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Dipole polarizability effect on the quadrupole moment of the first 2+ state in 12C

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A high-statistics Coulomb-excitation study of 12C has been carried out using the 208Pb(12C,12C)*208Pb* Coulomb-excitation reaction at 56 MeV using the Q3D spectrometer at the Maier-Leibnitz Laboratory (MLL) in Munich (Germany). Beam currents of approximately 10ˆ11 pps allowed the determination of the spectroscopic quadrupole moment of the first 2+ state at 4.439 MeV with unprecedented accuracy.

Furthermore, the effect of the nuclear dipole polarizability on E2 collective properties was investigated using large-scale shell-model calculations. The dipole polarizability parameter k accounts for deviations of the hydrodynamic model prediction with respect to the actual effects from the Giant Dipole Resonance (GDR). Away from shell closures and light nuclei, k values for ground states are observed to follow a smooth trend consistent with k=1. However, for light nuclei, values of k>1 are determined and recently, it has been shown that k values actually increase for excited states with respect to ground state values [1,2,3].

A no-core shell model (NCSM) calculation predicts κ(2+) = 2.1(2) and ground state κ(g.s.) = 1.5(2) in agreement with photo-absorption measurements κ(g.s.) = 1.6(2). The phenomenological WBP shell model interaction predicts a smaller κ(2+) = 0.9 and κ(g.s.) = 1.4. Assumingi k(2+)NCSM=2.1(2) and k(2+)WBP=0.9 yield QS(2+)=+0.12(3) eb and QS((2+)=+0.07(3) eb, respectively, confirming the oblate deformation for the 2+ state.

Such a discrepancy in k values is associated with the binding energy predictions by these models. The WBP interaction predicts a larger g.s. binding energy compared to experiment data hence the reduced κ value. Previous studies show highly bound nuclear systems e.g. magic nuclei present reduced κ values. This work proves sensitivity of polarizability to change in binding energies, a 5% decrease of binding energy results a significant change in polarizability. Therefore establishing the nuclear dipole polarizability as a probe for investigating long-range correlations of the nuclear force such as nuclear collectivity and shell effects.

[1] M. K. Raju, J.N.Orce, P.Navrátil, G.C.Ball, T.E.Drake et al., Phys. Lett. B. 777, 250 (2018).
[2] J. N. Orce, E. J. Martini, K. J. Abrahams, C. Ngwetsheni, et al., Phys. Rev. C 104, L061305 (2021).
[3] C. Mehl, J. N. Orce, C. Ngwetsheni et al., Under review for publication.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

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