The Daya Bay Measurement of $\sin^2 2\theta_{13}$

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Daya Bay Collaboration

Daya Bay has measured $\sin^2 2\theta_{13} = 0.089 \pm 0.010 \pm 0.005$ with 139 days of 6 antineutrino detector (AD) data (Chinese Physics **C37**:011001 2013). Two more ADs were installed and in operation by October 2012. The statistical uncertainty in $\sin^2 2\theta_{13}$ is expected to reach the current systematic uncertainty of 0.005 in fall 2013. We have estimated improvements in the systematic uncertainty based on calibration data and increased precision that is statistical in nature. We estimate that the total uncertainty in $\sin^2 2\theta_{13}$ can be reduced to 0.006 in one year and 0.003 after 3–4 years as shown in Fig. 1.

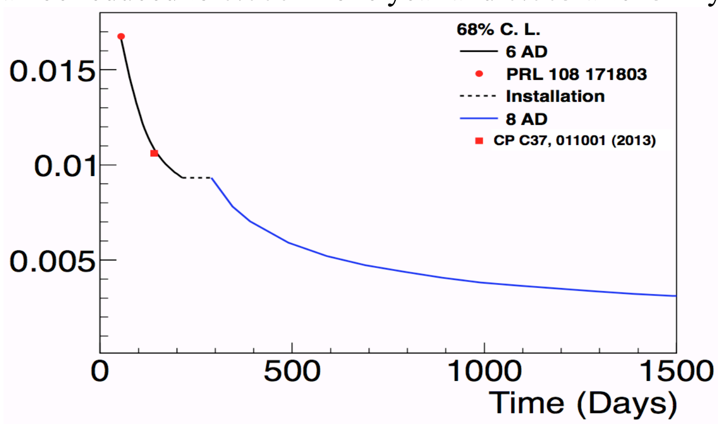

Figure 1: Projected total uncertainty in $\sin^2 2\theta_{13}$ for the Daya Bay experiment based on a rate-only measurement. A modest improvement is expected with the addition of spectral shape information.

Daya Bay's short-baseline antineutrino disappearance measurement is the most precise reactor measurement of $\sin^2 2\theta_{13}$ and will likely remain the most precise measurement of this fundamental parameter for the foreseeable future. Precise measurement of this quantity may shed light on symmetries between quarks and leptons at a fundamental level. Comparison of future long baseline accelerator measurements of θ_{13} to Daya Bay will allow precision tests of the νSM interpretation of neutrino oscillations with sensitivity to non-standard neutrino interactions and sterile neutrino scenarios. The expected improvement in $\sin^2 2\theta_{13}$ by Daya Bay will make θ_{13} the most precisely known neutrino mixing angle and extend the CP reach of long baseline accelerator experiments as shown in Fig. 2.

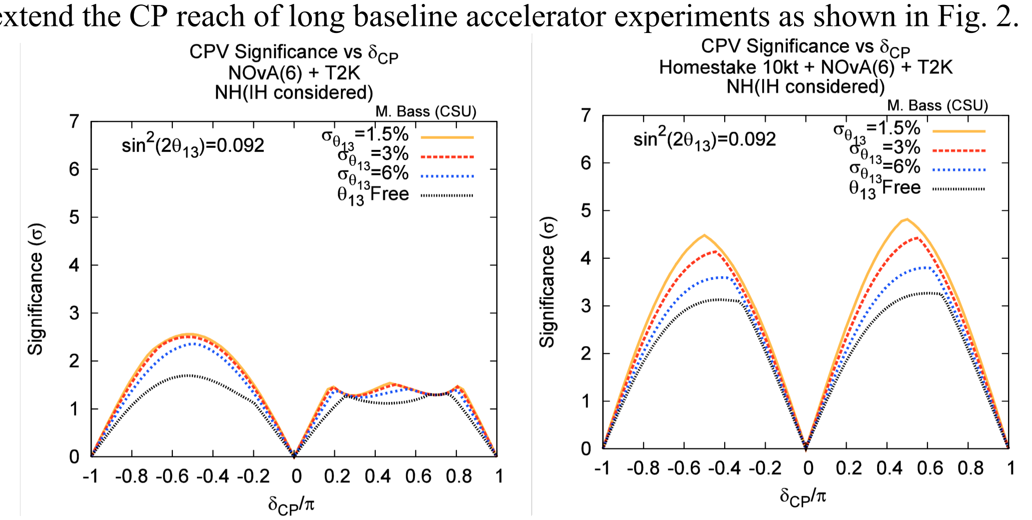

Figure 2: Significance with which CP violation can be observed, by NOvA+T2K (left) and NOvA+T2K+LBNE (right), as a function of the value of δ_{CP}. Observation of CP violation is equivalent to measuring $\delta_{CP} \neq 0, \pi$. The significance is calculated by minimizing over normal and inverted hierarchies, as the hierarchy is assumed to be unknown. The impact of θ_{13} precision is shown.

References

1. *Improved Measurement of Electron Antineutrino Disappearance at Daya Bay.*
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2. *Observation of electron-antineutrino disappearance at Daya Bay*.
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