

Neutrino News 2014



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Turin – 26/09/2014

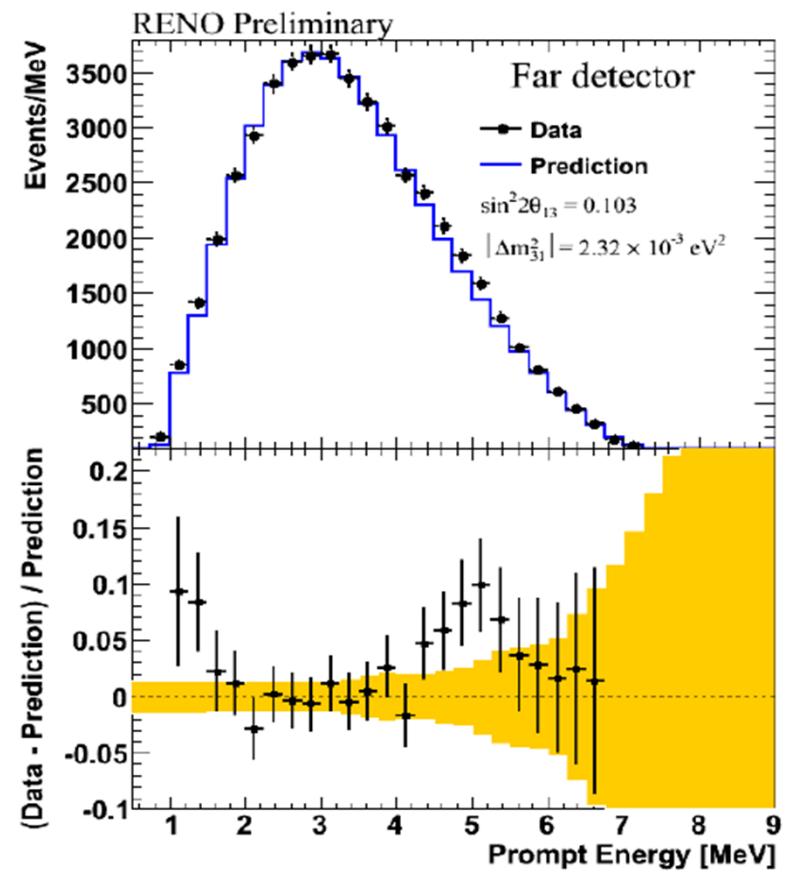
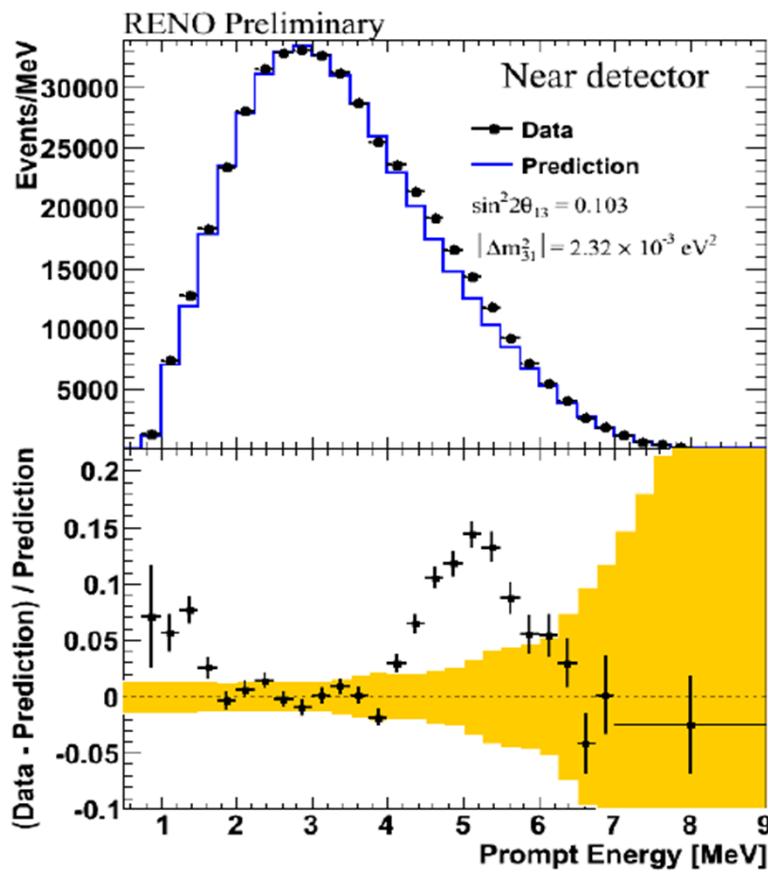
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www.nu.to.infn.it

NEUTRINO
TELESCOPES 2015
Venice, March 2-6 2015

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RENO anomaly (3.6σ) @ Nufact 2014



