Lifetime measurements in ^{75}Kr and systematic study of krypton isotopes

M. A. Cardona, G. García Bermúdez, A. Filevich, and E. Achterberg
Departamento de Física, Comisión Nacional de Energía Atómica, 1429 Buenos Aires, Argentina
(Received 21 February 1989; revised manuscript received 22 November 1989)

Lifetimes of states in ^{75}Kr, excited in the ^{54}Fe(^{24}Mg,$2pn$)^{75}Kr reaction at 75 MeV, have been measured using the recoil-distance technique. The $E2$ transition strengths in ^{75}Kr have been interpreted within the rigid-triaxial-rotor–plus–quasiparticle model. A consistent set of parameters, required for the application of this model, has been obtained from a systematic study of Kr isotopes. The prediction of the model describes the experimental data rather well and suggests a deformation of $\beta \approx 0.4$ for ^{75}Kr.

I. INTRODUCTION

The neutron-deficient Kr isotopes lie in the $A \cong 70-80$ mass region. This region has a subzone of high quadrupole deformations[1] ($\beta \cong 0.4$) and of "soft" nuclei responsible for the well-known effect of shape coexistence. Recently these properties, observed in Se, Kr, and Sr isotopes, stimulated a considerable amount of experimental and theoretical work. Piercey *et al.*,[2] who studied the nuclear structure of ^{74,76}Kr nuclei, found a strong perturbation of the first 2^+ state energy and attributed this effect to the interaction of a second excited 0^+ state with the ground state having a different shape. The study of the neighboring odd-even nuclei, for example ^{75}Kr, allows us to investigate the effect of the odd particle coupled to this soft core. This latter effect depends on whether the odd particle is a proton or a neutron. For instance, considering the well-known soft ^{72}Se nucleus[3] plus an extra proton, as in ^{73}Br,[4] an increase of the deformation to $\beta \cong 0.4$ and a band structure with a slowly increasing moment of inertia as compared with the ^{72}Se core nucleus, were observed. On the other hand, the odd-neutron ^{73}Se nucleus presents a decay scheme[5] that is well reproduced assuming the values of $\beta = 0.3$ and $\gamma = 12°-15°$ for the triaxial-rotor model parameters. These different observations, clearly indicating the different polarizing effects produced by the odd proton or neutron, partially motivated recent studies[6-9] of the band structure in the odd-neutron ^{75}Kr nucleus. They established two $\Delta I = 1$ bands built on the $(\frac{3}{2}^-)$ and $(\frac{5}{2}^+)$ states. The investigations of the ^{75}Kr nucleus structure to very high angular momentum were reported recently by Skoda *et al.*[10] and Winchell *et al.*[11] Comparing the energies of the positive-parity band with a simple Nilsson quasiparticle coupled to a rigid-rotor model, a deformation of $\beta \simeq 0.32$ was suggested.[8] Furthermore, Herath-Banda *et al.*[9] obtained the values of $\beta = 0.37$ and $\gamma = 12°-15°$ measuring the energies, intensities, and mixing ratios of gamma rays deexciting both bands in ^{75}Kr and comparing them with the prediction of the triaxial-rotor model.

This work carried out a more sensitive experimental measurement to study the polarizing effect of the odd neutron on the $^{74-70}$Kr core nuclei through the measurement of the electromagnetic transition strengths. For this purpose the lifetimes of excited levels of ^{75}Kr nuclei were measured and a consistent set of parameters to describe the transitional character displayed by the Kr isotopes was obtained.

II. EXPERIMENTAL METHODS AND RESULTS

The excited levels in ^{75}Kr were strongly populated using the reaction ^{54}Fe(^{24}Mg,$2pn$)^{75}Kr induced by a ^{24}Mg beam from the TANDAR accelerator. In order to maximize the production of the nucleus of interest, and to limit interfering effects of γ rays from other reaction channels (for instance, ^{74}Br) a beam energy of 75 MeV was used. Figure 1 shows a singles spectrum in which the origins of the strongest peaks are indicated.

The lifetimes were measured by the recoil-distance Doppler shift technique using a simple plunger device described elsewhere.[12] The target to stopper distance was modified by means of a micrometer screw and monitored at small values (≤ 50 μm) measuring the electrical capacity. The distance was determined using an inductive gauge[13] covering a range of linear displacements of $0-1000$ μm, with an overall accuracy of about 1 μm.

The target was a self-supporting enriched (97%) ^{54}Fe foil with a thickness of 350 μg/cm^2, and the stopper consisted of a flat sheet of natural lead, enough to stop the recoiling nuclei. The distance of minimum approach was established as 10 ± 5 μm measuring the capacity; and tests and calibrations of the device[12] were made using short, known lifetimes in ^{78}Kr. Two (HP)Ge detectors of 30% and 40% efficiencies, both with energy resolution of 2.1 keV, were installed at 0° and 170° with respect to the beam direction to observe the γ rays emitted in-beam.

