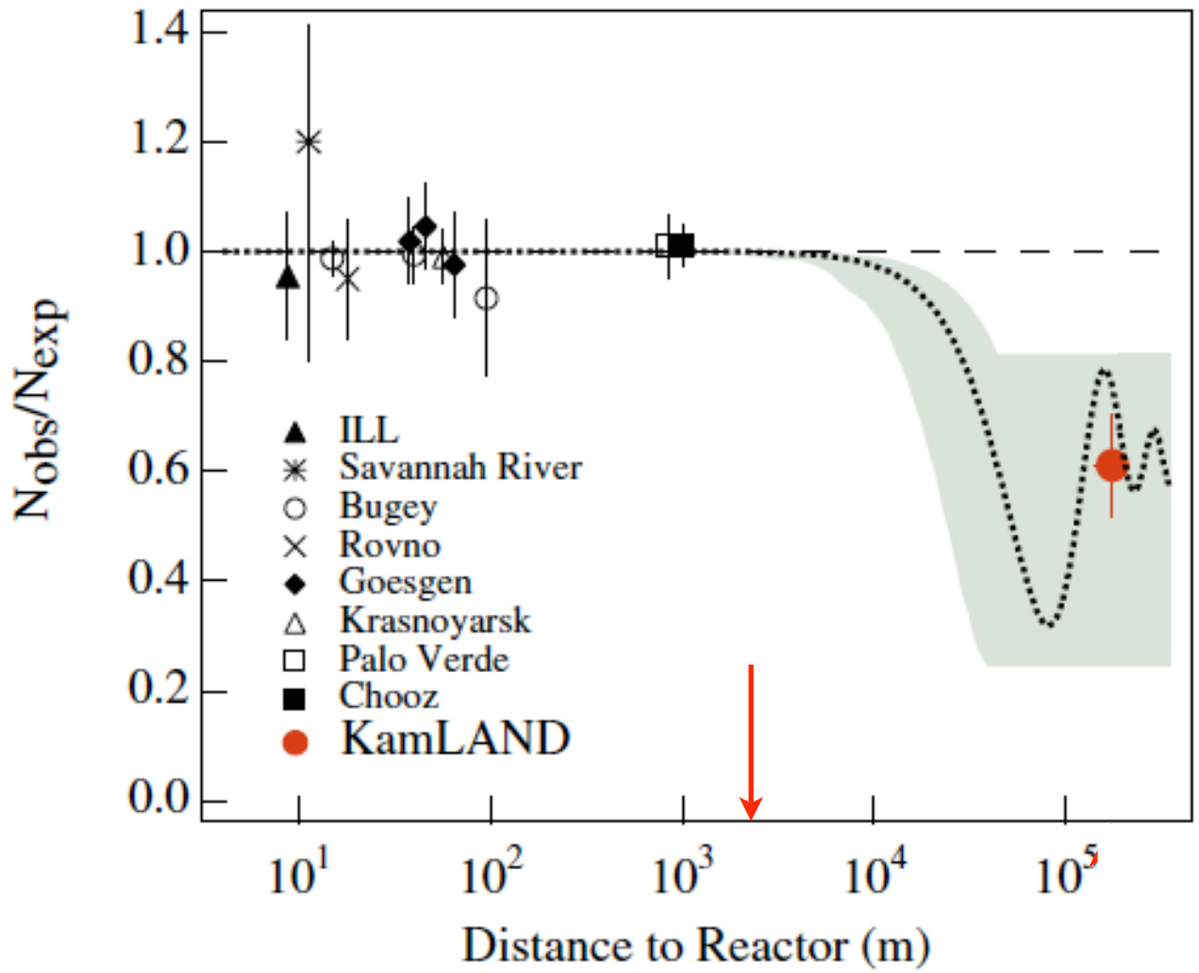
θ_{13} from Reactor Disappearance



kinematic phase:

$$\Delta_{ij} \equiv \frac{\delta m^2_{ij} L}{4E}$$

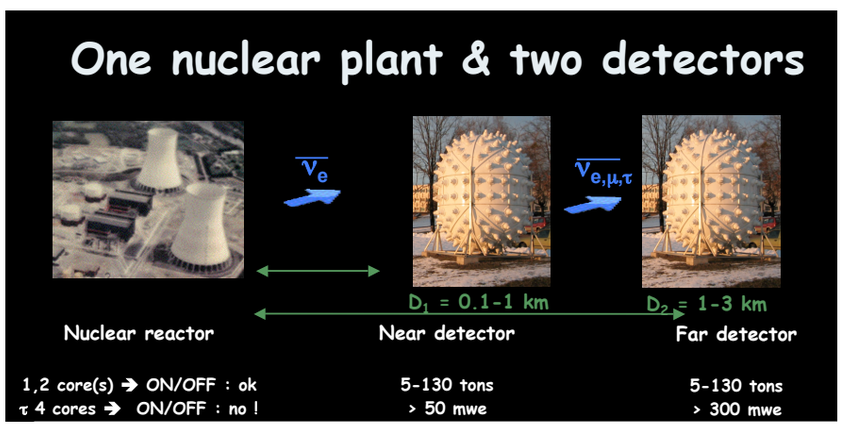
< 0.002

$$P(\bar{\nu}_e \to \bar{\nu}_e) \approx 1 - \sin^2 2\theta_{13} \sin^2\left(\frac{\delta m^2_{ee} L}{4E}\right) - \mathcal{O}(\Delta_{21})^2$$

$$\delta m^2_{ee} = \cos^2\theta_{12}|\delta m^2_{31}| + \sin^2\theta_{12}|\delta m^2_{32}|$$

Double Chooz:

