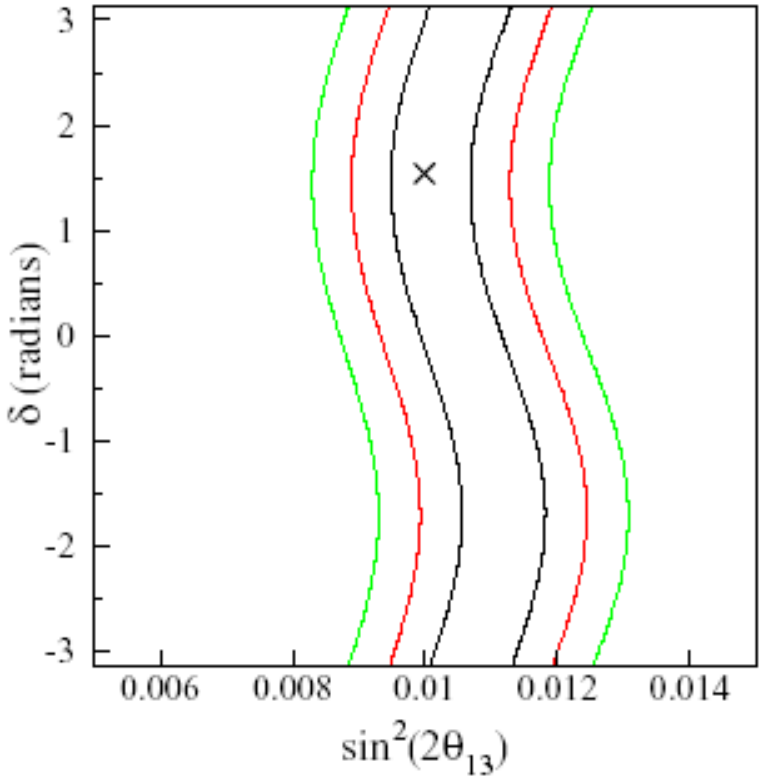
Physics of 9400 km Baseline Experiments

- Fermilab-Beijing:
  - Disappearance experiment:
    - First oscillation minimum at 17 GeV.
      - 'High energy' beam called for. Good for the event rates
      - Good energy resolution. Relatively free of the systematic uncertainties
        ➔ precise determination of the Δm^2_{23}
    - Second minimum at 5 GeV: spectacular oscillation pattern well visible.
    - Full oscillation observed ➔ decoupling of Δm^2_{23} and mixing angle determination ➔ precise determination of $\sin^2(2\theta_{23})$
  - Appearance experiment(s):
    - $\nu(\mu) \rightarrow \nu(\tau)$: systematic similar to CNGS, but the signal 40 $\times$ higher (at the oscillation maximum!)
    - $\nu(\mu) \rightarrow \nu(e)$: matter enhancement, clean determination of the mass hierarchy, relative insensitivity to CP violation

Physics of 9400 km Baseline Experiments

(cont...)

- Strong matter effect:
  - $\times$ 20 amplification in $\nu(\mu) \rightarrow \nu(e)$ probability over max in vacuum
  - $\times$ 20 improvement in S/N
  - Signal rate is ~ 200 events/Mton-year for $\sin^2(2\theta_{13}) = 0.01$.
  - Sign of ΔM^2 unambiguously determined
- Weak dependence on δ:
  - Signal compared with that from a shorter baseline **(2100 km)** can constrain δ



Constraints (1,2,3 σ) after 2 years of running and a 1 Mton detector, input parameters marked with X.

Physics of "9400 km+2100" km 2-Baseline Experiments

- Fermilab-Beijing + JPARC-Beijing:
  - Ultimate $\nu(\mu) \rightarrow \nu(e)$ appearance experiment:
    - Different energies/baselines

      ➔ different relative contributions of matter enhancements and CP violating effects

      ➔ clean determination of the neutrino oscillation parameters, breaking degeneracy of interpretation

Detector Issues

- Disappearance experiment: known beam flavor, do not need charge determination. Need
  - muon identification
  - Good energy resolution
- Appearance :
  - $\nu(\tau)$: very good granularity and high resolution (a la ICARUS)
  - $\nu(e)$:
    - good and efficient electron identification in complex inelastic events (even for the JPARC beam)
    - excellent e/π^0 separation

➔ Large Liquid Argon TPC a natural candidate ←