Evolution of octupole collectivity in tran-lead region

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Atomic nucleus comes in various shapes and sizes. The size is mainly related to atomic mass number, A; except for halo nuclei. Although no such simple dependence exists for nuclear shape, it is well known that nuclei near shell-closure are almost spherical, while others may posses prolate, oblate or reflection asymmetric shape. The nuclear deformation depends on the quantum states occupied by the nucleons near the Fermi surface. Therefore, successive addition of nucleons changes shape from spherical near closed shell to well-deformed near mid-shell. The evolution of shape is evident from irregular sequences of excitation energy in spherical nuclei turning into regular sequences forming band structures in deformed nuclei. The irregular sequences arise due to single particle excitations, while collective motion of nucleons manifest itself into regular sequences. The mechanism of two different modes of angular momentum generation and competition between them as nuclear shape evolves has always been central theme for nuclear structure investigations.

Francium isotopes provide ideal platform to investigate evolution of nuclear shape from spherical near ^{208}Pb [1, 2] to pear shape in the vicinity of $A = 220$, in Ra-Th region [3]. ^{215}Fr shows characteristics of spherical nucleus, while ^{217}Fr has alternate-parity bands connected with E1 transitions which is a signature of octupole deformation. Therefore, ^{216}Fr, which lie between the two, is the most suitable candidate to investigate the competition between the two modes. Furthermore, information on the unique positive-parity proton $i_{13/2}$ orbital is scarce, which can be easily accessed by studying odd$-Z$ nuclei such as ^{215}Fr.

High spin states in ^{215}Fr and ^{216}Fr were populated using ^{208}Pb(^{11}B, xn) fusion-evaporation reaction. The ^{11}B beam from 15-UD pelletron accelerator at IUAC, New Delhi, was bombarded on a self-supporting ^{208}Pb target of ~ 6 mg/cm^2 thickness. The excitation function in the energy range 54$-$62 MeV was performed at the beginning of the experiment to optimize the yields of ^{215,216}Fr nuclei. The gamma rays from excited states of the residual nuclei were detected using an array of 14 Compton suppressed clover detectors. The detectors were positioned at 90°, 123° and 148° with respect to the beam direction. The coincidence data acquired using CANDLE were sorted into various RADWARE compatible histograms for further analysis.

The data analysis reveals many new gamma transitions. These transitions form bands which are interconnected via strong E1 transitions and indicate that ^{216}Fr is the lightest isotope in this mass region, from where octupole deformation begins. The detailed results will be presented at the symposium.

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