Pramāṇa, Vol. 6, No 4, 1976, pp. 209–221. © Printed in India.

Levels in ^{74}As from the ^{74}Ge(p,nγe)^{74}As reaction

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MS received 26 September 1975

Abstract. The low-lying levels in ^{74}As have been studied by means of γ-ray and internal conversion electron spectroscopy following the ^{74}Ge$(p, n)^{74}$As reaction. New levels at 372·7, 532·8, 632·1, 731·6, 752·7, 758·3, 801·6, 902·9 and 1128·5 keV, not observed in earlier studies, have been established. J^{π} assignments have been made to several low-lying levels. An earlier ambiguity regarding the identification of an isomeric level has been clarified. The half-life of a level at 271·4 keV has been measured to be $1\cdot0 \pm 0\cdot1$ nsec; in addition, limits on half-lives of levels at 182·7, 277·5 and 425·4 keV have been assigned. The level structure is discussed on the basis of available nuclear models.

Keywords. Nuclear reaction ^{74}Ge$(p, n)^{74}$As; enriched target; $E_p = 3\cdot5$–$5\cdot0$ MeV; level scheme; J^{π}; internal conversion coefficients; half-lives of levels.

1. Introduction

In the course of earlier studies, Agarwal *et al* (1974) and Bharathi *et al* (1975) showed that the odd parity levels in the odd neutron nuclei ^{75}Se and ^{79}Kr have characteristics of deformed configurations. While the situation with regard to the even parity levels is not so unambiguous, they also show characteristics of a smaller deformation with a strong Coriolis coupling. The even-even nuclei with N = 40–50 show levels which are 'vibrational' in nature at low excitation and become quasi-rotational as the angular momentum increases (Wyckoff *et al* 1973, Baba *et al* 1974, Hamilton *et al* 1974). In this context, it will be interesting to see if the odd-odd nucl i in this region show deformed nature. With this view in mind, the level structure of ^{74}As has been studied and is reported here.

The level structure of ^{74}As has been the subject of a few experimental studies. Finckh *et al* (1970) made neutron time of flight studies following the ^{74}Ge$(p, n)^{74}$As reaction while Christiansen *et al* (1971) constructed a level scheme on the basis of γ-ray excitation functions and γ–γ coincidence experiments. They also reported an isomeric level with $T_{\frac{1}{2}} = 26\cdot8 \pm 0\cdot5$ *ns* at an excitation energy of 274 keV and determined its *g*-factor to be $0\cdot807 \pm 0\cdot010$. Fournier *et al* (1972) studied the the pick-up reaction ^{75}As $(p, d)^{74}$As while Rosner *et al* (1973) reported a study of the stripping reaction ^{73}Ge (He^3, $d)^{74}$As. Although the energy resolution in the last two experiments was not good enough to resolve the complex nature of the level scheme, the transferred l_n values in the pick-up and stripping reactions could still be assigned leading to possible spin and parity assignments to the levels. When the present work was in progress, a detailed γ-ray and internal conversion study was reported by Kimura (1973). Kimura made extensive γ-ray excitation function and internal conversion coefficient measurements. Further, a study of γ-ray angular distribution was reported by Mordechai *et al* (1973).

The present work contains detailed γ–γ coincidence and lifetime experiments in addition to γ-ray and internal conversion spectroscopic studies. Several of the ambiguities of the earlier works have been resolved as a result of the present work. Preliminary results of this work were reported earlier (Agarwal *et al* 1972, Lal *et al* 1974).

2 Experimental details

The experiments were performed using the 5·5 MeV Van de Graaff accelerator at BARC, Bombay. The experimental details are given below.

2.1. *Target preparation*

For conversion electron spectroscopy, thin targets ($\sim 50\,\mu g/cm^2$) made by vacuum evaporation of germanium oxide enriched with 95% of ^{74}Ge onto a thin carbon backing were used. For γ-ray spectroscopy, four such thin targets stacked together were used.

2.2. *γ-ray spectroscopy*

The excitation functions of γ-rays following the (p, n) reaction were measured by recording the γ-ray spectra with a 27 cm^3 Ge (Li) detector for several incident proton energies between 3·5 and 5·0 MeV, in steps of $\sim$100 keV. To record the γ-ray spectrum in the region 10–100 keV, a thin window Ge (Li) detector made in our laboratory was used. Two Ge (Li) detectors of volume 30 cm^3 were used for recording γ-γ coincident spectra. The resolving time of the coincidence circuit was $\sim 200\, ns$. The observed coincidence spectra were corrected for random events. The energy calibrations for the detectors were obtained by recording γ-ray spectra from standard radioactive sources (^{152}Eu, ^{137}Cs, ^{133}Ba and ^{22}Na). The relative intensities of γ-rays from ^{152}Eu and ^{133}Ba given by Greenwood *et al* (1970) were used to compute the relative efficiencies.

2.3. *Internal conversion electron spectroscopy*

A six gap "Orange" electron spectrometer described elsewhere (Bharathi 1973, Agarwal *et al.* 1974) was used for internal conversion electron spectroscopy. The electron spectra were recorded at 1% momentum resolution. The conversion coefficients were computed with respect to the well-known 191 keV E3-transition in ^{81}Kr produced in the $^{81}Br(p, n)$ reaction. The K-conversion coefficient of the 76·2 keV transition could not be determined unambiguously due to the presence of steep secondary electron background. The internal conversion electron lines were also used in lifetime measurements.

2·4. *Lifetime measurements*

The lifetime measurements were carried out by recording time spectra between transitions feeding and de-exciting levels of interest, one of the transitions being conversion electron and the other γ-ray or neutron. Two constant fraction trigger circuits and a fast time-to-amplitude converter (TAC) were used for the measurements. The TAC was calibrated by measuring the well-known lifetimes of the 122 keV level in ^{152}Sm and the 81 keV level in ^{133}Cs.

