Decays of ^{26}Na and ^{27}Na†

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^{26}Na and ^{27}Na were produced in the ^{10}B(^{18}O, 2p)^{26}Na and ^{11}B(^{18}O, 2p)^{27}Na reactions by bombarding pellets of boron with 42-MeV ^{18}O ions. ^{26}Na was also studied using the ^{18}O(^{13}C, $p\alpha$)-^{26}Na reaction at a ^{13}C beam energy of 35 MeV. After transfer of the target in a rabbit the β and γ rays were measured with NE102 and Ge(Li) detectors. ^{26}Na decays with $T_{1/2}=1.087 \pm 0.012$ sec and emits 10 γ rays involving 7 excited states of ^{26}Mg. From the end-point energy of β rays in coincidence with 1809-keV γ rays the mass excess of ^{26}Na is found to be -7004 ± 200 keV in agreement with the more accurate data of reaction Q values. ^{27}Na decays with $T_{1/2}=280 \pm 20$ msec in agreement with a previous measurement. γ rays of 984.77 ± 0.20 and 1698.5 ± 0.5 keV are emitted with relative intensities of 86.0 ± 2.9 and 14.0 ± 2.3, respectively. The spin of ^{27}Na is established as $J^\pi = \frac{3}{2}^+$ or $\frac{5}{2}^+$ from these data. From the end-point energy of ^{27}Na β rays in coincidence with 985-keV γ rays, compared with ^{26}Na β rays, the mass excess of ^{27}Na is -5650 ± 180 keV based on the ^{26}Na mass. This result is in fair agreement with a recent direct determination of the ^{27}Na mass.

I. INTRODUCTION

In a recent series of experiments[1-5] at Brookhaven several new $T_z = +\frac{5}{2}$ nuclides have been formed by heavy-ion compound reactions and their masses, half-lives, and decay schemes have been measured. The purposes of this work have been (1) to compare the spectroscopic observations with the predictions of various theoretical models, (2) to compare the masses of these nuclides with the predictions of theoretical mass formulations, and (3) to provide new input mass data which may lead to refinements of the mass formulas resulting in more reliable predictions of nuclear masses even further from the line of β stability. Among the $2s$-$1d$ shell members of the $T_z = +\frac{5}{2}$ sequence ^{21}O, ^{23}F, ^{25}Ne, ^{27}Na, ^{29}Mg, ^{31}Al, ^{33}Si, and ^{35}P, the previously unknown nuclides ^{31}Al, ^{33}Si, and ^{35}P have been established and their decay properties studied.[1-3,5] Details of the decay scheme of ^{25}Ne were obtained,[4] this nuclide having been first identified elsewhere[6] by means of different techniques.

As a continuation of this program we have undertaken an investigation[7] of ^{27}Na. This activity, along with a number of other new isotopes of sodium, was reported by Klapisch *et al.*[8] who bombarded U with high-energy protons and observed resultant sodium isotopes with an on-line mass spectrometer. A half-life of 295 ± 10 msec[9] was obtained for ^{27}Na and its mass excess was determined[10] to be -5880 ± 140 keV. β rays with an end-point energy of 7.6 ± 0.5 MeV were also reported,[8] but there has been no other information of the ^{27}Na decay scheme.

^{26}Na is a known radioactivity having a half-life of 1.04 ± 0.03 sec[11] from earlier measurements and 1.07 ± 0.03 sec[9] according to more recent work. Only one β-ray branch, to the 1809-keV first excited state of ^{26}Mg, has been reported in the literature,[11] although there are many other states to which allowed β-ray branches could take place. When ^{26}Na was observed in some early experiments on the ^{18}O + ^{13}C reaction we decided to check its half-life and search for β-ray branches not previously reported.[7] During later work on ^{27}Na it became clear that a knowledge of the ^{26}Na decay scheme would help in providing a more accurate mass value for ^{27}Na. This is due to the proximity of the end-point energies of the ^{27}Na β rays feeding the 985-keV state of ^{27}Mg and the ^{26}Na β rays feeding the 1809-keV state of ^{26}Mg. Since the energy of the latter can be calculated on the basis of accurate reaction Q values it can be used as an internal calibrator when both ^{26}Na and ^{27}Na are produced simultaneously as in some of the present experiments. In order to use ^{26}Na most effectively as a calibrator the shape of the β-ray spectrum leading to the 1809-keV state must be well defined. This means that the contributions to the total spectrum of pulses in the NE102 scintillator in coincidence with 1809-keV γ rays due to β rays feeding higher states that γ cascade through the 1809-keV state (amounting to ~12% of all decays) must be subtracted out along with effects due to γ-ray summing. In turn these corrections

require a reasonably accurate knowledge of the ^{26}Na decay scheme.

