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SINGLE-PARTICLE ASYMPTOTIC NORMALIZATION COEFFCIENTS IN MIRROR MEDIUM-MASS NUCLEI

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The asymptotic normalization coefficients (ANCs) show how likely nucleons can stay in classically forbidden region and their knowledge if important for studying peripheral reactions such as proton capture in stellar environments.
We investigate relations between neutron, C_n, and proton, C_p, ANCs in mirror nuclear states for medium-mass nuclei, 40 ≤ A ≤ 100, using a two-body potential model with local and nonlocal nucleon-core interactions. Assuming that nuclear potential wells in mirror states are the same, we calculate ratios $R_b = (C_p/C_n)^2$ and compare them to predictions of model-independent analytical formula (7) from [1]. We found that despite increasing strength of the Coulomb interaction with nuclear mass this formula has an accuracy similar to that found in earlier investigations for light nuclei. The analytical formula works better for nonlocal than for local potentials, with the accuracy on most cases within 5%.

Fig. 1. Ratio R_b in terms of analytic estimate R_0 as a function of proton separation energy S_p for different orbital momentum of removed nucleon, calculated in local (left panel) and nonlocal (right panel) models. The spread of R_b reflects different choice of nucleon-core potentials.

The study is extended to bound-unbound mirror pairs by assessing relations between C_n and the width Γ_p of a mirror proton resonance. The deviation of the calculated ratio Γ_p/C_n^2 from prediction of analytical formula (see expression (8) in [1]) is similar to that obtained for bound-bound mirror pairs. The knowledge of the ratio Γ_p/C_n^2 can be used to determine widths of narrow proton resonances of astrophysical importance by measuring ANCs of mirror neutron states in peripheral transfer reactions.

1. N. K. Timofeyuk et al., Phys. Rev. Lett. 91, 232501 (2003).

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