3. Results

Figure 1 shows a γ-ray spectrum obtained at $E_p = 5\cdot0$ MeV with the 27 cm^3 Ge(Li) detector. The background γ-rays are appropriately marked in the spectrum. The energies, thresholds and assignments in the level scheme for various γ-transitions are given in table 1. Table 2 gives a summary of γ–γ coincidence measurements. Figure 2 shows an internal conversion electron spectrum taken at $E_p = 5\cdot0$ MeV. In figure 3, the measured conversion coefficients are compared with the theoretical values (Hager and Seltzer 1968) to determine the multipolarities of various transitions. The values of α_k for these transitions are given in table 1 along with the deduced multipolarities. On the basis of threshold measurements energy sum relations and γ–γ coincidence measurements, a level scheme of ^{74}As shown in figures 4 *a* and 4 *b* is proposed. In the following, we discuss only those transitions and levels which have not been reported earlier or which had some ambiguity in origin.

3.1. *The* 182·7 *keV level*

In addition to confirming the 3$^-$ assignment of Kimura to this level, the present work yields an upper limit of 0·6 *ns* for the half-life of the level.

3.2. *The* 258·9, 271·4 *and* 277·5 *keV levels*

Christiansen *et al* (1971) measured a half-life of $26\cdot8 \pm 0\cdot5$ *ns* through the

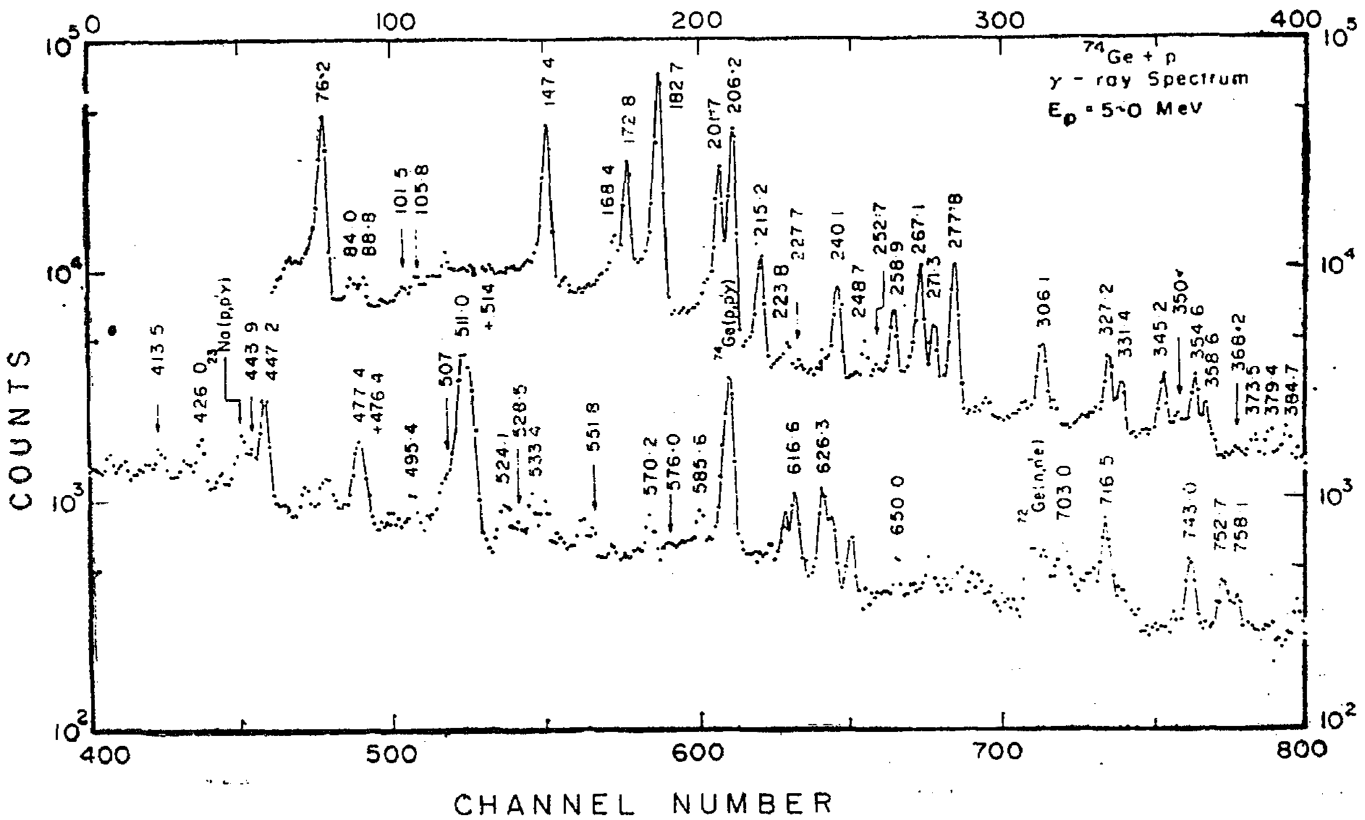

Figure 1. Gamma-ray spectrum obtained by proton bombardment of Germanium oxide enriched in ^{74}Ge ($\sim$95%) at $E_p = 5\cdot0$ MeV using a 27 cm^3 Ge (Li) detector. The numbers indicate the gamma-ray energies in keV. The background gamma-rays are appropriately marked.

147·4–76·2 keV cascade and attributed it to a level at 273·8 keV. They concluded that this level decays by a 76–183–14 keV cascade. On the basis of threshold measurements, Kimura 1973) showed that the 76 keV γ-ray has the same threshold as the 278 keV γ-ray. For energy balance, he proposed that the 278 keV level decays *via* a $278 \xrightarrow{19} 259 \xrightarrow{76} 183$ keV or a $278 \xrightarrow{76} 202 \xrightarrow{19} 183$ keV cascade. He also found negligible neutron feed to the 259 keV level in the case of the first sequence. However, he could neither distinguish between the above two possibilities nor

Table 1. List of γ-rays from the ^{74}Ge$(p, n)^{74}$As reaction at $E_p = 5{\cdot}0$ MeV.

