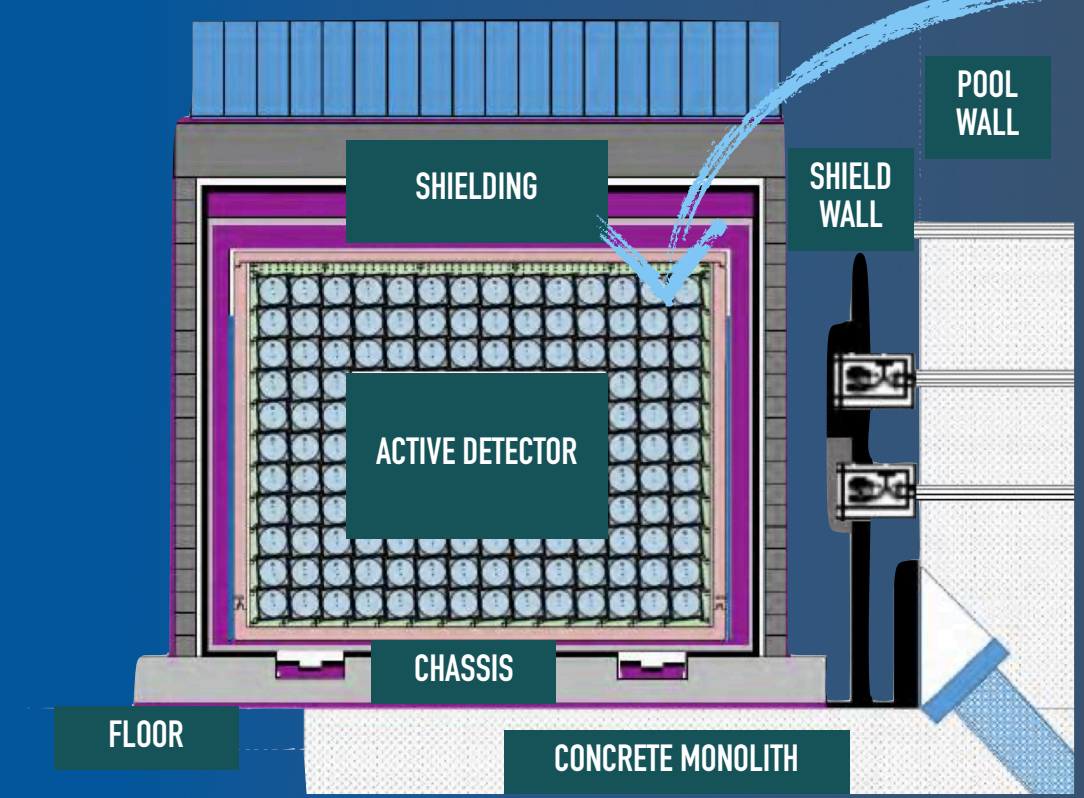


FINAL SPECTRUM, FLUX AND DIRECTIONALITY ANALYSES OF PROSPECT



by Cristian Roca on behalf of the PROSPECT collaboration

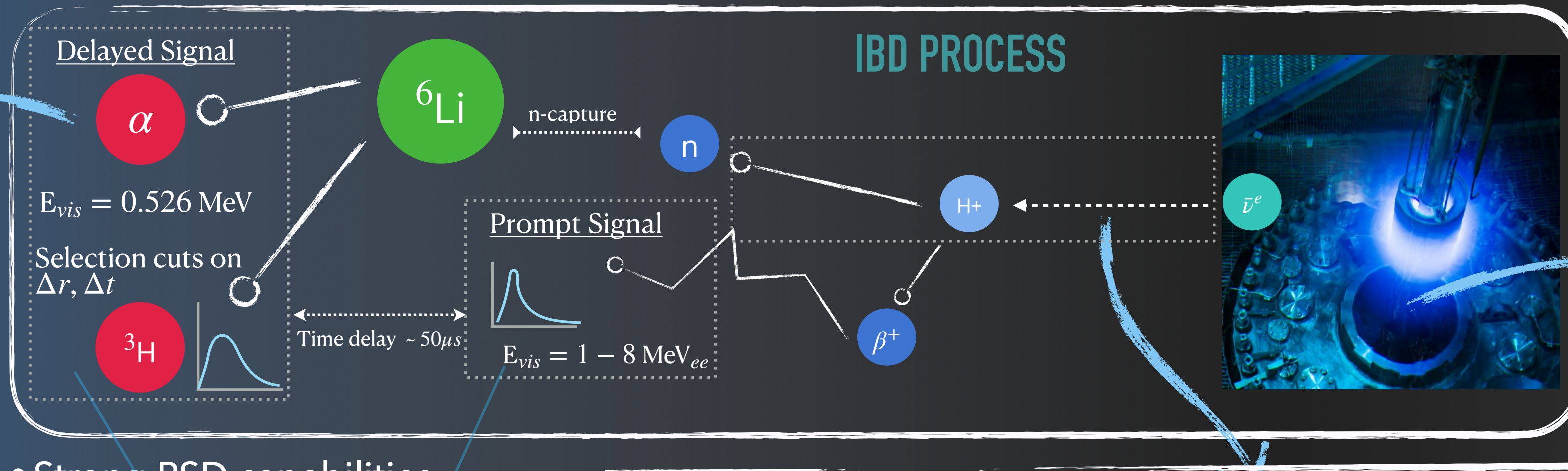
PROSPECT OUR DETECTOR



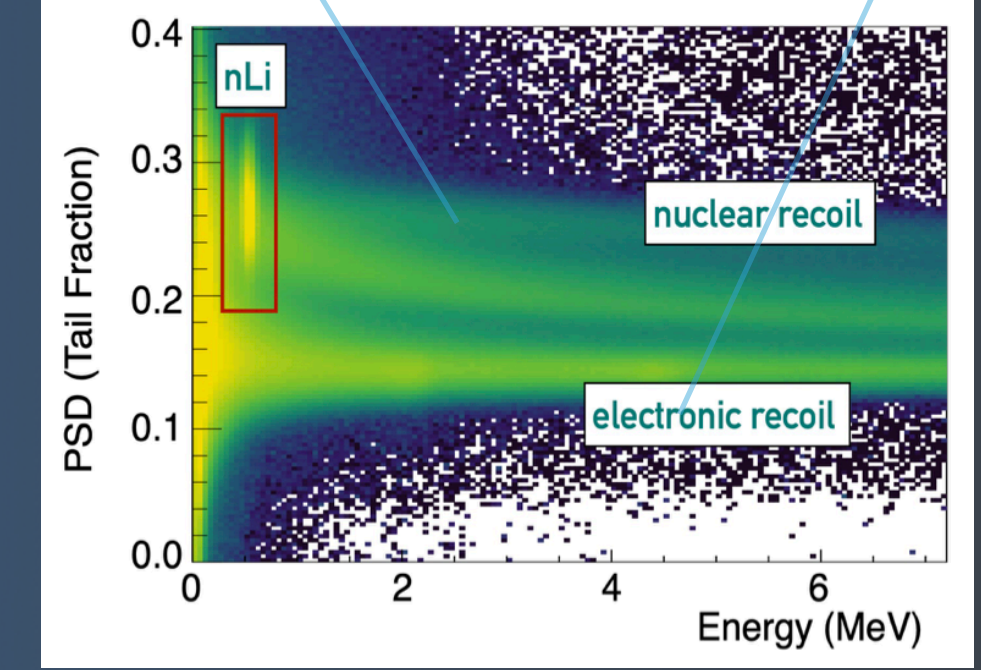
