Experimental study of nuclei in the vicinity of "island of inversion" through the fusion reaction

S S Ghugre*
UGC-DAE, Consortium For Scientific Research, Kolkata Centre, Sector III, LB-8, Bidhan Nagar, Kolkata 700 098, India

Neutron-rich nuclei are currently of great interest as they exhibit a rich variety of structural properties, which are remarkably different from those of nuclei near β-stability line. One of the most studied neutron-rich region is the $N \sim 20$ region, where the deformed states compete favorably with the spherical states, resulting in the *island-of-inversion* [1]. High spin spectroscopy in this neutron-rich region presents a formidable challenge. The earlier studies on these nuclei, were performed using methods [2] which had an inherent limitation regarding the population of higher-angular momentum states. The use of fusion reaction with neutron-rich target and neutron-rich projectile is ideal for populating high spin states of nuclei in this region. Further, the level structure of nuclei as one approaches the *island-of-inversion* is not well understood and is equally important to help us understand the intriguing phenomena in the neutron-rich nuclei.

As a part of our on-going programme we have investigated the level structures of ^{32,33,34}P and ^{32,33}S, using $^{18}O(^{18}O$, xnyp) & $^{18}O(^{16}O$, xnyp) reactions at an incident beam energy of about 34 MeV. The de-exciting gamma-transitions were recorded using an array of clover detectors. These detectors have a dual advantage of higher efficiency at $E_\gamma \geq 2$ MeV, and are capable of providing information on the linear polarization of the observed γ-transitions. These polarization measurements when coupled with the angular correlations help us assign uniquely the spin-parity for the observed levels.

The level structures of these nuclei have been substantially extended due to the observations of several new transitions. The 4^- level in ^{34}P has been confirmed to be a mixed transition with $\Delta J = 2$ & $\Delta J = 3$ admixture. Similar mixed transitions have indeed been reported in the neighboring $N = 19$ nuclei. The experimental results have been compared with the predictions of the spherical shell model. The shell-model calculations are able to reproduce the observed energy levels to a reasonable degree. However, the observed transition probabilities are not reproduced by the calculations. These would be discussed in details during the presentation.

The results indicate the need for a employing a larger model space and/or an appropriate Hamiltonian within the *sd-pf* model space, which takes into account all possible microscopic intra- as well as inter-shell interactions.

References

[1] C Thibault *et al.*, Phys. Rev. C **12**, 644 (1975).
[2] T Motobayashi *et al.* Phys. Lett.**B346**, 9 (1995).

*Electronic address: ssg@alpha.iuc.res.in