

SYSTEMATIC STUDY OF THE SPECTROSCOPIC PROPERTIES OF ALUMINIUM ISOTOPES WITH $N < Z$

Abir **SELIM**¹, Mouna **BOUHELAL**¹

¹ LPAT, Echahid Cheikh Larbi Tebessi University 12000, Tebessa, Algeria

Abir Selim: ORCID 0009-0007-0462-5496

abir.selim@univ-tebessa.com

Mouna Bouhelal: ORCID 0000-0001-7346-9801

mouna.bouhelal@univ-tebessa.dz

Abstract

Neutron-deficient nuclei provide a valuable testing ground for investigating the evolution of nuclear structure far from stability. The ($N \nmid Z$) aluminium isotopes offer a particularly interesting sequence in which changes in shell structure and cross-shell excitations can significantly influence their spectroscopic properties. The corresponding mirror nuclei offer a complementary structural information through the comparison of analogue states and their associated electromagnetic observables and provide important tests of mirror symmetry and shell-model descriptions in this region.

A systematic shell-model study of $^{20-25}\text{Al}$ and their corresponding mirror nuclei is performed using the $(0+1) \hbar\omega$ PSDPF interaction. The study explores the spectroscopic properties over a broad excitation-energy range, with particular emphasis on the evolution of nuclear configurations and the role of cross-shell excitations in shaping both low- and high-lying states. Calculated excitation energies and spin-parity assignments are systematically compared with the available experimental data. Electromagnetic properties, including magnetic dipole and electric quadrupole moments, transition strengths and selected lifetimes, are also investigated to provide further insight into the structure and configuration mixing of the calculated states.

The calculations reproduce the main features of the experimental energy spectra and their evolution across the isotopic chain