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Emergence of triaxiality in 74Se from electric monopole transition strengths

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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 ρ2(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. Noteworthy,
the ρ2(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, where large ρ2(E0; 2+2 ⟶ 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 ρ2(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 74Se in a recent β-decay study. 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 03 state. While this interpretation explains several observables in 74Se, others are not reproduced. If this picture is correct, the ρ2(E0; 2 +2 ⟶ 2 1) value should be negligible and the ρ (E0; 0 3 ⟶ 0 2) value should be large. Noteworthy, former studies identified the 0+2 state as another shape-coexisting state, and the 2+ state as the band-head of a γ-band.
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 74Se is required.
This contribution presents new experimental results regarding internal conversion coefficients and monopole transition strengths in 74Se. A large ρ2(E0; 2 +
2 ⟶ 2 1) value has been measured, with a magnitude comparable to those in the close Ni isotopes, while the ρ2(E0; 0 +3 ⟶ 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.

Attendance Type

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Primary author: MARCHINI, Naomi (University of Florence - INFN Florence section)

Presenter: MARCHINI, Naomi (University of Florence - INFN Florence section)

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