Band structure of some very neutron deficient Cesium isotopes

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Experimental data show that the very neutron-deficient A≈120, Z=55 cesium isotopes are well deformed and display a wealth of interesting collective structures. Smith et al [1] have performed high spin spectroscopy using the Gammasphere array and extended the previously observed negative parity band of ^{117}Cs upto high spin. Liden et al [2] have extended the $h_{11/2}$ negative parity band of ^{119}Cs upto spin $I^{\pi}=35/2^{-}$. Besides this some positive parity bands are also observed in ^{117,119}Cs nuclei.

In order to investigate band structure of these very neutron deficient Cs nuclei, Projected Shell Model (PSM) [3] has been employed. The Hamiltonian employed in present work is

$$\hat{H}=H_0-\frac{1}{2}\chi\sum_{\mu}\hat{Q}^{\dagger}_{\mu}\hat{Q}_{\mu}-G_M\hat{P}^{\dagger}\hat{P}-G_Q\sum_{\mu}\hat{P}^{\dagger}_{\mu}\hat{P}_{\mu}$$

where H_0 is the spherical single–particle Hamiltonian. The strength of quadrupole force χ is adjusted such that the known quadrupole deformation parameter ε_2 is obtained by the usual Hartree+BCS self-consistent procedure. The monopole pairing force constant G_M are adjusted to give known energy gaps. For all the calculations, the monopole pairing strength G_M used in the calculations are

$$G_M^{\nu}=\left[19.60-15.70\frac{N-Z}{A}\right]A^{-1}, G_M^{\pi}=19.60A^{-1}$$

These strengths are same as employed in the neighbouring even-even Barium isotopes [4]. The strength parameter G_Q for quadrupole pairing is assumed to be proportional to G_M. In present calculations G_Q is taken as 0.18 for both ^{117}Cs and ^{119}Cs.

In figure 1, comparison of experimental and theoretical negative parity bands is presented for ^{117,119}Cs. It is observed from the figure that the calculated results are in reasonable good agreement with experimental data. In figure 2 the band diagrams for ^{117,119}Cs are displayed. In case of ^{117}Cs , one finds that observed negative parity band upto spin $27/2^-$ is arising from two 1-qp proton bands having configurations $1\pi h_{11/2}[1/2]$,K=1/2 and $1\pi h_{11/2}[-3/2]$,K=-3/2. At spin $29/2^-$ these two 1-qp proton bands are crossed by three 3-qp bands having configurations $1\pi h_{11/2}[-3/2]+2\nu h_{11/2}[-3/2,5/2]$,K=-1/2, $1\pi h_{11/2}[1/2]+2\nu h_{11/2}[-3/2,5/2]$,K=1/2 and $1\pi h_{11/2}[-3/2]+2\nu h_{11/2}[-3/2,5/2]$,K=5/2. Thus, above spin $29/2^-$ the observed negative parity band is arising from these three 3-qp bands. In case of ^{119}Cs the states of observed negative parity band upto spin $23/2^-$ are arising from one 1-qp band having configuration $1\pi h_{11/2}[1/2]$,K=1/2 whereas the states above spin $23/2^-$ are arising from the superposition of four 3-qp bands having configurations $1\pi h_{11/2}[1/2]+2\nu h_{11/2}[-3/2,5/2]$,K=3/2, $1\pi h_{11/2}[1/2]+2\nu h_{11/2}[1/2,5/2]$,K=7/2, $1\pi h_{11/2}[1/2]+2\nu h_{11/2}[-3/2,5/2]$,K=1/2 and $1\pi h_{11/2}[1/2]+2\nu h_{11/2}[1/2,5/2]$,K=5/2. The detailed results of positive and negative parity bands for neutron deficient Cs nuclei would be presented in the symposium.

References:

[1] J.F. Smith et al, Phys. Rec. **C63**, 024319 (2001).

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[3] K. Hara and Y. Sun, Int. J. of Mod. Phys. **E4**, 637 (1995).

