

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

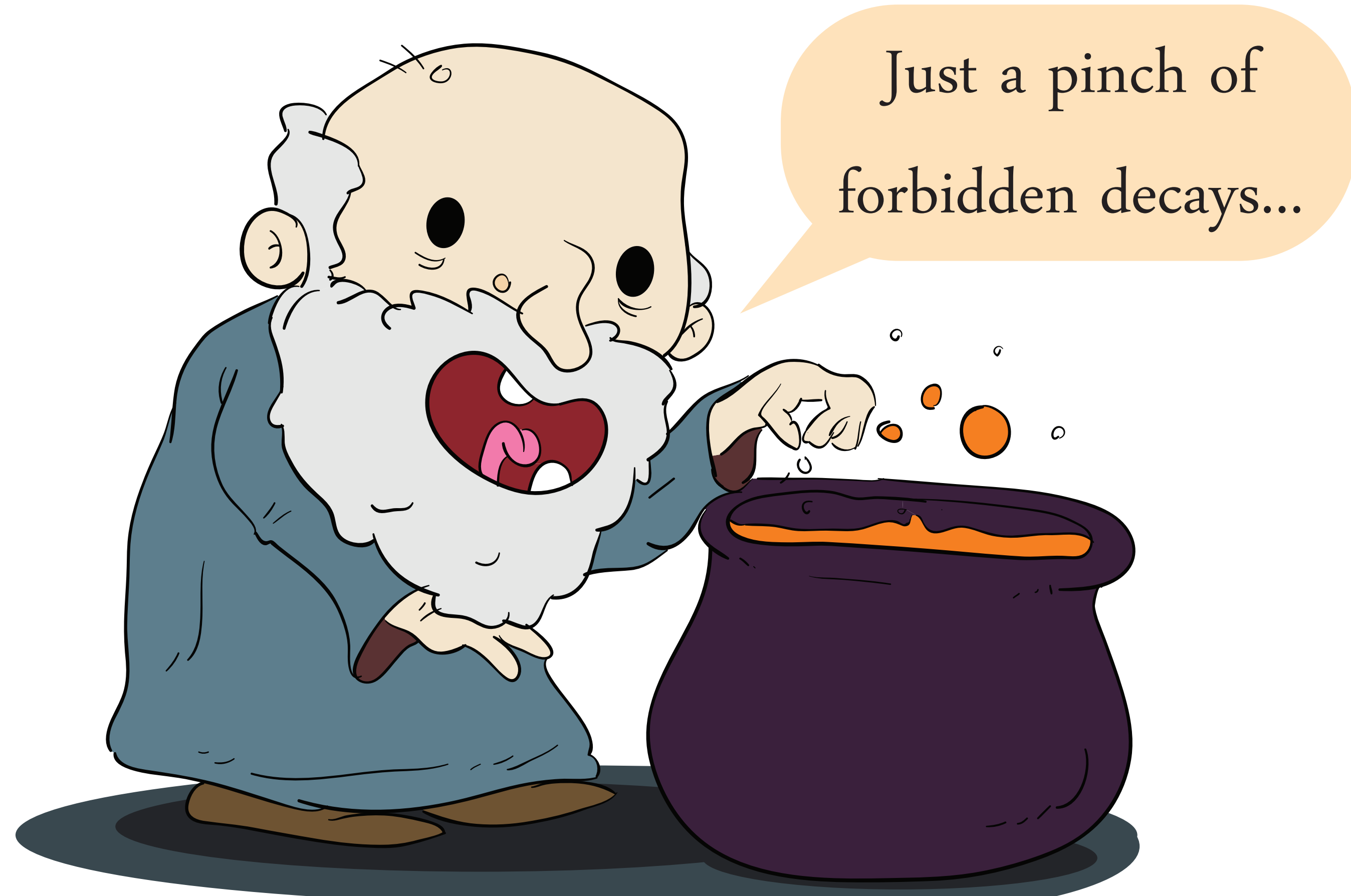
