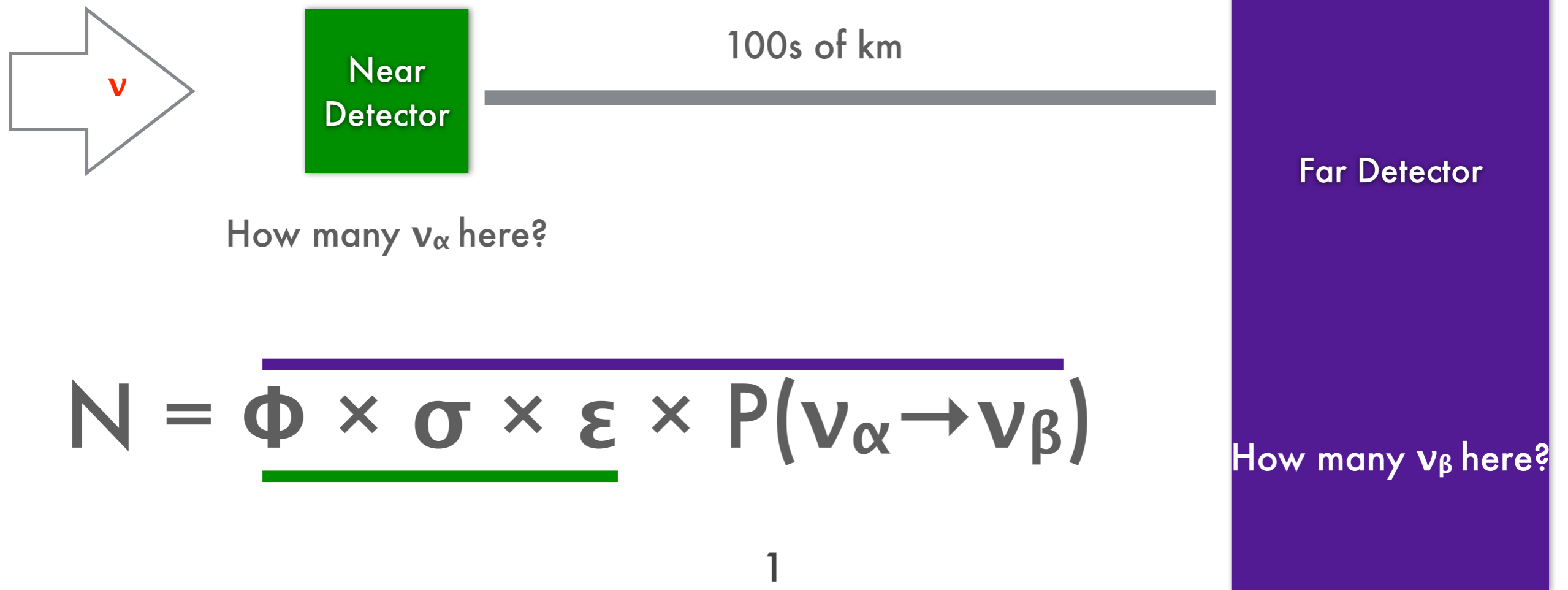
