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Shapes and collectivity of nuclei around Z = 50 studied by Coulomb Excitation

Content :

Numerous experimental and theoretical studies are currently focused on studying the nuclear shell structure of nuclei far from the line of stability. In particular, the evolution of nuclear properties, for example, the reduced transition probabilities across the Z = 50 isotopic chain, has been examined in detail. Radioactive ion beams yield new experimental results close to the doubly magic 100Sn and 132Sn, but very accurate data on the stable mid shell nuclei are also of great relevance for our understanding of nuclear structure. The Te nuclei with Z = 52 lies in the transitional region between the spherical nuclei at Z = 50 and deformed Xe and Ba nuclei. For the mid-shell 120,122,124Te nuclei the partial level show the expected vibrational-like structure with equal energy spacing between the phonon states [1].
In our previous Coulomb excitation experiment [2] at IUAC, New Delhi, where the particle detectors are in the forward direction, B(E2; 0+ ⟶ 2+) value in 120Te was re-measured with a much higher precision to allow a comparison with the predictions of the large scale shell model calculations (LSSM). Based on all experimental findings, including the excitation of higher excited states for 120,122,124Te, on obtained the best agreement with an asymmetric rotor behaviour.
The most sensitive probe to characterise a nuclear excitation is via a measurement of quadrupole moments. Therefore, to further investigate the second-order effects in Coulomb excitation (i.e. diagonal matrix elements) and to find an experimental proof of the deformation in 120Te, the present Coulomb excitation experiment was performed at Heavy Ion Laboratory (HIL), Warsaw, where the particle detectors are in the backward direction. The resulting transitional and diagonal E2 matrix elements, deduced B(E2) values and static quadrupole moments were extracted using the least square Coulomb Excitation search code - GOSIA [3]. The measured value for Q(2+) provides first experimental proof of the prolate shape of the 120Te nucleus in the 2+ state [4]. These values are also compared with the results obtained using Davydov-Filippov model assuming $\beta = 0.18$ and $\gamma \sim 27°$.
To further study the evolution of nuclear structure properties and in particular, nuclear deformation, across the Z=50 closed shell, 118Sn nucleus (isotone of 120Te with N=68) was also investigated. This will allow to understand the contribution of single-particle excitation to the collective motion of nuclei. Recent Total Routhian Surface calculations [5] show the co-existence of spherical ground state band with intruder rotational band, making 118Sn isotope an excellent candidate to study the phenomena of nuclear shape co-existence. With these motivations in mind, a multi-step

Coulomb excitation experiment using 32S bean was performed at HIL, Warsaw. The preliminary results obtained from this experiment will also be presented during the conference.

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