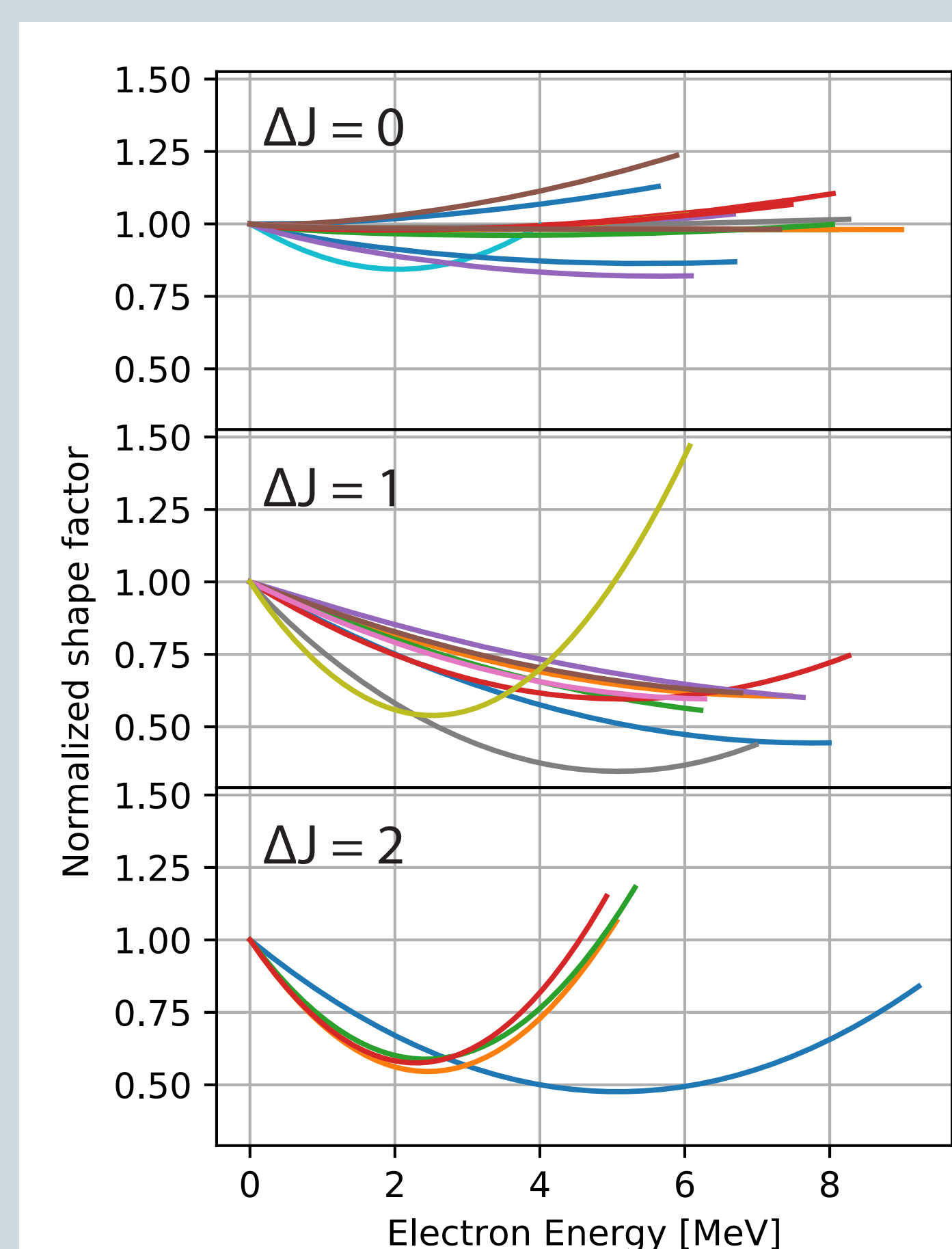
Forbidden beta decays have more complex shapes compared to allowed

