Employing reverse and regular conversion fits to obtain IBD antineutrino spectra

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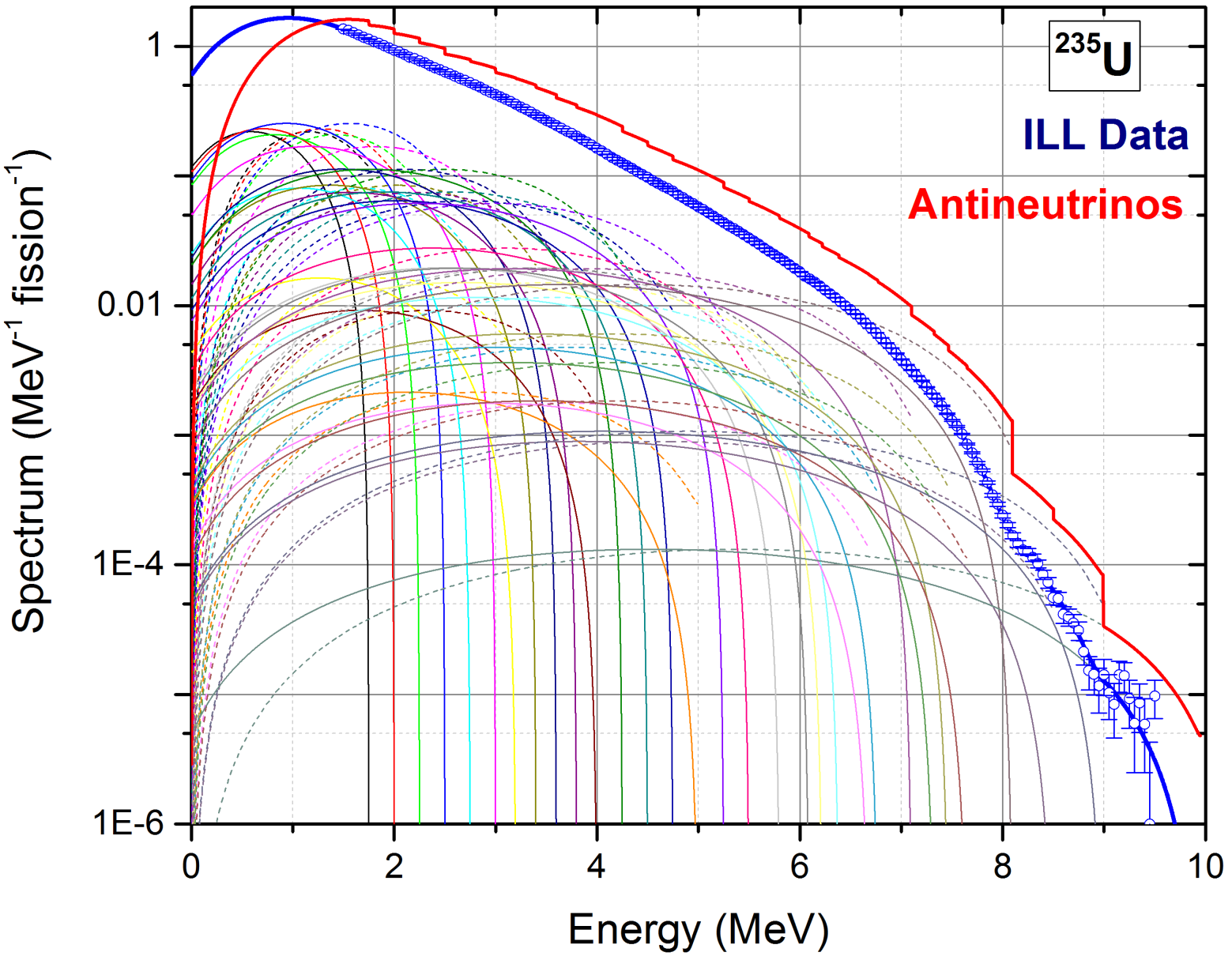
Conversion Method



Electron Spectrum measured at ILL, K. Schreckenbach *et al.*, Phys. Lett. **160B**, 325 (1985).

