

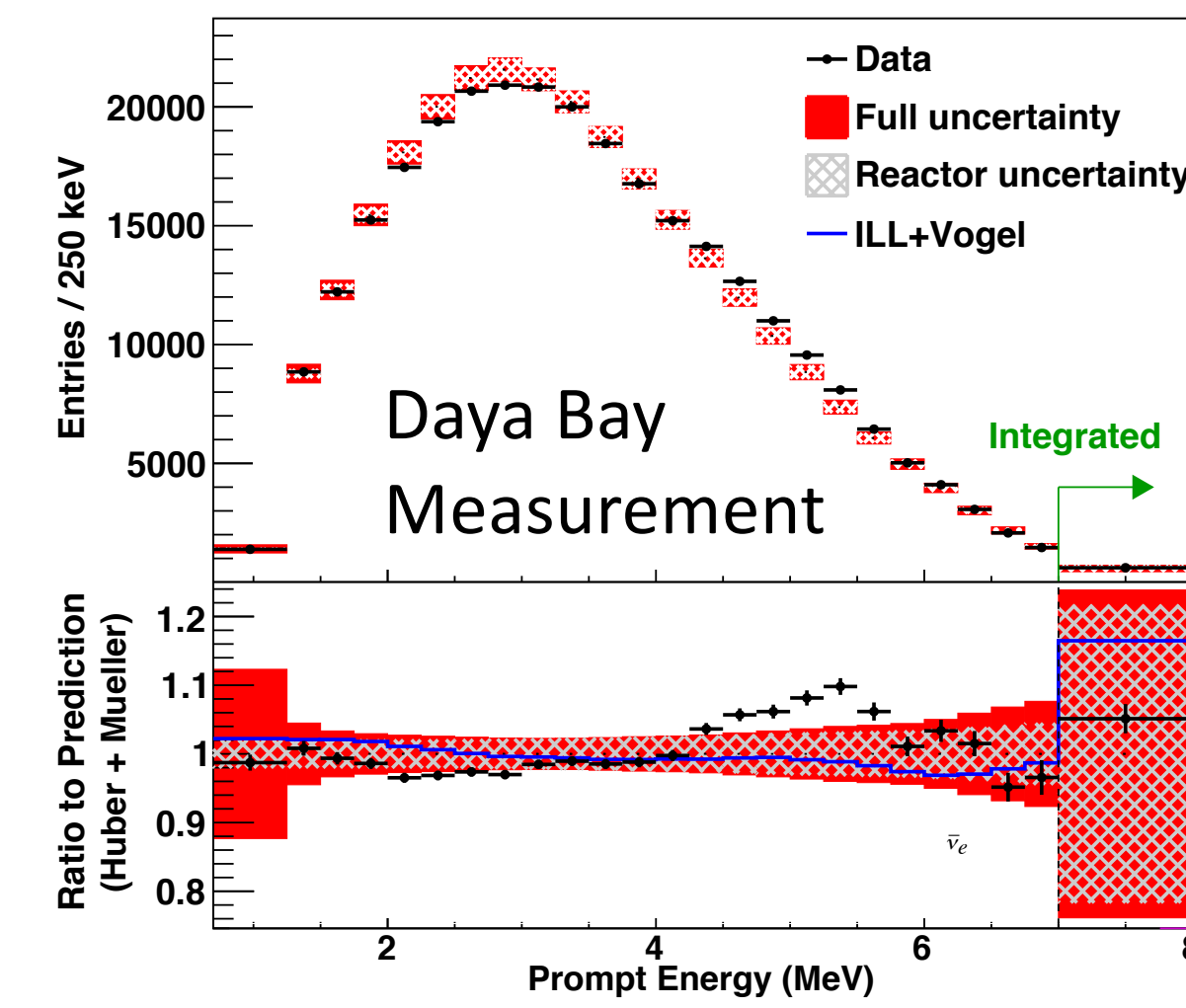
Towards a Joint Constraint of the ^{235}U Reactor Antineutrino Spectrum by Combining the Daya Bay, PROSPECT, and STEREO Measurements