Shape Factor depends on [2]

- ΔJ
- $\Delta \pi$
- Coulomb
- Nuclear structure

Nuclear shell model:
29 transitions

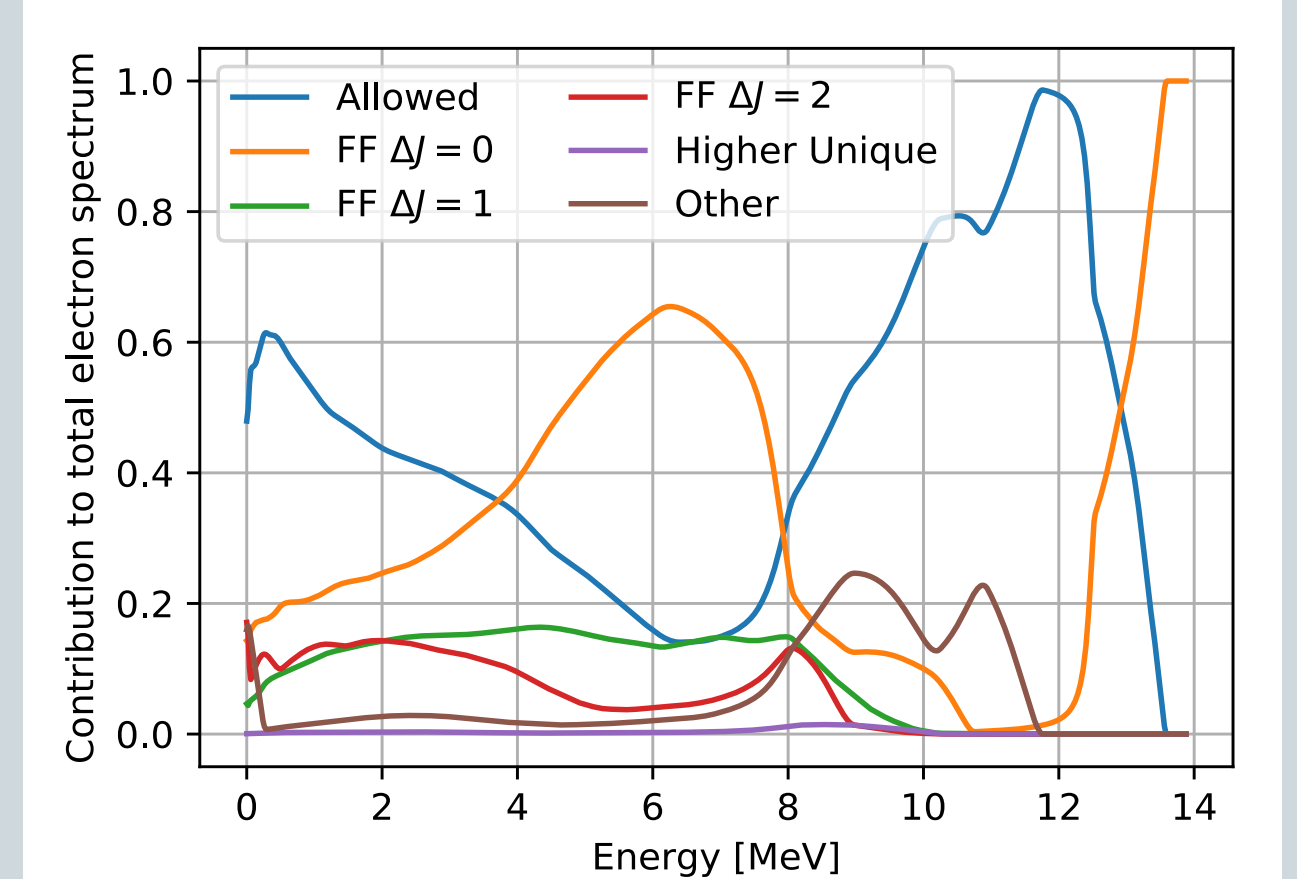
Generalize to parametrization
→ Monte Carlo sampling