A recoil velocity of $v/c = 2.19(4)\%$ was obtained from the energy separation between the shifted and unshifted peaks of the strong ^{75}Kr transitions. Two different experiments covering the distance ranges of $15-900$ μm and 15 μm-17 mm measuring 40 different flight distances were performed. The intensities of the different γ rays as a function of distance were normalized using the intensities of the Pb x rays produced in the stopper material. The measured decay curves were analyzed using the program TAUFIT.[14] The relative intensities of the emitted γ rays and their branching ratios together with the lifetime determine the electromagnetic decay properties of each level. Two independent γ-singles measurements, with the same experimental conditions as in the lifetime measurement, but placing the detector at 125° relative to the beam direction, were collected.

Two different γ rays of 179.7 keV and 178.6 keV, deexciting levels at 358.5 and 178.6 keV in the ^{75}Kr decay scheme, were previously reported.[8] Earlier experimental results[6] found both γ transitions with the same energy. The γ-ray intensities reported in Ref. 8 were obtained using γ-singles measurement of the ^{40}Ca(^{39}K,3pn) reaction, and erroneously considering the 177.8 keV transition from the decay of ^{73}Br,[4] at that time with unknown decay scheme, as γ-ray deexciting levels of ^{75}Kr. From the analysis of the neutron-γ coincidence experiment partially reported in Ref. 8, which excludes the $\alpha 2p$ reaction channel leading to ^{73}Br, it can be established that both transitions have the same energy, within experimental errors, in agreement with previous results.[6,9] The sum intensity of the doublet is included in Table I.

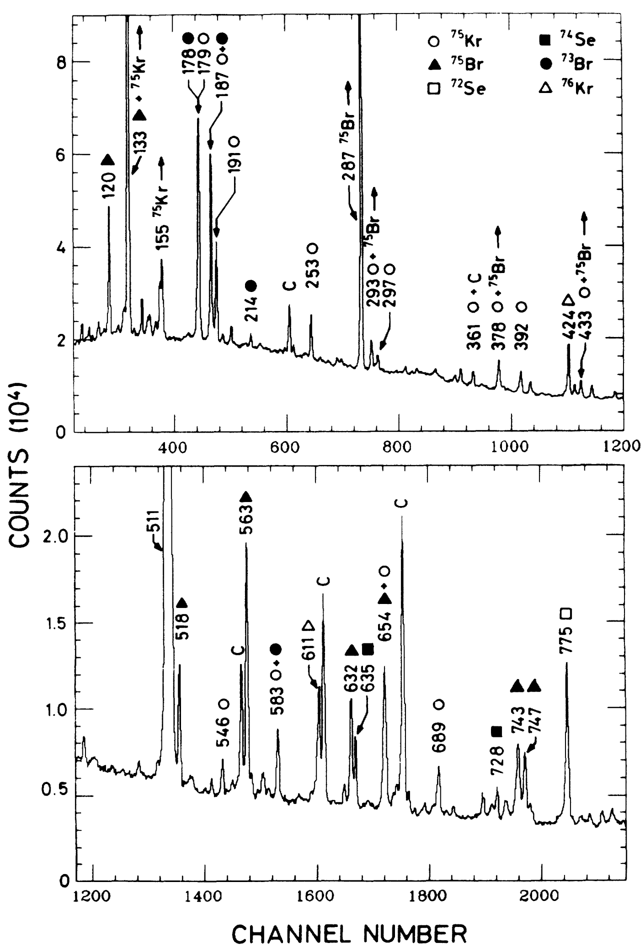

FIG. 1. Singles γ-ray spectrum from the ^{54}Fe + ^{24}Mg reaction at 75 MeV beam energy. Several reaction channels are labeled. Arrows show the transitions originated from the decay of the nuclei indicated. The letter C stands for unidentified lines.

In the following a discussion of lifetime measurement for positive- and negative-parity bands in ^{75}Kr is presented. The analysis proceeds from the highest energy level toward the ground state, and in each level the contribution of all previous γ rays as well as side feedings were taken into account. The side-feeding time was estimated to be negligible for the studied levels. This assumption is consistent with analysis made on side-freeding times of nuclei in the mass 70–80 region populated by different heavy-ion reactions.[15,16]

A. Positive-parity band

An upper limit of 3.6 ps was measured for the 689 keV γ ray, deexciting the 1067 keV level. The lifetime for the 770 keV level was determined by observing the 392 keV γ ray [Fig. 2(d)]. The 583 keV γ ray, also deexciting the same level, was contaminated with the ^{73}Br decay, and the lifetime of the 378 keV level was measured through the 191 keV γ ray. Figures 2(a) and (b) show that the shifted γ ray of 187 keV interferes with the unshifted γ ray of 191 keV at 0° with respect to the beam axis; for that case data obtained with the detector placed at 170° were used. The 187 keV γ ray is produced in the decay of both ^{73}Br and ^{75}Kr. From reported intensities of ^{73}Br (Ref. 4) it is possible to determine the degree of contamination as 18(3)%. Figure 3 shows the decay of the 187 keV doublet in which both components can be clearly identified. The first part of the decay curve is dominated

TABLE I. Independent measurement of γ-ray intensities of the ^{75}Kr nucleus and their average values.

