

Frontiers in Gamma Ray Spectroscopy

FIG18

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Coupling between two extreme excitation mode in weakly deformed ^{142}Eu

Content :

Spectroscopic investigation of weakly deformed nuclei in mass $A \sim 140$ region has generated considerable interest as they exhibit varieties of excitation mechanisms at higher excitation energy. The multi-particle configuration along with its small deformation plays an important role at higher excitation energy resulting in several novel phenomena, like shears mechanism, octupole correlation, chiral symmetry breaking etc. Among these magnetic rotation (MR) is a well known phenomena for generating angular momentum in weakly deformed nuclei manifested in a regular sequence of rotational-like bands consisting of stretched dipole transitions ($M1$). On the other hand breaking of reflection symmetry results octupole moment is also an important feature. The interaction between the orbitals of near the Fermi surface which differ by three units of angular momenta, leading to a sequence of interleaved states of opposite parity. Typically, this situation occurs when Fermi level is found between intruder sub-shell (l, j) and normal parity sub-shell ($l - 3, j - 3$) [1]. The dynamical correlation between this sub-shell resulted in enhanced $E1$ transitions between the sequences of interleaved states of negative and positive parity. For weakly deformed nuclei in $A \sim 140$ region protons can be easily excited to the $h_{11/2}$ orbital across the $Z = 64$ sub-shell closure. The interaction between $d_{5/2}$ and $h_{11/2}$ orbitals of the proton sector near the Fermi surface may leads the band of interleaved states of negative and positive parity connected by $E1$ transitions. Also, due to the presence of particles and holes in high j orbitals MR band can also be observed. This opens up the possibility of observing two extreme mode of excitation in the vicinity of $Z = 64$ sub-shell closure. In order to investigate these possibilities ^{142}Eu is populated through the reaction $^{31}\text{P}(^{116}\text{Cd}, 5n)$ at $E_{\text{lab}} = 148\text{-MeV}$ at TIFR, Mumbai with INGA as a detection system.

In ^{142}Eu a negative parity dipole band starting from 13^- to 21^- connected to the positive parity dipole band by three $E1$ transition reported earlier [2]. In the reported work, more connecting $E1$ transitions and cross over $E2$ transitions are placed. Along with the transition strength ($B(M1)$, $B(E1)$ and $B(E2)$) are evaluated from the lifetime measurement of the states of the negative parity dipole band. $B(M1)$ value shows decreasing nature with spin characteristics of MR band. The large $B(E1)$ value of the connecting transition and the ratio

B(E1)/B(E2) values may be understood as a result of octupole correlation. This observation also leads to the unique observation of coupling between two extreme mode of generation of angular momentum i.e. shears mechanism and octupole correlation in a single nuclei.

References:

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[2] M. Piiparinen et al., Nucl. Phys. A 605, 191 - 268 (1996).

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