Jeremy Gaison* for the Daya Bay, PROSPECT, and STEREO collaborations



Precision Reactor Neutrino Measurements Needed

- Spectral distortions from model measured in previous experiments
- Measurements made in LEU reactors with mixture of fuel isotopes
- HEU reactor measurements allow for direct measurements of ^{235}U
- **Contributions from individual isotopic fuels like ^{235}U crucial in constraining theoretical models**



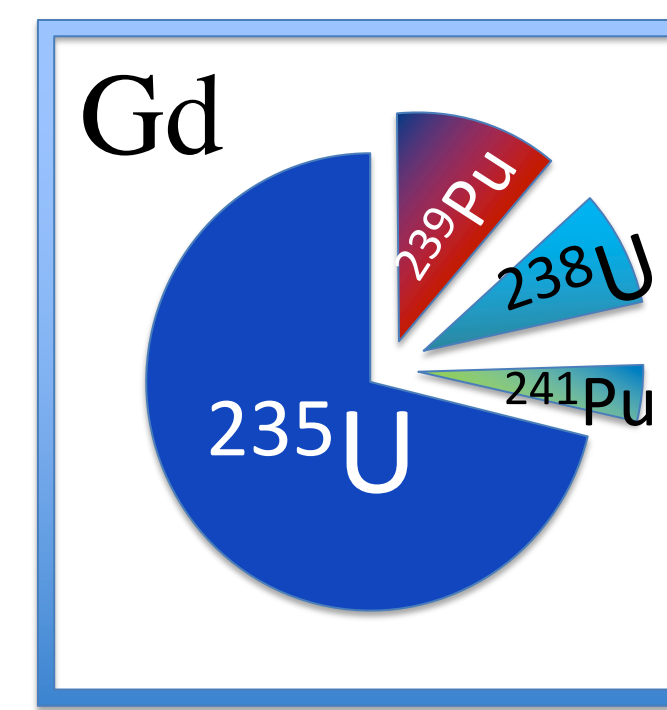
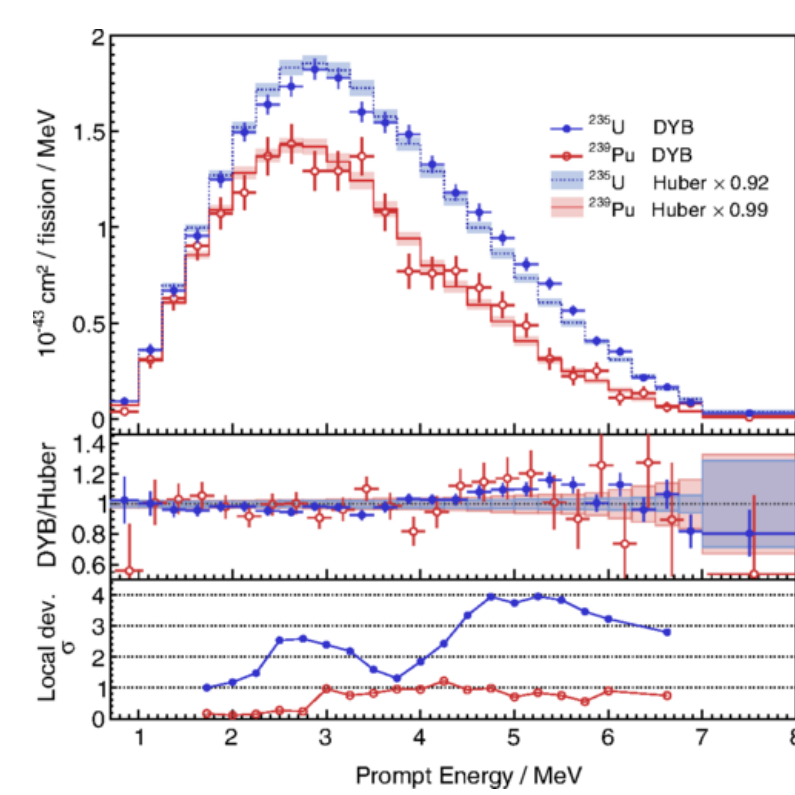
F. P. An et al., Ch Phys C 41, 1