E_γ (keV)	I_γ [a]		Average intensity
179	1600(90)[c]	1570(100)[c]	1585(67)[c]
187	1000(85)	1000(80)	1000(58)
191	677(30)	633(40)	661(24)
253	358(40)	363(40)	361(28)
293	159(40)	160(40)	160(28)
297	146(40)	149(40)	148(28)
358	40(5)		40(5)
361			155(30)[b]
378	226(40)	245(40)	236(28)
392	265(40)	286(40)	276(28)
433	133(30)	140(30)	137(21)
546	159(40)	161(40)	160(28)
583	185(40)	214(40)	200(28)
654			211(40)[b]
689	358(40)	323(40)	341(28)

[a]Two different and independent intensity measurements.
[b]Intensity from neutron-γ coincidence results of Ref. 8.
[c]Sum intensity of 179 keV doublet.

TABLE II. Lifetimes and transition strengths in ^{75}Kr.

E_x (keV)	E_γ (keV)	$2I_i \rightarrow 2I_f$	τ (ps)	Branching ratio (%)	$B(E2)$ (e^2fm^4)
378	378	$9^+ \rightarrow 5^+$	31(3)	26(2)	890(110)
770	583	$11^+ \rightarrow 7^+$	4.6(12)	42(4)	1110(310)
1067	689	$13^+ \rightarrow 9^+$	<3.6	70(4)	>960
612	433	$7^- \rightarrow 3^-$	15(2)	28(3)	1000(170)
905	546	$9^- \rightarrow 5^-$	3.6(10)	50(6)	2340(710)
1266	654	$11^- \rightarrow 7^-$	<4	58(7)	>870
187	187	$7^+ \rightarrow 5^+$	52(5)		
358	179	$5^- \rightarrow 3^-$	62(15)		
179	179	$3^- \rightarrow 5^+$	3000(500)		

by the deexcitation of the ^{75}Kr nucleus with a lifetime of 52(5) ps and at distances higher than 1000 μm, by the ^{73}Br 187 keV transition with a 1600(300) ps (Ref. 4) lifetime.

B. Negative-parity band

From the decay of the 361 keV γ ray an upper limit of 4 ps for the 1266 keV energy level was determined. The

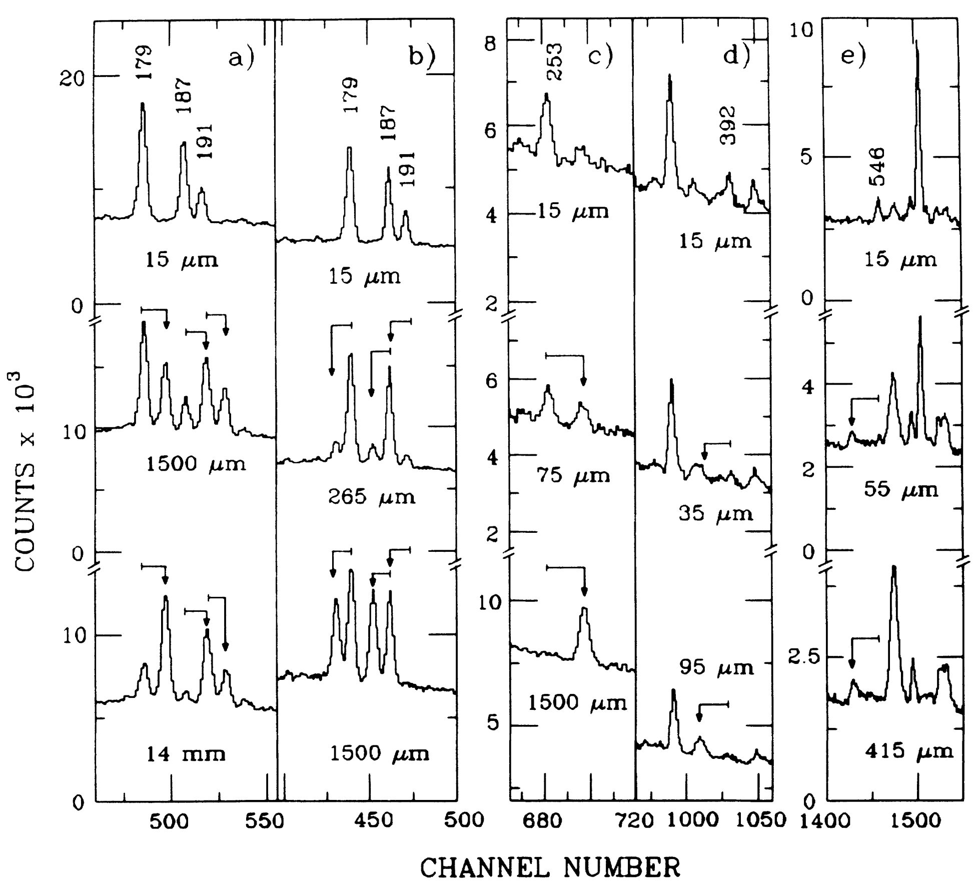

FIG. 2. The evolution of the γ-ray intensities, as a function of the indicated target-stopper distances, is shown for most of the γ-ray transition in ^{75}Kr. The shifted γ ray of 187 keV interferes with the unshifted γ ray of 191 keV at 0° (a); for this γ ray the lifetime was obtained analyzing the unshifted peak from the detector at 170° (b) with respect to the beam axis. As explained in the text, the peak labeled 179 in (a) and (b) is a triplet, containing two γ rays belonging to ^{75}Kr and another one from the ^{73}Br decay. (c) The 253 keV γ ray measured with the detector at 0°. (d) and (e) The 392 and 546 keV γ rays measured at 170°.

