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Triaxial Nuclear Shapes from Simple Ratios of Electric-Quadrupole Matrix Elements

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Theoretical models often invoke triaxial nuclear shapes to explain elusive collective phenomena, but such assumptions are usually difficult to confirm experimentally. The only direct measurements of the nuclear axial asymmetry γ is based on rotational invariants of zero-coupled products of the electric-quadrupole (E2) operator, which generally require knowledge of a large number of E2 matrix elements connecting the state of interest. We propose an alternative method to determine γ of even-even deformed nuclei using ratios of two E2 matrix elements only, which are typically well known. While this approach is based on modelling the rotation of a rigid triaxial nucleus following the Davidov and Filippov model, it is applied in such a way that it becomes practically model-independent and parameter-free. The results are in agreement with the Kumar-Cline model-independent values of γ (where measurements are available). The technique was applied to more than 60 deformed even-even nuclei suggesting that deformed nuclei generally exhibit well-defined axially-asymmetric shapes rather than deformation softness as it is commonly presumed.

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