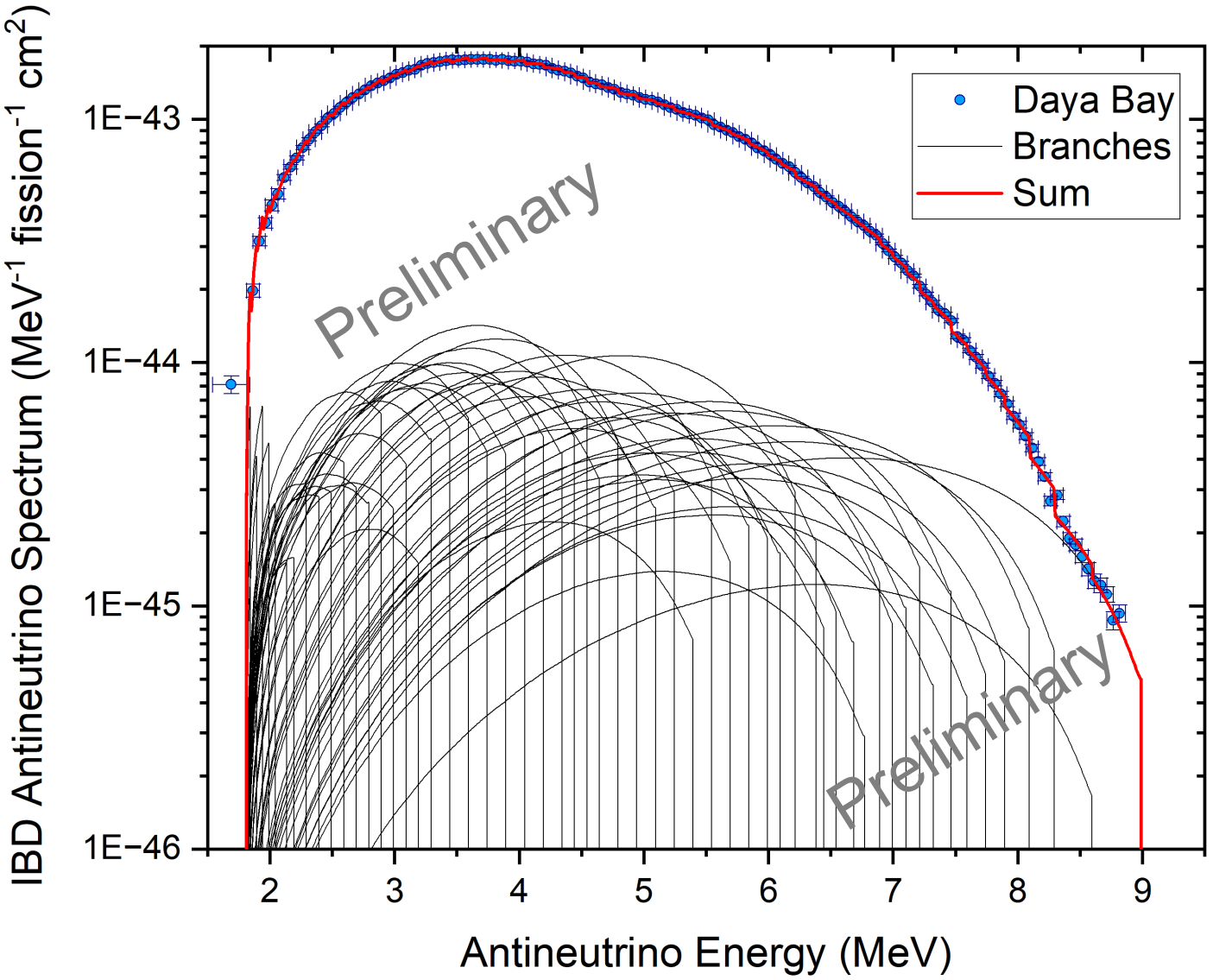
Assume **allowed shape** and must know **$Z_{eff}(E)$**, from ENSDF & ENDF/B or JEFF.

Can fit 31 branches for ^{235}U, with 50 keV bin, and 20 branches for ^{239,241}Pu with 100 keV bin.

Reverse Conversion Method

- Daya Bay 50 keV data, F. P. An *et al.*, Chinese Phys. C **45**, 073001 (2021)
- 50 keV binning.
- 141 data points.
- 57 average branches.
- Some end-point energies correspond to real values, ex. ^{100}Nb, ^{96}Y, and ^{92}Rb.
- Zeff using the effective cumulative values for Daya Bay:

$$CFY[k] = \sum f_i \, CFY_i[k]$$



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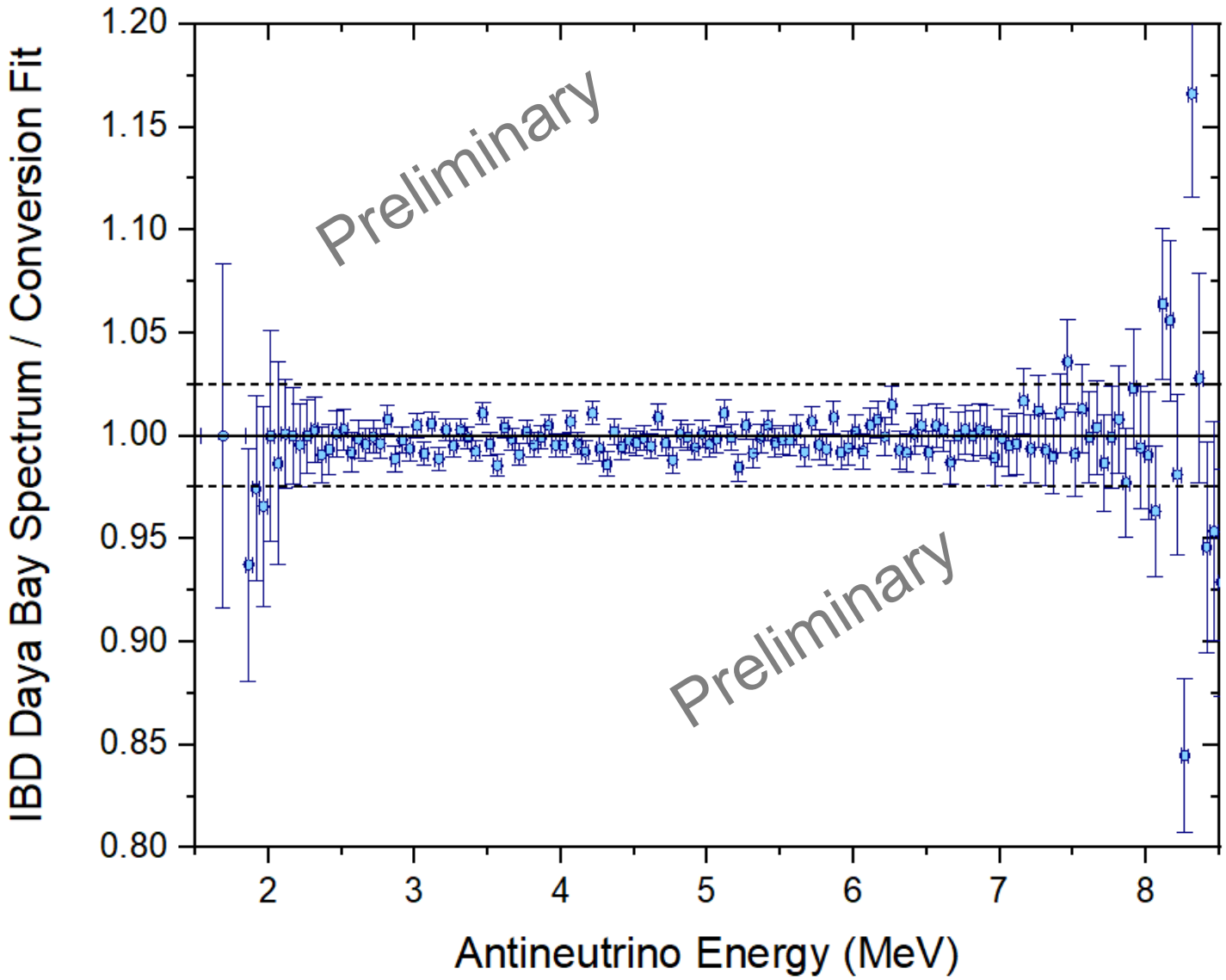
Reverse Conversion Method

Quality of fit can be gauged by ratio of data to fit.

Fit values are less than 2.5% from the measured ones in the 2.5 to 7 MeV region.



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From total electron spectrum to individual components

The Daya Bay electron spectrum from the reverse conversion can be written as:

$$S(E) = f_{235} \times S_{235}(E) + f_{239} \times S_{239}(E) + f_{238} \times S_{238}(E) + f_{241} \times S_{241}(E)$$

Dominant | Sub-dominant

Keeping in mind that $R_{59}(E) = S_{235}(E) / S_{239}(E)$, which has been measured by Kopeikin *et al*.