lifetimes of the 905 keV and 612 keV energy levels were measured through the decays of the 546 and 253 keV γ rays, shown in Figs. 2(e) and (c), respectively. The 358 and 179 keV levels decay with two γ rays of about the same energy. This doublet deexcites a spin cascade $(\frac{5}{2}^-)\rightarrow(\frac{3}{2}^-)\rightarrow(\frac{5}{2}^+)$ as suggested in a previous work.[8] It was suggested that the lifetime of the second γ ray, which involved a parity change, was in the order of nanoseconds. The decay curve of the 179 keV γ ray was even more difficult to analyze because of an interfering γ ray from the ^{73}Br decay with 10(2)% intensity and a lifetime of 510(210) ps.[4] Taking into account the abovementioned three components, the lifetime of the 358 keV $(\frac{5}{2}^-)$ state was determined to be 62(15) ps. The lifetime of the 179 keV isomeric state was measured analyzing the experimental data observed with target-to-stopper distances from 5–17 mm. The result obtained was 3000(500) ps.

It is worth mentioning that the errors of the lifetimes reported in Table II were estimated taking into account not only the statistical errors for each particular γ ray but also studying the contribution of the errors in the lifetimes and intensities of the γ rays feeding the levels of interest. In order to include all the uncertainties and to study their influence on the final lifetime error, a Monte Carlo method was used to simulate the decay scheme.[12]

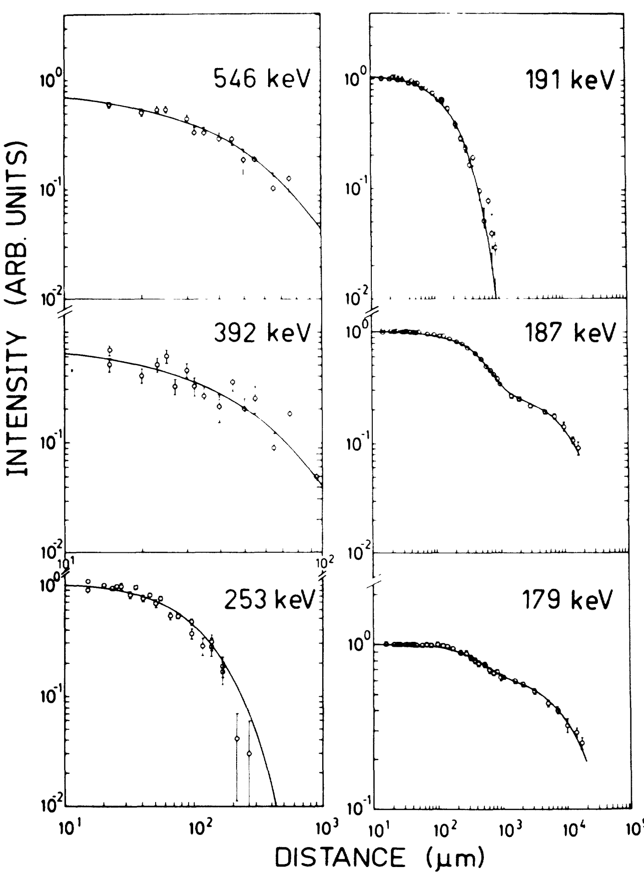

FIG. 3. Decay curves of several transitions in ^{75}Kr. The best fits through the data points are also shown.

TABLE III. The parameters moment of inertia $\theta_0/\hbar^2$, softness σ, asymmetry γ, and deformation β obtained from the fitting of the doubly even Kr isotopes.

	^{74}Kr	^{76}Kr	^{78}Kr	^{80}Kr
$\theta_0/\hbar^2$ (MeV^{-1})	14.3	12.8	11.0	5.9
σ (10^{-2})	0.05	0.2	0.6	9
γ (deg)	20	20	22	28
β	0.40	0.38	0.36	0.27

III. DISCUSSION

The comparison of the nuclear model prediction with the lifetime measurement allows us to investigate the collective properties of the nucleus. In order to reduce the number of free parameters and to study their evolution with neutron number, a systematic study of the known Kr isotopes was performed. For the doubly even nuclei the triaxial-rotor model with the Davydov approximation, which fixes the nuclear shape parameters at their average[17] values, was used. The softness of the core is approximately taken into account including a variable moment of inertia as described in Ref. 18. A pairing gap parameter of 1.2 MeV for all the analyzed Kr isotopes was assumed.

The shape coexistence effect[2] that greatly affects the energy of the first excited 2^+ state is well known in this mass region. The interaction of the two 0^+ states with different shapes, one of them being the ground state, produces this anomaly as explained by Piercey *et al.*[2] The energies of the positive-parity bands for the doubly even $^{74-80}$Kr nuclei up to the 10^+ state were normalized setting the energy of the first 2^+ level as zero in order to reduce the perturbation to the level schemes mentioned above. From the ratio of the predicted and unperturbed energy for the first 2^+ state of the ground band with respect to the second 2^+ state, an asymmetric deformation was obtained. The rotational band obtained by allowing the moments of inertia and the softness parameters to vary freely around reasonable values started at 2^+ and went up to a 10^+ state. Figure 4 shows the fitting results, and in Table III the corresponding parameters are reported. The ground-state band shows a regular de-

TABLE IV. Triaxial-rotor-model parameter used to describe the positive- and negative-parity bands in the odd Kr isotopes.