Another reason for making a study of ^{26}Na is that its mass as obtained from reaction Q values differs substantially from the mass based on one of two earlier β-ray measurements. Robinson, Lucas, and Johnson[12] obtained a total decay energy of 8.5 ± 0.3 MeV for ^{26}Na corresponding to a mass excess of −7700 ± 300 keV. According to later work by Klapisch *et al.*[8] the measured β singles end point corresponds to a mass excess of −7200 ± 500 keV. In the first reported reaction Q-value measurement on ^{26}Na Ball *et al.*[13] obtained a mass excess of −6853 ± 30 keV by the use of the ^{26}Mg-(^{7}Li, ^{7}Be)^{26}Na reaction. Their result has been confirmed in a study of the ^{26}Mg(t, ^{3}He)^{26}Na reaction by Flynn and Garrett[14] who obtained a ^{26}Na mass excess of −6903 ± 20 keV. Although the relatively less accurate β-ray result of Klapisch *et al.* agrees both with the earlier β-ray measurement and with the reaction Q values there is a discrepancy of 800 keV between the latter and the earlier β-decay energy found by Robinson *et al.* Our own experimental result is in excellent agreement with the reaction Q values.

II. EXPERIMENTAL METHODS AND RESULTS

A. Half-Lives and Decay Schemes of ^{26}Na and ^{27}Na

Most of the experimental techniques used in this work have been described thoroughly in previous papers.[1-5] ^{26}Na was first observed during searches for ^{29}Mg which could be formed in the ^{18}O(^{13}C, 2p)-^{29}Mg reaction. Targets[1,3,5] of $Ta_2{}^{18}O_5$ were bombarded with 35-MeV ^{13}C ions from one of the Brookhaven National Laboratory tandem Van de Graaff accelerators and the delayed γ-ray spectrum was measured in a Ge(Li) detector. Since it was expected that ^{29}Mg might decay with a half-life of about 1 sec, the timing setup was also appropriate for ^{26}Na and, in fact, one of the strongest background activities was ^{26}Na formed in the ^{18}O(^{13}C, $p\alpha$)^{26}Na reaction.

By routing the Ge(Li) spectrum into four successive 1-sec time bins in the computer the ^{26}Na lines could be identified from their decay rate. The decay of the strongest ^{26}Na line at 1809 keV, suitably corrected for dead time, leads to a value of 1.087 ± 0.012 sec for the ^{26}Na half-life. The intensities of all of the ^{26}Na γ rays observed in this work are listed in Table I together with the transition assignments to be discussed later. Corrections for γ-ray efficiency versus energy were made using an efficiency function measured in the same geometry. Summing corrections have also been included. Limits on unobserved γ-ray transitions have been placed at the 85% confidence level in all of our work.

For the study of ^{27}Na the reaction ^{11}B(^{18}O, 2p)^{27}Na was used at an ^{18}O beam energy of 42 MeV. Targets were made by compressing amorphous boron powder at 13 000 atm into pellets 4 mm diam and ~3 mm thick which were then sintered at high temperature making them hard and durable. The pellet was press-fitted into a Delrin rabbit. For the initial studies of ^{27}Na, boron enriched to 97% in ^{11}B was used to make the pellets. Tests of the yield of ^{26}Na produced in the ^{10}B(^{18}O, 2p)^{26}Na reaction were made with pellets enriched in ^{10}B to 97%. It was found that the isotopic ratio of ^{10}B to ^{11}B in natural boron gave suitable relative intensities of ^{26}Na and ^{27}Na for purposes of β-ray comparison measurements, and hence in the remainder of the work the pellets were made with natural

TABLE I. γ rays measured in the decay of ^{26}Na.

