LATTICE QCD (+EFT) FOR NEUTRINOLESS DOUBLE-BETA DECAY?

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THE ROADMAP FOR OvBB DECAY



THE ROADMAP FOR *0vBB* DECAY "QUESTIONS AHEAD"

Q1: How well can we achieve step (3) using the lattice QCD + EFT approach?

- A) What is the minimal set of quantities LQCD should compute? The leading LEC of the EFT?
- B) What is the required LQCD precision on matrix elements/LECs to be conclusive when matching to EFTs/nuclear many-body studies?
- C) Beyond minimal set of quantities, what is next for LQCD? Characterizing >2-nucleon correlations? Pionfull EFT matching? What are the challenges?
- D) Is there any benefit in stand-alone LQCD results for the matrix elements to test (EF) theories, assumptions, etc.? Can this be achieved given the LQCD framework?



THE ROADMAP FOR *0vBB* DECAY "QUESTIONS AHEAD"

Q2: Assuming (3) can be achieved in the few-nucleon sector, would that be adequate to achieve (4)?

- A) What are the benchmarks that may help diagnose shortcomings of the current many-body methods and identify sources of issues? LQCD+EFT+small ab initial structure calculations?
- B) Can we still make progress despite not knowing the proper EFT of large isotopes and their connection to EFTs of small nuclei?
- C) Would the two-neutrino process be a valuable problem for benchmarking theoretical approaches in small systems?



REMARKS AND REFERENCES

The co-conveners of various Snowmass topical groups have commissioned the production of a whitepaper that will study the 10-year plan of the community for a coordinated LQCD-EFT-Nuclear Structure effort in accessing nuclear matrix elements for the *0vBB* decay program.

A relevant Snowmass LOI:

Bridging particle and nuclear physics for neutrinoless double beta decay with EFTs, Cirigliano, ZD, Dekens, de Vries, Engel, Feng, Graesser, Jin, Mereghetti, Nicholson, Pastore, Ramsey-Musolf, van Kolck, and Walker-Loud.



Relevant recent reviews on the role of lattice QCD in the 0vBB program:

The Role of Lattice QCD in Searches for Violations of Fundamental Symmetries and Signals for New Physics (USQCD Collaboration), Cirigliano, ZD, Bhattacharya, Izubuchi, Shanahan, Syritsyn, and Wagman, Eur. Phys. J. A (2019) 55: 197.

Lattice QCD Inputs for Nuclear Double Beta Decay, Cirigliano, Detmold, Nicholson, and Shanahan, arXiv: 2003.08493 [nucl-th].