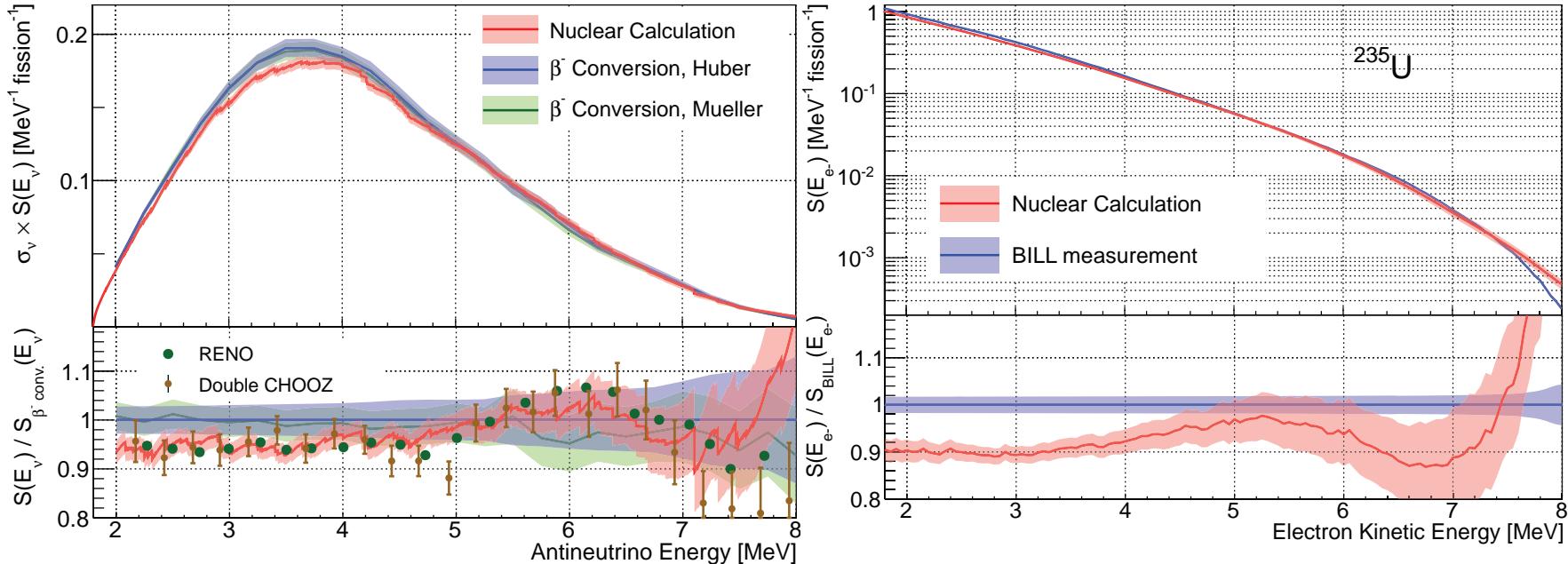
Fraction of 5 MeV excess (%) to total expected flux

- Near : 2.303 ± 0.117 (stat.) ± 0.395 (sys.) ± 0.492 (expected shape error)
- Far : 1.468 ± 0.390 (stat.) ± 0.499 (sys.) ± 0.482 (expected shape error)

Explanations?

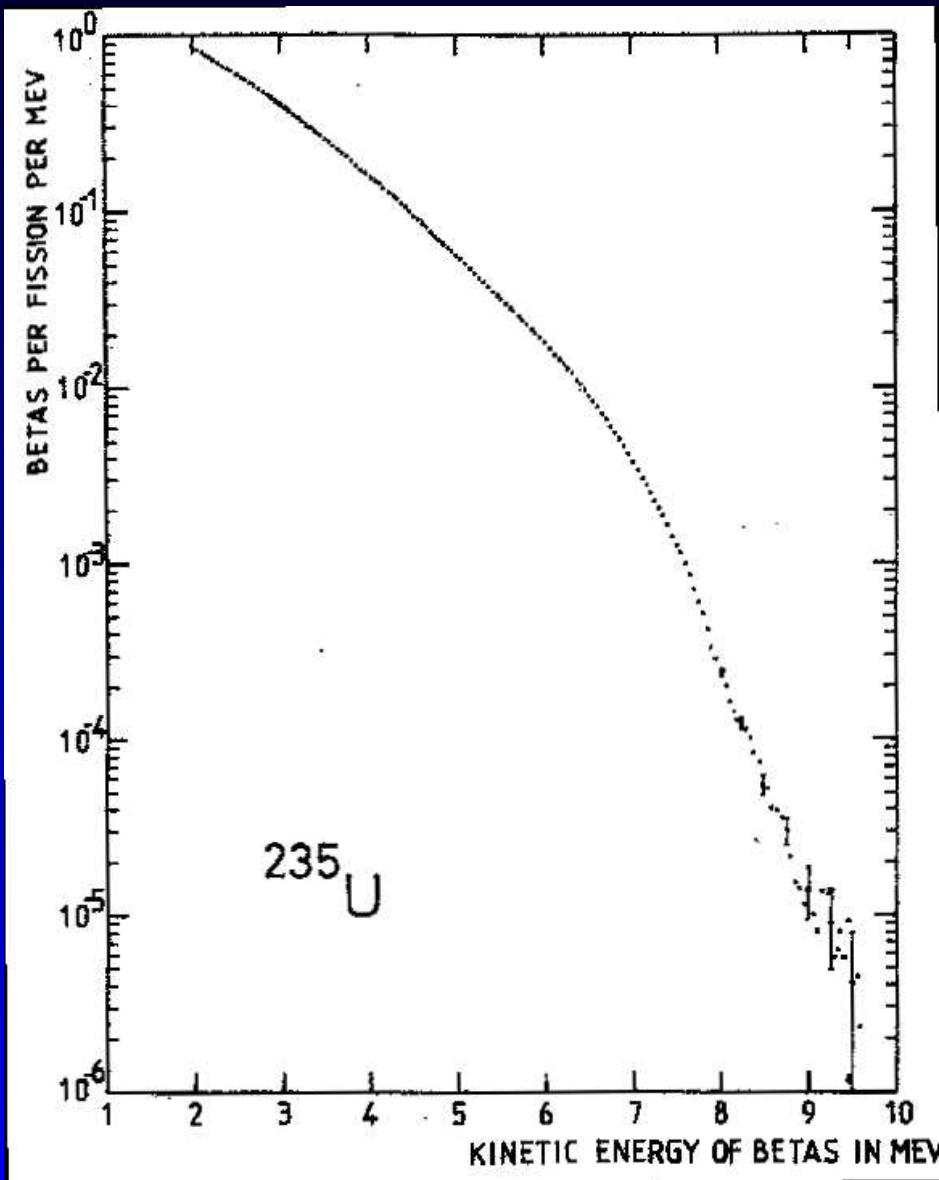
Direct summation of latest ENSDF database,
assuming allowed beta-spectrum shape

Dwyer and Langford, 2014



This direct summation, as all other direct summations,
does not agree with the Schreckenbach total
beta-spectrum.