E^a (keV)	Threshold^b E_p (MeV)	Assignment (keV → keV)		a_k^e	Multipolarity
18·3*		277·5	258·9		
76·2	3·7	258·9	182·7	(1·2 ± 0·3) (−1)	E1 (M1)
84·0*		266·9	182·7		
88·8*		271·4	182·7		
101·5*		372·7	271·4	< 1·4 (−1)	
105·8*		372·7	266·9	< 1·1 (−1)	
147·4	3·9	425·4	277·5	(3·1 ± 0·2) (−2)	M1
149·3	3·8	331·5	182·7		
168·4	3·9	446·1	277·5	(2·0 ± 0·3) (−2)	M1
172·8	3·6	172·8	0	(1·8 ± 0·1) (−2)	M1
182·7	3·6	182·7	0;	(1·6 ± 0·1) (−2)	M1
		(384·6	201·7)^c		
189·7	3·8	372·7	182·7		
201·7	3·6	201·7	0	(1·3 ± 0·2) (−2)	M1
		(384·6	182·7)^c		
206·2	3·6	206·2	0	(7·5 ± 0·8) (−3)	E1
215·2	3·9	421·4	206·2	(8·1 ± 1·0) (−3)	E1
223·8	4·1	649·7	425·5		
227·7	4·1	649·7	421·4		
240·1	3·9	446·1	206·2;	(9·1 ± 0·6) (−3)	M1 + E2
		507·0	266·9		
248·7	3·9	421·4	172·8	(1·6 ± 0·3) (−2)	M1 + E2
252·7	3·9	425·4	172·8		
258·9	3·9	465·1	206·2;	(7·5 ± 4·0) (−3)	M1 (E1)
		525·8	266·9		
267·1	3·7	266·9	0	(7·7 ± 2·0) (−3)	M1 + E2
271·3	3·7	271·4	0	(2·3 ± 0·6) (−2)	E2
277·8*		277·5	0	(3·5 ± 0·4) (−3)	E1
306·1*		731·6	425·5		
307·0		(514·0	206·2)^d		
327·2	4·2	752·7	425·5		
331·4		752·7	421·4;		
		(331·5	0)^d		
345·2	4·0	551·4	206·2		
350·1	3·9	532·8	182·7		
354·6	4·1	632·4	277·5		
358·6	4·2	743·1	384·6		
368·2*		551·4	182·7		
373·5	4·3	758·3	384·6		
379·4	4·0	585·8	206·2		
384·7	3·8	384·6	0		
413·5*		585·8	172·8		
426·0		(425·4	0)^d		

Table 1 (*contd.*)

E^a (keV)	Threshold^b E_p (MeV)	Assignment (keV → keV)		α_k^e	Multipolarity
443·9*		649·7	206·2		
447·2	3·9	447·2	0		
476·4		(649·7	172·8)^d		
477·4	4·2	902·9	425·5		
495·4	4·1	701·4	206·2		
507·0		(507·0	0)^d		
514·0		(514·0	0)^d		
524·1	4·2	801·9	277·5		
528·5	4·1	701·4	172·8		
533·4	4·2	716·3	182·7		
551·8		(551·4	0)^d		
570·2	4·2	743·1	172·8		
576·0*		758·4	182·7		
585·6	4·1	585·8	0		
616·6	4·2	616·6	0		
626·3	4·0	626·3	0		
650·0	4·1	649·7	0		
703·0*		1128·4	425·4		
716·5	4·2	716·3	0		
743·0	4·2	743·0	0		
752·7	4·2	752·7	0		
758·1	4·2	758·4	0		

[a] The errors on the energies for most of the transitions are less than $\pm$ 0·5 keV.
[b] The lowest proton energy at which the particular transition was observed.
[c] The transitions shown in brackets do not have a very definite place in the decay scheme.
[d] The transitions are based on Kimura's measurements.
[e] The numbers in the bracket in this column indicate the power of the multiplicative factor 10.
* Indicates that the transitions are based only on $\gamma-\gamma$ coincidence data.

Table 2. Summary of coincidence measurements.

E_γ in gate (keV)		E_γ in coincidence (keV)
76·2	..	147·4, 168·4, 182·7, 223·8, 306·1, 327·2, 354·6, 477·4, 524·1, 703·0
147·4		18·3, 76·2, 182·7, 223·8, 277·8, 306·1, 327·2, 477·4, 703·0
84·0 + 88·8	..	101·5, 105·8, 240·1, 258·9
172·8	..	248·7, 252·7, 413·5, 476·4, 528·5, 570·2
182·7	..	76·2, 84·0, 88·8, 147·4, 168·4, 189·7, 201·7, 223·8, 240·1, 258·9, 306·1, 327·2, 350·1, 354·6, 358·6, 368·2, 477·4, 524·1, 533·4, 576·0, 703·0
201·7	..	182·7, 358·6, 373·5
206·2	..	215·2, 227·7, 240·1, 258·9, 331·4, 345·2, 379·4, 443·9, 495·4
215·2	..	206·2, 227·7, 331·4
240·1	..	84·0, 182·7, 206·2, 267·1
258·9	..	84·0, 206·2, 267·1
277·8	..	147·4, 168·4, 223·8, 306·1, 327·2, 354·6, 477·4, 524·1, 703·0
306·1	..	76·2, 147·4, 182·7, 277·8.

