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Coexistence of single-particle and collective structures in 1f $_{7/2}$ nuclei

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Nuclei in $A \sim 50$ region that are close to the line of stability and have $(1f_{7/2})^n$ ground state configuration for both proton and neutron, were investigated. Particularly, ^{51}Cr (Z =24) and ^{50}V(Z =23) are of special interest as the proton $1f_{7/2}$ is only about half-occupied, but number of neutrons in neutron $1f_{7/2}$ orbital is just one short of the shell closure. The proton configuration is expected to induce collective behavior while the neutron configuration should lead to a single-particle structure. Hence these nuclei provide a fertile ground for studying the interplay of collective and single-particle effects. Two different experiments employing $^{27}Al($ ^{28}Si, $3p1n)^{51}Cr$ and $^{48}Ti(, pn)^{50}V$ reactions were carried out at Tata Institute of Fundamental Research, Mumbai, India and Variable energy Cyclotron Centre, Kolkata, India to investigate the level structures of these nuclei.

Earlier work on ^{50}V level scheme dates back to the sixties and seventies decade that were carried out with a modest number of Ge(Li) detectors[1, 2]. The latest work on ^{51}Cr nucleus was reported in the beginning of the decade of nineties employing only five HPGe detectors [3]. The present experimental setups consisted of large clover detector arrays (INGA: Indian National Gamma Array), and this has led to considerable extension in the level scheme of both of these nuclei. The level schemes mostly reveal irregular spacing of the levels and follow shell model pattern. However deformation, though not substantial, has been considered in the interpretation of non-yrast bands. Particularly both show a non-yrast band decaying to the ground state along with the yrast band. In ^{51}Cr, long-elusive fast feeding transitions to certain yrast states have been observed. Lifetimes of these states have been extracted employing DSAM technique. Large Scale Shell Model (LSSM) calculations using NuShellX @MSU[4] code has been carried out for both the nuclei in the full fp valence space in the present work, unlike the previous calculations that restricted the number of particle excitations. Experimental results, theoretical calculations and their interpretations will be presented in detail during the conference.

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