154 optically separated segments



- Segments filled with LiLS
- Energy resolution $\sim 5\% \sqrt{E}$



• Strong PSD capabilities

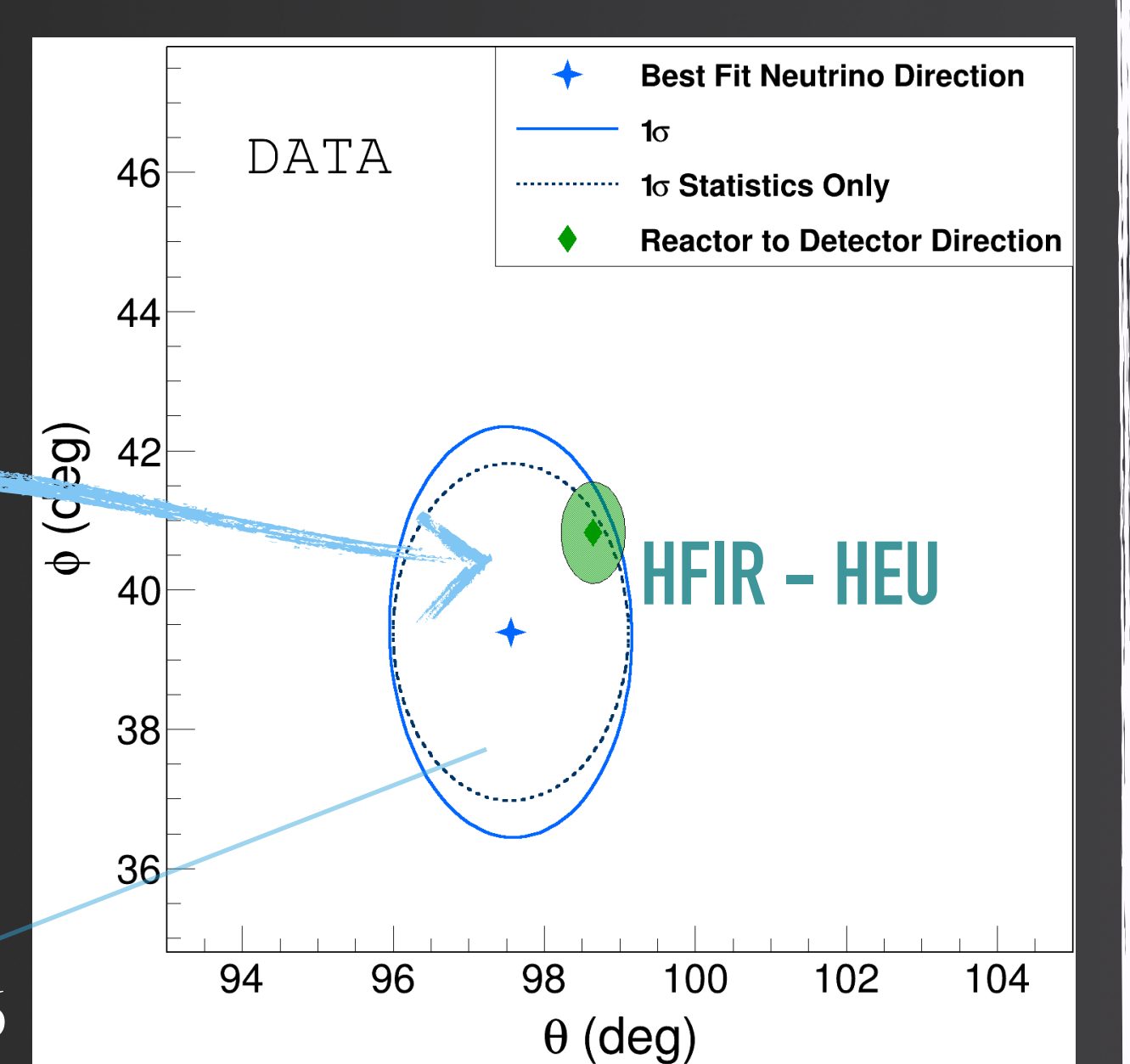


UPDATED DATASET SEER + DATA SPLIT

- ✓ IBD eff. counts +100%
- ✓ Signal : corr. Bkg x2.8
- ✓ Signal : acc. Bkg x 2

Neutron carries most of $\bar{\nu}_e$ direction!

- Measured: $\phi = 39.4 \pm 2.9, \theta = 97.6 \pm 1.6$
- BiPo-214 signal used to verify directionality
- Most precise measurement to date