	^{75}Kr		^{77}Kr		^{79}Kr	
Bandhead I	$\frac{3}{2}^-$	$\frac{5}{2}^+$	$\frac{3}{2}^-$	$\frac{5}{2}^+$	$\frac{1}{2}^-, \frac{5}{2}^-$	$\frac{7}{2}^+$
$\theta_0/\hbar^2$ (MeV^{-1})	14	9.5	14	8.0	12	7.7
γ (deg)	20	20	20	20	28	22
Fermi level (MeV)	44.9	44.3	45.0	44.6	45.8	45.3
β	0.4	0.4	0.4	0.35	0.28	0.28

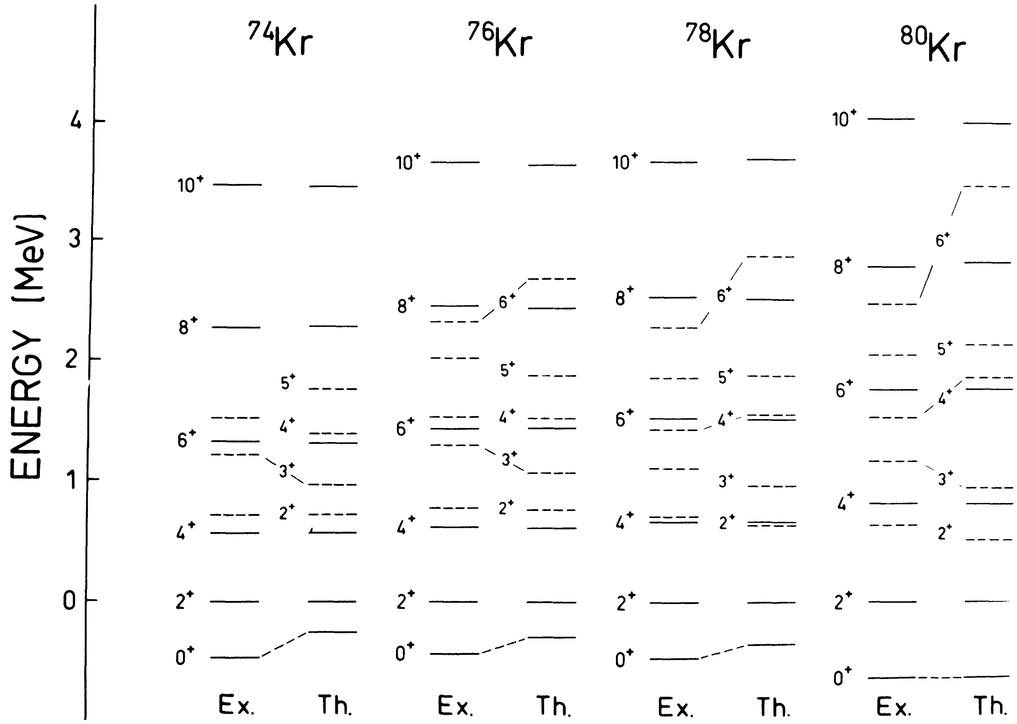

FIG. 4. Experimental and calculated excitation energy of the ground-state band and the γ band of doubly even Kr isotopes. The energies are normalized setting the energy of the first 2^+ level as zero.

crease in transition energy toward lighter Kr isotopes and was well reproduced with an increase in the moment of inertia and a decrease in the softness parameter σ.

The change in the triaxiality of the nucleus, as described in Fig. 1 of Ref. 18, strongly shifts the bandhead energy of the γ band, but barely affects the energies of the ground-state band. The triaxial degree of freedom represented by the parameter γ is strongly correlated with the energy of the second 2^+ state, the head of the γ band, and with the relative energy of the even- and odd-spin state members of that band. These changes are clearly indicated by the experimental data in Fig. 4 in which the γ band, showing up from ^{74}Kr to ^{80}Kr, shows a decrease in energy spacing between the two 2^+ states. The model prediction is reasonable considering that the experimental values were not fitted. Furthermore, Fig. 4 shows the energy of the ground states compared with the model prediction. As can be observed, the energy differences, which measure the degree of perturbation for the 0^+ state, reach a maximum at the $^{74-76}$Kr nuclei.

The deformation parameters β (Table III), were obtained[18] from previous lifetime measurements for the 4^+ levels, except for the 2^+ level in ^{74}Kr. It is worth noting that similar values of β were obtained by taking into account only the lifetime of the $2^+ \to 0^+$ transitions, suggesting that it is not very sensitive to the perturbation of the ground state.

The regular evolution of the positive-parity band energies for the Kr isotopes, shown in Fig. 4, were made apparent normalizing the level energies to the first 2^+ state

TABLE V. Comparison of the experimental and calculated $B(E2)$ values ($e^2\,\mathrm{fm}^4$) from the triaxial-rotor model [$B(E2)_{\mathrm{TAR}}$] and the projected Hartree-Fock [$B(E2)_{\mathrm{PHF}}$].

