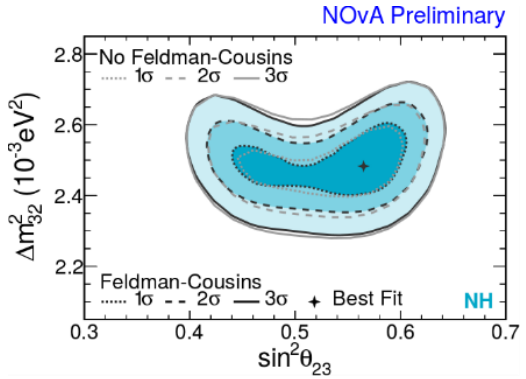
Measuring 3-flavor neutrino oscillations parameters with the NOvA experiment

Scientific Achievement

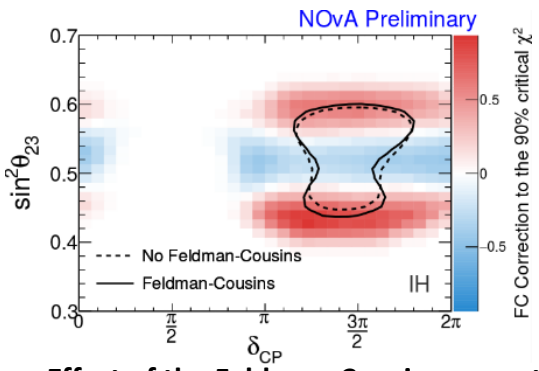
Leveraged HPC resources to perform complicated fits of neutrino oscillations data and determine confidence intervals for fundamental parameters.

Significance and Impact

World leading constraints on the neutrino mass hierarchy, the mixing angle θ_{23} and the CP violating phase δ_{CP}



Confidence intervals (1,2,3) with and without statistical corrections



Effect of the Feldman-Cousins correction on the 90% confidence contour: the blue (resp. red) areas show an increase (resp. decrease) of signficance.

Research Details

- 51 million hours consumed over two weeks for minimum disruption at NERSC.
- Would have taken one year on FNAL grid computing resources.
- Improved workflow with DIY : exploit near prefect strong scaling with hundreds of thousands of MPI ranks
- Unprecedented accuracy of statistical corrections.

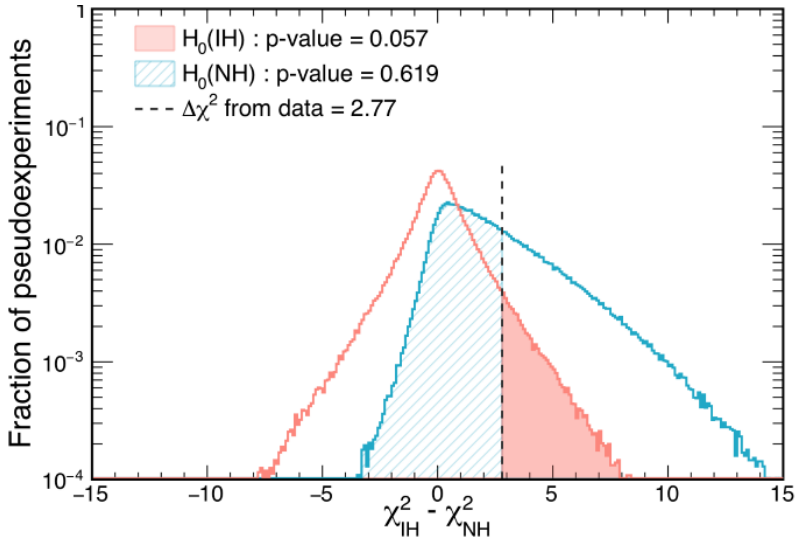


FIG. 5 CL_s pseudoexperiment distributions testing the Inverted and Normal neutrino mass hierarchy hypothesis for the 2019 NOvA datasets. Analysis required approximately 300k pseudoexperiment fits for each hypothesis to achieve a p-value of 0.057 or 1.9σ for Inverted mass hierarchy rejection.

Acero, M.A. et al. (NOvA Collaboration) (June 2019) arXiv:1906.04907

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