Individual Experiments Contribute Complementary Measurement Strategies

Daya Bay

- Multiple monolithic detectors
- 3.5 million antineutrinos
- Gd-doped scintillator
- ^{235}U spectrum extracted from deconvolution of measured spectrum vs isotope fission fraction of LEU reactors

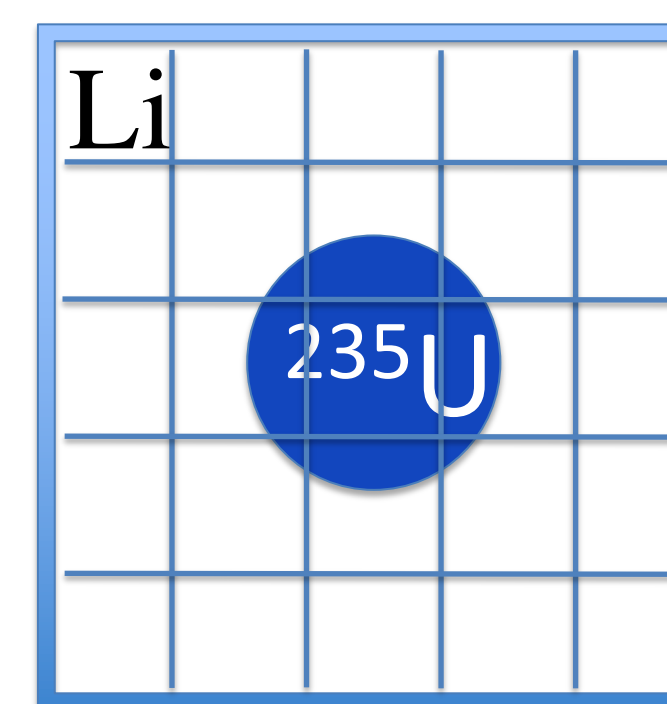
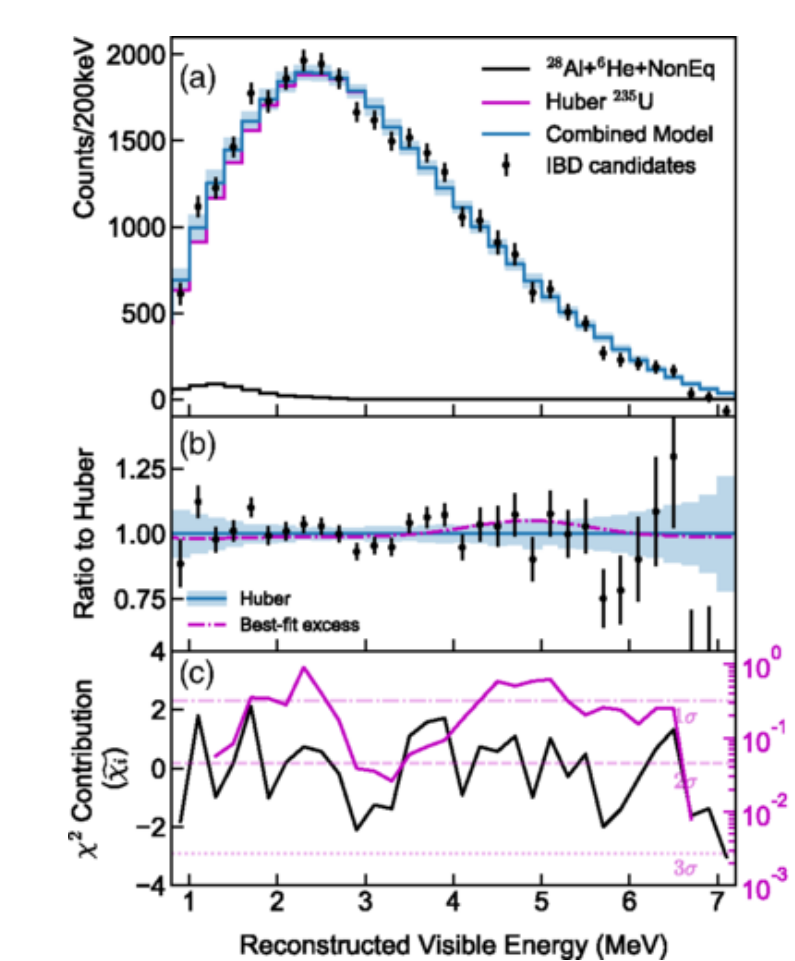
[D. Adey et al., Phys Rev Lett 123, 111801](https://arxiv.org/abs/1708.07461)