β -spectrum from fission



Schreckenbach, *et al.* 1985.

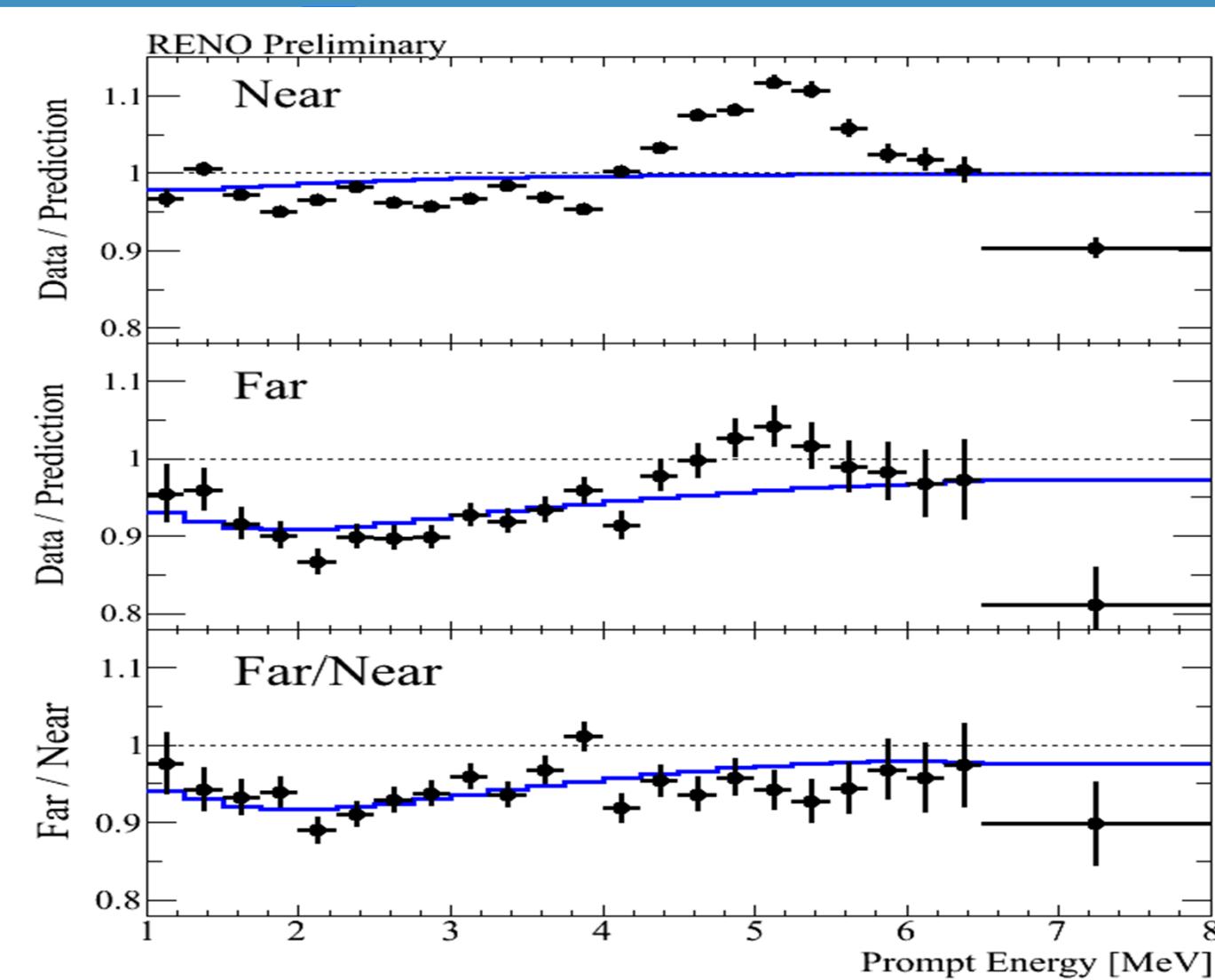
^{235}U foil inside the High Flux Reactor at ILL