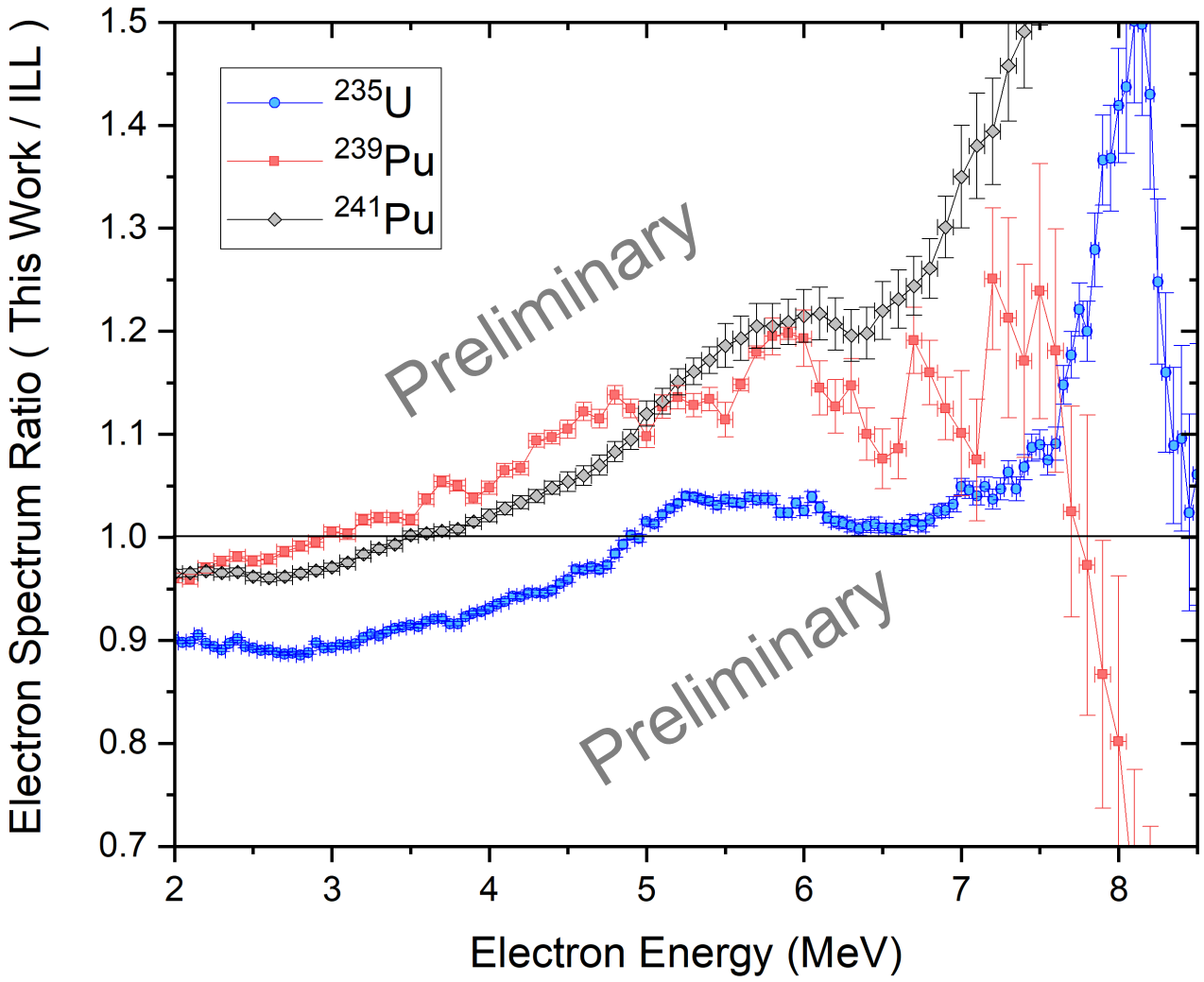
$$S(E) = f_{235} \times S_{235}(E) + f_{239} \times S_{235}(E) / R^{K}_{59}(E) + f_{238} \times S_{238}(E) + f_{241} \times S_{241}(E)$$

For consistency, we will use $R_{58}(E)$ and $R_{51}(E)$ from the Summation method, to obtain

$$S_{235}(E) = S(E) / (f_{235} + f_{239} / R^{K}_{59}(E) + f_{238} / R^{S}_{58}(E) + f_{241} / R^{S}_{51}(E))$$

From where we can obtain $S_{239}(E)$ and $S_{241}(E)$ as well as their ratios to the corresponding ILL measurements.

Ratio to ILL spectra



If the Daya Bay 50 keV data are correct.

And if the R_{59} from Kopeikin data are correct.

And if there are no other funny effects going on…

BILL may have had an energy dependent efficiency effect not taken into account.