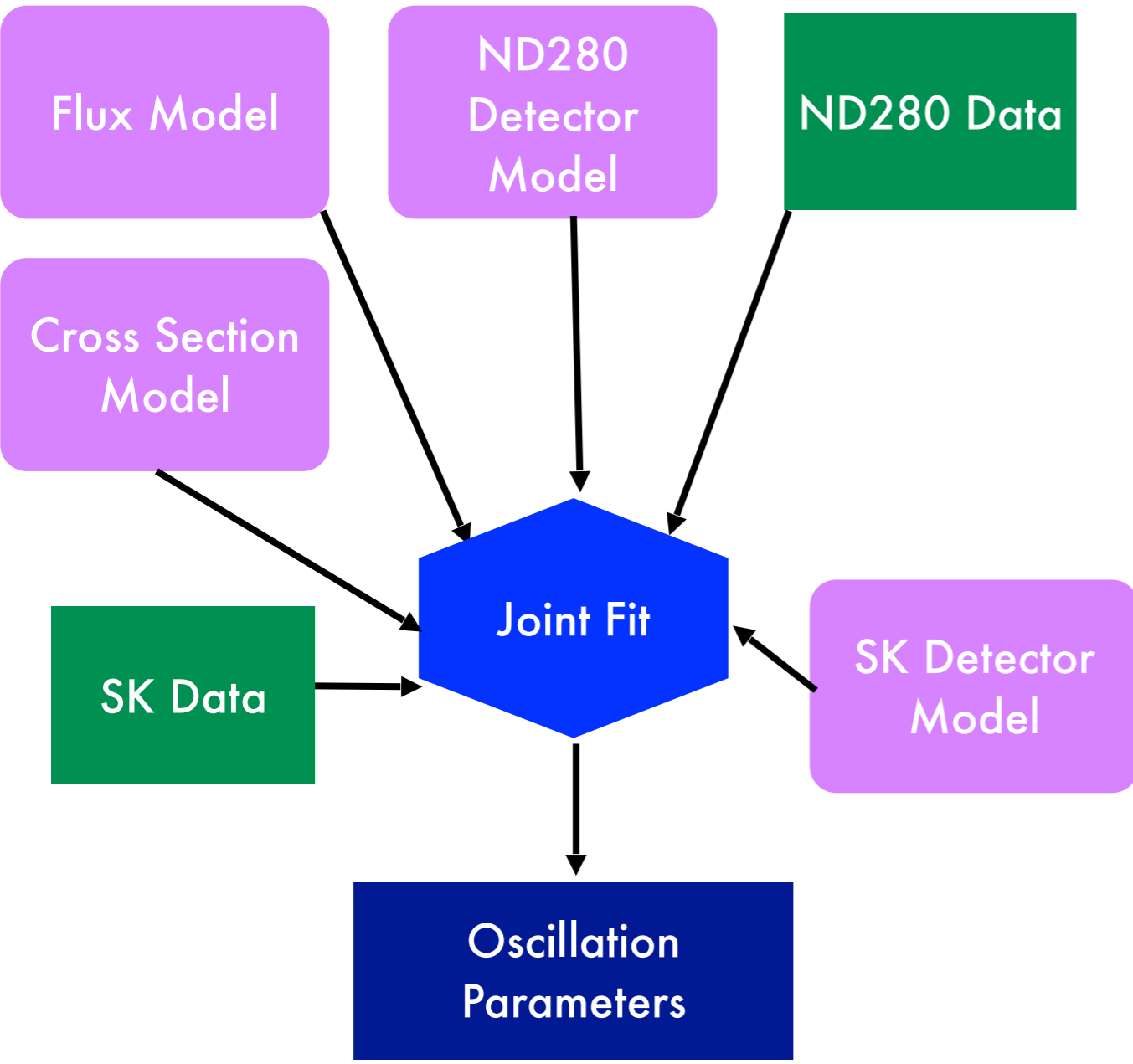