Electron spectroscopy
with a magnetic spec-
trometer

Same method used for
 ^{239}Pu and ^{241}Pu

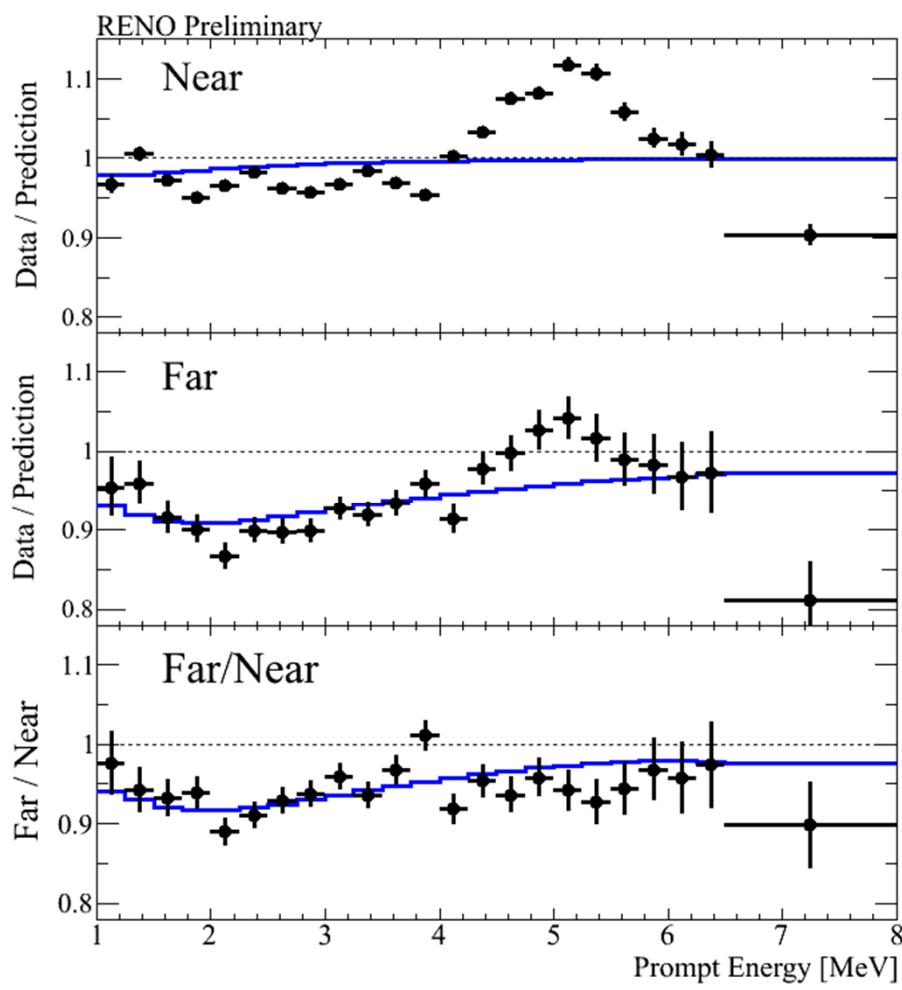
For ^{238}U there is a recent
measurement by Haag *et*
al. 2013.