3. Spectrum Changes

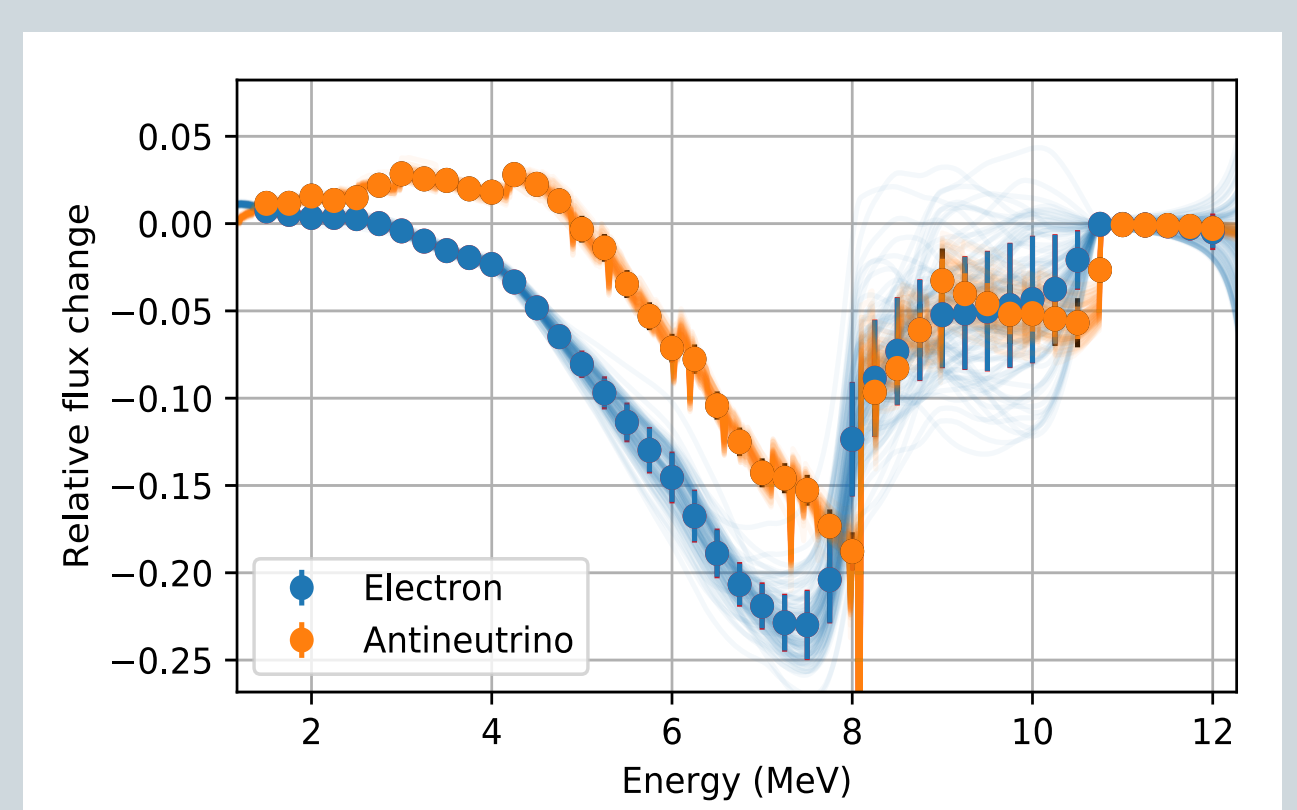
Usual approximations:

- Allowed, BUT dominant!
- Unique, BUT even worse!