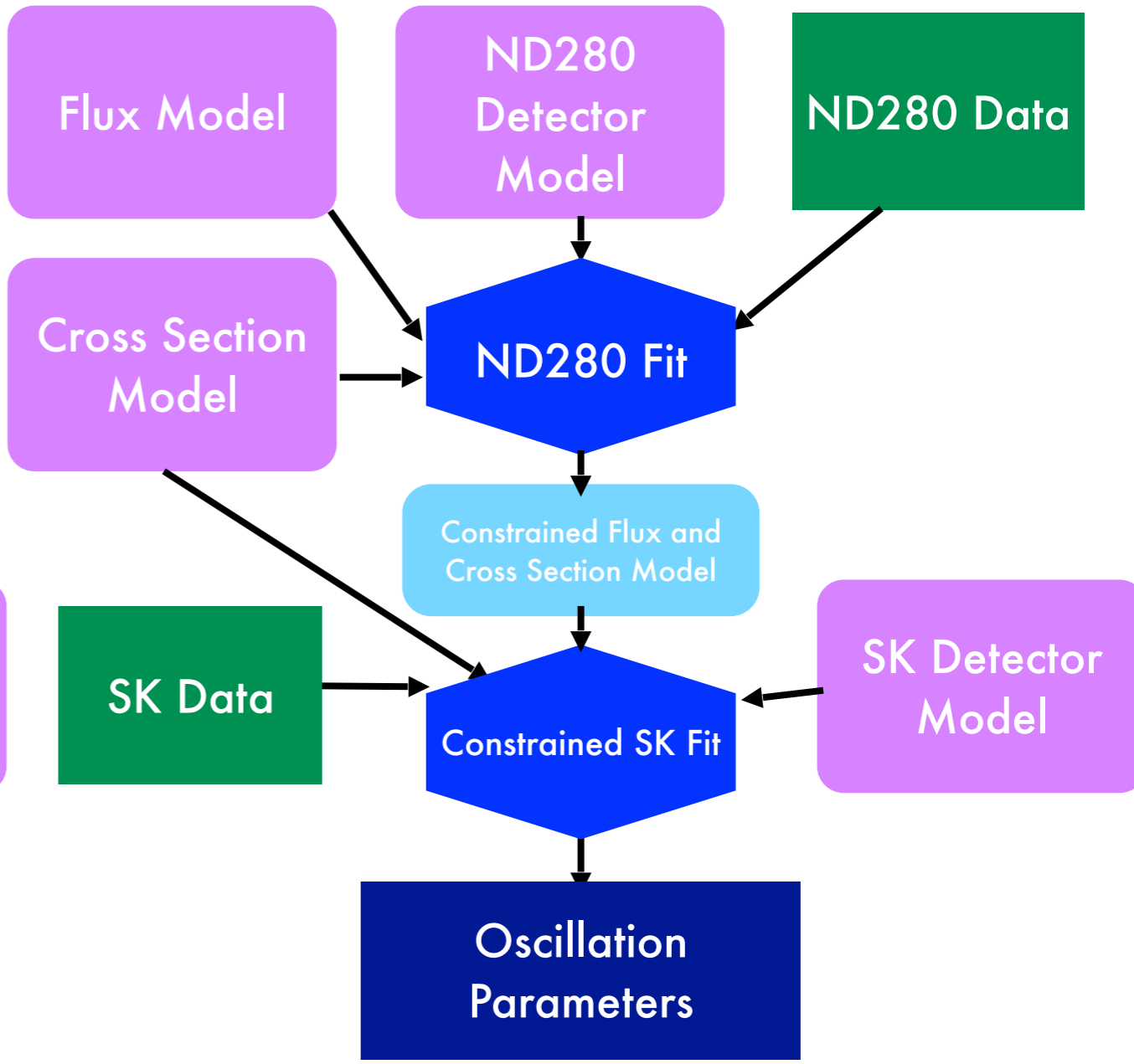
Long Baseline Experiments in a Nutshell



	Analysis 1	Analysis 2	Analysis 3
Kinematic variables for 1Re sample at SK	Erec- θ	p_e - θ	Erec- θ
Likelihood	Binned Poisson Likelihood Ratio	Binned Poisson Likelihood Ratio	Binned Poisson Likelihood Ratio
Likelihood Optimization	Markov Chain Monte Carlo	Gradient descent and grid scan	Gradient descent and grid scan
Contours/limits produced	Bayesian Credible Intervals	Frequentist Confidence Intervals with Feldman-Cousins (credible intervals supplemental)	Frequentist Confidence Intervals with Feldman-Cousins
Mass Hierarchy Analysis	Bayes factor from fraction of MCMC points in each hierarchy	Bayes factor from likelihood integration	Frequentist p-value from generated PDF
Near Detector Information	Simultaneous joint fit	Constraint Matrix	Constraint Matrix
Systematics Handling	Simultaneous fit then marginalization	Marginalization during fit	Marginalization during fit