PROSPECT

- Single segmented detector
- 50,000 antineutrinos
- Li-loaded liquid scintillator
- ~10m from HEU reactor, direct measurement of ^{235}U

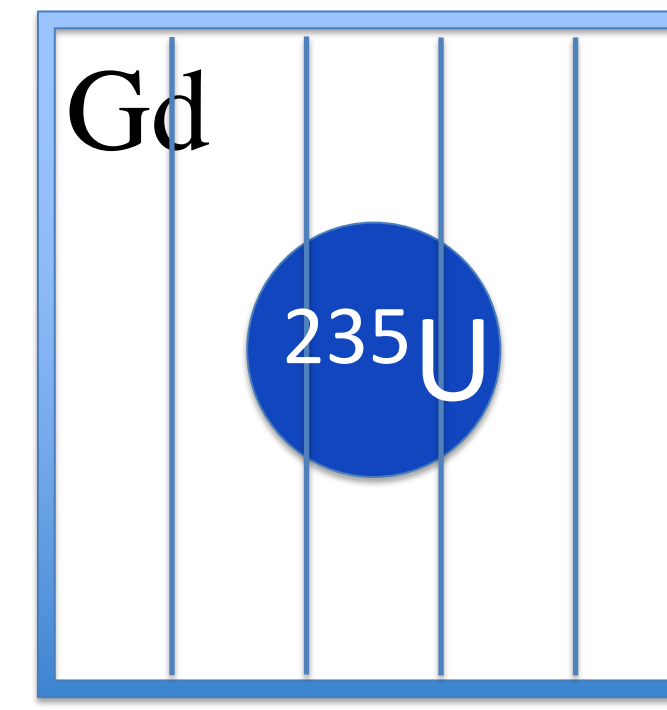
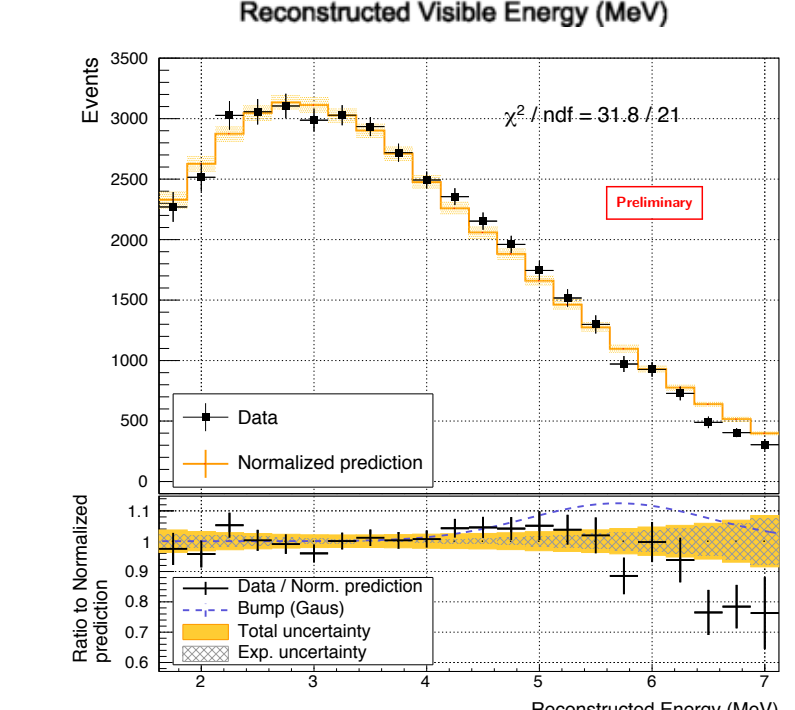
<https://prospect.yale.edu/LatestResults>



