Shell model description of the spectroscopic properties of ^{25}Al-^{25}Mg mirrors at excitation energies of astrophysical significance

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The ^{25}Mg and ^{25}Al mirror nuclei play a critical role in nucleosynthesis processes, such as in slow neutron capture process (s-process) and rapid proton capture process (r-process), respectively. The (α,n) reaction on ^{22}Ne producing ^{25}Mg is the main neutron source in massive stars [1]. In addition, ^{25}Mg is the origin of the formation of two other nuclei in stellar environments, the proton capture on ^{25}Mg, forms ***the rare long-lived radio-isotope*** ^{26}Al [2,3] and the neutron capture on ^{25}Mg, forms ^{26}Mg [4]. The J^{π} assignments of ^{25}Mg has a significant importance in determining the previous astrophysical reactions rates. Similarly, The (α,p) reaction on ^{22}Mg producing ^{25}Al [5] plays a critical role in XRB models. The astrophysical ^{25}Al(p,γ)^{26}Si [6] reaction represents one of the key remaining uncertainties in accurately modelling the abundance of radiogenic ^{26}Al ejected from classical novae.
Theoretical results for ^{25}Mg and ^{25}Al mirror nuclei employing our PSDPF effective interaction [6], including excitation energies, spin-parity assignments, and transition probabilities, have been systematically compared with available experimental data. Our interaction describes quite well these observables in both studied nuclei that are crucial in calculating the above astrophysical reaction rates. We will present in our contribution a detailed discussion of our work.

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