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Role of higher-order collective excitations on the barrier distribution in back-angle quasi-elastic scattering of massive systems

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Back-angle quasi-elastic (QE) scattering provides critical barrier information in massive nuclear reactions leading to the synthesis of superheavy nuclei. The shapes and peaks of QE barrier distributions serve as fingerprints of nuclear structures and reaction dynamics. In this work, we extend the high-accuracy R-matrix method [1] and the finite element method [2-4] to solve the coupled-channels equations for massive systems, which are demonstrated to be more stable than widely used modified Numerov method [5] and allows us to include higher-order vibrational and rotational couplings. Using the reactions 48Ti+208Pb and 51V +248Cm as examples, The calculations shows that higher-order collective excitations significantly smooth the barrier distributions, improving the agreement with experimental data.

References:
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Consent

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