STEREO

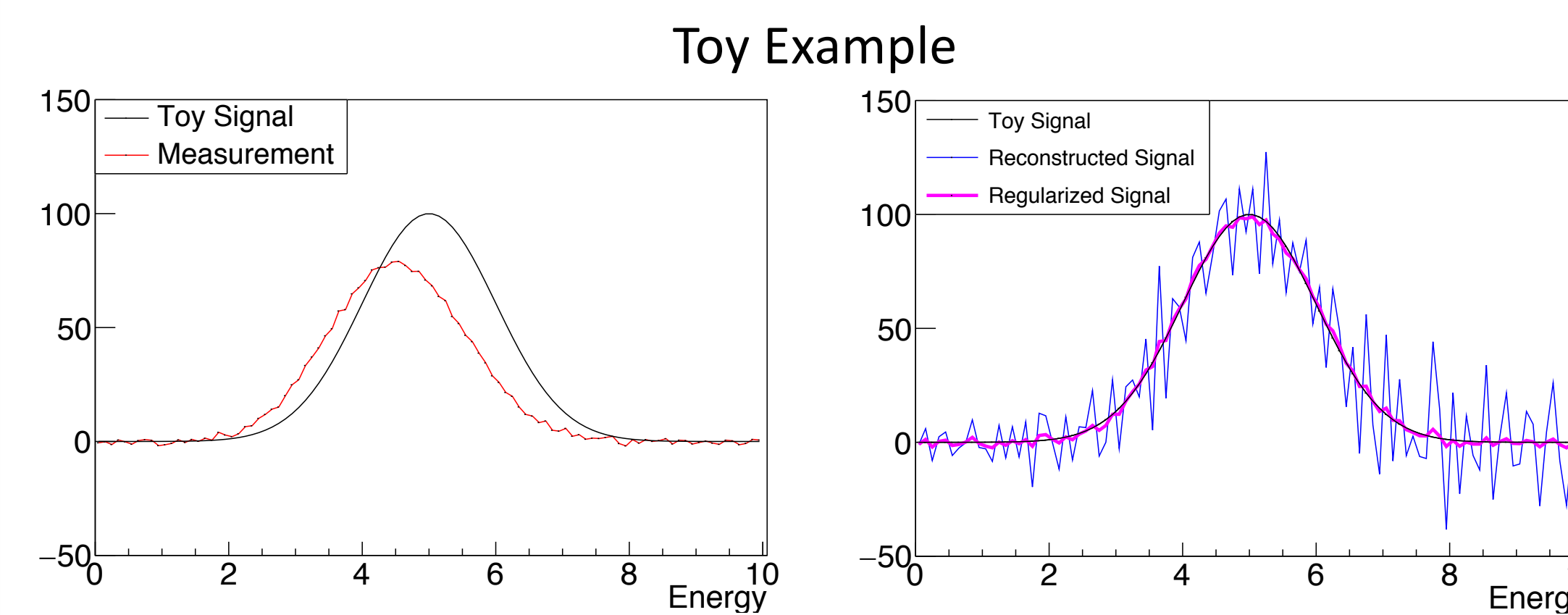
- Single segmented detector
- 43,000 antineutrinos
- Gd-loaded liquid scintillator
- ~10m from HEU reactor, direct measurement of ^{235}U

<https://www.stereo-experiment.org/publications.php>



Data Unfolding Allows for Direct Comparison of Measurements in Different Energy Spaces

