2_\beta} + \frac{\gamma^2}{\sigma^2_\gamma} + \frac{\delta^2}{\sigma^2_\delta} + \frac{\varepsilon^2}{\sigma^2_\varepsilon}$$

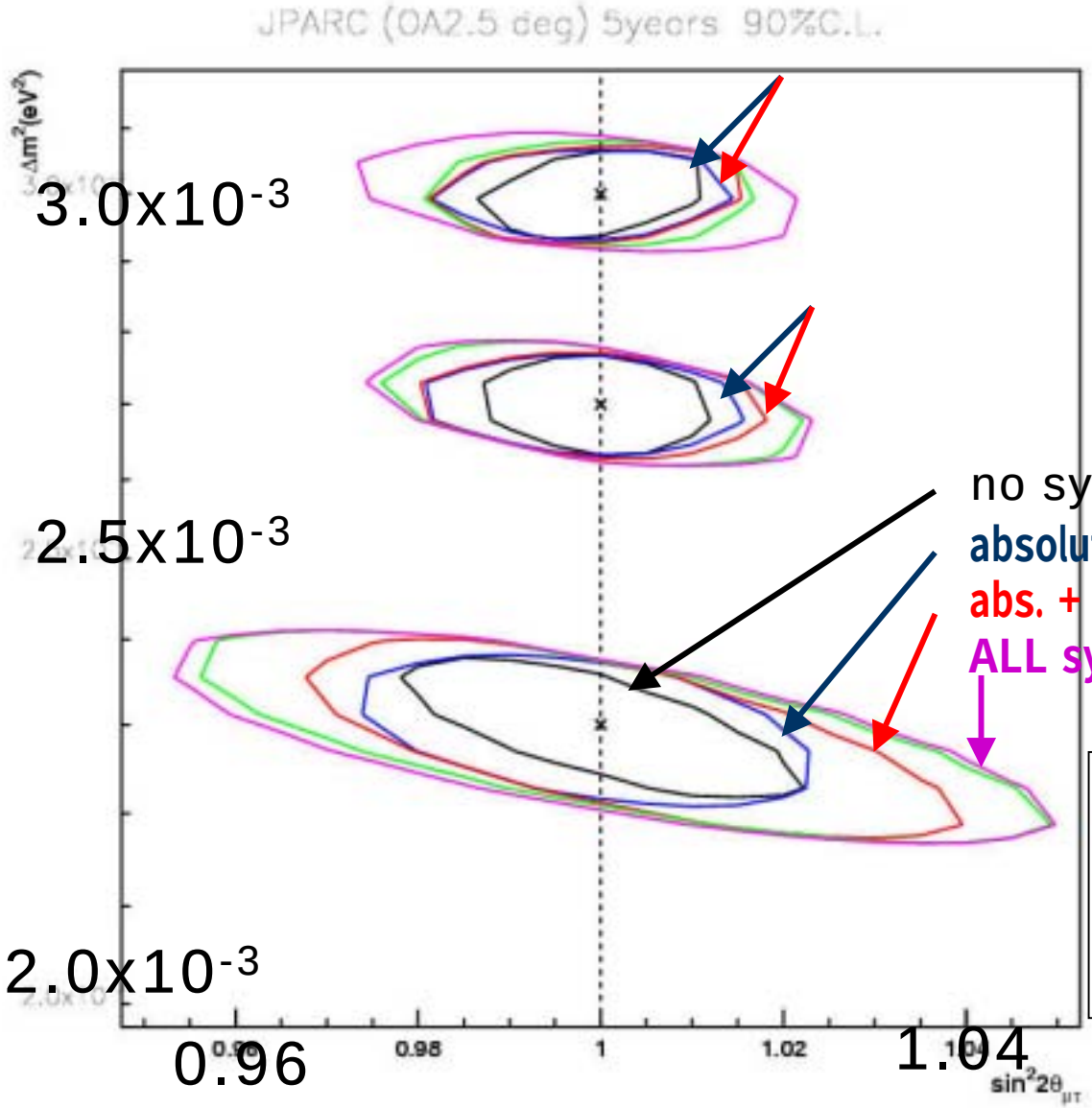
$$E_{\exp}(\alpha,\beta,\gamma,\delta,\varepsilon) = (1+\alpha)\sum_j W_\alpha f(\varepsilon) P(\Delta m^2, \theta)$$

$W_\sigma = 1$ CC Q.E.

$W_\sigma = (1+\beta)$ CC non-Q.E.