RENO anomaly (3.6σ) @ NOW 2014

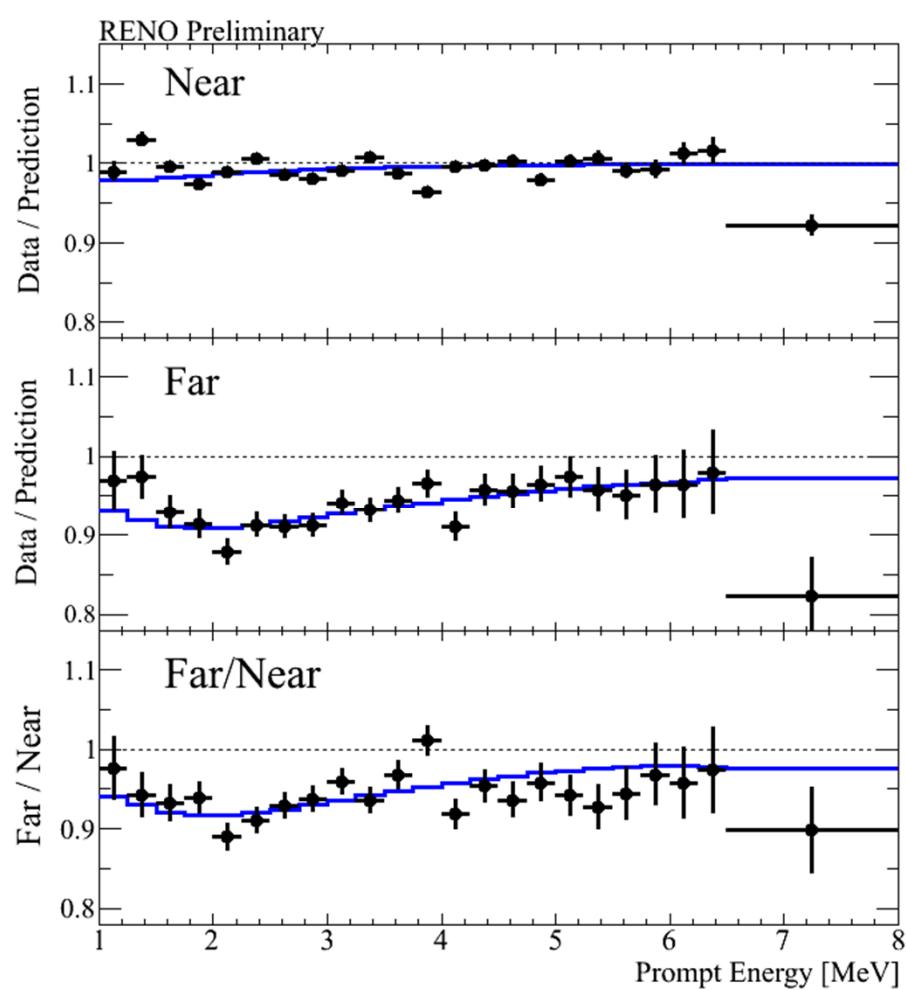


DATA/PREDICTION

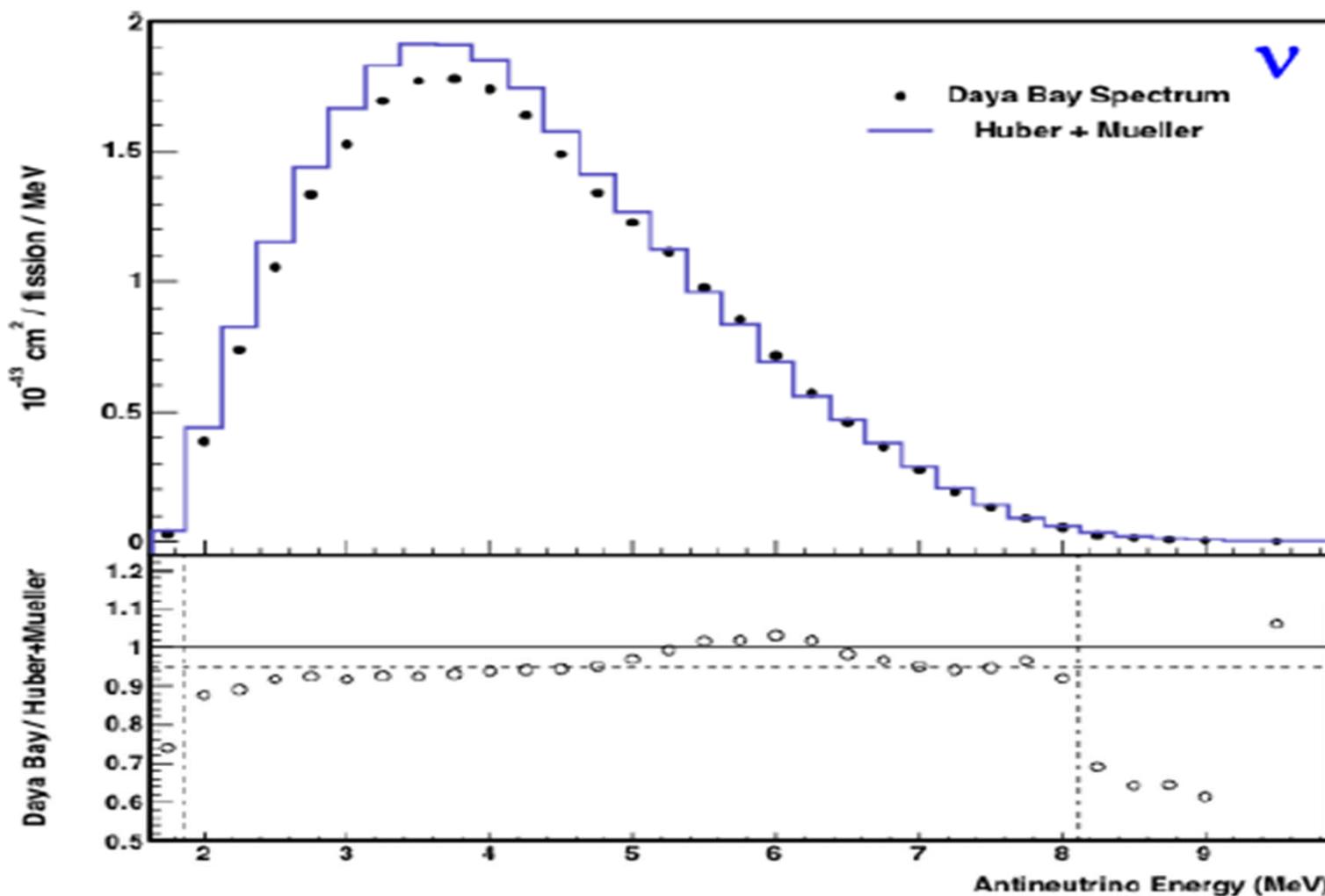
Without 5 MeV excess



With 5 MeV excess

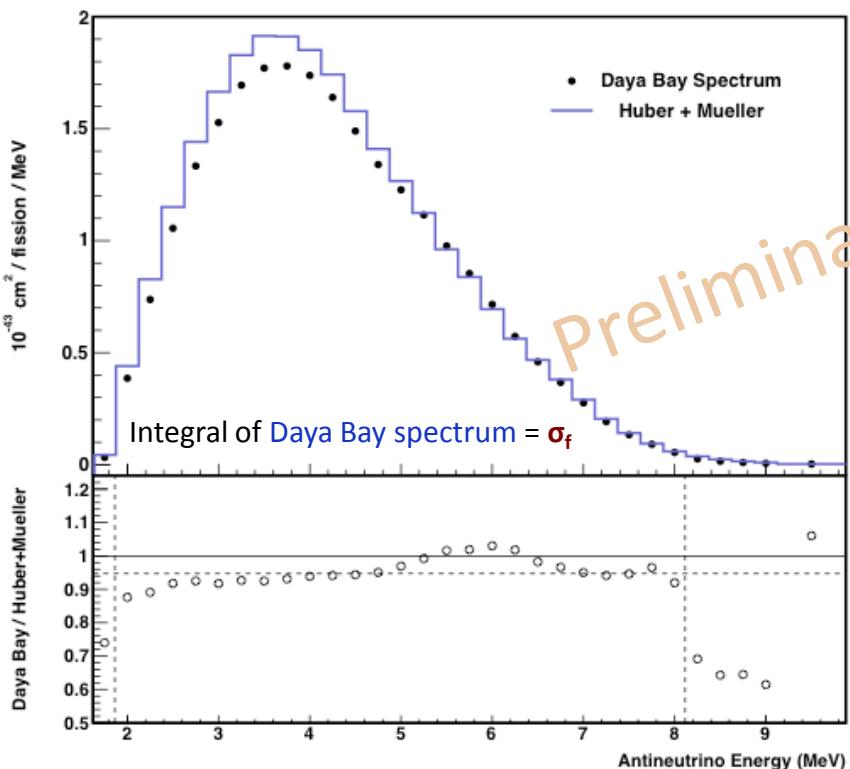


DYB anomaly (4.1σ) @Nufact 2014



Deduced antineutrino spectrum

- ❖ Extract a reactor antineutrino spectrum $S_{\text{obs_v}}(E_{\bar{\nu}})$:
 - ❖ It supplies data outside [2, 8] MeV and could be used for flux and spectrum prediction.