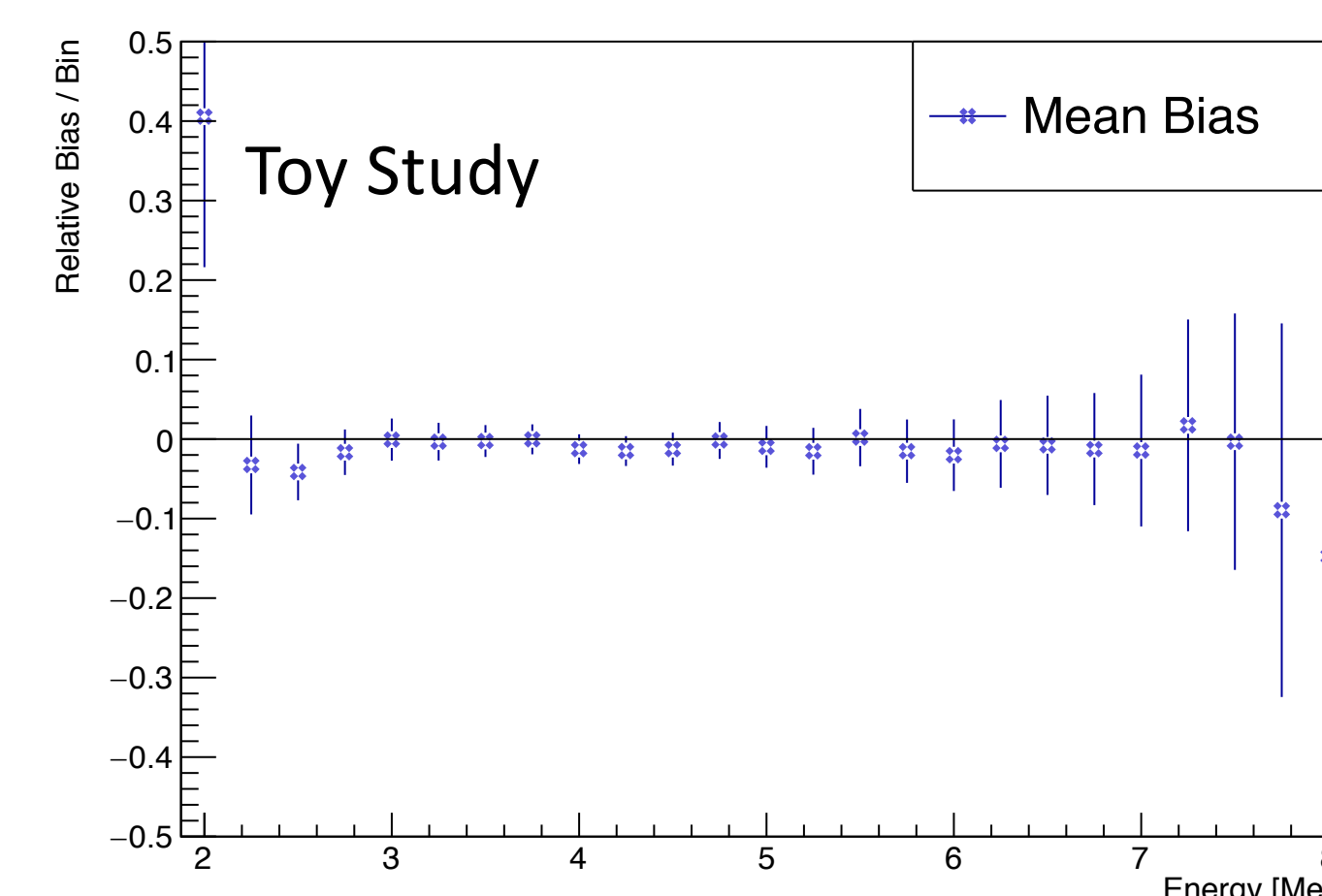
- Unfold data from measured prompt energy space into antineutrino energy space
- Reconstruction via inverse response without regularization amplifies statistical fluctuations



- Utilize Wiener-SVD[†] technique for data unfolding and selection of regularization parameter

