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Level structure and transition multipolarities in 54Mn

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Electromagnetic transition probabilities are of great interest to nuclear physicists as they provide detailed information about the nature of the wave functions of the initial and the final states. Odd-odd nuclei in the vicinity of Z = N = 20 and 28 shell closure present a unique opportunity for testing the underlying proton-neutron residual interaction. These nuclei exhibit a complex level structure due to many possible couplings of unpaired nucleons to the even-even core [1]. Hence, the investigation of their nuclear properties provides scope for understanding the single-particle energies and the residual neutron-neutron interactions in the shell model substructure [1,2]. The properties of the low and high spin states in odd-odd 54Mn (Z = 25, N = 29) have been studied [1-3] via different probes. Spectroscopic information such as -ray branching ratios, and multipole mixing ratios, were determined for transition energies, 54 keV up to 1509 keV (from J = 2+ up to 6+) [4,5]. The lifetimes of many states have been also measured [6]. In Kumar et al., [2], the excited states in 54Mn were populated using 51V(20Ne,xn,yp)54Mn reaction up to excitation energy of 5 MeV, = 15+. However, the information on the reduced transitions probabilities in 54Mn is still scarce despite numerous studies.

We shall report on the first conversion electron and electron-positron pair conversion study of 54Mn. Excited states up to 3 MeV have been populated in the 54Cr(p,n)54Mn reaction at 5.4 MeV bombarding energy, using DC beams from ANU Heavy Ion Accelerator Facility (HIAF). Internal Conversion Coefficients (ICC) for the low-lying states in 54Mn were determined in several transitions for the first time [6]. The deduced conversion coefficients allow for the assignment of multipolarities for transition energies > 1 MeV up to ~ 2.1 MeV (= 1+ up to 4+). The results are compared with shell-model calculations as a test of agreement between theory and the experiment.

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