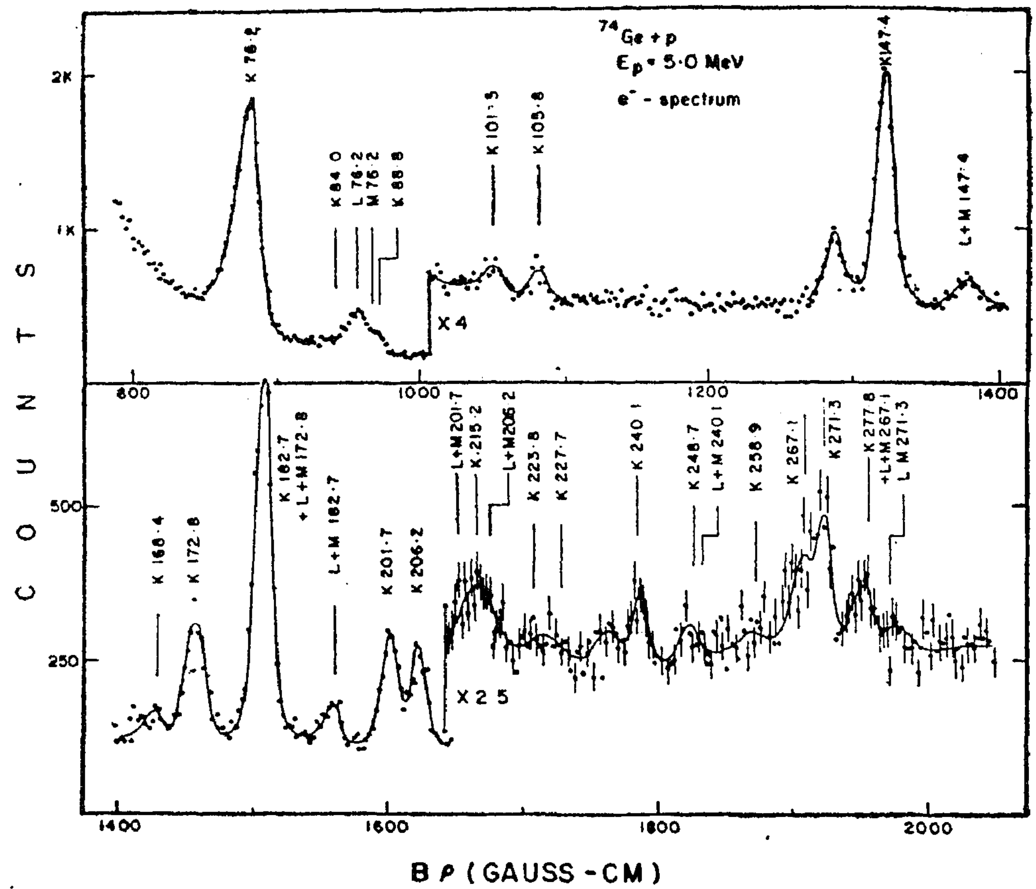

Figure 2. Internal conversion electron spectrum recorded with the six-gap spectrometer at $E_p = 5{\cdot}0$ MeV. The numbers indicate the energies of the transitions in keV.

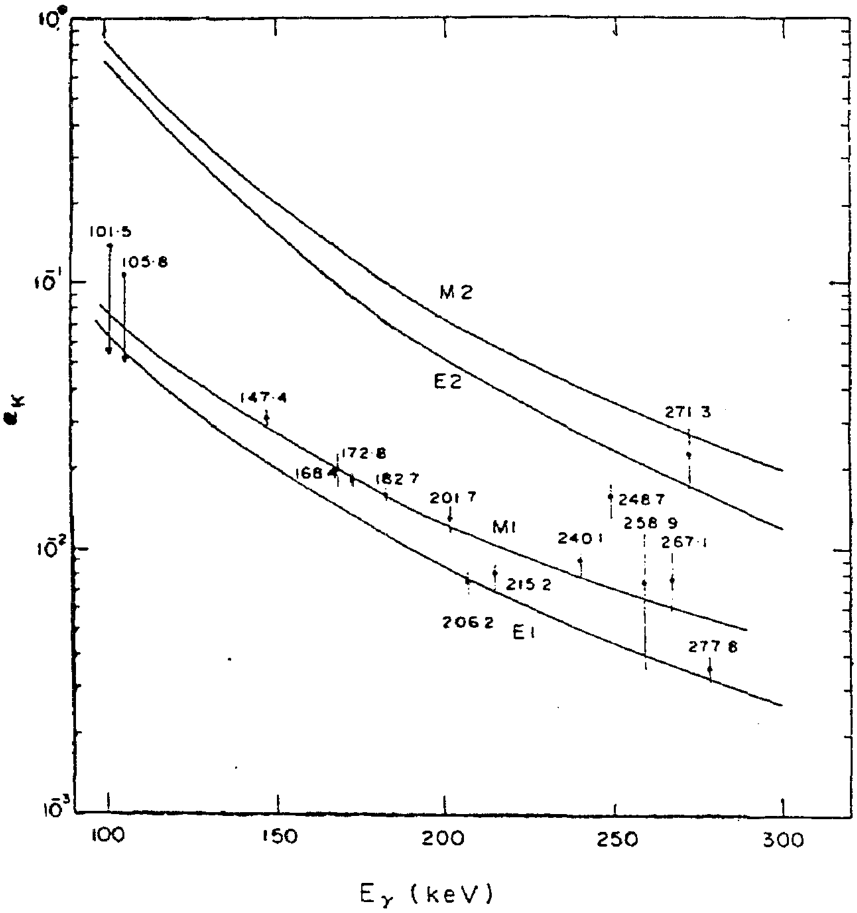

Figure 3. Comparison of the measured values of α_k with theoretical values. The continuous lines are the values of α_k taken from Hager and Seltzer (1968) for various multipolarities.

