TRS calculations for $\nu h_{11/2}$ band in ^{127}Xe

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One of the experimental signature of the axially symmetric and triaxial shape of nuclei is the ratio of E_{4^+} and E_{2^+}. It gives a value around 3.33 or 2.5 for axially symmetric or triaxial rotor, respectively. For Xe nuclei the

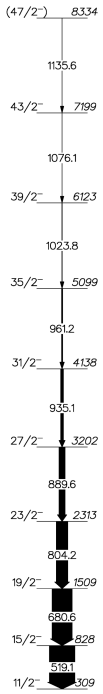

FIG. 1: Partial level scheme of ^{127}Xe, taken from Ref. [2].

value of this ratio is around 2.5, which indicates triaxial nature of these nuclei. A number of structural phenomenon associated with triaxiality were reported in these nuclei. Earlier, yrast negative band, based on $\nu h_{11/2}$ orbital, was studied up to $\sim 51/2^-$ state in $^{119-125}$Xe and theoretical Triaxial Rotor plus Particle model (TRPM) calculations suggest triaxial nature of this band [1]. But, for neutron rich ^{127}Xe, experimental information on high spin states was not adequate. Therefore, an experimental investigation has been carried out and states up to $47/2^-$ have been confirmed [2]. Further, total Routhian surface (TRS) calculations, based on macroscopic-microscopic model [3] have been carried out to get a prefatory idea on quadrupole and triaxial deformation of ^{127}Xe nucleus.

Total Routhian surface calculations have been carried out for negative parity states of ^{127}Xe with standard parameters. At low frequency, TRS predicts a large γ-softness with $\beta_2 \sim 0.17$ (fig. 2). Around $\hbar\omega \sim 0.355$ MeV (fig. 3), a crossing has been observed due to the negative parity neutron orbitals with

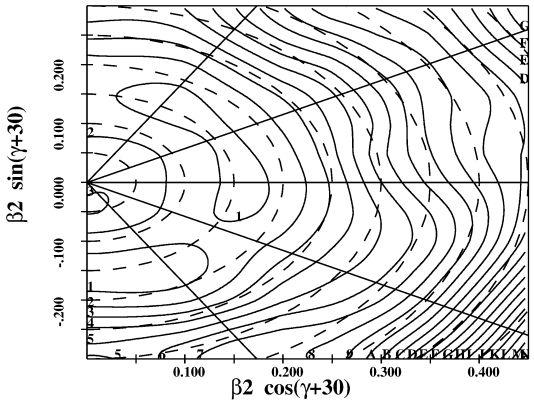

FIG. 2: Total Routhian Surface for yrast negative parity states of ^{127}Xe at low frequency ($\hbar\omega \sim$ 0.105 MeV).

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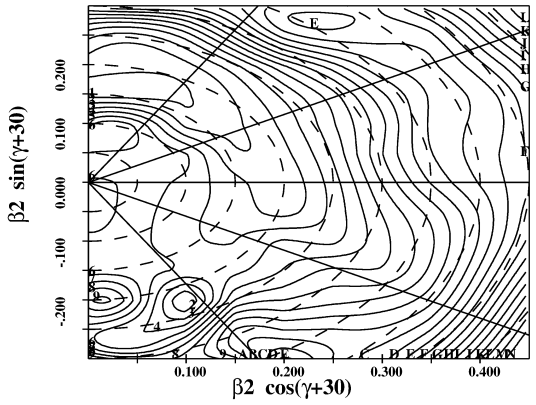

FIG. 3: Total Routhian Surface for yrast negative parity states of ^{127}Xe at moderate frequency ($\hbar\omega \sim 0.355$ MeV).

$\beta_2 \sim 0.2$ and $\gamma \sim 45°$. The next crossing,

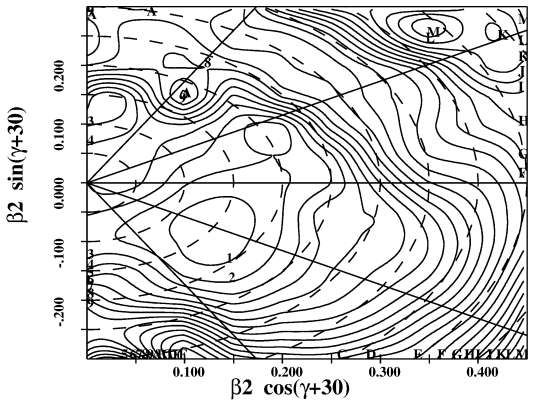

FIG. 4: Total Routhian Surface for yrast negative parity states of ^{127}Xe at higher frequency ($\hbar\omega \sim 0.455$ MeV).

most probably due to a positive parity proton orbital, has been predicted near $\hbar\omega \sim 0.455$ MeV (fig. 4), which drive the nucleus towards $\gamma \sim$ -60°.

The angular momentum (I) versus angular frequency ($\hbar\omega$) plot, deduced on the basis of TRS calculation, shows a sharp up-bending near $\hbar\omega \sim 0.355$ MeV. However, the experimentally deduced plot of the same shows a slow and continuous increment in I with increasing $\hbar\omega$ and a little higher slope after $\hbar\omega \sim 0.4$ MeV. This crossing has been explained due to the alignment of second pair of $h_{11/2}$ neutron [2] as also predicted from the present calculations.

In summary, theoretical TRS calculations have been carried out for negative parity states of ^{127}Xe. The first crossing due to a negative parity neutron orbital has been predicted at $\hbar\omega \sim 0.355$ MeV, as also observed in a recent experimental study on ^{127}Xe near $\hbar\omega \sim 0.4$ MeV.

Acknowledgments

The first author is thankful to CSIR, India, for financial support under SRF scheme.

References

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