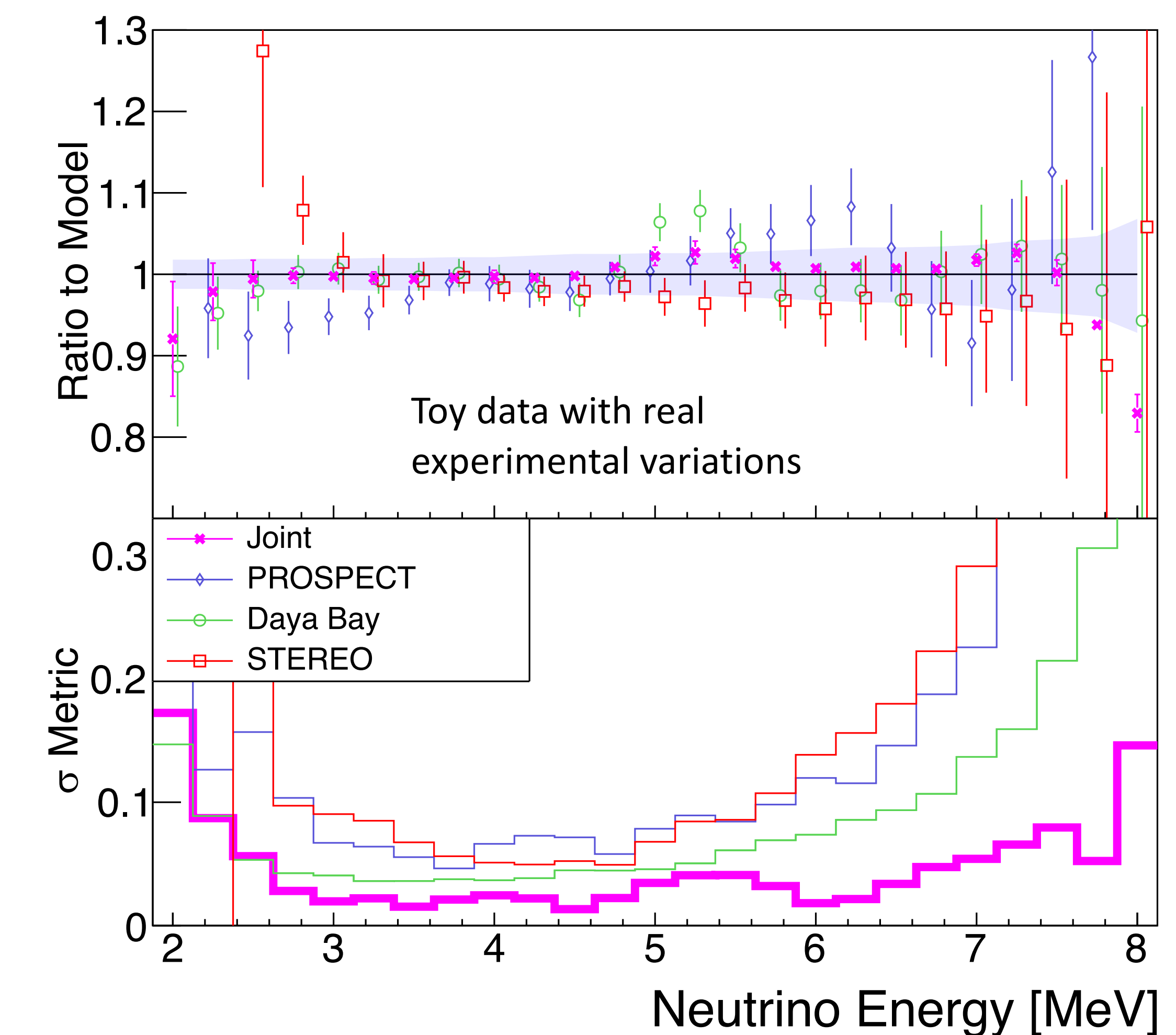
[†]W. Tang et al, JINST 12, P10002 (2017)

Uncertainty from Data Unfolding is Minimized with Wiener-SVD Regularization



- Average over 1000 toys used to demonstrate effectiveness of Wiener-SVD unfolding for each data set
- **Regularized unfolding suppresses fluctuations while keeping bias to order 1-2% percent for majority of fission spectrum**

Combination of Measurements Leads to Increased Spectral Precision



Error bars based on diagonal elements of full covariance matrix

Significant increase in precision when combining all measurements

- Joint measurement uses shape constraints from each experiment with relative normalization allowed
- Unfolded uncertainty has strong bin-to-bin correlations
- Sigma metric is sum over all independent and correlated uncertainties to better reflect the uncertainty space

$$\sigma = \sqrt{\sum_i |V_{ij}|}$$

Collaborations



Funded by



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