Normalize the unfolded spectrum to **$\text{cm}^2/\text{fission}/\text{MeV}$** .

$$S_{\text{obs_}\bar{\nu}_e}(E_{\bar{\nu}_e}) = \frac{S_{\text{unfolded}}(E_{\bar{\nu}_e})}{P_{\text{eff}}(E_{\bar{\nu}_e}, L) \cdot N_p \cdot F_{\text{total}}}$$

where

N_p is number of protons per unit target mass;

$P_{\text{eff}}(E_{\bar{\nu}_e}, L)$ is survival probability of $\bar{\nu}_e$ weighted by flux;

F_{total} is total number of fissions of all reactors.

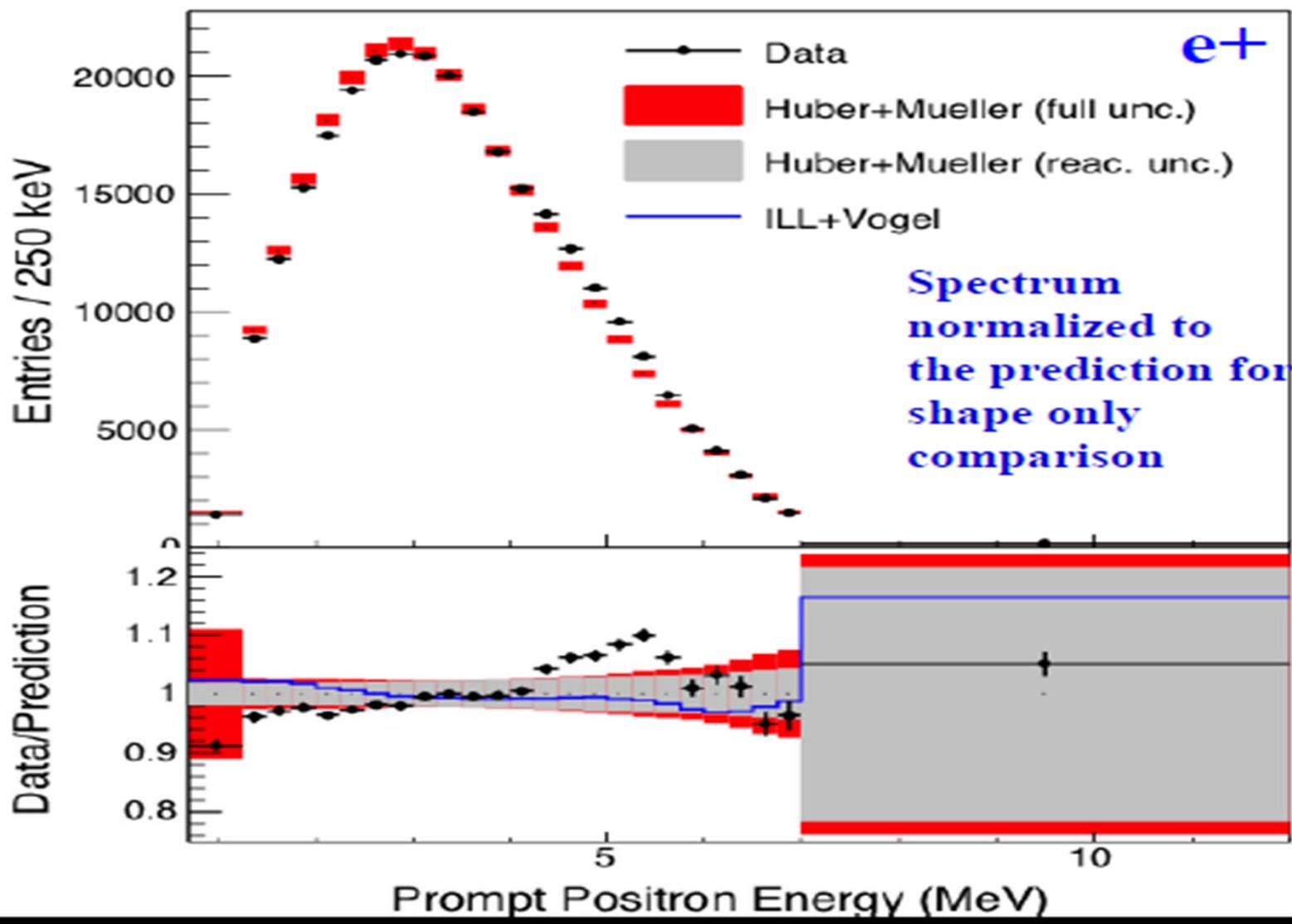
$$S_{\text{pred_}\bar{\nu}_e}(E) = \left(\sum_k \alpha_k S_k(E) + c^{ne}(E) + \text{SNF}(E) \right) \cdot \sigma_{IBD}(E)$$

