# Nuclear structure properties of some neutron-deficient cerium nuclei

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The nuclear structure investigations of the neutron-deficient deformed nuclei in the A≈130 mass region have provided much useful information on the nature of both collective and single-particle excitations. Light neutron–deficient odd–neutron cerium isotopes with A≈130 can be cited as one such example which are of current interest in high spin nuclear structure physics because of being well deformed with quadrupole deformation of $\beta_2$ = 0.25-0.30. Multiple bands have been recently reported to exist in $^{125-131}$Ce. However, the negative parity band based on $7/2^-$ is found to be lower in energy than the other bands in $^{125,127}$Ce whereas in $^{129}$Ce, the negative parity band based on $7/2^-$ is found to be higher in energy than positive parity band based on $5/2^+$. In $^{131}$Ce, the negative parity band close to the ground state band has a band head $9/2^-$.

The purpose of the present work is to interpret the negative parity bands observed in $^{125-131}$Ce in the framework of Projected Shell Model (PSM) and also to test the applicability of this model for odd mass in the A= 120-130 mass region. In the present study the results are obtained for the yrast spectra, transition energies and the energy of some of the lowest lying bands in $^{125-131}$Ce.

The Hamiltonian [1] employed in the present work is

$$H = H_0 - \frac{1}{2}\chi\sum_{\mu} Q_{\mu}^{+} Q_{\mu} - G_M P^{+} P - G_Q \sum_{\mu} P_{\mu}^{+} P_{\mu}$$

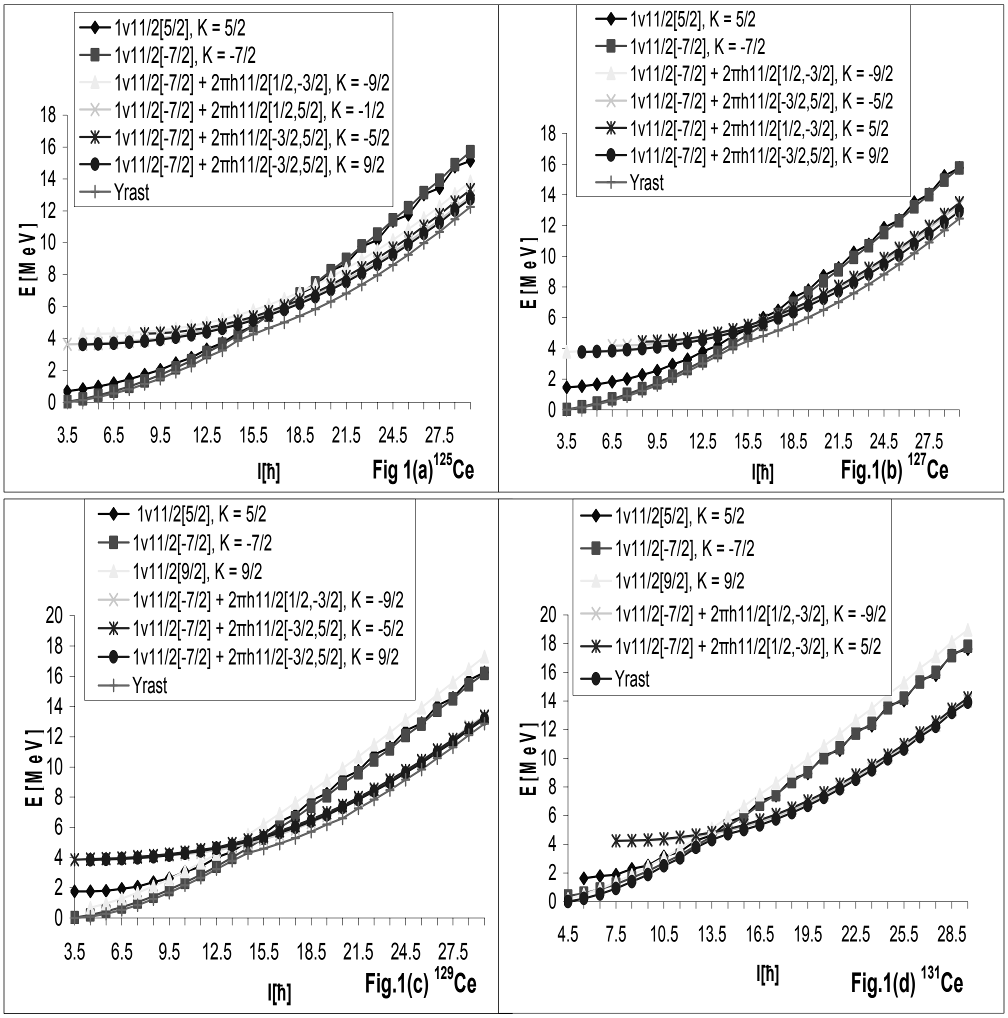
where $H_0$ is spherical single particle Hamiltonian. The second term in the Hamiltonian is the quadrupole-quadrupole interaction and the last two terms the monopole and quadrupole pairing interaction, respectively. The strength of the quadrupole force $\chi$ is adjusted such that the known quadrupole deformation parameter $\varepsilon_2$ is obtained by the usual Hartree+BCS self-consistent procedure. The monopole pairing strength $G_M$ is taken as

$$G_M^{\nu} = \left[20.40 - 13.13\frac{N-Z}{A}\right]A^{-1},$$
$$G_M^{\pi} = 20.25A^{-1}.$$

The strength parameter $G_Q$ for quadrupole pairing is taken as 0.18. From the comparison of experimental and theoretical results , it is found that the yrast spectra and transition energy are very well reproduced and agreement is satisfactory. The calculated results also reproduce the observed band head spin of the nuclei $^{125-131}$Ce.The results presented in the band diagrams (see figs.1(a)-1(d) ) suggest that the low-lying yrast spectra in $^{125-131}$Ce arise from a single band whereas the higher angular momentum states could be thought to be arising from a superposition of bands which indicates the possibility of co-existence shapes in $^{125-131}$Ce at higher spins.

## References

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


1v11/2[5/2], K = 5/2
1v11/2[-7/2], K = -7/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = -9/2
1v11/2[-7/2] + 2πh11/2[1/2,5/2], K = -1/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = -5/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = 9/2
Yrast
E [ M e V ]
I[ħ]
Fig 1(a) 125Ce
1v11/2[5/2], K = 5/2
1v11/2[-7/2], K = -7/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = -9/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = -5/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = 5/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = 9/2
Yrast
E [ M e V ]
I[ħ]
Fig.1(b) 127Ce
1v11/2[5/2], K = 5/2
1v11/2[-7/2], K = -7/2
1v11/2[9/2], K = 9/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = -9/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = -5/2
1v11/2[-7/2] + 2πh11/2[-3/2,5/2], K = 9/2
Yrast
E [ M e V ]
I[ħ]
Fig.1(c) 129Ce
1v11/2[5/2], K = 5/2
1v11/2[-7/2], K = -7/2
1v11/2[9/2], K = 9/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = -9/2
1v11/2[-7/2] + 2πh11/2[1/2,-3/2], K = 5/2
Yrast
E [ M e V ]
I[ħ]
Fig.1(d) 131Ce