Octupole correlations in ^{118}Xe

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Introduction

The Xe-Cs-Ba nuclei having A $\sim$ 120 exhibit competing shape driving tendencies because of the orbitals occupied by the neutrons and the protons. Due to availability of $d_{5/2}$ and $h_{11/2}$ orbitals near the fermi surface make them suitable to exhibit octupole correlations in the neutron deficient Ba, Cs and Xe nuclei with mass A $\sim$ 120. The octupole correlations in atomic nuclei are attributed by the long-range octupole–octupole interaction between nucleons [1, 2]. Theoretical calculations have predicted octupole correlations to occur in nuclei having Z and/or N 34, 56, 88, 134. Experimental evidences of strong octupole correlations have been observed in $^{122-125}$Ba, $^{122-124}$Cs, $^{120-121}$Xe nuclei [3–8]. For neutron deficient nuclei having A $<$ 120, due to their closeness to the proton drip line, are difficult to populate via heavy ion fusion evaporation reactions, hence octupole correlations have been reported in very limited cases like ^{114,116,117}Xe and ^{110}Te [9, 10]. 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 [9] 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 $\sim$ 120 region. With this motivation, an experiment was carried out recently to explore the high spin states in neutron deficient ^{118}Xe nuclei.

The Experiment

The ^{93}Nb (^{28}Si, $p2n$) ^{118}Xe fusion evaporation reaction was performed at a beam energy of 115 MeV provided by the 15UD pelletron accelerator present at IUAC, Delhi. Self-supported ^{93}Nb target of thickness 0.9 mg/cm^2 on a 10 mg/cm^2 thick Pb backing was used to carry out the experiment. The de-exciting gamma rays produced in the experiment were detected with the Indian National Gamma Array (INGA) setup [11], consisting of 16 Compton suppressed Clover detectors arranged at five different angles. A total of 6*10^8 prompt γ - γ coincidences events were collected. Offline data analysis was carried out using INGAsort [12] and RADWARE [13] software packages.

Results and Discussion

Partial level scheme of ^{118}Xe developed in the present work has been shown in Fig. 1. All the γ- rays presented in the level scheme were reported in the ref. [14]. Relevant en-

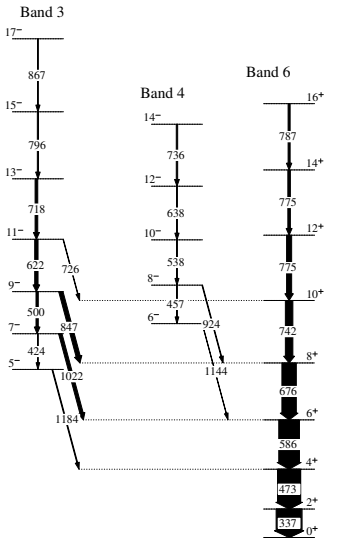

FIG. 1: Partial level scheme of ^{118}Xe

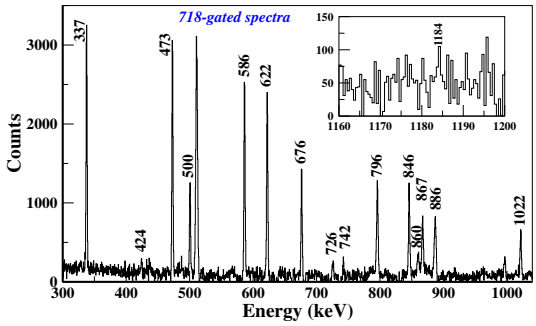

FIG. 2: Coincidence spectrum in ^{118}Xe obtained from gating on 718 keV transition.

ergy gated spectrum has been shown in Fig. 2. Dipole nature of the interlinking transitions was determined from the angular distribution asymmetry ratio. The enhancement of E1 transition rates were realized from the ratio of reduced transition probabilities of electric dipole and electric quadrupole transitions. Large magnitude of B(E1)/B(E2) ratio (of the order of 10^{-7} fm^{-2}) obtained in the present work supports the existence of octupole correlations in the ^{118}Xe nuclei.

Acknowledgments

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