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Observation of gamma vibrational bands in even-Xe isotopes

The nuclei with few valence protons above $Z=50$ major shell closure, disclose a diverse structural phenomena, which are worth exploring. In these nuclei of $A=120-130$ region, the valence neutrons mainly promote the collectivity, whereas, the valence protons dominates the single particle structures in the nuclear structures. The available orbitals for both the protons and neutrons are, viz., $2d_{5/2}$, $1g_{7/2}$, $3s_{1/2}$, $1h_{11/2}$, $2d_{3/2}$. The shape driving effects are promoted by low- Ω as well as medium to high- Ω v unique parity $h_{11/2}$ orbital.

The Xe ($Z=54$) isotopes have valence protons in paired condition outside $Z=50$ shell closure and these isotopes in $A=130$ mass region lie in the transitional region between γ -soft rotor to vibrational nature near the $N=82$ shell closure [1, 2]. The different structural effects [3,4], such as, signature splitting, wobbling, chirality, γ -vibrational bands are the key indicators of triaxiality, depicted by different Xe isotopes. For quasi- γ band, the sequence of 2_2^+ , 3^+ , 4_2^+ , 5^+ , 6_2^+ etc states and their decaying transitions to ground state bands are the main features. The yrast and near-yrast level structures of $^{128,130}\text{Xe}$ have been investigated via two complimentary reactions using heavy and light ion beams. The experiment was carried out at Variable Energy Cyclotron Centre (VECC), Kolkata, using 43 MeV α -beam from K-130 Cyclotron to populate ^{130}Xe on 2 mg/cm² thick ^{130}Te two targets back to back, evaporated on a 600 $\mu\text{g}/\text{cm}^2$ Mylar backing at VECC, Kolkata (India). The de-exciting gamma rays are detected by 11 Compton suppressed HPGe Clover detectors and 1 Low-Energy Photon Spectrometer (LEPS) of INGA setup at VECC, Kolkata coupled to PIXIE-16 based digital data acquisition system [5]. The experiment to populate ^{128}Xe , was performed at BARC-TIFR Pelletron LINAC Facility, Mumbai using $^{124}\text{Sn}(^9\text{Be},6n)$ fusion evaporation reaction at 40 MeV beam energy. Indian National Gamma Array (INGA) setup at TIFR, Mumbai in this experiment were consisted of 18 Compton suppressed Clover High Purity Ge (HPGe) detectors. The systematics γ -vibrational band in $^{128,130}\text{Xe}$ are observed from both the experiments. The theoretical calculation using TPSM has been done and the experimental observations are in good agreement with the theoretical results. The detailed results will be presented.

References:

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