



Contribution ID: 98

Type: Oral

Level structure and transition multipolarities in ^{54}Mn

Tuesday, 17 May 2022 16:30 (20 minutes)

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 ^{54}Mn ($Z = 25$, $N = 29$) have been studied [1-3] via different probes. Spectroscopic information such as γ -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 ^{54}Mn were populated using $^{51}\text{V}(^{20}\text{Ne}, \text{xn}, \text{yp})^{54}\text{Mn}$ reaction up to excitation energy of 5 MeV, = 15+. However, the information on the reduced transitions probabilities in ^{54}Mn is still scarce despite numerous studies.

We shall report on the first conversion electron and electron-positron pair conversion study of ^{54}Mn . Excited states up to 3 MeV have been populated in the $^{54}\text{Cr}(p, n)^{54}\text{Mn}$ 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 ^{54}Mn 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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Session Classification: Posters