E_γ (keV)	Transition (keV)	I_γ [a] (rel)
1002.9 ± 0.5 [a]	3942 → 2938	0.8 ± 0.3
1129.7 ± 0.1 [b]	2938 → 1809	5.8 ± 0.3
1412.3 ± 0.8 [a]	4350 → 2938	3.2 ± 0.4
1808.65 ± 0.07 [b]	1809 → 0	100.0
1896.7 ± 0.6 [a]	4835 → 2938	2.0 ± 0.15
2133.0 ± 1.0 [a]	3942 → 1809	0.60 ± 0.10
2509.8 ± 0.8 [a]	4320 → 1809	0.55 ± 0.14
2523.3 ± 0.6 [a]	4333 → 1809	1.33 ± 0.12
2541.0 ± 0.6 [a]	4350 → 1809	2.46 ± 0.16
2938.24 ± 0.13 [b]	2938 → 0	0.61 ± 0.10
2353 [a]	5292 → 2938	<0.3
3092 [a]	4901 → 1809	<0.3

[a] Present results.

[b] γ-ray energy from E. A. Samworth, E. K. Warburton, and G. A. P. Engelbertink, Phys. Rev. C 5, 138 (1972).

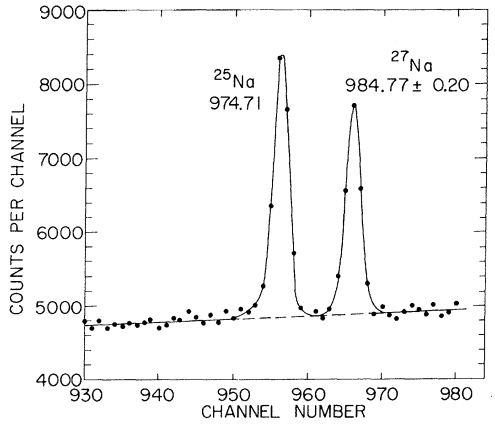

FIG. 1. A portion of the γ-ray spectrum from a boron target irradiated with 42-MeV ^{18}O ions showing one of the ^{27}Na lines and a γ-ray peak due to ^{25}Na decay.

boron.

A portion of the γ-ray spectrum from the irradiated boron pellet is shown in Fig. 1. Due to the neighboring ^{25}Na peak of 974.71 ± 0.12 keV arising from either the ^{11}B(^{18}O, α)^{25}Na reaction or the ^{12}C(^{18}O, $p\alpha$)^{25}Na reaction on carbon contamination, the ^{27}Na γ-ray energy could be measured with an accuracy of ±0.2 keV. One other ^{27}Na γ-ray peak was observed at 1698.5 ± 0.5 keV. Comparisons of these γ-ray energies with the known levels of ^{27}Mg are shown in Table II which also includes relative intensities of these lines as well as upper limits on the intensities of γ rays following other possible β-ray branches of ^{27}Na.

The decays of the two ^{27}Na lines were measured by routing the spectra of γ-ray singles and γ rays in coincidence with β rays >2 MeV into successive 0.3-sec time bins in a computer. The data for the 985-keV peak with background subtracted and corrections made for dead time are shown in Fig. 2. Because of a limitation of seven bins in the computer the singles counts were recorded for four periods of 0.3 sec each and the coincidences for three periods as shown in Fig. 2. The ^{27}Na half-life adopted from all of the data is 280 ± 20 msec. This agrees with the more accurate result of Klapisch *et al.*,[9] i.e., 295 ± 10 msec. The decay of the 1699-keV line was consistent with the ^{27}Na half-life within the rather poor statistics of the measurements of this peak.

B. Masses of ^{26}Na and ^{27}Na

In order to determine the masses of ^{26}Na and ^{27}Na the spectra of β rays entering an NE102 detector were measured in coincidence with γ-ray peaks in the Ge(Li) spectrum. Because of the high energies expected for these β rays the NE102 detector was made 5.1 cm thick and 7.6 cm in diameter. Following the procedures used previously[1-5] digital windows were set on peaks and backgrounds in the Ge(Li) spectrum so that the corrected coincident β-ray spectrum could be obtained for each peak alone. In these experiments there were β rays in coincidence with γ-ray peaks from the activities ^{28}Al (E_β = 2863 keV), ^{23}Ne (E_β = 3939 keV), and ^{20}F (E_β = 5393 keV) which were present in good yields and served as internal calibrations for finding the end point of the ^{26}Na β rays leading to the 1809-keV state. The end-point energies derived from the Kurie plots (corrected for experimental resolution) of the calibration activities, further corrected for an energy loss of 100 keV due to absorption in the rabbit exit window and detector covering, fell on a straight line which was extrapolated to determine the end-point energy of the ^{26}Na Kurie plot. The resulting corrected value for the ^{26}Na end point was 7400 ± 200 keV where most of the error arises from the uncertainty in the extrapolation from the ^{20}F end point at 5393 keV and from linearity considerations. This result corresponds to a ^{26}Na mass excess of −7004 ± 200 keV which differs by 116 ± 200 keV from the value based on the reaction data discussed earlier.