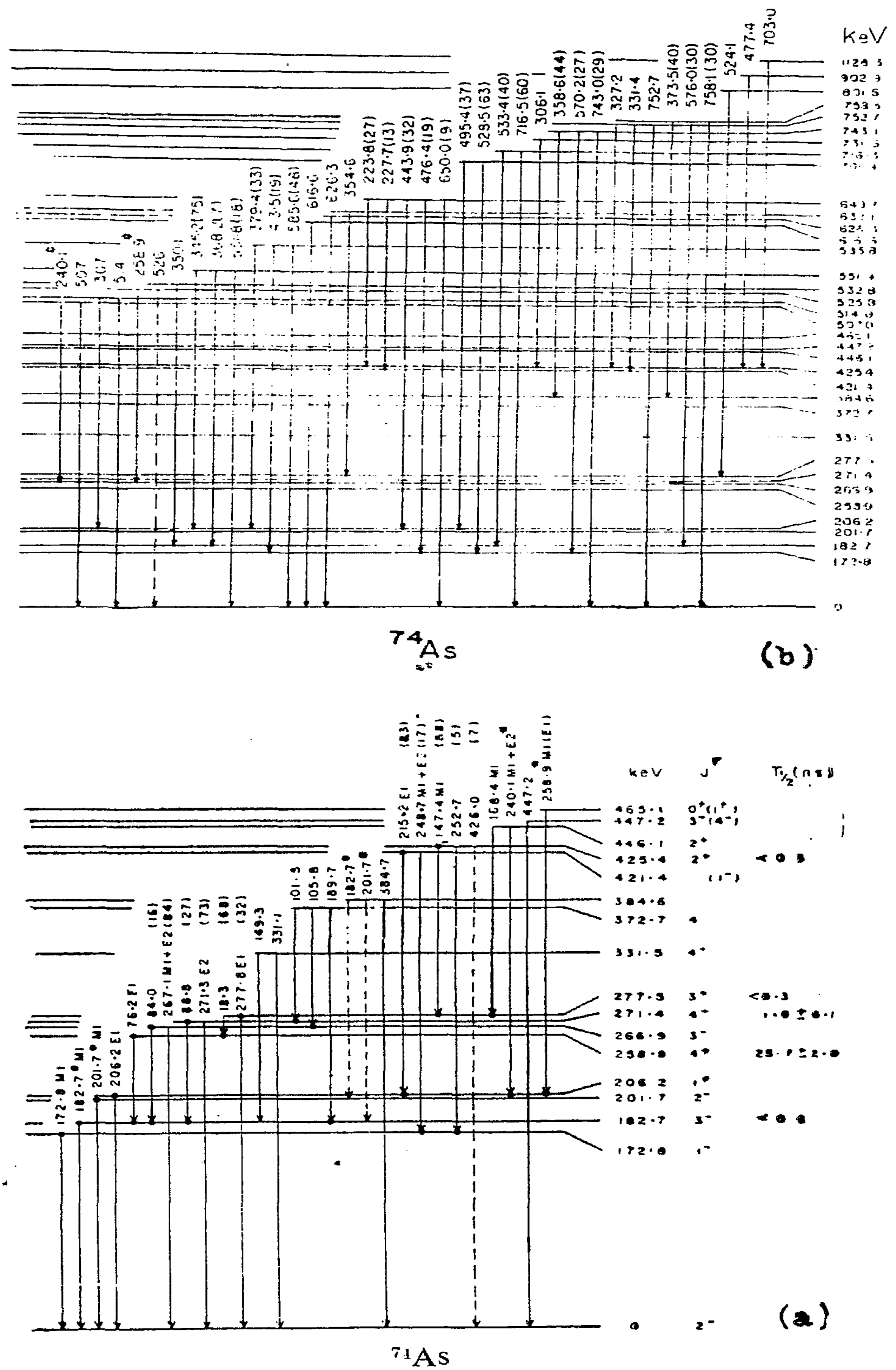

Figure 4. Proposed level scheme of ^{74}As. The branching ratios are indicated on top of the transitions. The decay properties of the low lying levels are shown in figure 4 *a* while those of the higher energy levels are shown in figure 4 *b*. The transitions indicated by an asterisk have been assigned at two places. The value of the half-life for the 258·9 keV level quoted in figure 4 *a* is obtained from the present work.

directly detect the 19 keV γ-ray. It was also not possible to decide whether the measured half-life belongs to the 278 keV or 259 keV level. These ambiguities were resolved in the present work by the following experiments.

In order to identify the isomeric level, time spectra were recorded between neutrons and the K-conversion electrons corresponding to the 76·2, 182·7 and 277·8 keV transitions. A 5 cm dia × 5 cm thick plastic phosphor was used for the detection of neutrons. A 3 cm thick lead shield placed in front of the detector prevented most of the γ-rays from the target from reaching the detector. Figure 5 shows the time spectra. One can conclude from this figure that the 277·5 keV level has a short lifetime ($T_{\frac{1}{2}} < 1$ *ns*) and that the 76·2 keV γ-ray originates from a level having the long lifetime ($T_{\frac{1}{2}} = 26{\cdot}8$ *ns*). This rules out the 76–19–183 keV cascade from the 278 keV level discussed above, leaving only the possibility of the 19–76–183 keV cascade. This was further confirmed by taking a γ-ray spectrum with a NaI (Tl) detector in coincidence with the K-147·4 keV conversion line with both prompt and delayed gates. Only the 76·2 and 182·7 keV transitions appeared in the delayed spectra. These experiments thus establish the sequence of decay of the 277·5 keV level and also assign the 26·8 *ns* half-life to the 258·9 keV level.

In order to establish the existence of the 19 kev transition, a γ-ray spectrum in the energy region 10–100 keV was recorded with the thin window Ge (Li) detector. A coincidence spectrum was also taken with this detector gated by the 147·4 keV γ-ray which was accepted by the 27 cm³ Ge (Li) detector. Figure 6 shows both