Start up end of 2008



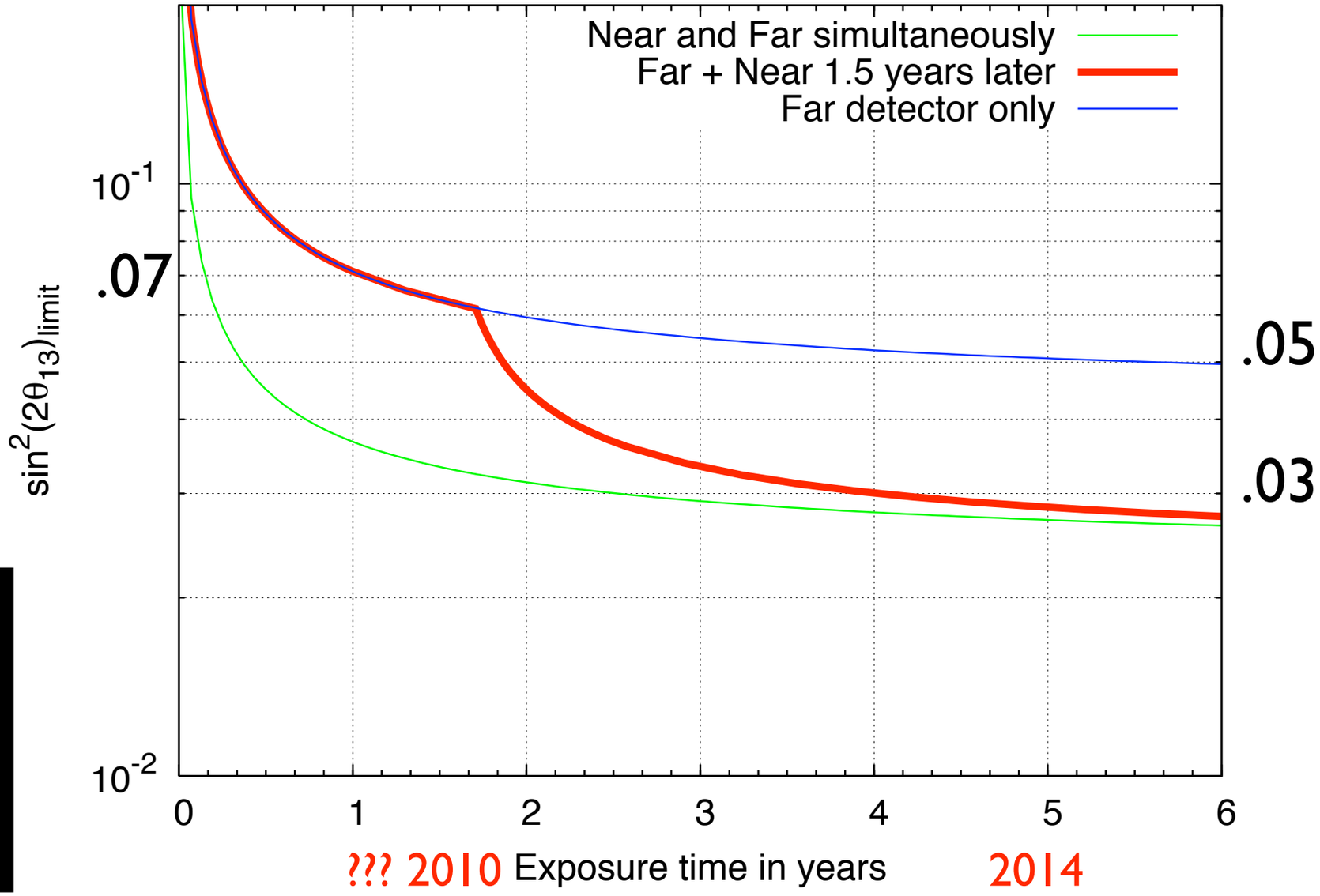


Figure 18: $\sin^2(2\theta_{13})$ sensitivity limit for the detectors installation scheduled scenario

Daya Bay

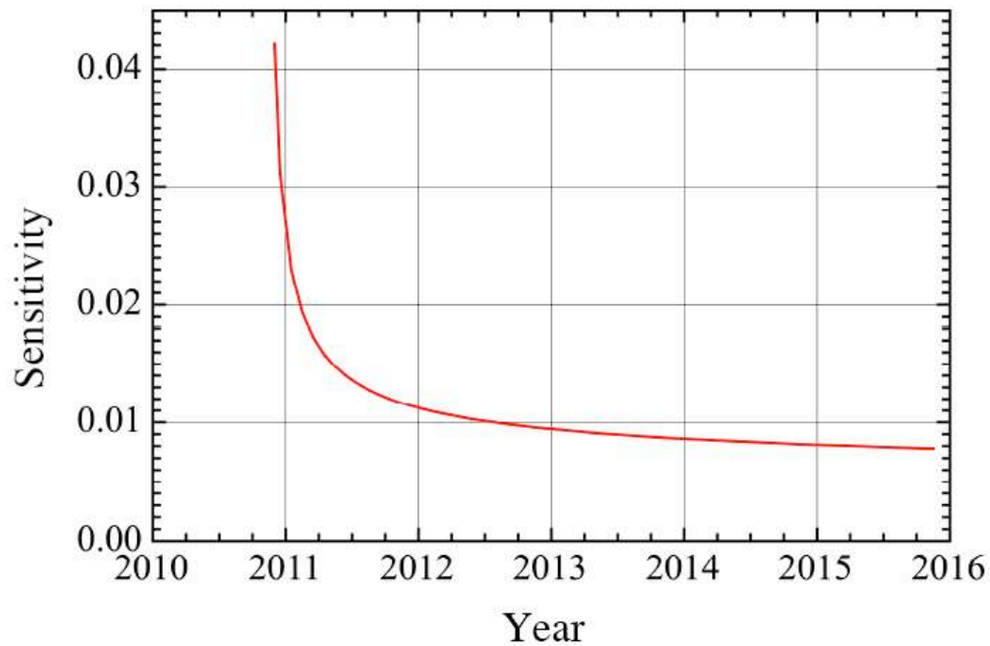


Fig. 2.19. Expected $\sin^2 2\theta_{13}$ sensitivity at 90% C.L. versus time. The curve is calculated with the assumption of two near sites and one far site with data acquisition beginning in Dec. 2010. The value of Δm^2_{31} is taken to be 2.5×10^{-3} eV^2.

