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l-forbidden M1 transitions in N=50 isotones

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The occurrence of pairs of nuclear states at low energy, differing in orbital angular momentum by two units and corresponding to single-particle states within the nuclear shell model, is frequently observed in odd-mass nuclei located near closed shells across the nuclear chart. Such single-particle states experimentally observed as the ground state and low-lying first-excited state in many odd-A nuclei across several mass regions. They can be labelled with the radial quantum number nr, the orbital angular momentum l and the total angular momentum j, and correspond to $|n_r\ l\ j=l+1/2>$ and $|n_r-1\ l+2\ j'=l+3/2>$, respectively, for example the pairs $s_{1/2}-d_{3/2}$, $p_{3/2}-f_{5/2}$ and $g_{7/2}-d_{5/2}$.

Magnetic dipole M1 Δl=2 transitions between pairs of states of this kind are l-forbidden in the extreme shell model picture [1,2] because the magnetic dipole isovector operator does not change the orbital angular momentum. Nonetheless, such transitions are still experimentally observed, although with rates that are generally much lower than those of allowed transitions, or even below the single-particle limit. It is expected that these transitions result from the breakdown of l-forbiddenness, influenced by other nuclear dynamic effects, such as core polarization and meson exchange mechanisms [3]. Therefore the investigation of l-forbidden M1 transitions may provide insight into the role of these effects within the atomic nucleus [4].

Semimagic nuclei with Z = 50 [5,6] and N = 50 [7] with varying number of neutrons or protons, respectively, are excellent laboratories to probe l-forbidden M1 transitions. The presentation will focus on odd-A N = 50 isotones in the vicinity ^{78}Ni, where the M1 transitions probabilities are obtained from excited level lifetime measurements employing fast-timing methods. New results will be presented for ^{83}As, ^{85}Br, obtained from experiments performed at ISOLDE/CERN and ILL, respectively. They will be discussed in the context of other available data for the region, completing the systematics from ^{81}Ga to ^{87}Rb where the dominant single-particle configurations are due to the $p_{3/2}$ and $f_{5/2}$ orbitals in the 28–50 proton shell. The results will be compared to shell model calculations in order to understand the role of the occupation of the proton orbitals and core polarization effects [8].

[1] I.M. Govil and C.S. Kurana, Nuclear Physics 60 (1964) 666.
[2] R.G. Sachs and M. Ross, Phys. Rev. 84 (1951) 379.
[3] W. Andrejtscheff, L. Zamick, N.Z. Marupov et al., Nuclear Physics A 351 (1981) 54.
[4] P. von Neumann-Cosel and J. N. Ginocchio, Phys. Rev. C 62 (2000) 014308.
[5] R. Lica, H. Mach, L.M. Fraile et al., Phys. Rev. C 93 (2016) 044303.
[6] J. Benito, L.M. Fraile, A. Korgul et al., Phys. Rev. C 110 (2024) 014328.
[7] V. Paziy, L.M. Fraile, H. Mach et al., Phys. Rev. C 102 (2020) 014329.
[8] Horie and Arima, Prog. Theor. Phys. 11 (1954) 509.

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