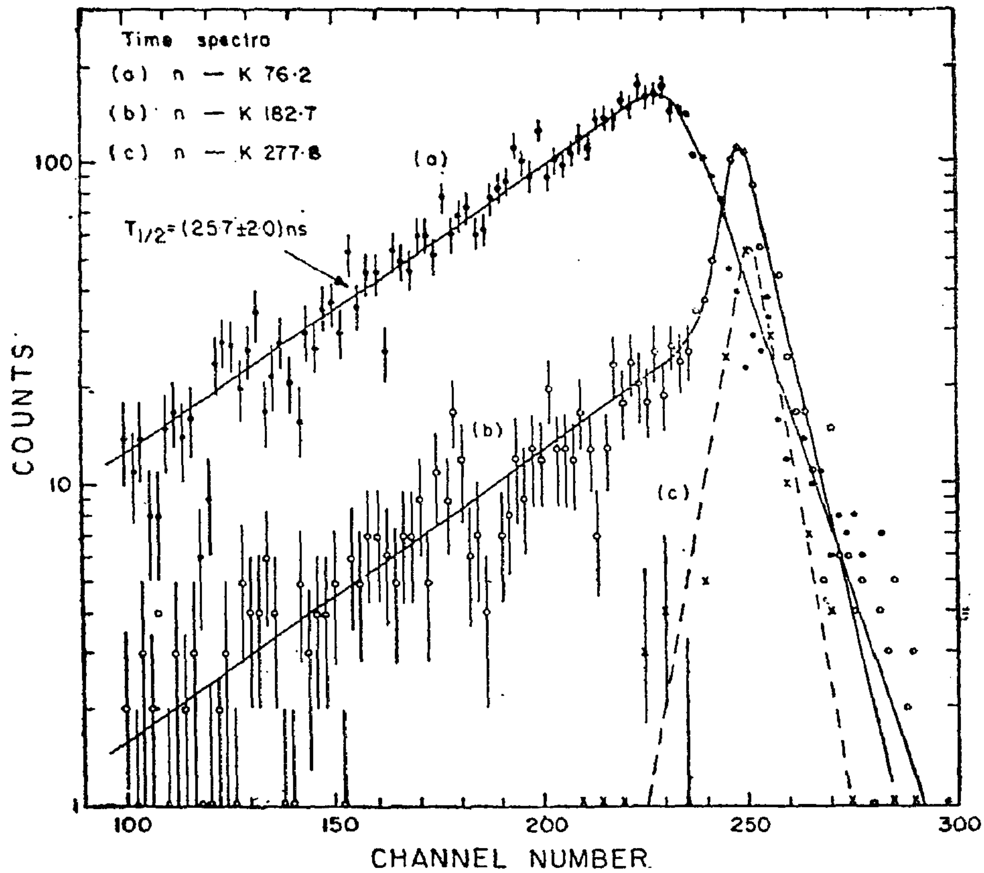

Figure 5. Time spectra obtained by choosing neutrons in the stop channel of TAC and the K-conversion lines corresponding to (*a*) 76·2, (*b*) 182·7 and (*c*) 277·8 keV transitions in the start channel.

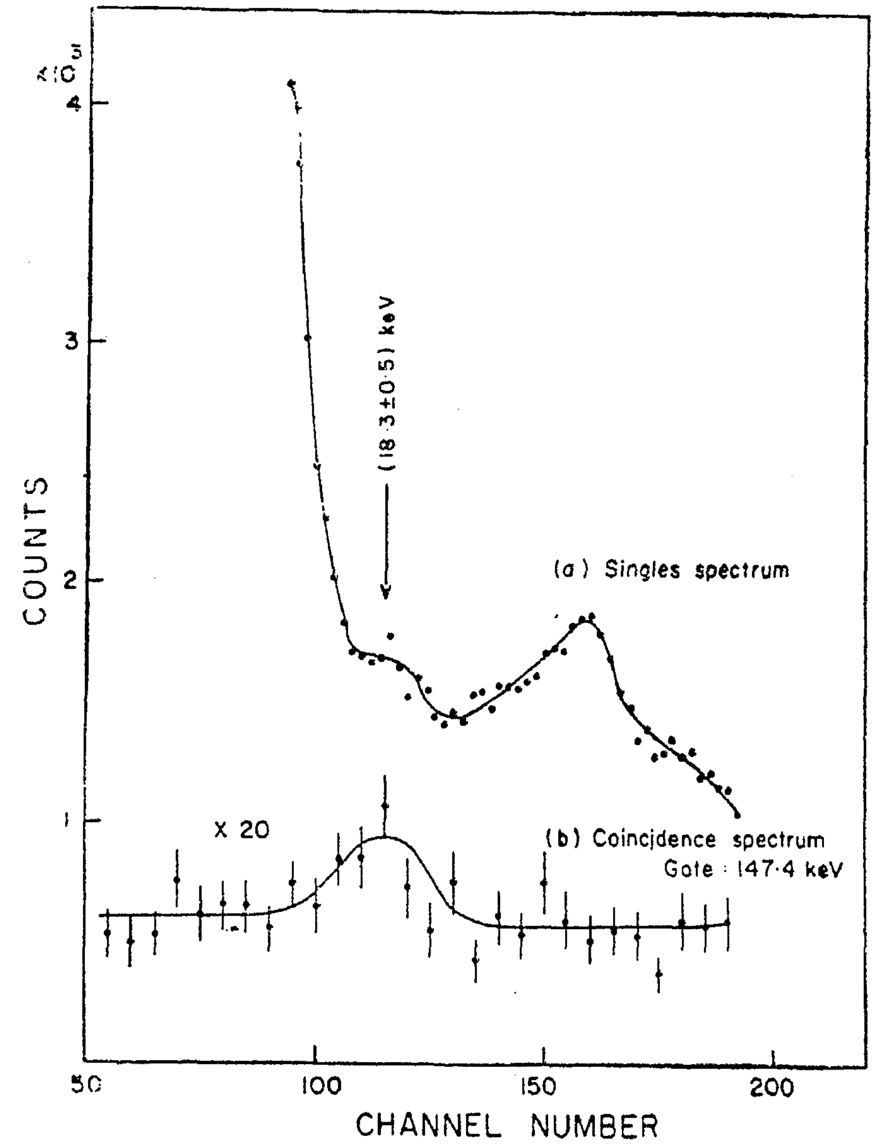

Figure 6. (*a*) Singles γ-ray spectrum taken with a thin window Ge (Li) detector at $E_p = 5 \cdot 0$ MeV. (*b*) Coincidence γ-ray spectrum taken with the same detector gated by the $147 \cdot 4$ keV line.

the singles and coincidence spectra taken at $E_p = 5 \cdot 0$ MeV. A $18 \cdot 3 \pm 0 \cdot 5$ keV γ-ray is clearly seen in both the spectra. In this experiment, very low beam current ($\sim 50\, nA$) was used to avoid pile-up due to large x-ray background from the target. There is no indication of the $14 \cdot 9$ keV γ-ray assigned by Christiansen *et al* (1971) further supporting the cascade proposed above.