$W_\sigma = (1+\beta)(1+\gamma)$ NC non-QE

Sensitivity (OA2.5° beam)



This plot shows contritubion of each systematic error sources

Region btwn red and blue corresponds to non-QE/QE systematic error

no sys. error

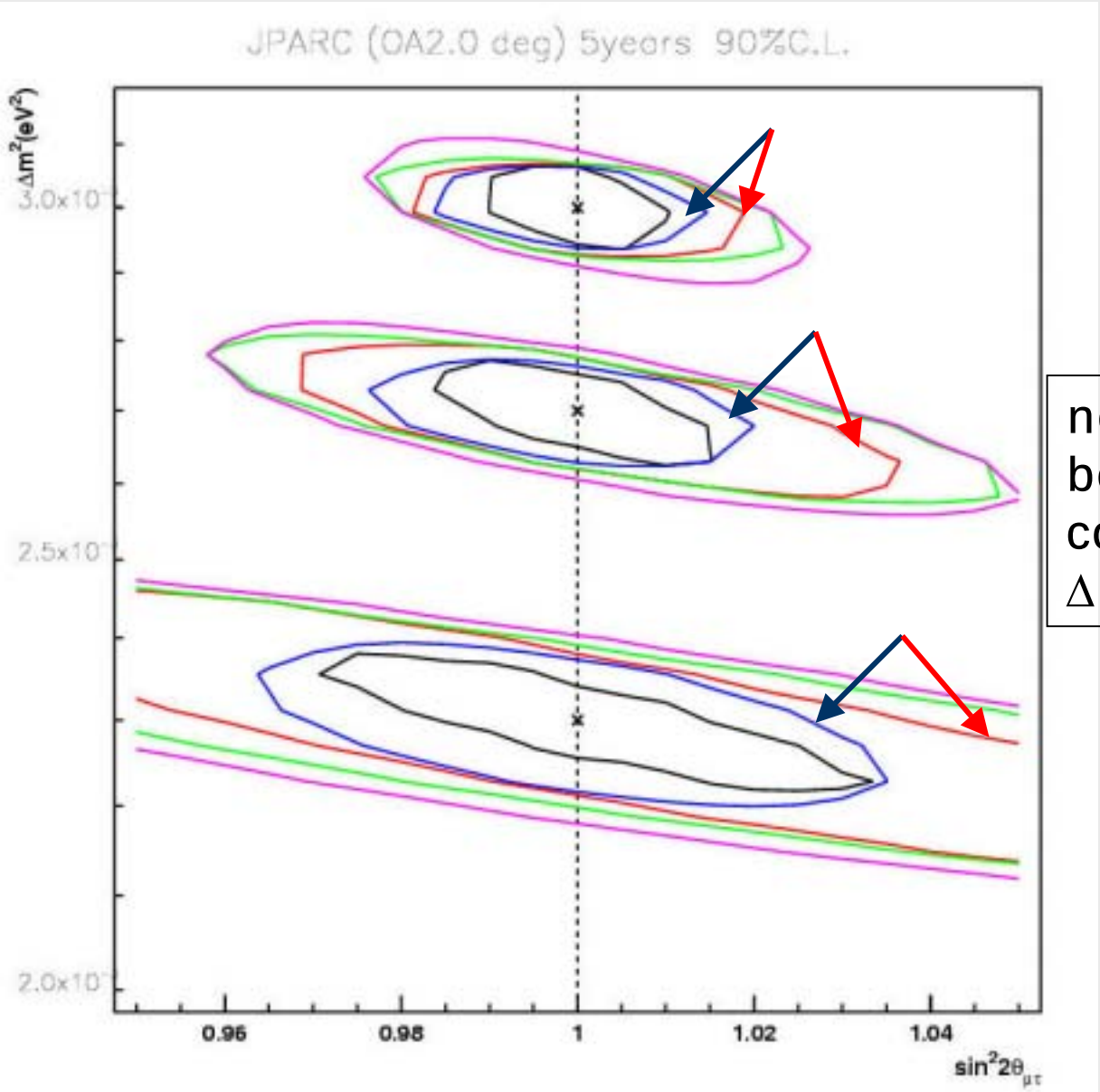
absolute flux error included

abs. + non-QE/QE error included

ALL sys. error included

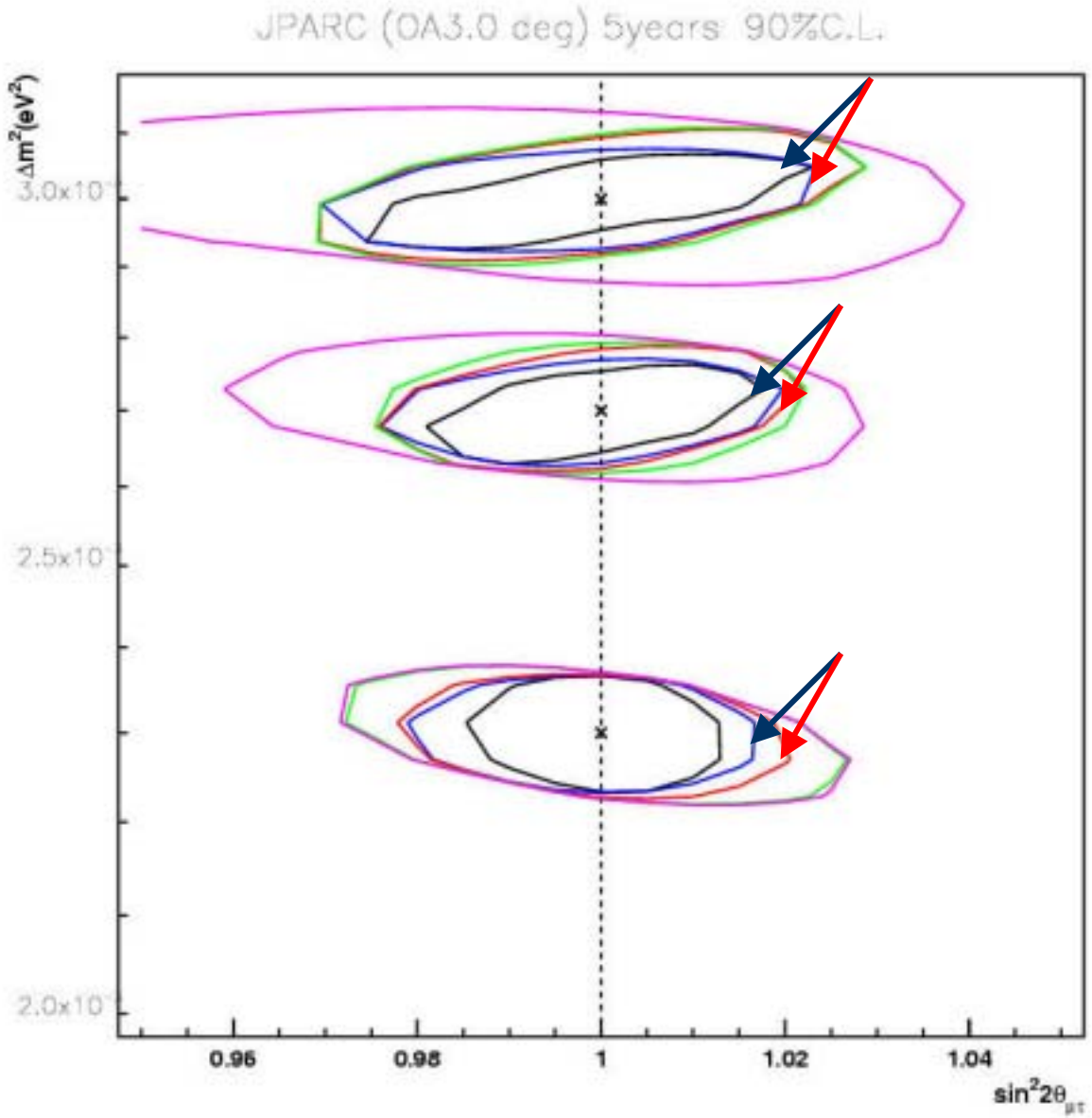
OA2.5° beam well optimized for non-QE/QE systematic error in $\Delta m^2 = 2.5 \sim 3.0 \times 10^{-3}$ eV²

Sensitivity (OA2.0° beam)



non-QE/QE sys. error becomes large contribution in $\Delta m^2 < 3.0 \times 10^{-3}$ eV^2

Sensitivity (OA3.0° beam)



systematic error due to non-QE/QE ratio is small, but large effect by other systematic source expected in $\Delta m^2 > 2.5 \times 10^{-3}$ eV^2

Summary

- contribution of non-QE events and effect of its systematic error in disappearnce measurement was investigated for various beam configuration
- systematic error can be reduced by selecting suitable OA beam configuration for $\Delta m2$ value
- However, improvements of smaller non-QE/QE systematic error may be effective for OA2.0° beam and unsuitable beam configuration