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Measurement of Quadrupole Deformation using E2 and M1+E2 Transitions in Heavy Isotopes in the Mass Range of $150 < A < 250$

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The measurement of a permanent electric dipole moment (EDM) in atoms is crucial for understanding the origins of CP-violation. Quadrupole and octupole deformed nuclei exhibit significantly enhanced atomic EDM. However, accurate interpretation of the EDM in such systems requires the characterization of their deformation. While nuclear deformation is indicated in various structure models, experimental confirmation, particularly in heavy isotopes essential for EDM measurements, is lacking.
Nuclear E2 γ-ray transitions allow access to quantify quadrupole deformation, but these transitions are often mixed with M1 transitions. Both E2 and M1 transitions are well characterized by Weisskopf estimates, which rely on a single-particle approximation. However, deviations from measurements arise due to collective nuclear deformation. To utilize E2 and E2+M1 transition lifetimes for determining quadrupole deformation, accurate Weisskopf estimates for heavy nuclei are essential. Currently, Weisskopf estimates are only available for the mass range $A < 150$.
This work extends Weisskopf estimates for non-deformed nuclei in the mass range $150 < A < 250$, aided by theoretical structure models. This facilitates a comprehensive study of the deviation of E2 and M1+E2 transition lifetimes from the newly established Weisskopf estimates in deformed isotopes. Estimates of collective nuclear quadrupole deformation in isotopes relevant to EDM measurements, obtained from M1+E2 transition lifetimes, will be presented, also aiding in the identification of isotopes lacking definitive measurements for quadrupole deformation.

session

I. Nuclear Structure and Reactions

Primary author: MOHANMURTHY, Prajwal (Massachusetts Institute of Technology)

Co-authors: Prof. WINGER, Jeff (Mississippi State University); Ms QIN, Lixin (Wellesley College)

Presenter: MOHANMURTHY, Prajwal (Massachusetts Institute of Technology)

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