Emergence of triaxiality in ^{74}Se from electric monopole transition strengths

The 2_2^+ state in non-doubly-magic, even-even nuclei is commonly interpreted as due to a collective excitation. In the vibrational and rotational limits, this state originates from vibrations around the ground-state shape. Even though these basic paradigms are known to represent only a first-order approximation of the nuclear structure, they are still used for classifying isotopes throughout the chart of the nuclides and as a basis for more complex theoretical approaches. Nevertheless, since the appearance of low-energy nuclear vibrations has been debated in the recent literature, the possible vibrational interpretation of the 2_2^+ state also needs to be carefully reanalysed.

Monopole transitions ($E0$) are an ideal tool to investigate nuclear structure because they are related to the radial distribution of the electric charge inside the nucleus. Therefore, monopole transition strengths $\rho^2(E0)$ are sensitive to changes in the shape of the nuclear states. In particular, this observable is zero if the shape of the two involved states is the same and/or if there is no configuration mixing between their wavefunctions [1]. Noteworthy, the $\rho^2(E0)$ value between the first two 2^+ states is zero in both the vibrational and axially-symmetric rotational limits. A surprising result has been recently obtained in the Ni isotopic chain [2], where large $\rho^2(E0; 2_2^+ \rightarrow 2_1^+)$ values have been measured. Apart from simple models, a more sophisticated method based on the shell model was also applied to explain these large $\rho^2(E0)$ values, unsuccessfully.

Selenium isotopes are thought to be collective in their low-lying structure. Which kind of collectivity, however, is still a matter of debate. A nearly spherical-vibrational scenario was suggested for ^{74}Se in a recent β-decay study [3]. The anomalous low energy of the 0_2^+ state, which is a member of the two-phonon multiplet in this case, was explained as due to the mixing between the 0_2^+ state and the intruder, strongly-deformed 0_3^+ state. While this interpretation explains several observables in ^{74}Se, others are not reproduced. If this picture is correct, the $\rho^2(E0; 2_2^+ \rightarrow 2_1^+)$ value should be negligible and the $\rho^2(E0; 0_3^+ \rightarrow 0_2^+)$ value should be large. Noteworthy, former studies identified the 0_2^+ state as another shape-coexisting state, and the 2_2^+ state as the band-head of a γ-band [4]. Given the most recent suggestions regarding the appearance of multiple-shape coexistence in the neighbouring Ni isotopes, and the emerging role of triaxiality in the nearby ^{76}Se and the close Ge and Zn isotopes, further investigation in ^{74}Se is required.

This contribution presents new experimental results regarding internal conversion coefficients and monopole transition strengths in ^{74}Se. A large $\rho^2(E0; 2_2^+ \rightarrow 2_1^+)$ value has been measured, with a magnitude comparable to those in the close Ni isotopes, while the $\rho^2(E0; 0_3^+ \rightarrow 0_2^+)$ value has been deduced to be small. Also, for the first time microscopic Beyond-Mean-Field (BMF) calculations for ^{74}Se will be present, and the role of triaxiality in this isotope discussed.

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