Updated Measurement of the ^{235}U Antineutrino Spectrum by PROSPECT

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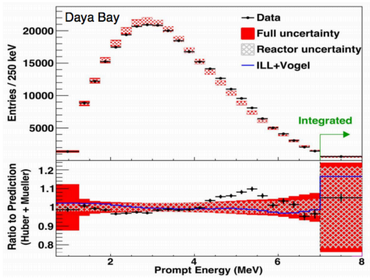
Power Reactor Bump Measurements

Daya Bay and other experiments at power reactors measure an **event excess ('bump')** in the antineutrino spectrum relative to leading reactor models. *Phys. Rev. Lett. 116, 061801, 2016, Daya Bay*

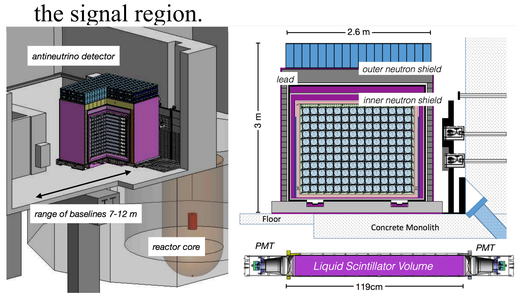


While the detected events in these experiments come from a variety of isotopes, PROSPECT measures antineutrinos from a research reactor so that >90% of the flux comes from ^{235}U.

Detector Setup

The PROSPECT detector consists of 154 optically separated segments sandwiched by photomultiplier tubes and filled with liquid scintillator, and has an **energy resolution** of $<5\%/\sqrt{E}$.

Fiducialization, particle identification, shower vetoing, and other analysis cuts allows PROSPECT to achieve a **>1:1 signal-to-background ratio** in the signal region.



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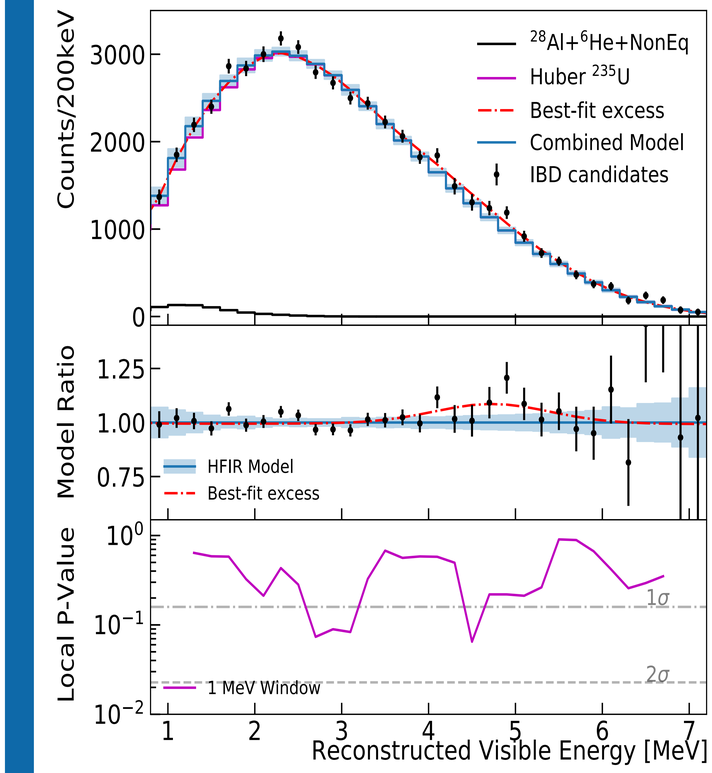
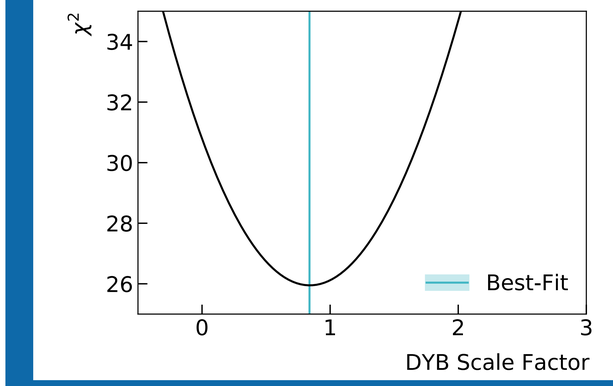
The PROSPECT antineutrino spectrum is in **good agreement** with the Huber model. We **disfavor** the "**No Bump**" and "**All ^{235}U**" hypotheses for event excess at over 2σ.

Comparison to Huber



Shape Analysis



Results

- **50559 ± 406 events** with **1.4 signal-to-background** ratio.
- 82 days RxOn, 65 days RxOff exposure
- Comparison with Huber gives χ^2/d. o. f. of **30.79/31.**
- **Good agreement (<2σ)** with Huber within all 1MeV-wide regions
- Best-fit excess of **0.84±0.39***, giving a χ^2/d. o. f. improvement of **4.84** over the no-bump case.
- **Disfavor no-bump and all-^{235}U cases at over 2σ.**

*Relative to Daya-Bay, assuming equal-isotope hypothesis. 1.0 would be a Daya-Bay sized bump

Also check out these other PROSPECT Posters:

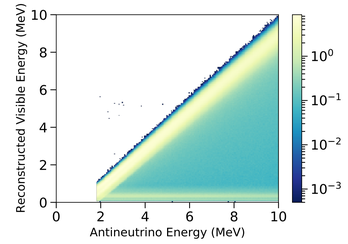
- 158: Updated Event Selection for the PROSPECT Experiment
- 408: PROSPECT: Latest Results for Sterile Neutrino Oscillation Search
- 527: Detector Characterization and Calibration for PROSPECT
- 540: PROSPECT Experiment Upgrade and Science Goals
- 556: Towards a Joint Measurement of the 235U Reactor Antineutrino Spectrum by the Daya Bay, PROSPECT, and STEREO Experiments

PROSPECT

Paper: https://prospect.yale.edu/LatestResults

Detector Response and Uncertainty Treatment

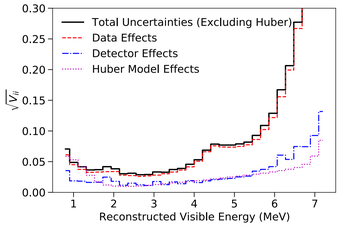
By modelling the PROSPECT detector in Geant4 and optimizing simulation parameters with calibration, we can produce simulations that accurately reflect all detector and analysis. We use this to build a response matrix which can convert models in true neutrino energy to terms of PROSPECT's reconstructed visible energy.



We use covariance matrices to quantify our uncertainties:

- Matrices generated by creating MC toys while varying the relevant parameter
- Data effects include statistics, background normalization, and veto uncertainties
- Model effects include, ^{28}Al and ^{6}He activation and non-equilibrium uncertainties
- Detector effects include energy scaling, energy loss, resolution, panel thickness, fiducialization, and energy thresholds uncertainties

Currently, PROSPECT is still **statistics-limited** in its measurement



Acknowledgements:

This material is based upon work supported by the U.S. Department of Energy Office of Science and the Heising-Simons Foundation.

Additional support is provided by BNL, Illinois Institute of Technology, LLNL, NIST, ORNL, Temple University, Yale University and University of Hawaii.

Supported By: U.S. Department of Energy Office of Science; Heising-Simons Foundation