start
end 2009
near 2 det
only, 1 hall

all 8 by
end 2010

first result
by ???

$\nu_\mu \to \nu_e$

with MATTER

$$P_{\mu\to e} \approx \left| \sqrt{P_{atm}} e^{-i(\Delta_{32}\pm\delta)} + \sqrt{P_{sol}} \right|^2$$

where $\sqrt{P_{atm}} = \sin\theta_{23}\sin 2\theta_{13} \frac{\sin(\Delta_{31}\mp aL)}{(\Delta_{31}\mp aL)} \Delta_{31}$

in vac $\sin\Delta_{31}$

and $\sqrt{P_{sol}} = \cos\theta_{23}\sin 2\theta_{12} \frac{\sin(aL)}{(aL)} \Delta_{21}$

in vac $\sin\Delta_{21}$

$a = G_F N_e/\sqrt{2} = (4000\ km)^{-1}, \quad \pm = sign(\delta m^2_{31}) \qquad \Delta_{ij} = |\delta m^2_{ij}|L/4E$

$$P_{\mu\to e} \approx P_{atm} + 2\sqrt{P_{atm}P_{sol}}\cos(\Delta_{32}\pm\delta) + P_{sol}$$

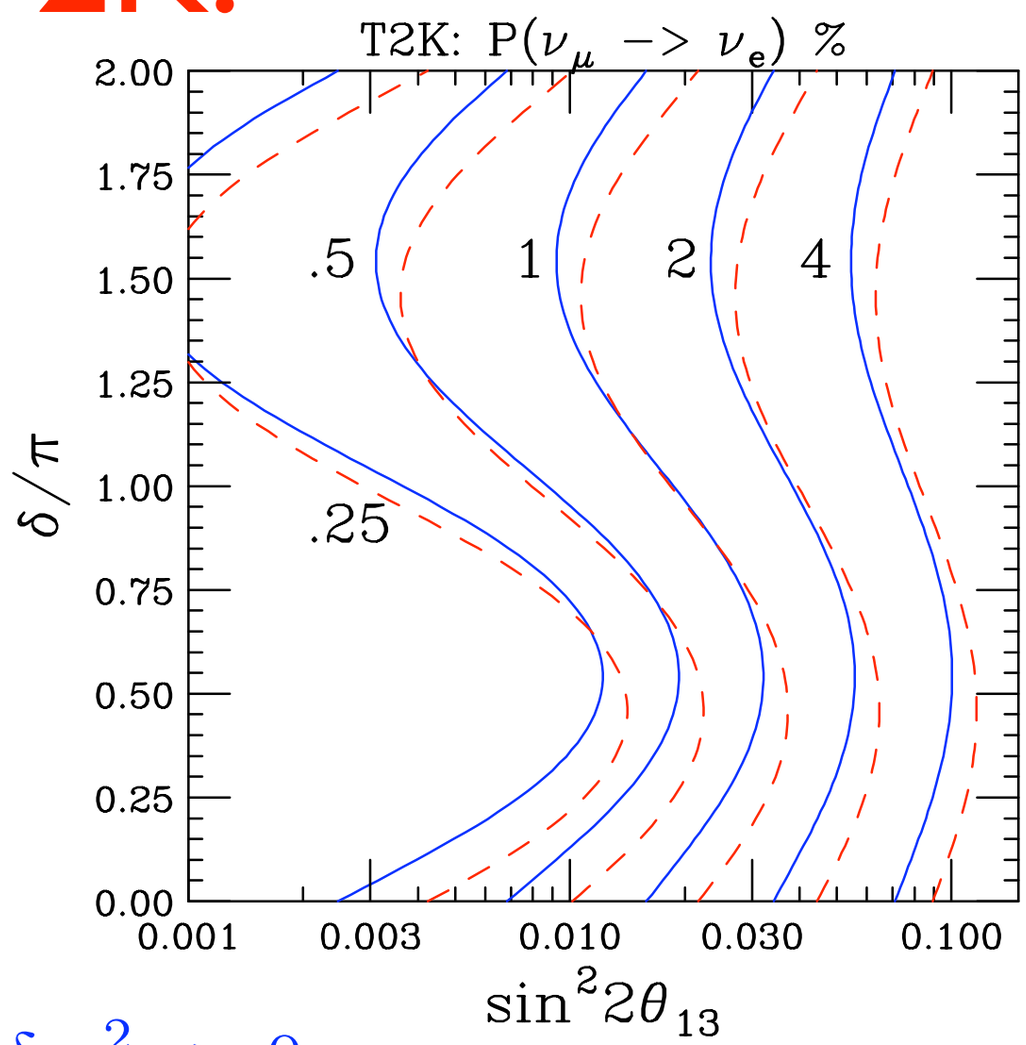
$$\Updownarrow$$

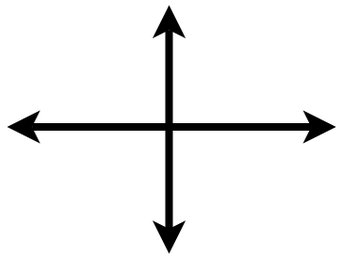
$$\cos(\Delta_{32}\pm\delta) = \cos\Delta_{32}\cos\delta \mp \sin\Delta_{32}\sin\delta$$

only CPV

T2K:

VOM: $\Delta_{31} \neq \pi/2$





Matter Effect:

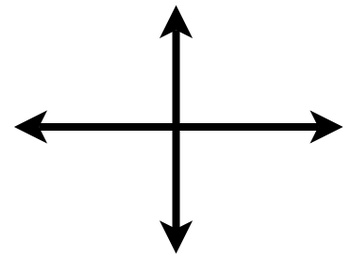
$\delta m^2_{31} > 0$

$\delta m^2_{31} < 0$

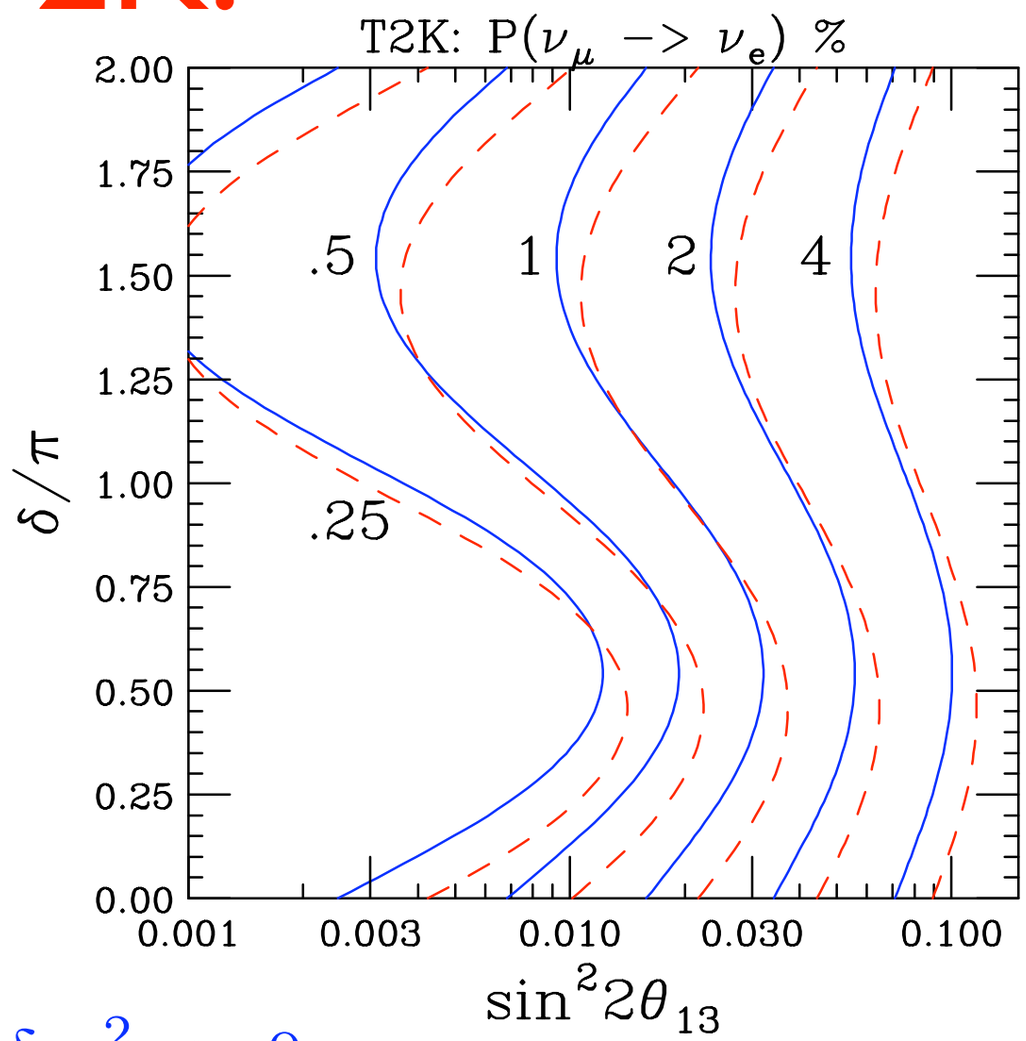
Beam 1%

T2K:

VOM: $\Delta_{31} \neq \pi/2$



Matter Effect:

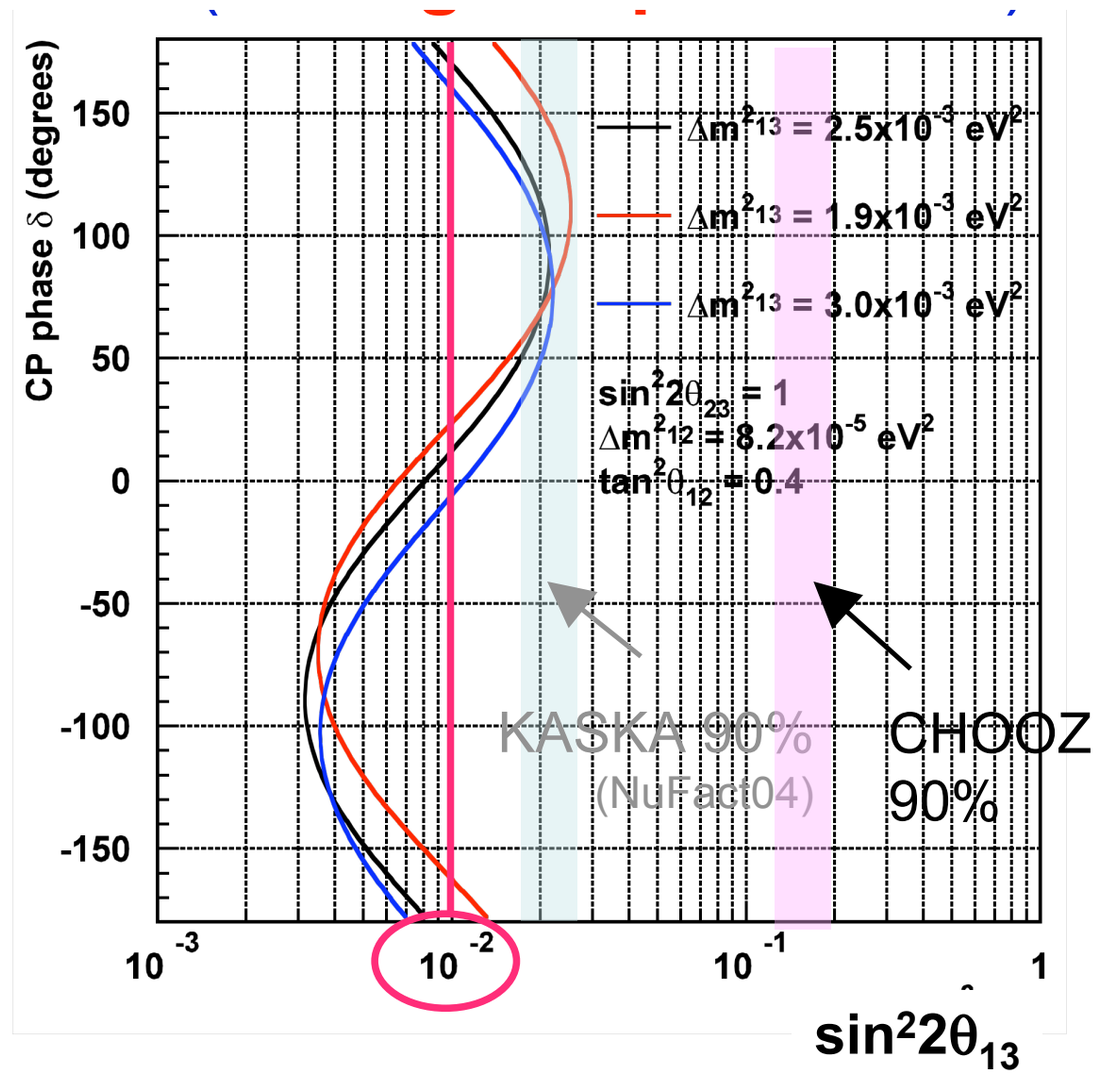


$\delta m^2_{31} > 0$

$\delta m^2_{31} < 0$

Beam 1%