The ^{235}U points are smaller than the $^{239,241}Pu$ points due to use of the $^{207}Pb(n,\gamma)$ in the normalization of the ^{235}U spectrum.

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But wait… There is more…

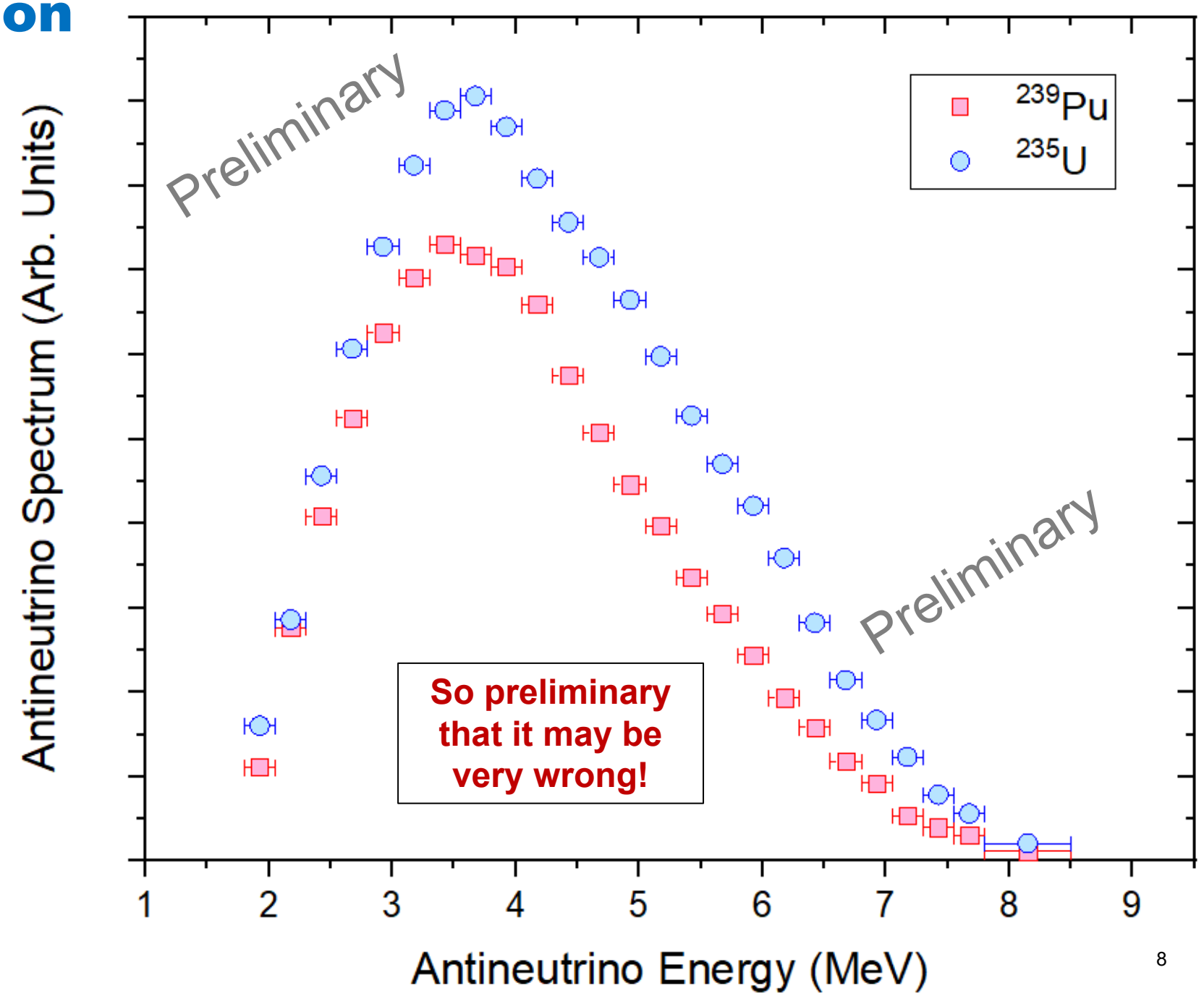
- The deduced $S_{235}(E)$, $S_{238}(E)$, $S_{239}(E)$, and $S_{241}(E)$ *inherit* the 50 keV binning from the Daya Bay data.

- We could perform a regular Conversion analysis to obtain the corresponding antineutrino spectra

Standard Conversion

For ^{235}U and ^{239}Pu, we need a high-fidelity Conversion analysis (work in progress).

Anyone can do this calculation, all the data, except for Z_{eff}, is available.



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Conclusions

Acknowledgements

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