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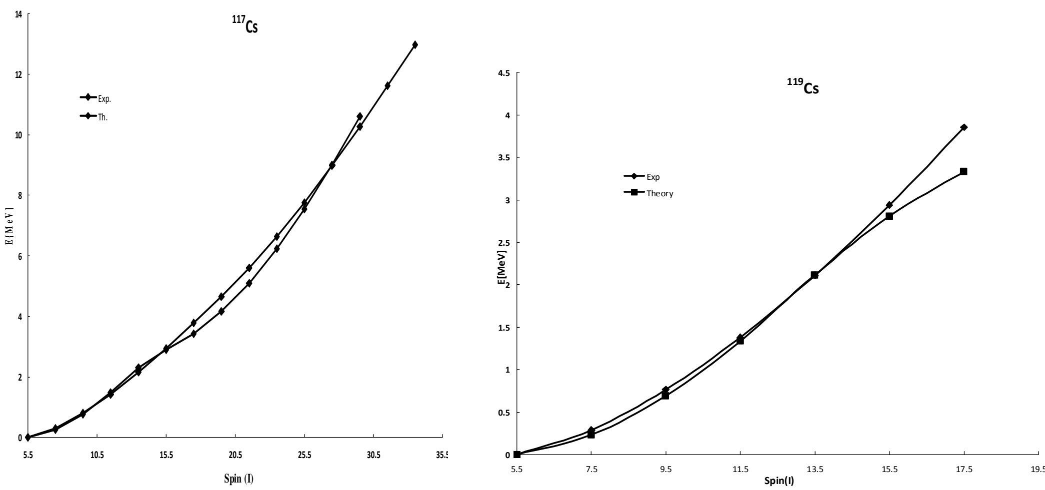

Figure 1. Comparison of the calculated energies E(I) of the negative parity band with experimental data of ^{117,119}Cs isotopes. The calculated negative parity band consists of the lowest states after diagnolization at each angular momentum

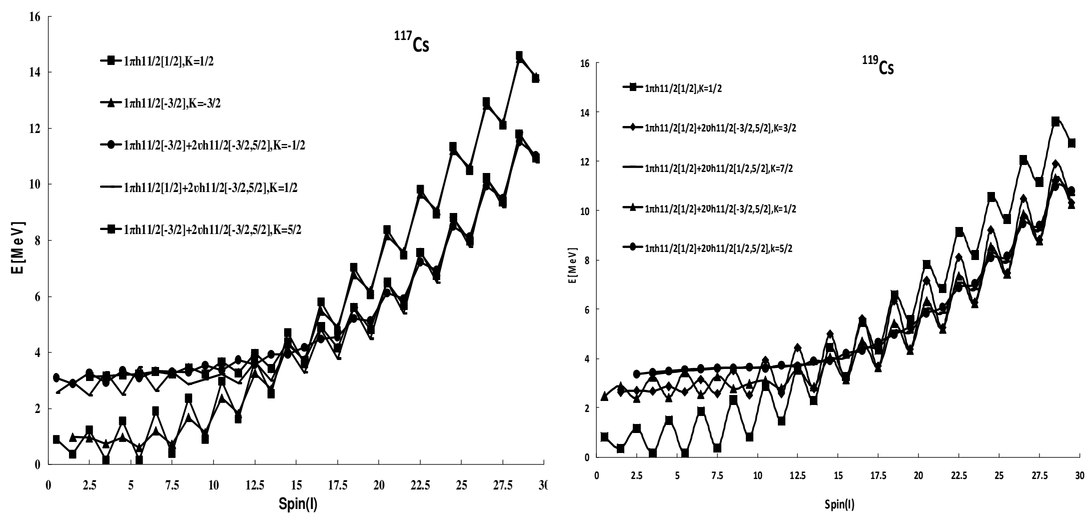

Figure2. Band diagrams for $^{117,\,119}$Cs isotopes.