Forbidden transitions in the reactor anomaly

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1. Background

Short-baseline reactor neutrino experiments see 2 problems compared to theory [1]:
- Total # of detected antineutrinos 6% lower
- Detected energy spectrum has a bump

However, theory depends on knowledge of ~8000 (forbidden) beta decays: HARD!

2. Shape Factors

Forbidden beta decays have more complex shapes compared to allowed

Shape Factor depends on [2]
- $\Delta J$
- $\Delta \pi$
- Coulomb
- Nuclear structure

Nuclear shell model: 29 transitions

Generalize to parametrization $\rightarrow$ Monte Carlo sampling

3. Spectrum Changes

Usual approximations:
- Allowed, BUT dominant!
- Unique, BUT even worse!

New ab initio calculations

Theory prediction drops by $\sim 5\%$ wrt Huber-Mueller

4. Reactor Bump

Experiments see 'bump' between 4-6 MeV wrt Huber-Mueller prediction

Correction from forbidden decays mitigates bump

5. Conclusions

Forbidden decays are indispensible:
- Dominate most of the spectrum
- Theory predictions drop by $\sim 5\%$ (cfr. 6% anomaly)
- Partially mitigate reactor bump

6. References