The E1-multipolarity of the $277 \cdot 8$ keV transition measured in the present work and by Kimura (1973) and the excitation function data for this transition by Kimura fix the spin and parity of the $277 \cdot 5$ keV level as 3^+. The multiplarity of the $76 \cdot 2$ keV transition could be either M1 or E1 from α_k measurement. Hence the possible spins for the $258 \cdot 9$ keV level are 2, 3 and 4. Mordechai *et al* (1973) measured the angular distribution of the $76 \cdot 2$ keV γ-ray and found a negative value for the angular distribution coefficient A_2. This is consistent only with a $J = 4$ assignment for the $259 \cdot 9$ keV level assuming a pure dipole nature for the radiation. Further, since this is the isometric level, it follows that the g-factor measured by Christiansen *et al* (1971) refers to this level. Their analysis of the g-factor suggests a $(\pi 2p_{3/2}^{-1}, \nu\, 1f_{5/2}^{-1})$ configuration for this level with spin 3^+ or 4^+. Thus combining all the available data we can get an unambiguous assignment of 4^+ to the $258 \cdot 9$ keV level and E1 multipolarity for the $76 \cdot 2$ keV transition.

In order to make lifetime measurements on the 271·4 and 277·5 keV levels, one is compelled to use a plastic phosphor to detect the radiation in order to obtain good time resolution. The n—e^- measurements did not show narrow time spectra. Hence γ–e^- measurements were made with a 5 cm × 5 cm plastic scintillator with no lead absorber in front. Two lifetime measurements, one with the K–271·4 keV conversion line and the other with the K–277·8 keV line accepted in the beta ray spectrometer, were made. The time spectra are shown in figure 7. Two well-separated peaks caused by the difference in flight times of neutrons and γ-rays feeding the above levels appear in the spectra. From the left peak in each of the spectra corresponding to γ-e^- cascade, we can extract the lifetimes of these levels. These measurements yield $T_{\frac{1}{2}} = 1\cdot0 \pm 0\cdot1$ *ns* for the 271·4 keV level and $T_{\frac{1}{2}} \leq 0\cdot3$ *ns* for the 277·5 keV level.

3·3. *The* 331·5 *keV level*

This level decays to the ground state (2⁻) and the 182·7 keV level (3⁻). Kimura (1973) has proposed 4⁻, 5⁻ as the possible spins for this level. If the spin were 5⁻, the ground state transition from this level would be M3 in charater and this cannot compete with the 149·3 keV transition feeding the 182·7 keV level. Thus, the spin 4⁻ is the only possibility for this level.

3.4. *The* 372·7 *keV level*

This level is proposed on the basis of observation of 189·7–182·7 keV; 101·5, 105·8–(84·0 + 88·8) keV coincidences. Since this level decays only to levels of

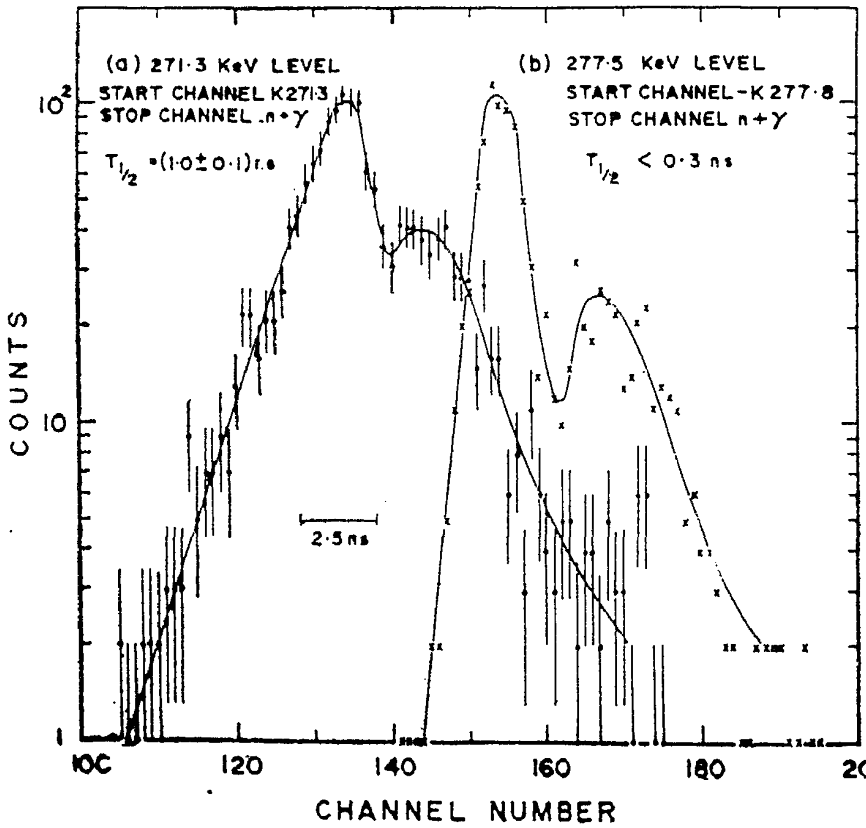

Figure 7. Decay curves for the 271·4 and 277·5 keV levels. K-conversion electrons corresponding to the 271·3 and 277·8 keV transitions were chosen in the start channel of TAC, and neutrons and γ-rays in the stop channel. Neutrons of energy greater than 50 keV were accepted in the fast channel.

spin 3^- and 4^- but not to the ground state (2^-), a spin 4 could be assigned to the level. In the present work, only upper limits for the conversion coefficients of the 101·5 and 105·8 keV transitions could be obtained. Hence the parity of the level could not be fixed.

3.5. *The* 384·6 *keV level*

This level decays to the ground state. The dotted 182·7 keV (384·6 → 201·7) and 201·7 keV (384·7 → 182·7) transitions from this level are based on the 201·7–182·7 keV coincidence data. Since there is an ambiguity as to whether this level decays through the 182·7–201·7 keV cascade or the 201·7–182·7 keV cascade, they are shown as dotted. Kimura (1973) has shown a possible transition of energy 212·0 keV from this level to the 172·8 keV level. In the present work, no γ-ray of this energy was seen either in the singles or coincidence spectra. Kimura assumed that this level decays only to the ground state and on the basis of excitation function for this ground-state transition assigned 4^- to this level. The observation in the present work of an additional cascade transition (182·7 or 201·7 keV) does not make the 4^- assignment unique.

