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Study of octupole correlations in neutron deficient nuclei having A<120 by means of lifetime measurement.

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The nuclei having A ~120 (50 ≤ Z ≤ 56) are of considerable interest because of the competing shape driving tendencies of their orbitals occupied by the neutrons and the protons. Due to presence of both quadrupole and the octupole collectivity in the neutron deficient Ba, Cs and Xe nuclei with mass A ~ 120 have attracted much attention in recent years. For nuclei with A < 120, due to their closeness to the proton drip line and therefore difficulty to populate via fusion evaporation reactions, octupole collectivity has been reported in very few cases like ^{114,116,117}Xe & ^{110}Te [1,2]. In these reported cases also, there have been several ambiguities observed in the nature of octupole correlations. Like in ^{110}Te, the measured B(E1) strengths (the most prominent experimental evidence considered for octupole correlations) are found to be in agreement when compared to those in the neutron-rich barium nuclei. However, when compared to ^{114,116}Xe, the B(E1) values in ^{110}Te are found to be about an order of magnitude larger, thereby making the T_z scaling of the dipole moment suggested in [1] questionable. Also, in case of ^{114}Xe, the B(E1) value of the $5^- \rightarrow 6^+$ transition is two orders of magnitude larger than that of $5^- \rightarrow 4^+$ transition, thus contradicting a simple interpretation based on fixed intrinsic octupole deformation. Also, decoupling negative-parity bands observed in ^{118}Xe are suggested to have octupole character at low spins but there is a need to be confirmed using lifetime measurements [3]. So, more experiments are needed to systematically investigate whether the octupole phenomenon is common in the A ~120 region. With this motivation, recently experiment was carried out to explore the high spin states in neutron deficient ^{118}Xe nuclei via lifetime measurement using Doppler shift attenuation method (DSAM) technique at the Inter University Accelerator Centre (IUAC), Delhi. High spin states in ^{118}Xe were populated using the ^{93}Nb (^{28}Si, p2n) ^{118}Xe fusion evaporation reaction at a beam energy of 115 MeV. The target consisted of nicely rolled 93Nb foil of thickness ~ 1.0 mg/cm^2 on 10 mg/cm^2 thick Pb backing. The de-exciting gamma rays were detected with the Indian National Gamma Array (INGA) setup [4], consisting of 16 Compton suppressed Clover detectors arranged in five rings at angles 32°, 57°, 90°, 123°, and 148° with respect to the beam direction. Data was collected in γ - γ coincidences mode for the 9 shifts resulting in total number of counts acquired in γ-γ coincidence were 6*10^8. To optimize yield of ^{118}Xe, excitation function was taken at 112, 115, 116 and 120 MeV of beam energy. A number of symmetric and asymmetric matrices were constructed by sorting gain matched list mode data. Lineshape analysis were carried out for some of the prominent transitions observed in yrast band, negative-parity band and interlinking transitions of E1 character. E1 character of these interlinking transitions are confirmed using angular correlation and linear polarization asymmetry ratio (Δ_{asym}) measurements. These lineshape results would be further discussed in the seminar.

References:
[1] S. L. Rugari et al., Phys. Rev. C 48, 2078 (1993).
[2] E. S. Paul et al., Phys. Rev. C 50, R534 (1994).
[3] S. Tormanen, et al., Nuclear Physics A 572 417 –458 (1994).
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Experimental nuclear physics

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Theoretical nuclear physics

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