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Exploring the Spectroscopy of the Low- and Intermediate-Spin States in ^{148}Sm .

Despite the extensive experimental and theoretical studies that have been conducted on the low-lying positive-parity 0_2^+ , 2_2^+ , and 4_3^+ states in the transitional deformed nuclei, their microscopic identity remains unclear. Properly understanding the nature of these states remains one of the greatest challenges in nuclear structure physics. In order to gain a deeper understanding of how such states are formed, $^{148}\text{Nd}(^4\text{He}, 4n)^{148}\text{Sm}$ fusion reactions have been carried out at the iThemba Laboratory for Accelerator Based Sciences (LABS) to populate the low and intermediate spin states in the ^{148}Sm nucleus. The AFRODITE γ -ray spectrometer used in this reaction comprised of 9 high-purity germanium detectors (HPGe), five positioned at 90° and four at 135° with respect to the beam direction. The data analysis has been carried out using both the MT-sort for sorting obtained data into γ - γ matrices and Radware software packages for decay scheme analysis. The work has extended the decay scheme of ^{148}Sm with approximately 33 γ -ray transitions, 28 new energy levels, and further made a few adjustments on both low- and intermediate spin states. Additionally, this work supports the alternating parity structures that earlier authors had observed and reported. The previously reported γ -band heads have also been further investigated, and the present analysis partially agrees with some of the proposed γ -band heads; however, no new structures have been observed on top of the γ -band head. This work has further conducted a systematic comparison of the even-even isotones in the $N = 86$ region to further confirm the behavior of transitional nuclei. The ^{148}Sm and its neighboring isotones exhibit the characteristics of spherical and vibrating nuclei, such behavior gives rise to mixed nuclear excitation. An improved γ -ray spectrometer with augmented low- and high-photon detectors would provide more information about the γ -bands observed in the ^{148}Sm nucleus.

Notes

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