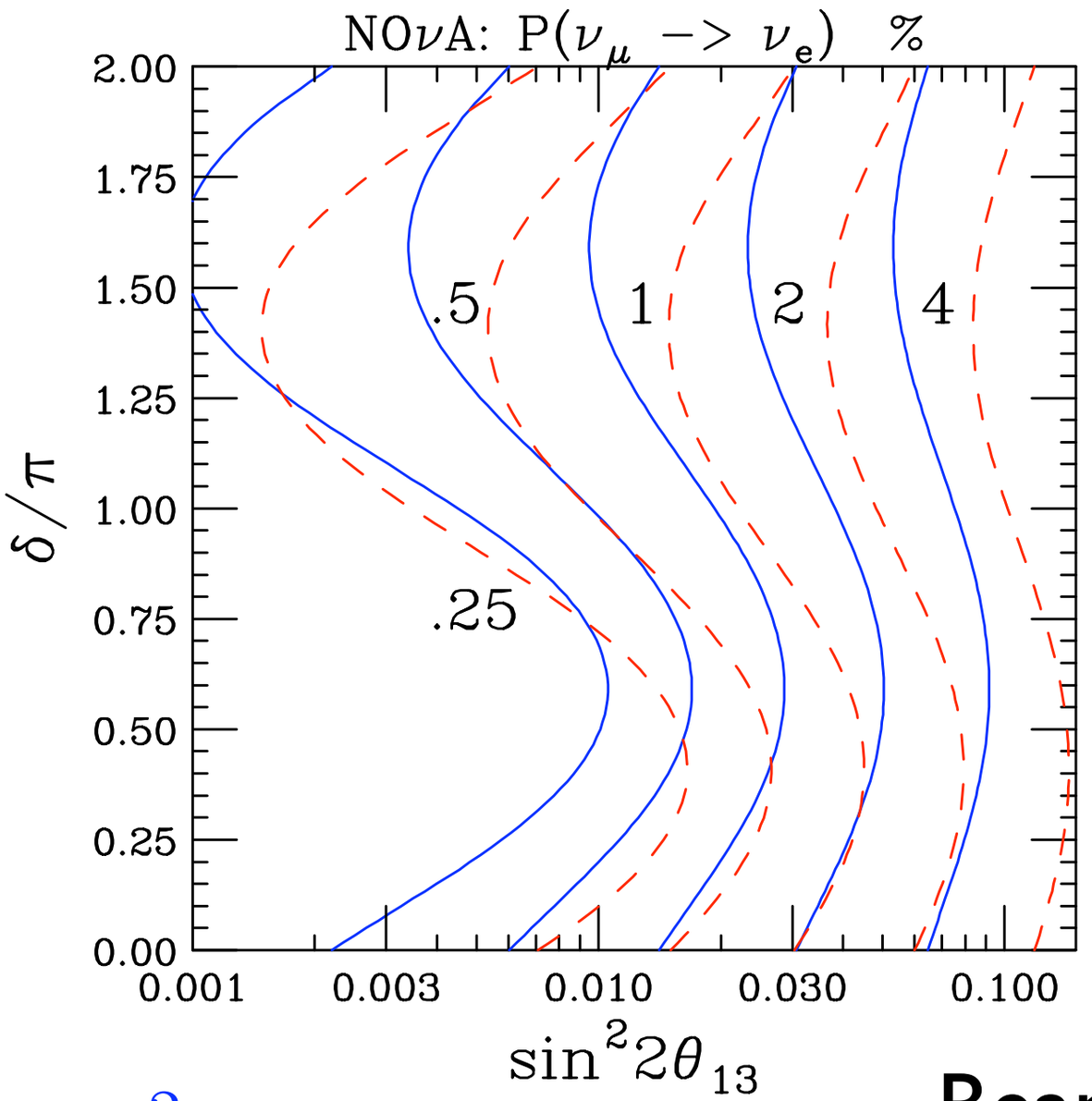
Aihara for T2K, P5 talk



Phase I

Sensitivity approx 0.5%

NOvA:

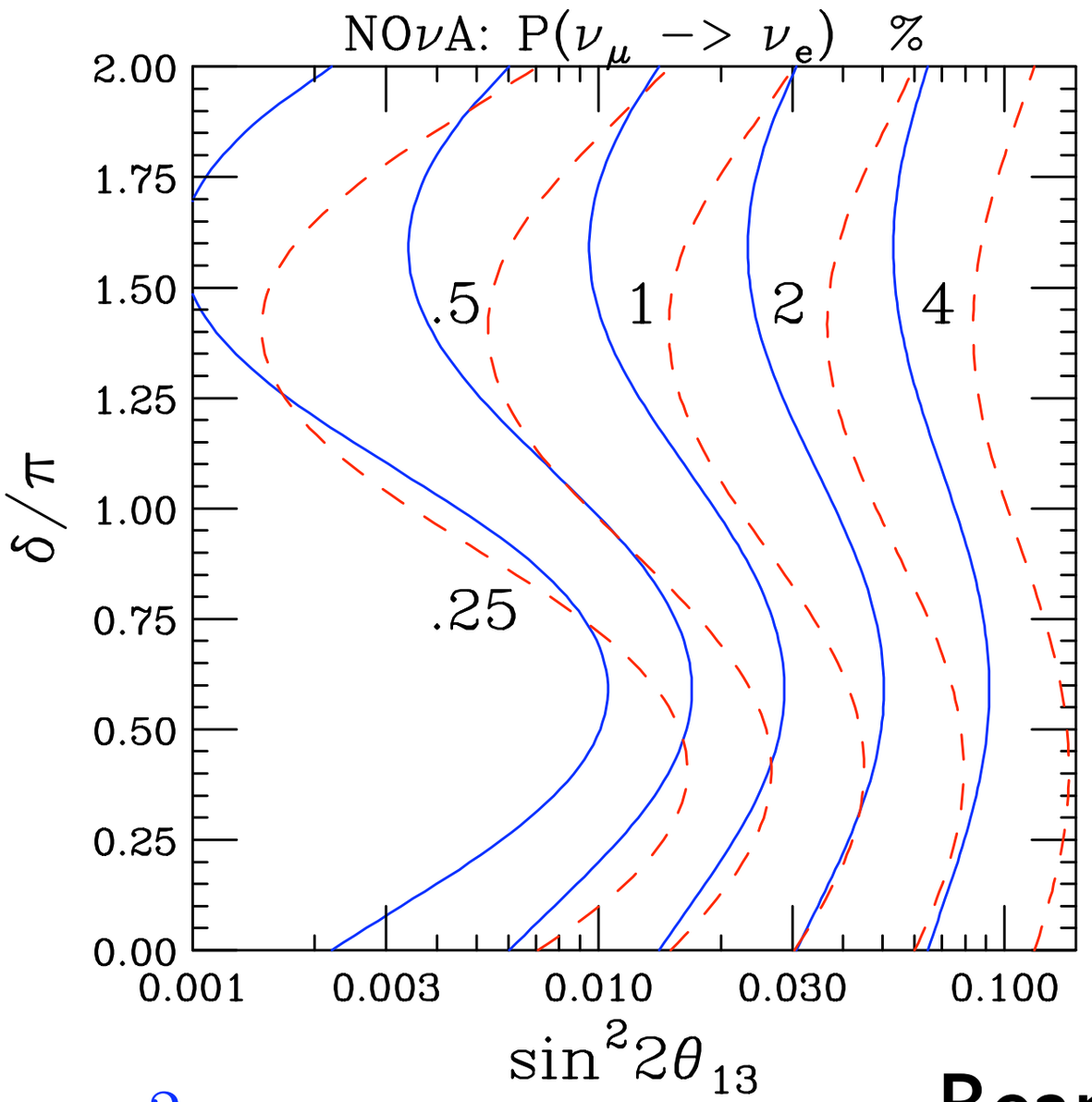


$\delta m^2_{31} > 0$

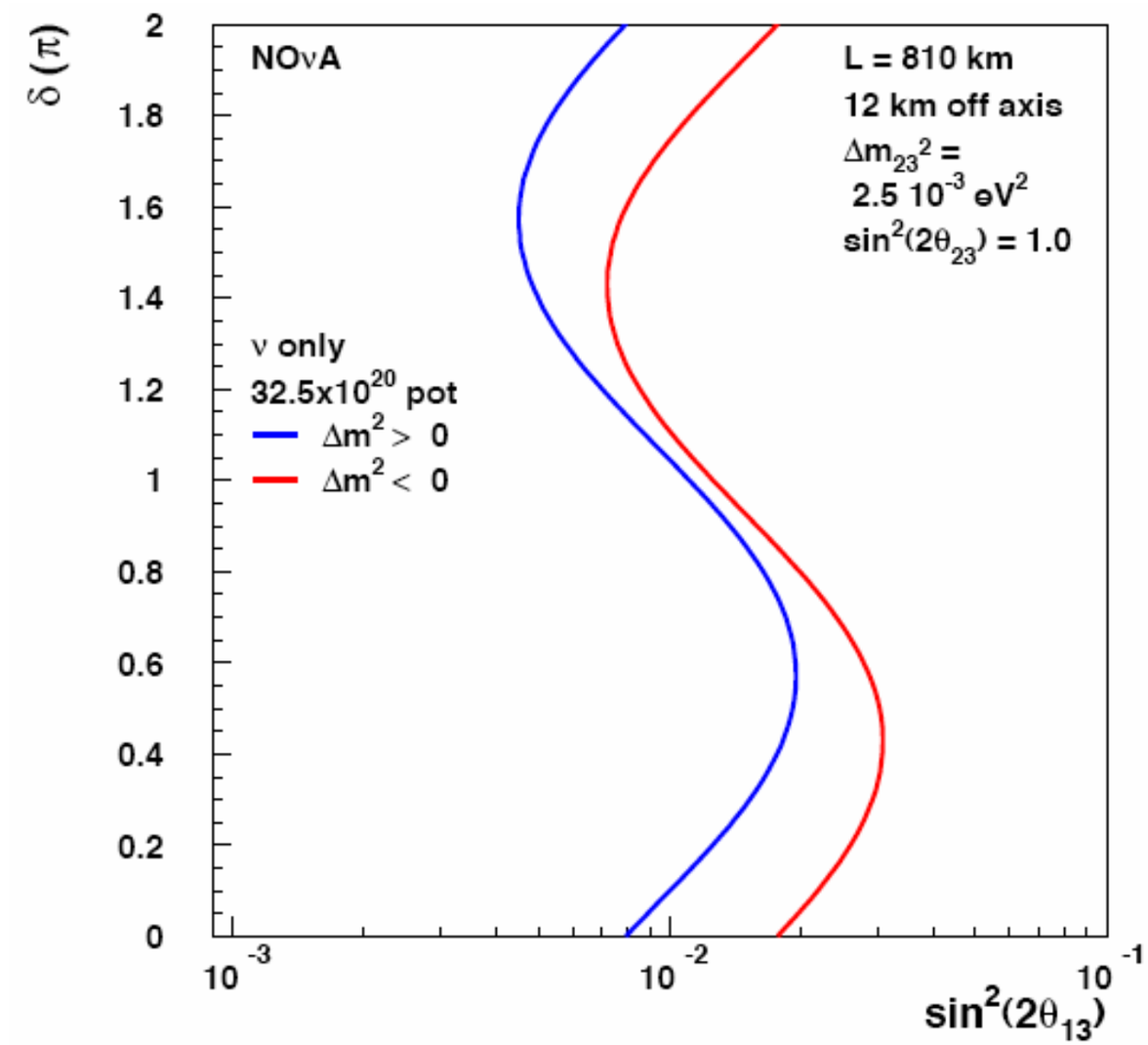
$\delta m^2_{31} < 0$

Beam 1%

NOvA:



NOvA @ NO-VE 2007



$\delta m^2_{31} > 0$

$\delta m^2_{31} < 0$

Beam 1%

Phase I

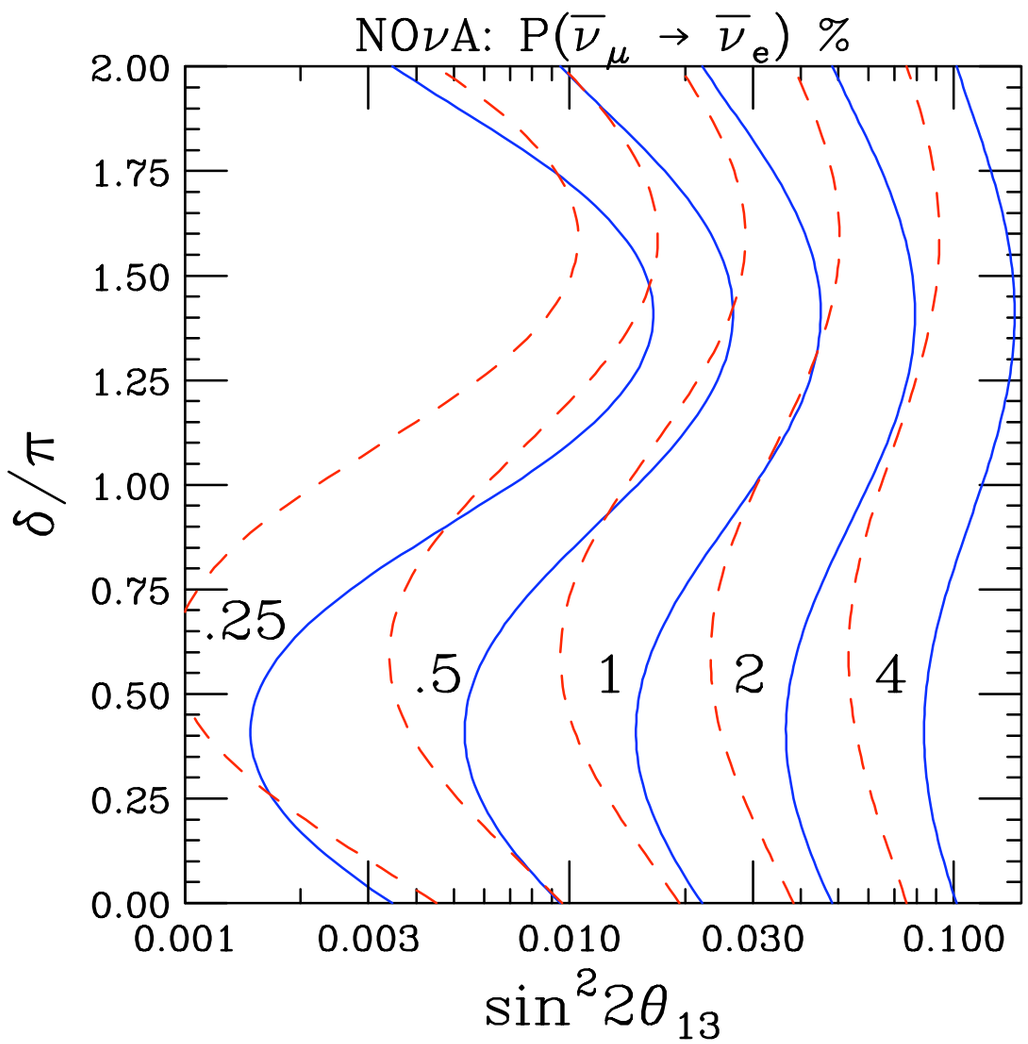
Sensitivity approx 0.5%

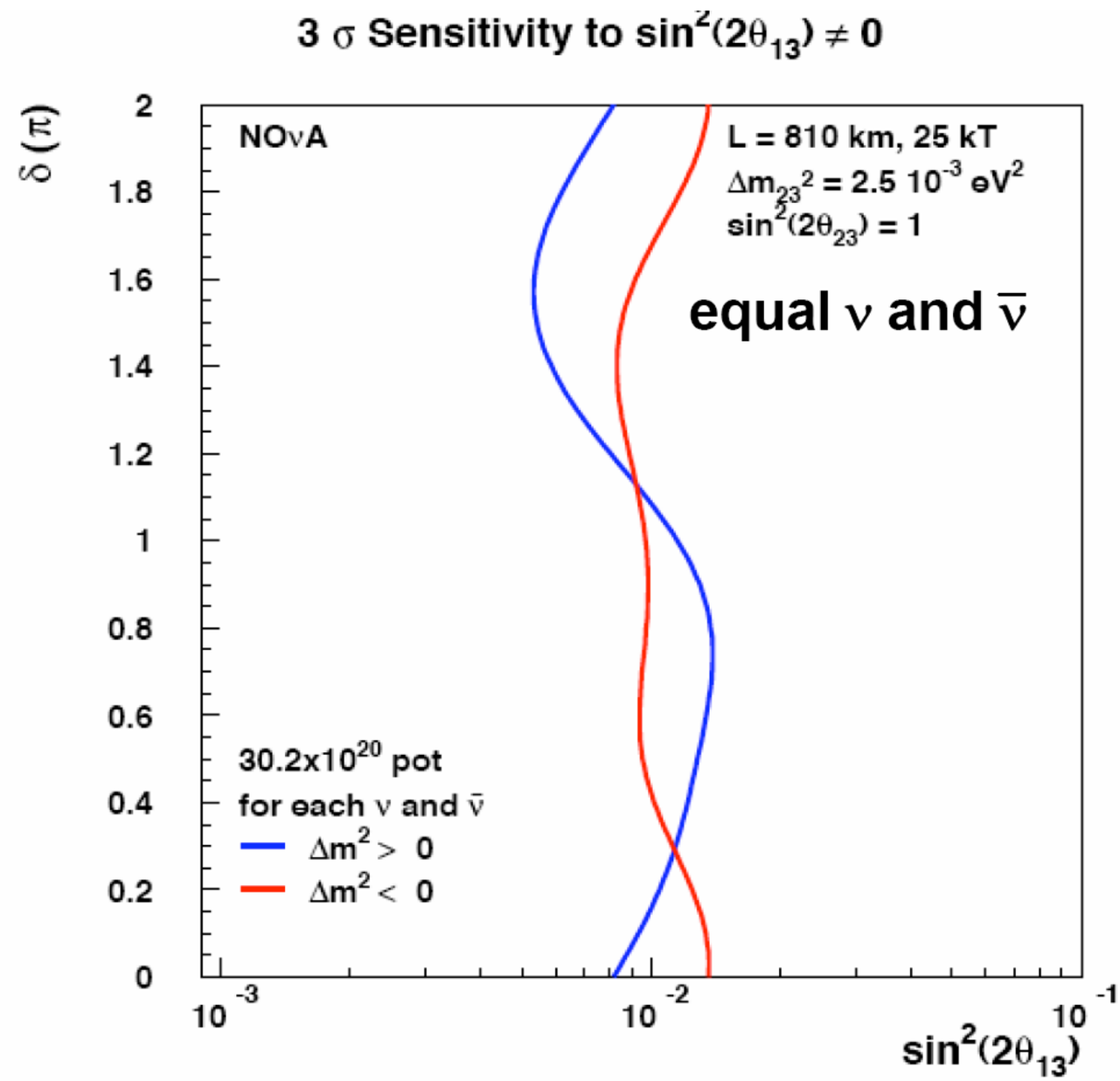
5 years with ν only run

NOvA:

$\delta m^2_{31} > 0$

$\delta m^2_{31} < 0$





Beam >1%