where

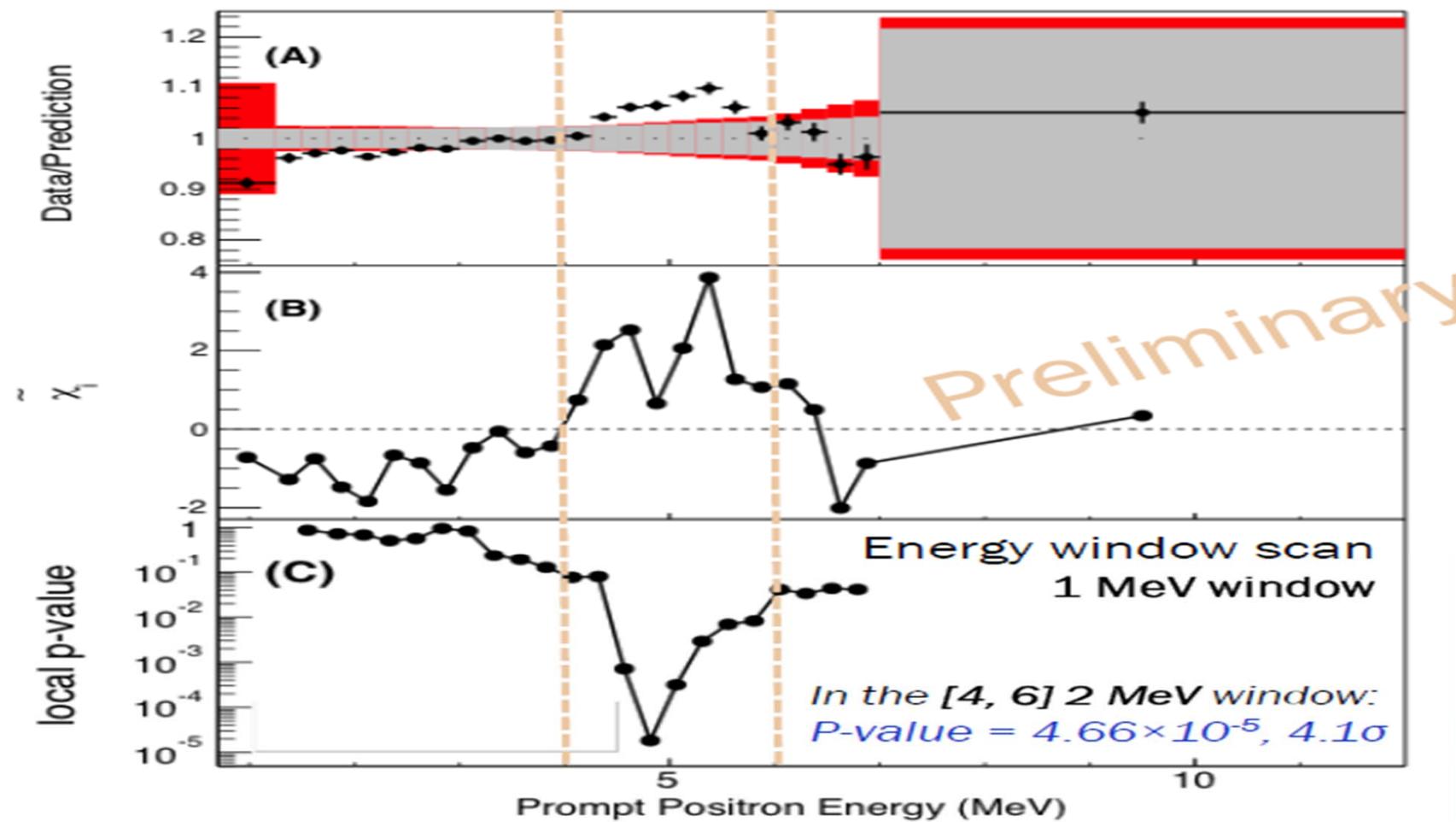
α_k are the effective fission fractions of Daya Bay

- ❖ Compare Daya Bay spectrum $S_{\text{obs_v}}(E_{\bar{\nu}})$ and Huber+Mueller Prediction $S_{\text{pred_v}}(E_{\bar{\nu}})$:
 - ❖ Same rate deficit as flux measurement, and same shape deviation structure as in comparison of positron spectrum.