		^{75}Kr			^{77}Kr
$2I_i \to 2I_f$	$B(E2)_{\mathrm{exp}}$	$B(E2)_{\mathrm{TAR}}$	$B(E2)_{\mathrm{PHF}}$	$B(E2)_{\mathrm{exp}}$	$B(E2)_{\mathrm{TAR}}$
$9^+ \to 5^+$	890(110)	772	629	300(55)	582
$11^+ \to 7^+$	1110(310)	1160	1064	700(150)	850
$13^+ \to 9^+$	>960	1680	1349	1425(165)	1300
$7^- \to 3^-$	1000(170)	1027	819	1500^{+290}_{-220}	1000
$9^- \to 5^-$	2340(710)	1485	1223	2180(260)	1520
$11^- \to 7^-$	>870	1955	1447	2120(250)	1975

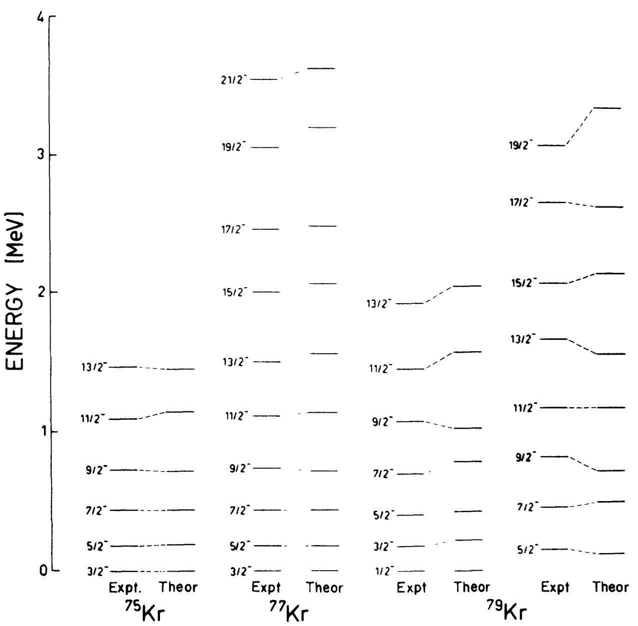

FIG. 5. Comparison of experimental and calculated excitation energies of negative-parity bands of ^{75,77,79}Kr.

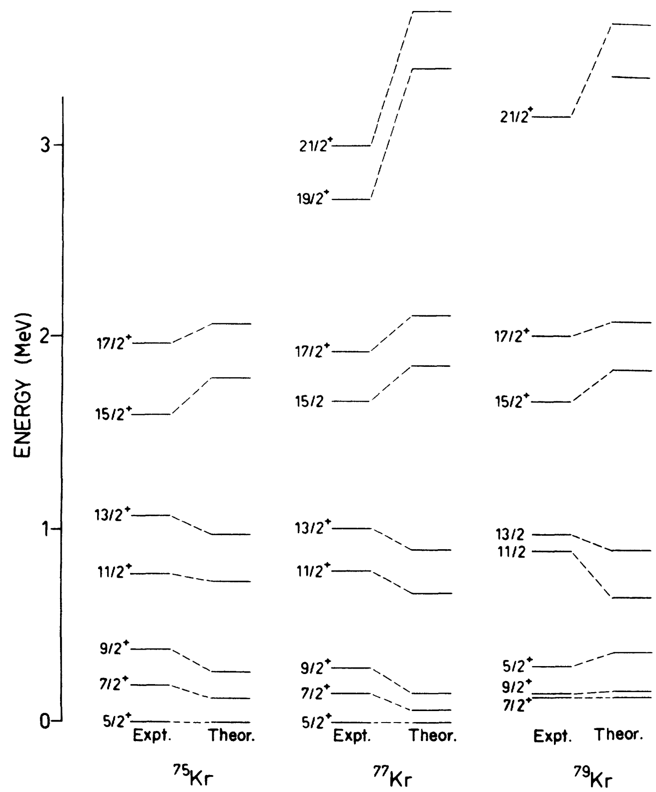

FIG. 6. Comparison of experimental and calculated excitation energies of positive-parity bands of ^{75,77,79}Kr.

instead of the ground state. The moment of inertia and the β values obtained from the fitting procedure change accordingly, reaching almost constant values for the ^{74,76}Kr pair, which is the core of the ^{75}Kr nucleus with a suggested deformation of $\beta \approx 0.4$.

The odd isotopes of Kr were described by coupling a quasiparticle to the triaxial core. The rotational part of the Hamiltonian includes the so-called recoil term and the Coriolis interaction. Due to the low values of the softness parameter obtained for the ^{74,76}Kr core nuclei (Table III), a rigid core was considered. The odd particle moves in the space spanned by the Nilsson orbitals of the $N=3$ and $N=4$ oscillator shells for negative- and positive-parity states, respectively. The quasiparticle eigenfunctions were calculated by a standard BCS procedure (without blocking), and the Nilsson parameters for the odd neutron were $\mu_n = 0.29$ and $k_n = 0.073$, obtained from Larsson *et al.*[19]

With the purpose of decreasing the number of free parameters, the empirical attenuation of the Coriolis matrix elements, as well as the splitting of the $g_{9/2}$ multiplet independent of the deformation parameter, were ignored. The comparison of the experimental decay scheme with the calculated one, assuming the parameters listed in Table IV, is shown in Figs. 5 and 6 for negative and positive parities, respectively. The change of the Fermi level parameter follows the mass of the different isotopes. The agreement is very good as far as the negative-parity states are concerned. The overall agreement for the positive-parity band can be greatly improved by introducing an *ad hoc* "Coriolis attenuation" parameter and an empirical splitting of the Nilsson multiplet not included in the present calculation. From systematic comparison with theory of the experimental data for the doubly even and odd-even Kr isotopes a set of parameters was obtained.