ANTINEUTRINO DIRECTIONALITY

ANTINEUTRINO FLUX

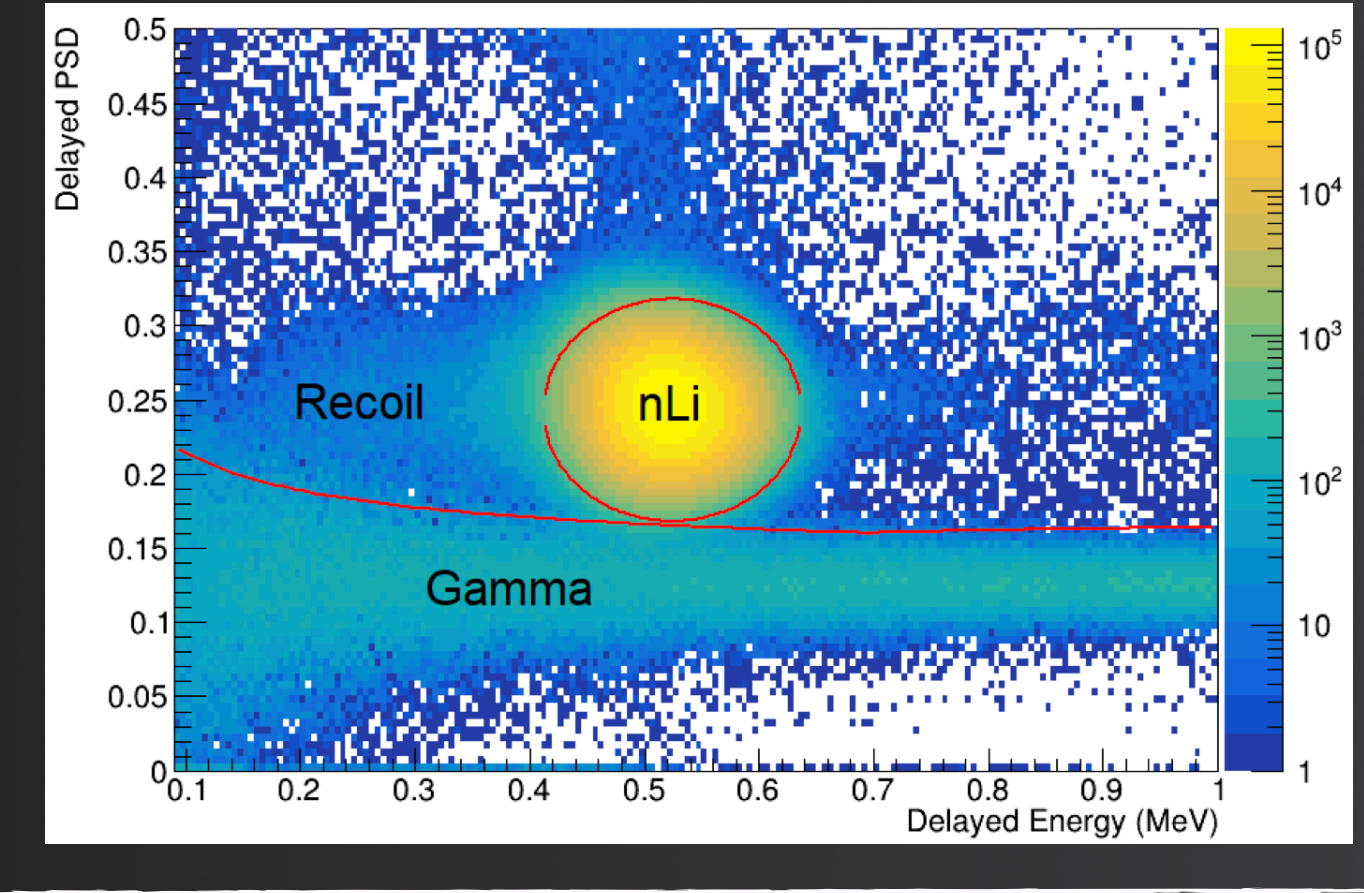
Nuclide	Observed / Expected
HEU	1.014 ± 0.108
LEU	0.792 ± 0.072
SPP-I	0.941 ± 0.026
SPP-II	1.006 ± 0.029
Krasnoyarsk-87	0.925 ± 0.046
Krasnoyarsk-99	0.946 ± 0.028
Krasnoyarsk-04	0.936 ± 0.039
Krasnoyarsk-87	0.942 ± 0.192
SLERP	0.945 ± 0.021
All HEU - pure 235U	0.951 ± 0.012
DB+LEU (no osc)	0.923 ± 0.015

Currently work in progress:

- Aim for 2-3% uncertainty
- Required precise: Rx power, num of protons, baseline... ..in fact there is an equation

