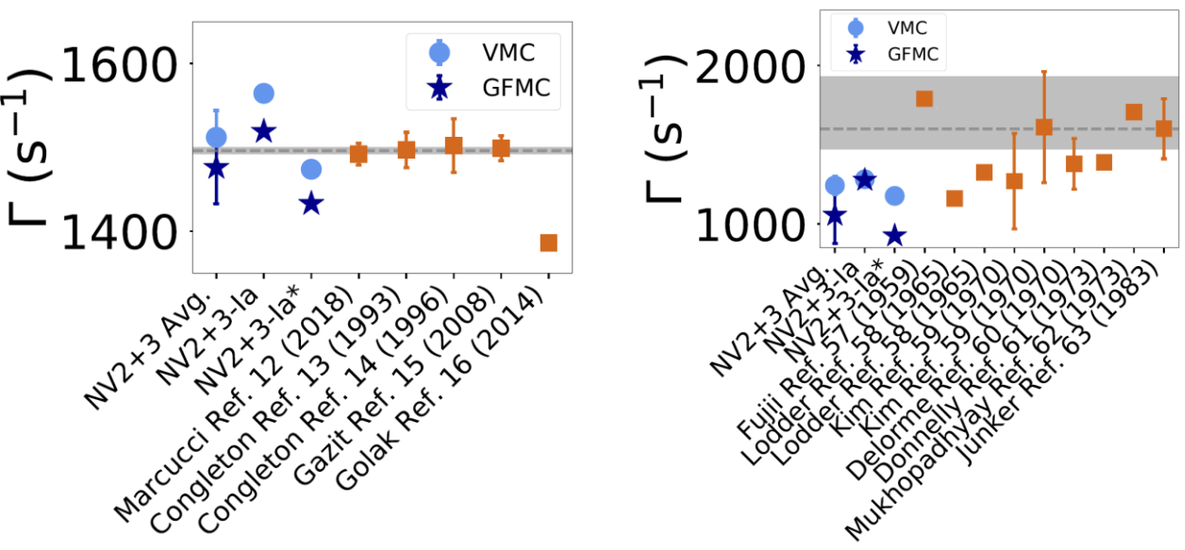
Ab initio calculation of muon capture in light nuclei

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- *Ab initio* frameworks are used to predict neutrinoless double beta decay matrix elements, but model validation for this process is not possible
- Muon capture takes place in the same kinematic regime as neutrinoless double beta decay and provides a means to validate nuclear models with experimental data
- We validate the Norfolk model of chiral interactions in light nuclei and provide the first *ab initio* calculation of the ^{6}Li muon capture rate



The ^{3}He (left) and ^{6}Li (right) muon capture rates predicted in this work with variational (light blue circles) and Green's function Monte Carlo (dark blue stars). Previous calculations (orange squares) and experimental data (gray shaded regions) are shown for comparison. The A=3 capture rate is in good agreement with the data, while a discrepancy in apparent in A=6. This was the first *ab initio* muon capture rate in A=6 and further study is required to understand the origin of the discrepancy.

Impact

- Using eight model classes of the Norfolk potential, we provided an analysis of the uncertainty due to various choices in fitting chiral EFT potentials
- Our ^{3}He muon capture rate agrees with previous chiral EFT calculations
- Discrepancies in the ^{6}Li results with data should lead to additional *ab initio* evaluations of the rate to further understand its origins

Accomplishments

- G. B. King, S. Pastore, M. Piarulli, and R. Schiavilla, Phys. Rev. C 105, L042501 (2022).