DYB anomaly (4.1σ) @Nufact 2014



DYB anomaly (4.1σ) @ICHEP 2014

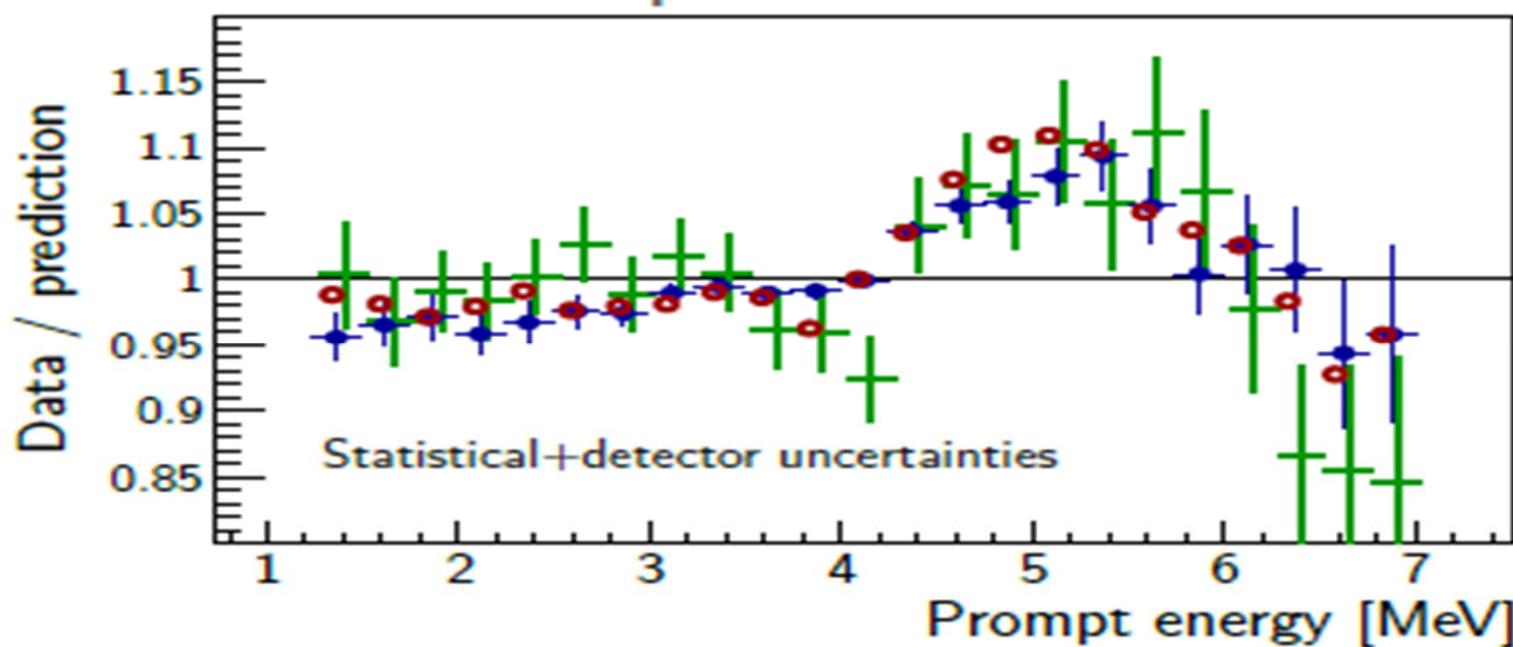


Reactor 5 MeV anomalies @TAU 2014

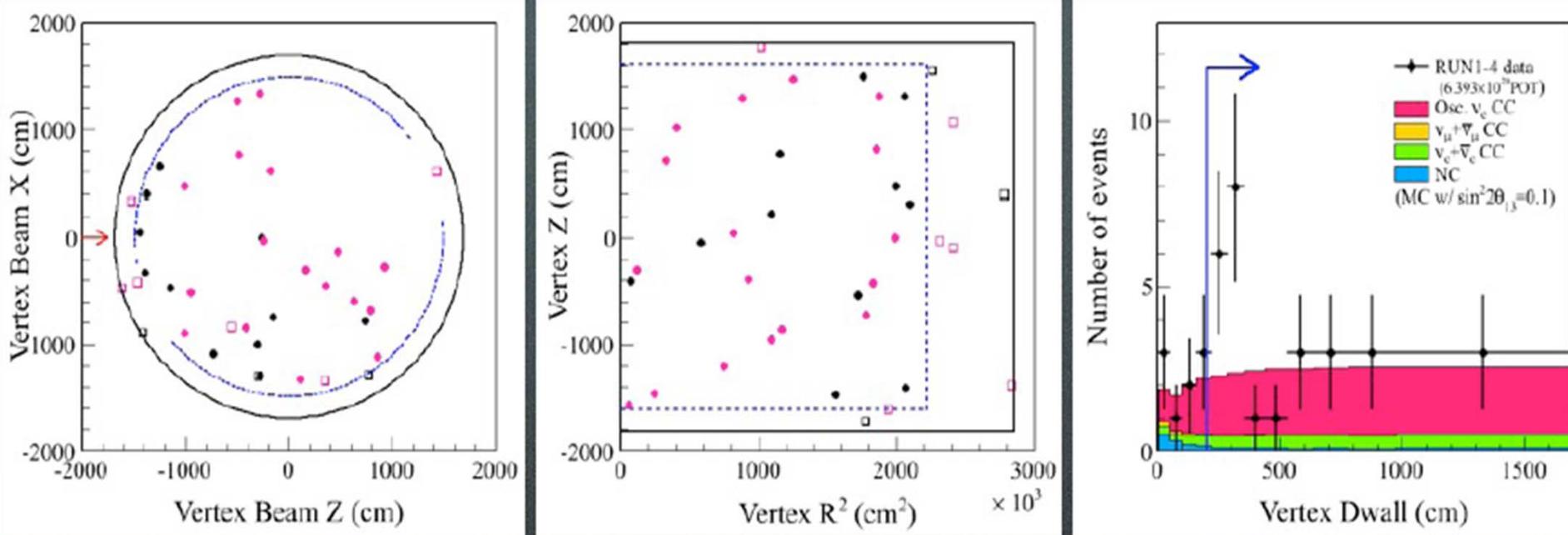
Data (normalized to prediction)

- Daya Bay near [ICHEP2014]
- Double Chooz far [Nu2014]
- RENO near [Nu2014]

All three experiments



T2K anomaly @EPS 2013



T2K anomaly @EPS 2013

data	MC	poisson	cumulative	p-value
3	2	0,180447	0,85712346	0,142877
1	1,8	0,297538	0,46283689	0,537163
2	2	0,270671	0,67667642	0,323324
3	2	0,180447	0,85712346	0,142877
6	2,3	0,020614	0,99063807	0,009362
8	2,4	0,002477	0,99913802	0,000862
1	2,4	0,217723	0,30844104	0,691559
1	2,5	0,205212	0,2872975	0,712703
3	2,6	0,217572	0,73600164	0,263998

Number of events

Neutrino News 2014 : Beyond 3 ν paradigm !