The electromagnetic $E2$ operator consists of a collective part and a single-particle term as described in Ref. 20, where effective charge values of 1.5 for protons and 0.5 for neutrons were used. Considering the deformation parameter β as the only free parameter, the $B(E2)$ values

TABLE VI. Experimental and calculated $B(E2)$ values (e^2fm^4) from the triaxial rotor model [$B(E2)_{\text{TAR}}$] in ^{79}Kr.

Positive band			$\frac{1}{2}^-$ band		$\frac{5}{2}^-$ band	
$2I_i \to 2I_f$	$B(E2)_{\text{exp}}$	$B(E2)_{\text{TAR}}$	$2I_i \to 2I_f$	$B(E2)_{\text{TAR}}$	$2I_i \to 2I_f$	$B(E2)_{\text{TAR}}$
$13^+ \to 9^+$	782(58)	778	$5^- \to 1^-$	607	$9^- \to 5^-$	710
$17^+ \to 13^+$	980^{+370}_{-210}	1100	$7^- \to 3^-$	840	$11^- \to 7^-$	950
$21^+ \to 17^+$	900^{+400}_{-220}	1320	$9^- \to 5^-$	560	$13^- \to 9^-$	978

shown in Tables II and V were obtained.

The theoretical work of Ahalpara *et al.*[21] considers a ^{56}Ni nucleus as a core and includes a modified Kuo's effective interaction between the valence particles to describe the structure of the ^{75,77}Kr isotopes. The projected Hartree-Fock calculation predicts for ^{75}Kr the $B(E2)_{PHF}$ shown in Table V together with our triaxial-rotor calculation $[B(E2)_{TAR}]$.

Table V shows that the experimental values for ^{75}Kr are well reproduced by the triaxial-model calculation. The projected Hartree-Fock calculation predicts a lower value for the $(\frac{9}{2}^+)\rightarrow(\frac{5}{2}^+)$ transition. The ^{77}Kr experimental data from Ref. 22 are also reasonably reproduced except for the $(\frac{9}{2}^+)\rightarrow(\frac{5}{2}^+)$ transition which shows a discrepancy of almost a factor of 2. Wörmann *et al.*[22] obtained better agreement with a model in which the asymmetry parameter was changed from 20° to 40°. The model prediction for the ^{79}Kr nucleus shown in Table VI is in good agreement with the reported measurements.[23]

The set of parameters obtained by fitting the energies and electromagnetic transition strengths of the Kr isotopes allows us to make a reasonably good prediction of the experimental values for ^{75}Kr and suggests consistently that the deformation increases towards lighter Kr isotopes reaching a value of $\beta\approx0.4$.

IV. CONCLUSIONS

Comparing the known decay schemes for different Kr isotopes with the results obtained from the triaxial-rotor model, a set of parameters reproducing the measured energies and lifetime values reasonably well was obtained.

The decrease in transition energy (Fig. 4) towards lighter even-even Kr isotopes was well reproduced with a progressive increase in the moment of inertia and rigidity. The asymmetry and deformation parameters γ and β change rapidly from ^{80}Kr to ^{78}Kr and reach a value of about $\gamma=20°$ and $\beta=0.4-0.38$ for the ^{74,76}Kr nuclei. Similar deformation parameters were obtained from the lifetime of the 4^+ and 2^+ states. These results suggest that the lifetime measurement does not show the same degree of perturbation due to different shapes as do to the energies of the 0^+ levels. In conclusion, the doubly even ^{74,76}Kr isotopes, core of the ^{75}Kr nucleus, were well reproduced assuming a rigid-triaxial rotor with a deformation of $\beta=0.4$.

On the other hand, the coupling of the odd neutron to the core was described using the full space of the $N=3$ and $N=4$ oscillator shells for the negative- and positive-parity states, respectively. The Fermi level is forced to follow the mass change to reduce the number of free parameters, and without introducing the attenuation of the Coriolis matrix elements and any *ad hoc* splitting of the $g_{9/2}$ multiplet, the set of parameters reported in Table IV was obtained. As it can be observed (Table IV) the moment of inertia changes for different parity bands. Changes in the moment of inertia $\theta_0/\hbar^2$ (7.7 to 12 MeV^{-1}) and in the γ value (22° to 28°) from positive- to negative-parity bands of ^{79}Kr were reported (Table IV). This is also partially reflected in the underlying ^{78,80}Kr nuclei, core of the ^{79}Kr nucleus, which show similar values of the parameters associating the positive-parity band to the ^{78}Kr core and the negative-parity band to the ^{80}Kr nucleus. To explore further the changes in the parameters for different bands, lifetime measurements for ^{79}Kr comparing the results with model predictions (Table VI) would be required.