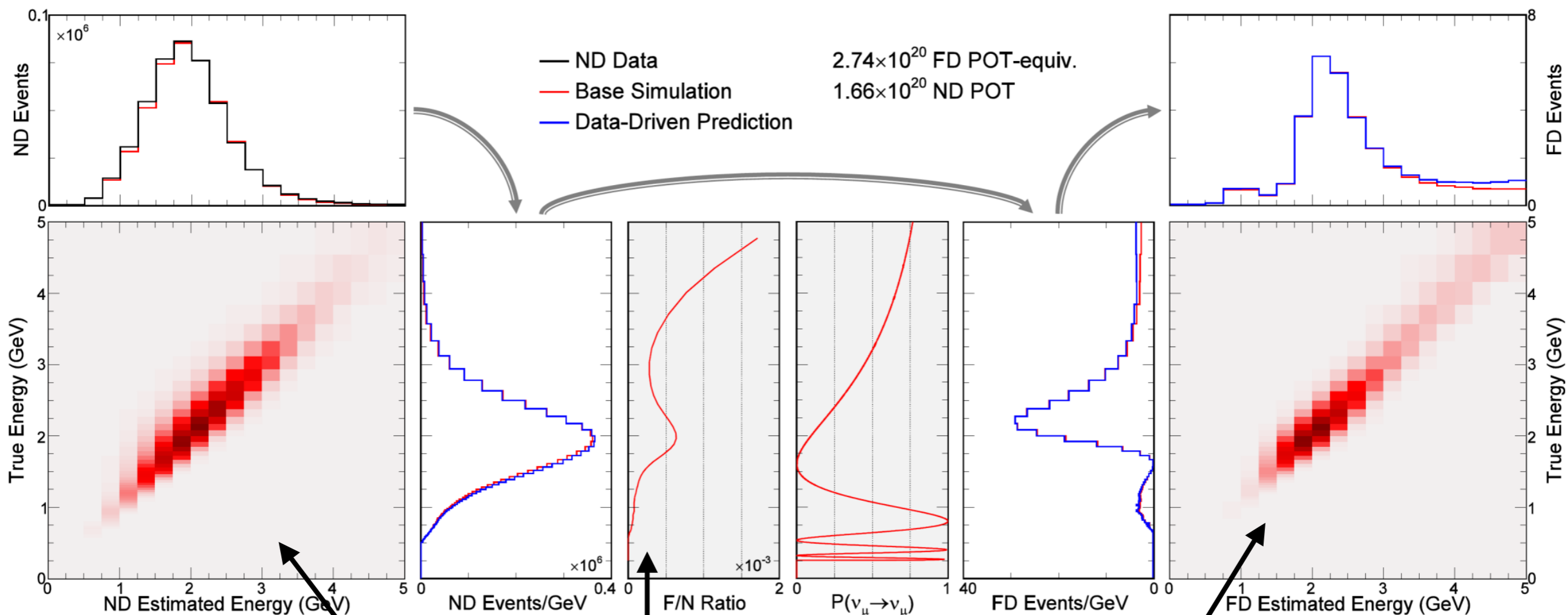
Joint Fit



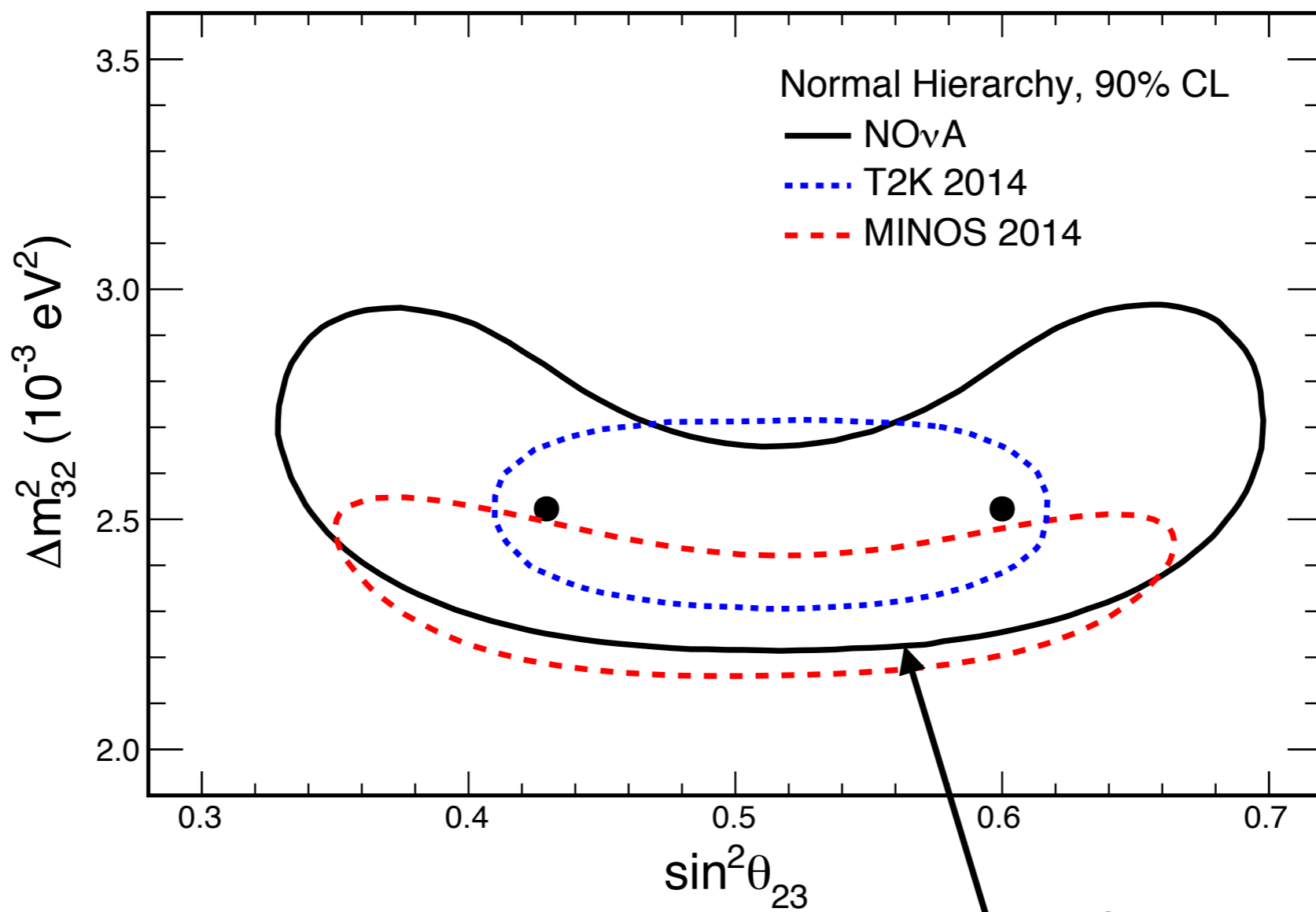
Separate ND and SK Fits

Select CC inclusive

Select CC inclusive

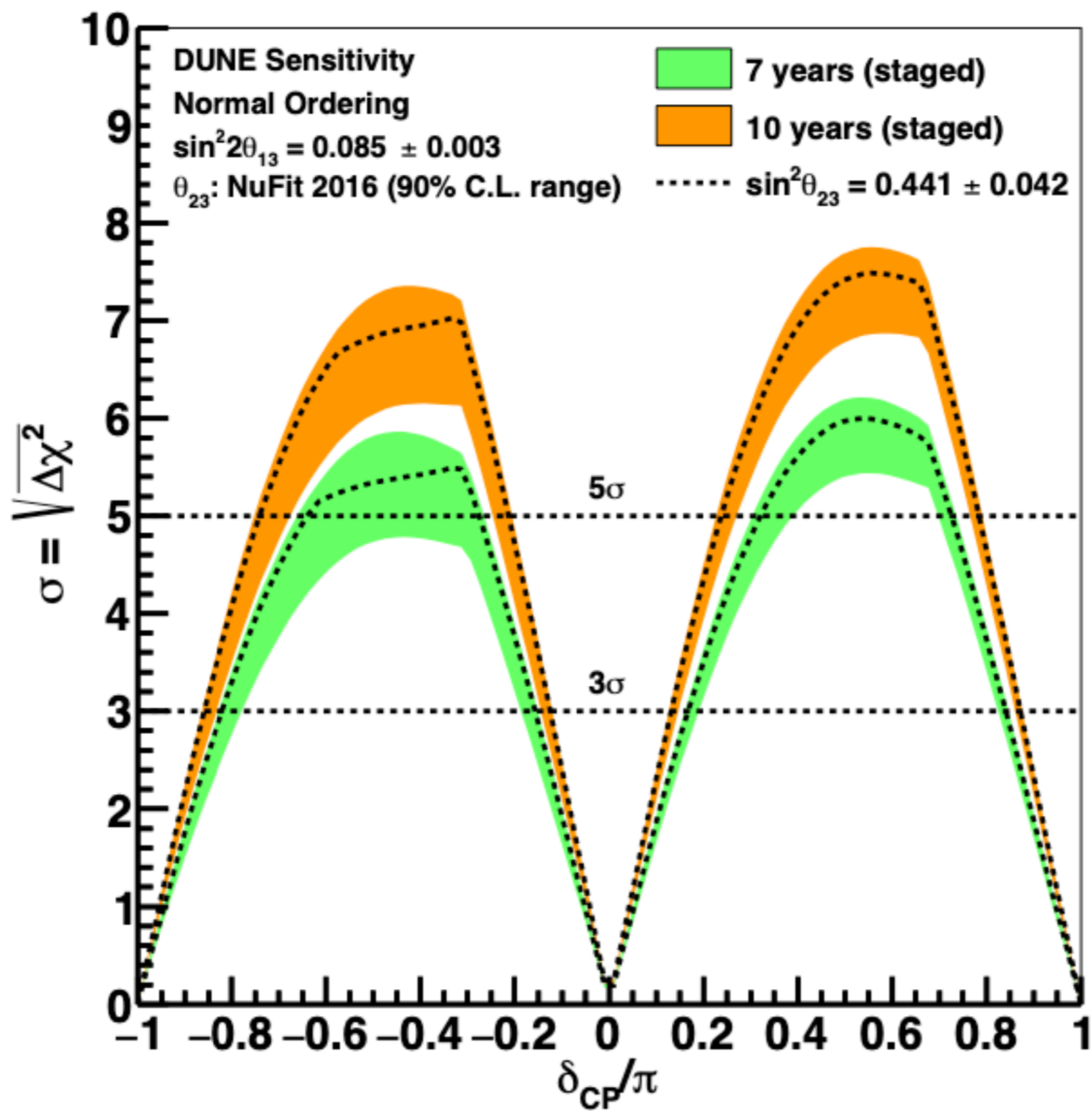


Estimated from simulation
Use a binned ML method



Adamson, P., et al. "First measurement of muon-neutrino disappearance in NOvA." *arXiv preprint arXiv:1601.05037* (2016).

confidence level contours
 Feldman-Cousins
 Profiling treatment of systematics
 Gradient descent



Reading List

1. Basic Textbooks

1.1. Cowan, Glen. Statistical data analysis. Oxford university press, 1998. (written by a particle physicist, website for the book has lots of examples)

1.2. Gelman, Andrew, et al. Bayesian data analysis. CRC press, 2013. (not written by a physicist, lots of good MCMC info)

1.3. Bishop, Christopher M. Pattern recognition and machine learning. Springer, 2006.

2. Conferences/Summer Schools

2.1. The PhyStat series covers 20 years of thinking of statistics in particle physics

2.2. There is a yearly machine learning summer school