New ab initio calculations

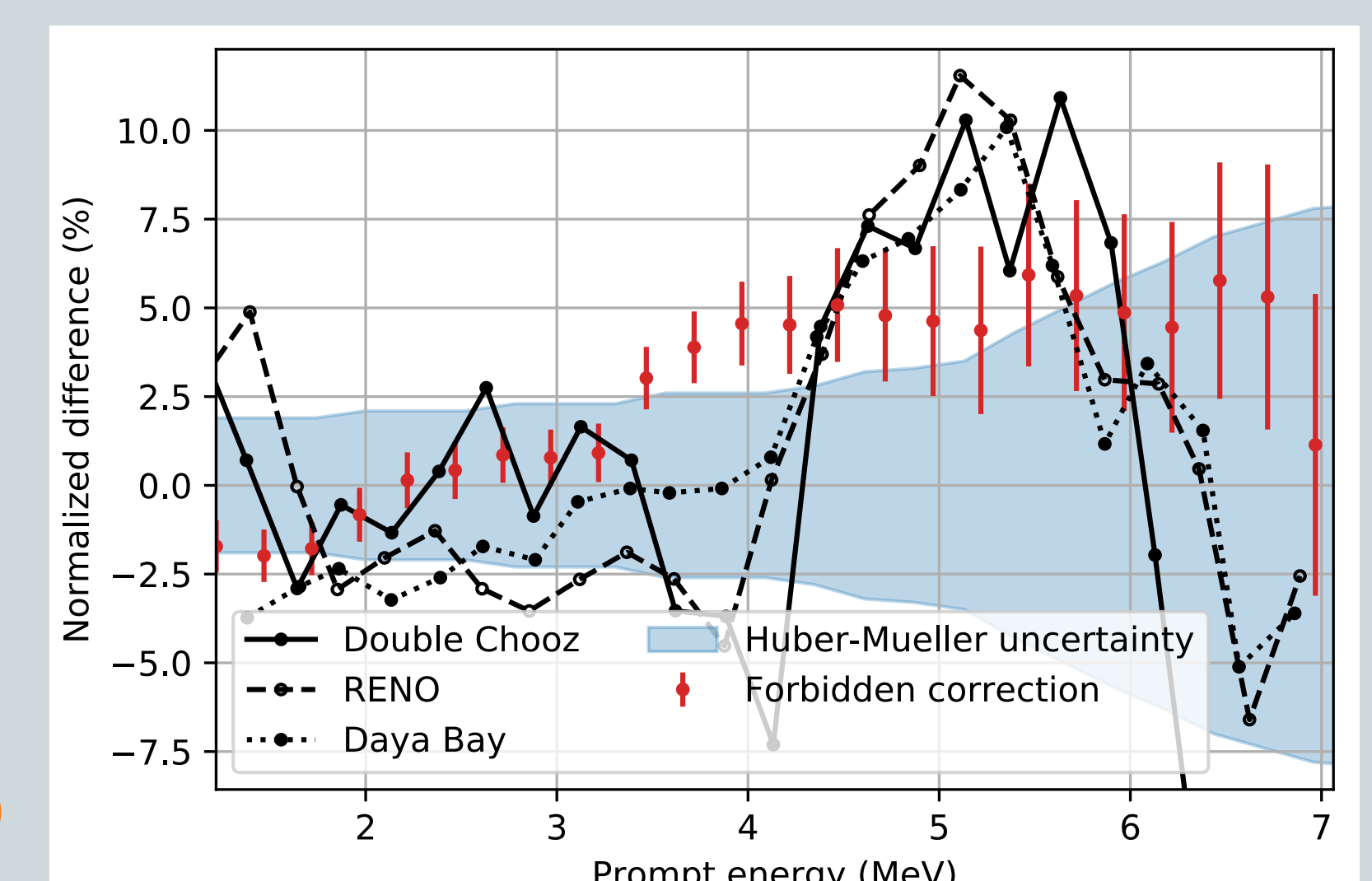
Theory prediction **drops by ~5%**
wrt Huber-Mueller



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 indispensable:

- Dominate most of the spectrum
- Theory predictions drop by ~5% (cfr. 6% anomaly)
- Partially mitigate reactor bump

6. References

- [1]: A. C. Hayes and P. Vogel, Ann. Rev. Nucl. Part. Sci., 66 (2016) 219
[2]: H. Behrens and W. Bühring, "Electron Radial Wave Functions and Nuclear Beta-Decay" (1982) Oxford
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