Study of yrast bands in neutron-rich odd mass Strontium nuclei

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The study of neutron-rich nuclei is one of the current topics in Nuclear Physics. Neutron-rich isotopes with N ≥ 60 and A ≈ 100 are characterized by strong axial deformation. Strontium isotopes are the most deformed nuclei known so far in this region. Quadrupole deformations of β ≈ 0.4 have been deduced for ^{98}Sr, ^{99}Sr and ^{101}Sr from the lifetimes of the first excited states and from mean-square radii measured by collinear laser spectroscopy [1-5]. For this mass region, the valence nucleons begin to fill the $\hbar_{11/2}$ neutron and the $g_{9/2}$ proton orbitals.

In this paper, the Projected Shell model has been used to study various nuclear structures properties of some neutron-rich odd mass isotopes of Sr in the mass region A ≈ 100. The Hamiltonian used in these calculations is composed of single-particle energies, monopole pairing between like particles, quadrupole-quadrupole and quadrupole pairing interactions and is of the form

$$\hat{H} = \hat{H}_0 - \frac{1}{2}\chi\sum_{\mu}\hat{Q}_{\mu}\hat{Q}^{\dagger}_{\mu} - G_M\hat{P}^{+}\hat{P} - G_Q\sum_{\mu}\hat{P}^{+}_{\mu}\hat{P}_{\mu}$$

The monopole pairing force constants G_M are adjusted to give the known energy gaps. For performing calculations in this work, we have taken

$$G_M = \left(G_1 \mp G_2\frac{N-Z}{A}\right)\frac{1}{A}(\text{MeV})$$

where + (-) is for neutron (proton). In this work, $G_1$and G_2 are taken, as 20.20 and 12.12 MeV, respectively. The strength parameter G_Q for quadrupole pairing is assumed to be proportional to G_M.

In this work, the nuclear structure properties like yrast spectra, transition energies and band diagrams for $^{97\text{-}101}$Sr isotopes have been calculated. The results for yrast spectra and transition energies have also been compared with the experimental data whereas the band diagrams have revealed a new physics in these isotopes due to the band crossing phenomena.

In figures1[a-c], the yrast spectra, transition energies and band diagram for ^{99}Sr have been presented. From the comparison of the yrast spectra and transition energies, it is found that the experimental data is reproduced as there is a very good agreement between the calculated and experimental data which is indicative of the fact that the applied framework of calculations is fairly reliable in the mass region A ≈ 100. Further, the results on band diagram for ^{99}Sr, presented in figure 1(c), give us an idea about the coexistence of shapes at high spins.

Similar results are also calculated for ^{97}Sr and ^{101}Sr and experimental data is also very well reproduced in these isotopes. These results are not presented in this paper due to space limit but would be discussed in the symposium.

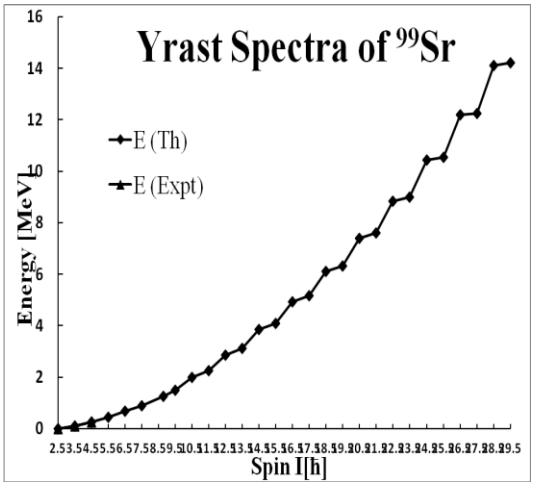

Figure 1(a)

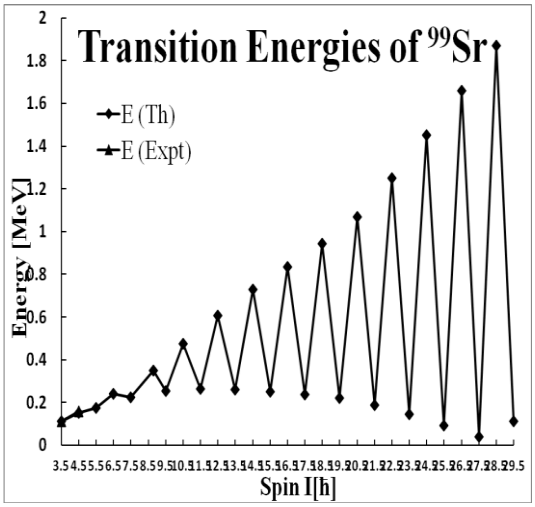

Figure 1(b)

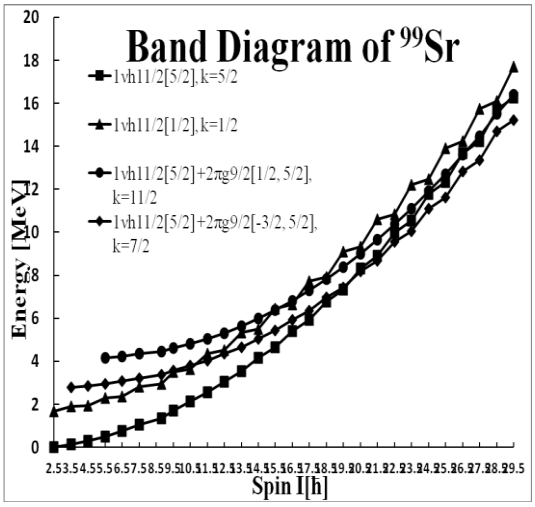

Figure 1(c)

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