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Directional Correlation and Multipole Mixing of the Gamma Transitions in ^{99}Tc*

S. S. BHATI, NIRMAL SINGH, P. C. MANGAL** and P. N. TREHAN

Department of Physics, Panjab University, Chandigarh, India

Gamma-gamma directional correlation studies in ^{99}Tc were carried out by using a fast-slow coincidence set up. The 740–181 and the 740–(41)–140 keV cascades were measured with a pair of 3″ × 3″ NaI (Tl) crystals, the 740–41 keV cascade with a pair of 2″ × 2″ NaI(Tl) detectors and the 41–140 keV cascade with 1½″ × ½″ and 2″ × 2″ NaI(Tl) detectors. Least square fitting to the angular correlation data was done by the method of Rose.[1] The graphical method of Arns and Wiedenback[2] was used to obtain spin sequence and mixing ratios.

In the case of 740–181 keV cascade, a lead absorber was placed in front of the crystal detecting 740 keV gamma ray to avoid possible back scattering effects. For the cascade involving 41 keV as intermediate transition [740–(41)–140], necessary correction for the unobserved transition was applied. The correction for the interfering cascades in the various angular correlation studies were calculated using the relative intensity data obtained by employing Ge(Li) detectors.[3] From the results of directional correlation measurements and taking the admixture in 181 keV transition to be E2 + 0.7% M3 from internal conversion data,[4] multipole admixtures in various transitions were obtained. The results are summarized in Table I.

The data of 740–(41)–140 keV cascade is compatible with theory for the spin sequence $3/2^+ \rightarrow 5/2^+ \rightarrow 7/2^+ \rightarrow 9/2^+$. Therefore the spin assignment $3/2^+$ for the 921 keV level is confirmed.

The values of the mixing ratios obtained by us for the 41 and the 140 keV transitions agree with those of internal conversion measurements[5] whereas the mixing ratio of 140 keV transition is in large disagreement with ref. 5. A comparison of of the experimental reduced transition probabilities with that of single particle estimates shows that 180 and 140 keV states are predominantly single particle states with a little admixture of rotational components.

References

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Table I.

Cascades (keV) with spin sequence	Correlation coefficients	Transitions (keV)	Multipole admixture
740–181 $(3/2^+ \rightarrow 5/2^+ \rightarrow 9/2^+)$	$A_2 = 0.093 \pm 0.009$ $A_4 = 0.020 \pm 0.017$	740	E2 + 1.0% M1
740–(41)–140 $(3/2^+ \rightarrow 5/2^+ \rightarrow 7/2^+ \rightarrow 9/2^+)$	$A_2 = -0.068 \pm 0.004$ $A_4 = -0.005 \pm 0.001$	140	M1 + (5 ± 1)% E2
740–41 $(3/2^+ \rightarrow 5/2^+ \rightarrow 7/2^+)$	$A_2 = -0.075 \pm 0.023$ $A_4 = 0.035 \pm 0.033$	41	$M1 + (0.7^{+0.5}_{-0.4})\%$ E2
41–140 $(5/2^+ \rightarrow 7/2^+ \rightarrow 9/2^+)$	$A_2 = 0.087 \pm 0.008$ $A_4 = 0.013 \pm 0.015$	140	M1 + (5 ± 1)% E2

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** Present address: Regional Centre for Post Graduate Studies, P. U. Rohtak, India.