Use of n-capture in ${}^6\text{Li}$ as delayed events:

- Compact signal ~ 0.5 MeV
- Excellent PSD - nuclear recoil
- $\sim 77\%$ n-captures



${}^6\text{Li}$ N-CAPTURE FRACTION

LOOK AT THE EQUATION!

$$\sigma_f^{obs} = \frac{R_{obs}}{P_{th} \cdot N_p \cdot \epsilon} = \frac{\text{Rate of IBDs}}{\text{Rx thermal power} \cdot \text{Num of protons} \cdot \text{Det. efficiency}}$$

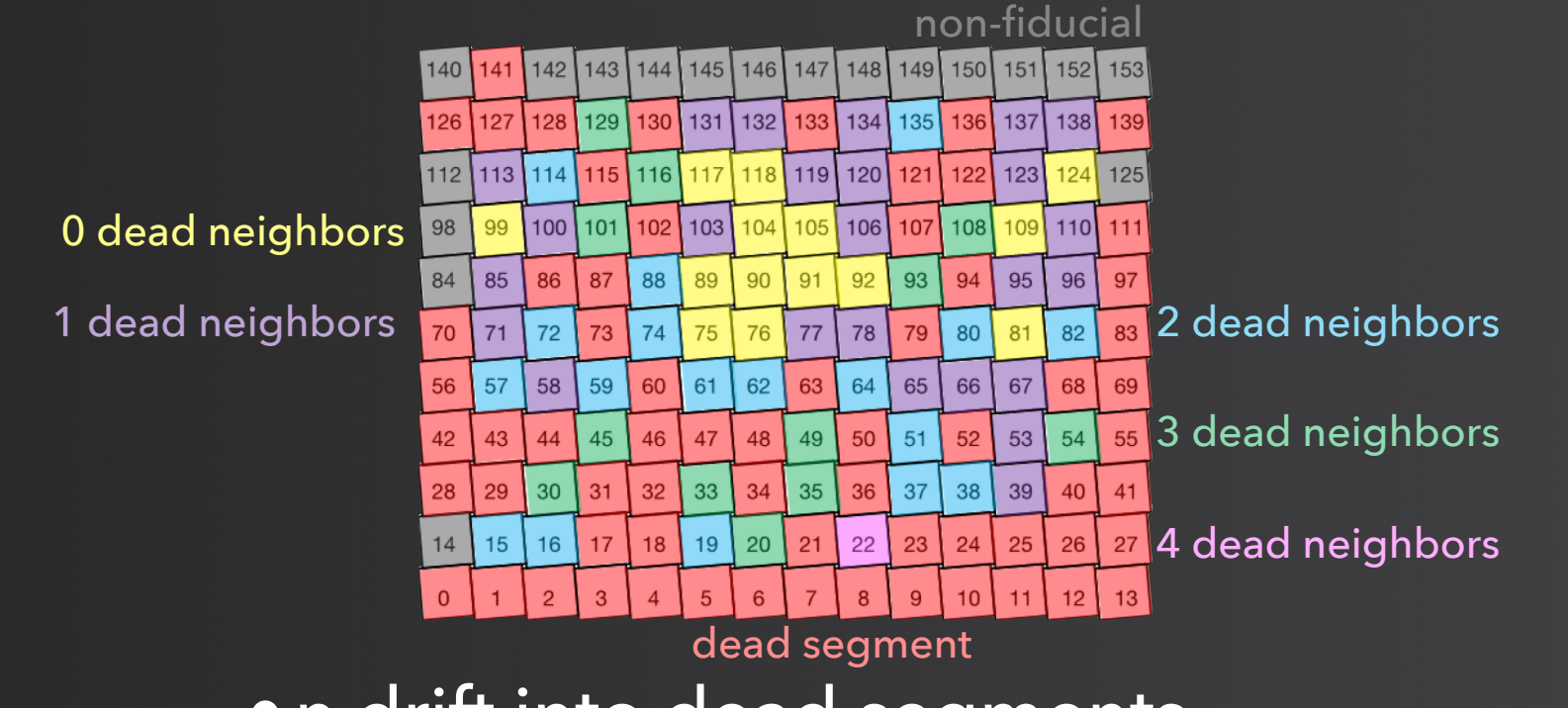
Energy per fission $\langle E_f \rangle$ Baseline $4\pi L^2$