3.6. *The* 421·4 *keV level*

There are two transitions from this level: 248·7 and 215·2 keV feeding the 172·8 and 206·2 keV levels respectively. The multipolarities of the 215·2 (E1) and 248·7 (M1 + E2) keV transitions and the modes of decay of this level suggest a spin 1^- for this level. However, Kimura found the multipolarity of the 215·2 keV transition to be M1 but did not report α_k for the 248·7 keV transition. Hence, the spin 1^- assigned in this work contradicts Kimura's assignment of 1^+.

3.7. *The* 425·4 *keV level*

This level decays to the ground state, the 172·8 keV level and the 277·5 keV level. The 252·7 (425·5 → 172·8) keV transition shown as a possible transition by Kimura is confirmed in the present work on the basis of threshold and $\gamma-\gamma$ coincidence data. Further, an upper limit of 0·3 *ns* is placed on the half-life of this level from the lifetime measurements.

3.8. *The* 507·0 *keV level*

Kimura reported only a ground state transition from this level. On the basis of the 240·1–(84·0 + 88·8) keV coincidences observed in this work, a 240·1 keV transition is assigned between this level and the 266·9 keV level.

3.9. *The* 514·0 *keV level*

This level decays to the ground state and the 206·2 keV level. Kimura has shown a 235·6 keV transition feeding the 277·5 keV level. In the present work, this transition was not found to be coincident with the 76·2 keV γ-ray and hence is not assigned in the decay scheme.

3.10. *The* 525·8 *keV level*

The assignment of this new level is based only on the observation of a 258·9 keV γ-ray in coincidence with the gate: 84·0 + 88·8 keV. The ground state transition from this level is shown as dotted as its threshold could not be determined unambi-

3.11. *The* 532·8 *keV level*

This level is proposed on the basis of the observed 350·1–182·7 keV $\gamma-\gamma$ coincidences. The 350·1 keV γ-ray has been assigned as a transition from the 551·4 keV level (551·4 → 201·7) by Kimura. This assignment is incorrect as the γ-ray was observed in the present work to be in coincidence only with the 182·7 keV γ-ray but not with the 201·7 keV γ-ray. The assignment made in the present work is also consistent with the observed threshold of the 350·1 keV γ-ray.

3.12. *The* 626·3, 632·1 *and* 649·7 *keV levels*

The main evidence for the existence of the 632·1 keV level is the observation of a 354·6 keV γ-ray in coincidence with the 76·2, 182·7 and 277·8 keV γ-rays. While the existence of the 626·3 keV level has been confirmed in the present work, our coincidence data rule out the 241·3 and 354·7 keV transitions from this level shown by Kimura. The 649·7 keV level decays to five different levels having spins $1^{\pm}$ or $2^{\pm}$. Since it does not decay to any of the states with $J > 2$ its spin can only be 1.

3.13. *The* 701·4, 731·6, 752·7, 758·3, 801·6, 902·9 *and* 1128·5 *keV levels*

These are new levels which were not reported earlier. The transitions shown from these levels are assigned from the threshold and $\gamma-\gamma$ coincidence data.

4. Discussion

In the present work, the properties of low-lying levels in ^{74}As *viz.*, spin and parity, decay modes, branching ratios and lifetimes have been determined. An unambiguous identification of the isomeric level previously observed is made.

The neighbouring odd-neutron nuclei show well-developed rotational bands (Baba *et al* 1974) while the even-even nuclei show quasi-rotational bands (Hamilton *et al* 1974). Although the odd-proton nuclei do not show well-developed bands, they have been satisfactorily explained by Scholz and Malik (1968) on the basis of strong Coriolis coupling. In the case of the odd-odd nucleus ^{74}As studied in the present work, it has not been possible to identify levels that could be fitted into rotational bands. However, the significant $l_n = 2$ spectroscopic factor found by Fournier *et al* (1972) and the enhanced B (E2) value for the 271·4 keV transition measured in the present work [B (E2) = 15 ± 2 Weisskopf units] lend support to the view that even in some low-lying states, we are dealing with substantial deformed state components.

In the absence of a simplified understanding of the observed levels on the basis of rotational model, one could explain the levels in terms of mixed shell model configurations. In ^{74}As, the valence protons are in the $f_{5/2}$, $p_{3/2}$ and $p_{1/2}$ orbitals while the valence neutrons are in the $g_{9/2}$, $p_{1/2}$ and possibly in $f_{5/2}$ orbitals. Thus, the negative parity levels could arise as a result of coupling the $g_{9/2}$ neutron to a proton in one of the negative parity orbitals. Since such a coupling would give rise to a large number of levels with a given spin, it is likely that there is a large configuration mixing. The occurrence of low-lying 1^- states (172·8 and possibly 421 keV) indicates that the low-lying odd parity states would have significant admixture from the $\nu 2d_{5/2}$ configuration. This may be understood again in terms of deformation, since this kind of excitation involves core-excitation.

The positive parity levels could be obtained by coupling either the $p_{1/2}$ or $f_{5/2}$ neutron to a proton in the negative parity orbitals. The g-factor measurement of Christiansen *et al* (1971) supports a ($\pi 2p_{3/2}^{-1}$, $\nu 1f_{5/2}^{-1}$ assignment for the 4^+ level at 258·9 keV. Assuming the 18·3 keV transition to be a pure M1 transition, its B(M1) value is less by a factor of ~ 5 than that expected for a

$$(\pi 2p_{3/2},\ \nu 1f_{5/2})_{3+} \rightarrow (\pi 2p_{3/2},\ \nu 1f_{5/2})_{4+} \text{ transition.}$$

In conclusion, the complexity of the level scheme does not allow a simple interpretation of the observed levels. However, it would be worthwhile doing a detailed shell-model calculation of the properties of the levels in ^{74}As taking into account the known properties of the neighbouring odd-proton and odd-neutron nuclei.

Acknowledgements

The authors wish to thank B Sahai, P J Bhalerao, M Y Vaze, S K Ambardekar and M G Patwardhan for their help during the experiment. The efficient operation of the Van de Graaff accelerator is appreciated.

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