The $^{75-77}$Kr nuclei show approximately a common set of parameters which reflects the great similarities found in their decay properties. The deformation follows smoothly the evolution of the core nucleus, approaching a value of $\beta=0.4$ (Table IV).

The overall predictions of the triaxial model fit the data reasonably well. The $B(E2)$ value for the $(\frac{9}{2}^+)\rightarrow(\frac{5}{2}^+)$ transition in ^{77}Kr was not well reproduced by the triaxial model and suggests that further investigation is required. The theoretical prediction shows a much better agreement for the negative-parity band compared to the positive one, as shown in Figs. 5 and 6.

Concluding the set of parameters describing the ^{75}Kr nucleus was obtained by the following procedure: (a) analyzing the doubly even core nucleus and taking into account the levels from 2^+ up to 10^+; (b) reducing, as much as possible, the number of parameters describing the overall behavior of the energies and the electromagnetic transition strengths.

The comparison of a large amount of data for known Kr isotopes shows that the rigid-triaxial-rotor model describes the nuclear structure of ^{75}Kr reasonably well. A common set of parameters describes the core ^{74,76}Kr as well as the ^{75}Kr nucleus. Therefore, from the lifetime measurements of ^{75}Kr, it can be concluded that a large deformation of about 0.4 and a negligible core polarizing effect by the odd neutron were found.

---

[1]R. Bengtsson, P. Möller, J. R. Nix, and J. Zhang, Phys. Scr. **29**, 402 (1984).

[2]R. B. Piercey *et al.*, Phys. Rev. Lett. **47**, 1514 (1981).

[3]J. H. Hamilton, A. V. Ramayya, W. T. Pinkston, R. M. Ronningen, G. García Bermúdez, H. K. Carter, R. L. Robinson, H. J. Kim, and R. O. Sayer, Phys. Rev. Lett. **32**, 239 (1974).

[4]B. Wörmann, J. Heese, K. P. Lieb, L. Lühmann, F. Raether, D. Alber, H. Grawe, and B. Spellmeyer, Z. Phys. A **322**, 171 (1985); J. Heese, K. P. Lieb, L. Lühmann, S. Ulbig, B. Wörmann, D. Alber, H. Grawe, H. Haas, and B. Spellmeyer, Phys. Rev. C **36**, 2409 (1987).

[5]A. Dewald, A. Gelberg, U. Kaup, R. Richter, K. O. Zell, and P. von Brentano, Z. Phys. A **326**, 509 (1987).

[6]A. V. Ramayya and J. Ebert, in *Proceedings of the Conference on Heavy-Ion Collisions, La Rabida, Spain, 1982,* edited by G. Madurga and M. Lozano (Springer-Verlag, Berlin, 1982), p. 317.

[7]G. Winter, J. Döring, W. D. Fromm, L. Funke, P. Kemnitz, and E. Will, Z. Phys. A **309**, 243 (1983).

[8]G. García Bermúdez, C. Baktash, and C. J. Lister, Phys. Rev. C **30**, 1208 (1984).

[9]M. A. Herath-Banda, A. V. Ramayya, L. Cleemann, J. Eberth,

J. Roth, T. Heck, N. Schmal, T. Mylaeus, W. Koenig, B. Martin, L. Bethge, and G. A. Leander, J. Phys. G **13**, 43 (1987).
[10]Skoda *et al.*, in *Proceedings of the Conference on Nuclear Structure of the Zirconium Region* (Springer-Verlag, Berlin, 1988), p. 317.
[11]D. F. Winchell, M. S. Kaplan, J. X. Saladin, H. Takai, J. J. Kolata, and J. Dudek, Phys. Rev. C (to be published).
[12]G. García Bermúdez, M. A. Cardona, and A. Filevich, Nucl. Instrum. Methods (to be published).
[13]Supplied by Tesa S.A., CH-1020 Renens, Switzerland.
[14]F. Riess, private communication.
[15]J. Heese, K. P. Lieb, L. Lühmann, F. Raether, B. Wörmann, D. Alber, H. Grawe, J. Eberth, and T. Mylaeus, Z. Phys. A **325**, 45 (1986).
[16]L. Lühmann, M. Debray, K. P. Lieb, W. Nazarewicz, B. Wörmann, J. Eberth, and T. Heck, Phys. Rev. C **31**, 828 (1985).
[17]A. S. Davydov and G. F. Filippov, Nucl. Phys. **8**, 237 (1958).
[18]H. Toki and A. Faessler, Z. Phys. A **276**, 35 (1976).
[19]S. E. Larsson, G. Leander, I. Ragnarsson, and N. G. Alenius, Nucl. Phys. **A261**, 77 (1976).
[20]H. Toki and A. Faessler, Nucl. Phys. **A253**, 231 (1975).
[21]D. P. Ahalpara, A. Abzouzi, and K. H. Bhatt, Nucl. Phys. **A445**, 1 (1985).
[22]B. Wörmann, K. P. Lieb, R. Diller, L. Lühmann, J. Keinonen, L. Cleemann, and J. Eberth, Nucl. Phys. **A431**, 170 (1984).
[23]J. Panqueva, H. P. Hellmeister, L. Lühmann, F. J. Bergmeister, K. P. Lieb, and T. Otsuka, Nucl. Phys. **A389**, 424 (1982).