Enhanced $E1$ transitions in ^{119}I

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I. INTRODUCTION

The γ-soft nuclei in A$\approx$120 are intriguing as the number of valence nucleons outside the ^{100}Sn shell core is sufficient to induce deformation in the system. The availability of octupole driving $\pi d_{5/2}$ and $\pi h_{11/2}$ orbitals close to the Fermi surface in odd I isotopes makes them suitable candidates to exhibit octupole correlation [1]. Octupole correlation arises when nucleons near the Fermi surface occupy opposite parity states with $\Delta l = \Delta j = 3$. The phenomenon is predominant in nuclei having having Z, N = 34, 56, 88, 136. The experimental fingerprint of octupole correlation is the existence of enhanced $E1$ transitions between the alternate parity bands or observation of collective $E3$ transitions [1]. The ^{119}I (Z=53, N=66) nucleus has three protons in $\pi g_{7/2}/d_{5/2}$ and a couple of neutrons in νd$_{3/2}$ respectively. The nucleons can easily be excited to the $h_{11/2}$ orbital, which along with the occupancy of $d_{5/2}$ may lead to octupole interaction in iodine nuclei. Recently, on the basis of B($E1$)/B($E2$) measurements, octupole correlation was reported around $I \approx 8\hbar$ in ^{127}I by S. Chakraborty *et. al* [2]. In search of possible occurrence of octupole correlation in ^{119}I, the B($E1$)/B($E2$) ratio at high-spin states were measured and compared with other nuclei where octupole correlation has already been reported.

II. EXPERIMENTAL DETAILS

The excited states of ^{119}I were populated through ^{109}Ag(^{13}C, 3nγ)^{119}I reaction at a beam energy of 54 MeV. The ^{13}C beam, provided by the 14UD pelletron accelerator (TIFR) was incident on a ^{109}Ag target of thickness 1.05 mg/cm^2 backed with 10 mg/cm^2. The emitted γ rays were detected in Indian National Gamma Array (INGA), which consisted of 18 Compton suppressed clover HPGe detectors. A total of 1.66×10^9 $\gamma\gamma$ coincidence events were collected into a two-dimensional matrix format by using RADWARE software [3]. Efficiency and energy calibrations were carried out using the ^{152}Eu and ^{133}Ba standard radioactive sources.

III. RESULTS AND DISCUSSION

In this work a couple of new $E1$ γ-transitions with energies 477* and 419* keV have been observed in addition to the already known γ rays.

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The multipolarities of these transitions are determined using DCO ratio. The DCO ratio is defined as:

$$R_{DCO} = \frac{I(\gamma_1)\ at\ 157°,\ gated\ by\ \gamma_2\ at\ 90°}{I(\gamma_2)\ at\ 90°,\ gated\ by\ \gamma_1\ at\ 157°}$$

The R_{DCO} values of stretched dipole and quadrupole transitions are ≈0.5 (1.0) and ≈1.0 (2.0), respectively, in a pure quadrupole (dipole) gate. Clover detectors facilitate the linear polarization measurement studies of *EM* radiation. The polarization asymmetric parameter $\Delta_{asym}(\frac{a(E_\gamma)N_\perp - N_\parallel}{a(E_\gamma)N_\perp + N_\parallel})$ is positive (negative) for electric (magnetic) transitions, where $N_\perp$ ($N_\parallel$) is the intensity of γ-ray transitions scattered perpendicular (parallel) to the reaction plane and a(E_γ) is a correction factor arising from any experimental asymmetry. The value of a(E_γ) was determined from the ratio of parallel to perpendicular scattered events of unpolarized γ rays from ^{133}Ba and ^{152}Eu radioactive sources. By fitting the experimentally observed a(E_γ) values at different energies with a expression, a(E_γ) = a_0 + bE_γ, we obtained a_0 = 1.024(5) and b = 1.004(8)×10^{-6} keV^{-1}. We have confirmed the spin and parity of the level via which the transitions 477* and 419* keV were observed to decay by using R_{DCO} and asymmetry measurements.

The enhanced $E1$ nature of two new γ-transitions and one already known transition is determined from the ratio of the reduced transition probability of electric dipole and electric quadrupole transitions, which is defined as:

$$\frac{B(E1)}{B(E2)} = \frac{1}{1.3 \times 10^6} \frac{E_\gamma^5(E2) I_\gamma(E1)}{E_\gamma^3(E1) I_\gamma(E2)} [fm^{-2}]$$

The observed B($E1$)/B($E2$) ratio for 662-, 477*- and 419*-keV transitions of ^{119}I are given in table.I and have been compared with different nuclei (*see* Fig. 1), in which octupole correlation is reported. We have also calculated the intrinsic electric dipole moment, D_0 by using the following relation [4]:

$$D_0 = Q_0 \left[\frac{5}{16} \frac{B(E1)}{B(E2)} \right]^{1/2} [efm]$$

where Q_0 is the intrinsic electric dipole moment. The value of Q_0 (2.80 b) is taken from the ref.[5].

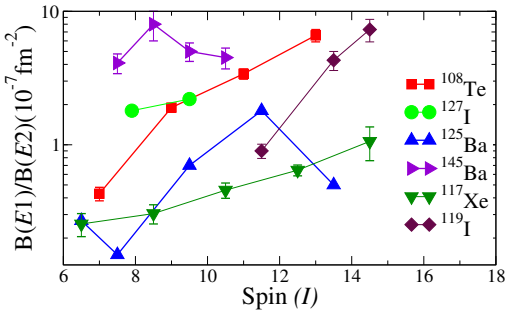

FIG. 1: The experimental B($E1$)/B($E2$) ratios as a function of spin in different nuclei.

The observed values of B($E1$)/B($E2$) show the possible evidence of octupole correlation in ^{119}I. Other details will be presented during the conference.

TABLE I: Measured B($E1$)/B($E2$) ratios and deduced electric dipole moment in ^{119}I.

$E\gamma$ (keV)	$I_i \rightarrow I_f$	B($E1$)/B($E2$) ($10^{-6} fm^{-2}$)	D_0 (efm)
662	$23/2^- \rightarrow 21/2^+$	0.090 (11)	0.047 (4)
477*	$27/2^- \rightarrow 25/2^+$	0.43 (7)	0.102 (12)
419*	$29/2^- \rightarrow 27/2^+$	0.73 (14)	0.130 (18)

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