DETECTION EFFICIENCY CORRECTION

$$\epsilon_d = \epsilon_{MC} \prod_i c_i$$

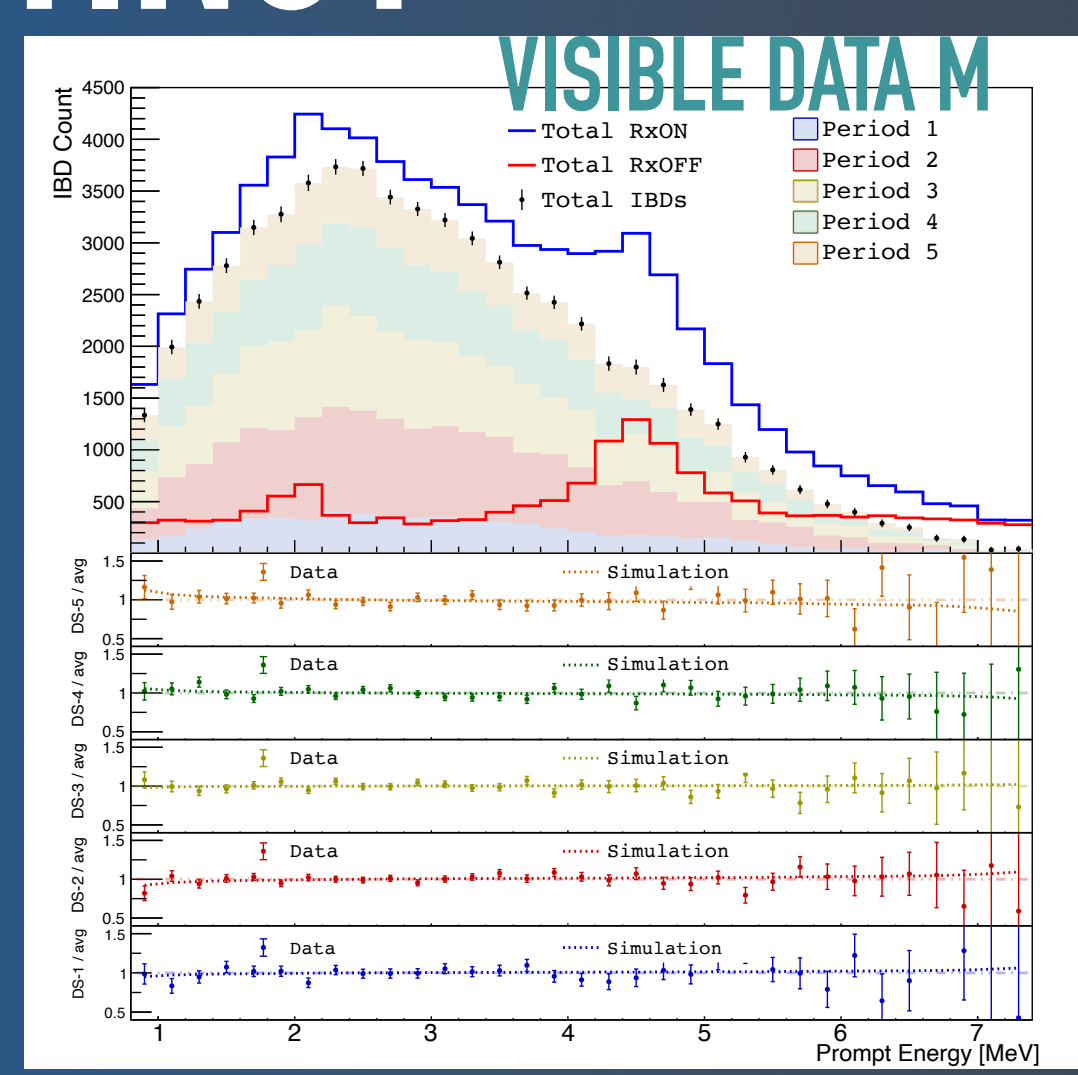
- Apply IBD-like cuts to calibration data and MC to calculate correction
- Separate correction for prompt/delay

INACTIVE MATERIAL INEFFICIENCY



- n drift into dead segments
- $\sim 65\%$ IBD segment eff.

