

Seminar Series Abstract

B(E2) measurements in light radioactive nuclei for guiding *ab initio* calculations

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Ab initio calculations are capable of describing nuclear properties in low mass nuclei from the basic building blocks of nucleons and their interactions. Different nuclear interactions and techniques are used in the *ab initio* framework to calculate experimental observables, which when verified by experiment, can guide these calculations. Measuring electromagnetic transition strengths can provide stringent tests of these *ab initio* calculations, but many are limited to low mass nuclei ($A < 20$). In this region, the number of electromagnetic transition strength measurements for unstable nuclei is severely lacking. In order to provide more tests of *ab initio* calculations, Coulomb excitation experiments were performed to measure the E2 transition strengths of the first excited state transition in ${}^7\text{Be}$ and ${}^8\text{Li}$. The ${}^7\text{Be}$ and ${}^8\text{Li}$ were produced and separated with TwinSol at the Notre Dame Nuclear Science Laboratory and the excitation cross sections were measured using γ -ray yields produced via Coulomb excitation in coincidence with the scattered nuclei. The $B(E2; 3/2^- \rightarrow 1/2^-)$ of ${}^7\text{Be}$ and the $B(E2; 2^+ \rightarrow 1^+)$ of ${}^8\text{Li}$ were deduced from these experiments, then compared to No-Core Shell-Model and Green's Function Monte Carlo calculations with several different interactions. In the comparison to the *ab initio* calculations, it was found that taking a ratio of the transition strengths in ${}^7\text{Be}$ and its mirror nucleus, ${}^7\text{Li}$, yielded a robust and converged value across all the considered *ab initio* calculations. Further, the *ab initio* calculations for this ratio showed no dependence on the choice of interaction and were in good agreement with each other and the experimental results. In a similar way, a ratio was constructed for ${}^8\text{Li}$ by taking a ratio of the $B(E2)$ with the square of the electric quadrupole moment of the ${}^8\text{Li}$ ground state. However, the *ab initio* results for this ratio did vary with the interaction choice, not displaying the same interaction independence seen in the ${}^7\text{Be}$ case, and only one interaction was in good agreement with the experimental result. This discrepancy between the two comparisons indicates a substantial difference in the structure of the first excited state in ${}^7\text{Be}$ compared to ${}^8\text{Li}$. Additionally, the sensitivity of the calculated ${}^8\text{Li}$ transition strength to the choice of interaction makes it useful for gaining insight into the interactions used by *ab initio* calculations.