EXPERIMENTAL SIGNATURE OF PROJECTILE COUPLING IN ^{28}SI+ ^{154}SM REACTION: STUDY THROUGH FUSION AND QUASI-ELASTIC SCATTERING

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We have studied the coupling to collective states of the ^{28}Si projectile in its fusion with a deformed Sm target. Before categorizing the nature of these states, theoretically, as vibrational or rotational, we wish to directly extract the experimental signature of the ^{28}Si coupling from the corresponding barrier distribution (BD). To this end, the BDs of the ^{28}Si+^{154}Sm and ^{16}O+^{154}Sm systems have been compared using existing fusion data, scaled to compensate for the differences between the nominal Coulomb barriers and the respective coupling strengths. However, the large error bars on the high-energy side of the fusion BD prevent any definite identification of such signatures. We have, therefore, performed a quasi-elastic (QE) scattering experiment for the ^{28}Si+^{154}Sm system and compare its results with existing QE data for the ^{16}O projectile. The comparison now reveals a well defined peak-like structure on the high-energy side of the BD, due to the ^{28}Si coupling. In contrast with previous studies, it is found that a coupled-channels calculation with vibrational coupling to the first 2^+ state of ^{28}Si reproduces this structure rather well. However, an almost identical result is found with the rotational coupling scheme if one correctly accounts for the large hexadecapole deformation of the projectile. A value around that given by Mőller and Nix ($\beta_4 \approx 0.25$) leads to a strong cancellation in the reorientation term that couples the 2^+ state back to itself, making that state look vibrational in this process. Thus, unlike the fusion experiment, our new QE results not only show a sensitivity to the ^{28}Si hexadecapole deformation, but are also capable of giving a physically reasonable estimate for β_4.