INVERTING?



Inverted Response R^{-1}

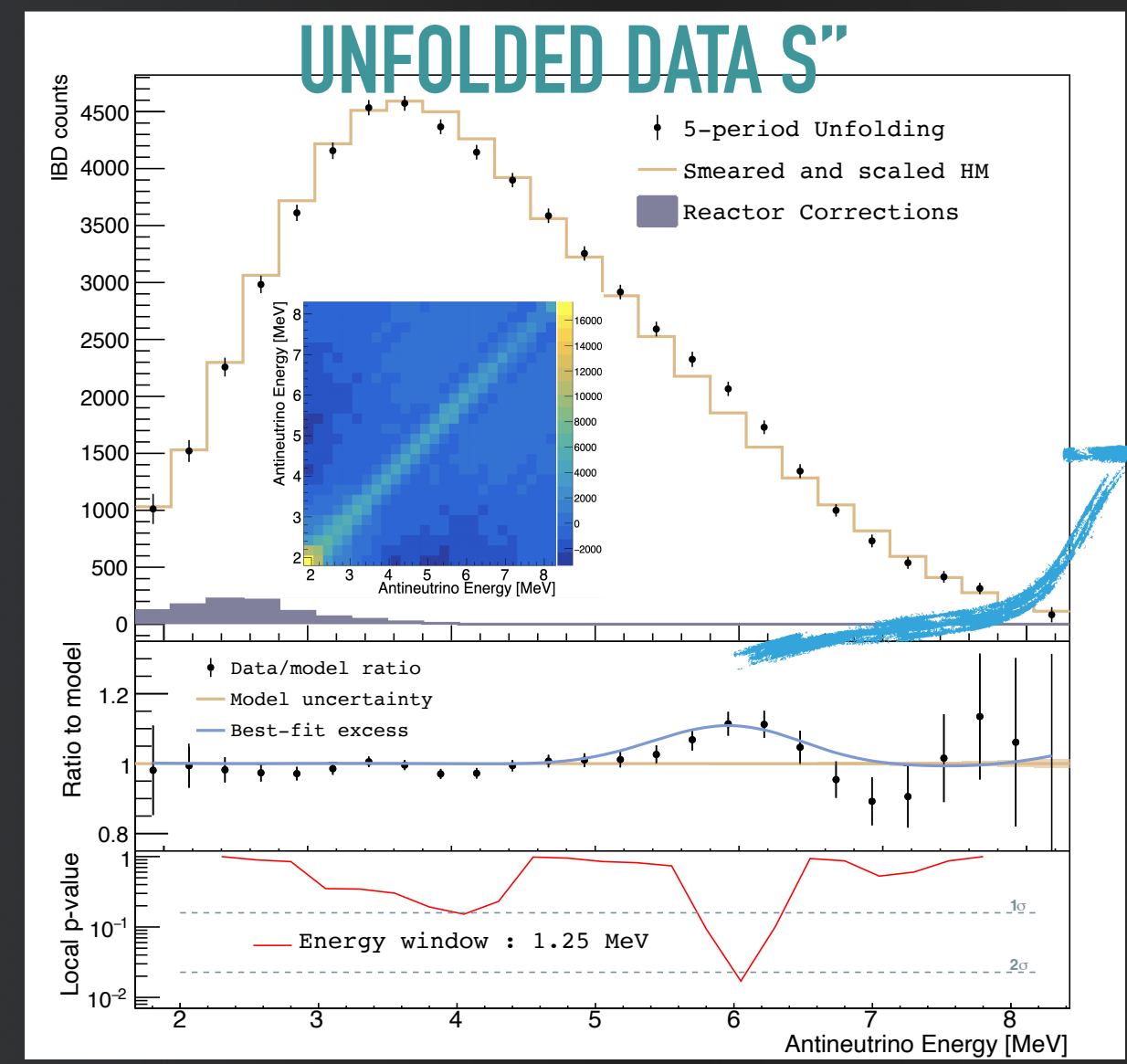
$$S'' = R^{-1} \cdot M \cdot F$$

Whoops... $R^{-1} \cdot M = S' \neq S$

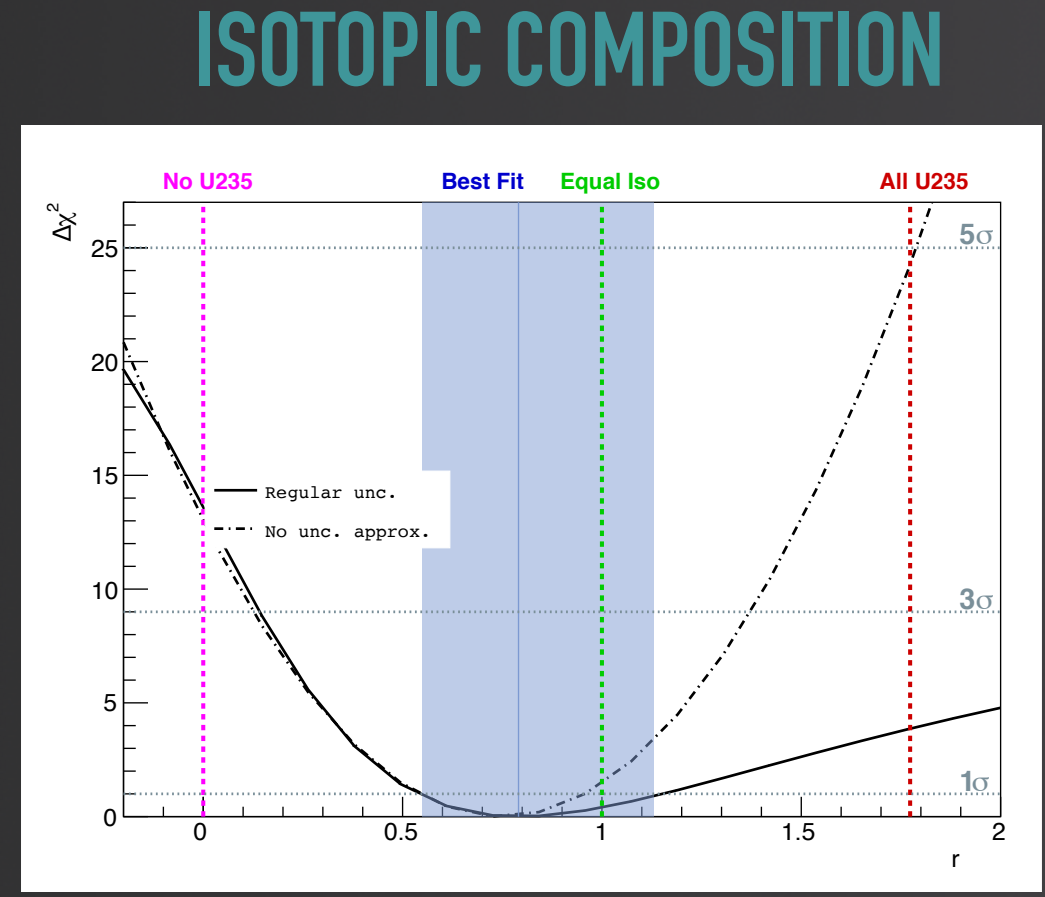
Complications:
 - R is not necessarily invertible; pseudo-inverse using SVD
 - Small elements in R can blow up in pseudo- R^{-1}
 - Measurements containing experimental noise N !

UNFOLDING ANTINEUTRINO SPECTRUM WIENER-SVD TECHNIQUE

1. Gen Prompt Toy
2. Unfold Toys
3. Compare with Model
4. Find F Minim χ^2



- Excess observed at ~ 6 MeV
- LEU-gaussian excess fitted on P-I unfolded data



- Equal isotope hypothesis preferred
- Multi-reactor measurement with corr systematic would strengthen results

ACKNOWLEDGEMENT

THIS WORK WAS PERFORMED UNDER THE AUSPICES OF THE US DEPARTMENT OF ENERGY OFFICE OF HIGH ENERGY PHYSICS BY LLNL UNDER CONTRACT DE-AC52-07NA27344, THE HEISING-SIMONS FOUNDATION, CFREF AND NSERC OF CANADA, AND INTERNAL INVESTMENTS AT ALL INSTITUTIONS. RELEASE NUMBER LLNL-POST-865381

