Study of octupole correlations in neutron deficient Xe nuclei with mass A < 120.

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Introduction

The nuclei having A ~120 ($50 \leq Z \leq 56$) 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. The theoretical studies [1, 2] reveal that these nuclei (with Z ~ N ~ 56) either possess a very shallow octupole deformed minima in the Strutinsky ground state deformed energy, or enhanced octupole collectivity due to dynamical correlations. However, octupole softness is predicted to disappear rapidly when N or Z differ from 56 by more than a few units [1]. Experimentally, the evidence of strong octupole correlations have been observed in $^{122\text{-}125}$Ba, ^{122,124}Cs, ^{120,121}Xe nuclei of A ~ 120 region [3-9]. 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 [10,11]. 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 [10] 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. So, more experiments are needed to systematically investigate whether the octupole phenomenon is common in the A ~120 region. Theoretical studies are also called for to explore the origin of the octupole correlations in these nuclei. 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 Center (IUAC), Delhi.

Experimental Details

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 beam was provided by the 15UD Pelletron accelerator present at IUAC, Delhi. Monoisotopic ^{93}Nb foil of thickness ~ 1.28 mg/cm^2 on an 8 mg/cm^2 thick Pb backing was fabricated using rolling technique. The de-exciting gamma rays were detected with the Indian National Gamma Array (INGA) setup

[12], 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. Prompt γ - γ coincidences data was collected for the 9 shifts.

Data analysis

Partial level scheme of ^{118}Xe [13] from previous work is shown in Figure 1.

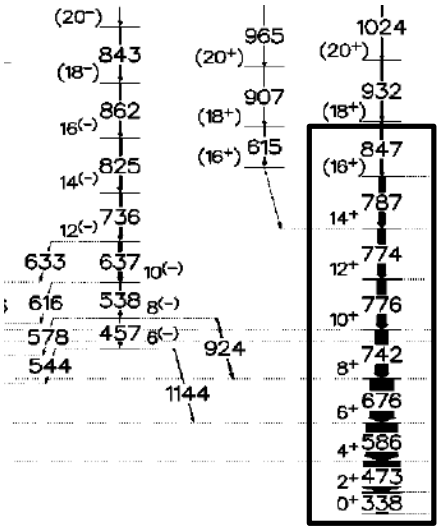

Figure 1 Partial level scheme of ^{118}Xe [13].

Energy spectrum of ^{118}Xe resulting from the present work after gating on 676 KeV energy peak of ground state band is shown in Figure 2.

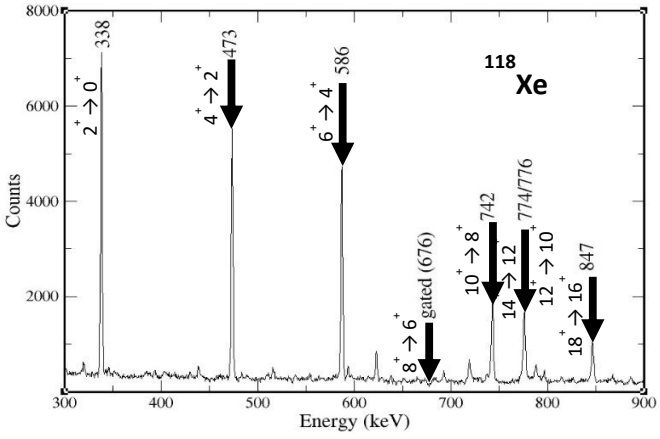

Figure 2. Coincidence spectrum for band 6 in ^{118}Xe obtained from gating on 676-keV transition.

In the energy spectrum various gamma energy peaks of ^{118}Xe ground state band are clearly marked with their transition levels. The energy spectrum presented above is just the preliminary work. The detailed analysis of the data is in progress and results will be presented later.

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