In order to obtain the mass of ^{27}Na the β-ray spectrum in coincidence with 985-keV γ rays was

TABLE II. γ-ray energies and intensities measured in the decay of ^{27}Na and the β-ray branches derived.

Known ^{27}Mg level (keV)	E_γ (keV)	I_γ (rel)	I_β (%)	$\log_{10} ft$
984.7 ± 0.2 [a]	984.77 ± 0.20	86.0 ± 2.9	86.0 ± 2.9 [b]	4.1 [b]
1698.7 ± 0.4 [a]	1698.5 ± 0.5	14.0 ± 2.3	14.0 ± 2.3 [b]	4.7 [b]
1939.9 ± 0.4 [c]	955	<2.5	<3.5	>5.3
	1940	<2.7		
3109.2 ± 0.5 [d]	1169	<2.9	<2.9	>5.0
3476.3 ± 0.6 [a]	3476	<2.0	<2.0	>5.0

[a] B. Skaali, Phys. Norv. 4, 45 (1970).

[b] Derived by assuming that the β-ray transition intensity to the ground state is negligible.

[c] Mean of a and Ref. 17.

[d] Reference 17.

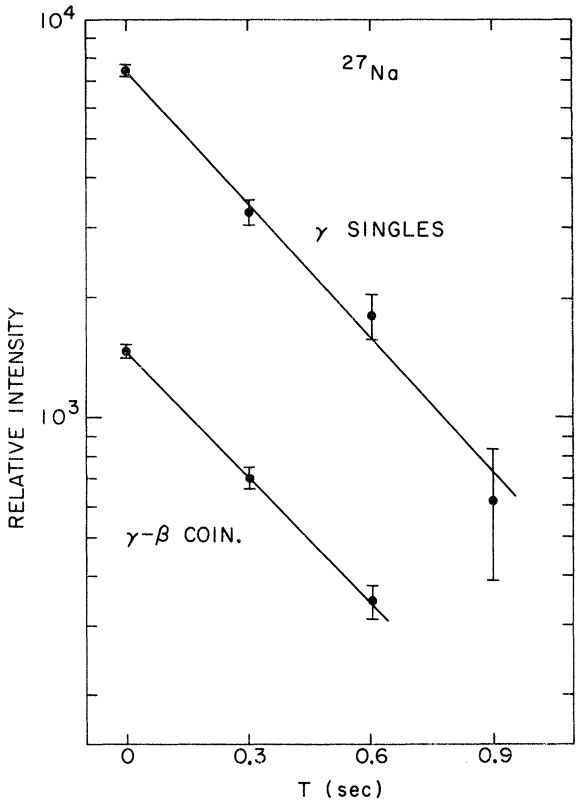

FIG. 2. Decay of the ^{27}Na 985-keV line in singles and in coincidence with β rays >2 MeV. From these data the half-life of ^{27}Na is 280 ± 20 msec.

compared with the ^{26}Na β rays in coincidence with 1809-keV γ rays. However, to make use of the entire ^{26}Na spectrum the corrections for contributions of inner β-ray groups and of γ-ray summing were calculated by a computer program on the basis of the proposed ^{26}Na decay scheme. Figure 3 shows the corrected ^{26}Na spectrum and the ^{27}Na spectrum. The curve drawn so as to give the best fit to the ^{26}Na data has been stretched by a factor of 1.060 to give the best fit to the ^{27}Na data as shown in the figure. By using the ^{26}Na β end-point energy from the accurate reaction Q-value data the measurement leads to a ^{27}Na end-point energy of 7950 ± 180 keV where the error is an estimate based mostly on the variation in the stretching factor that results in a noticeably poorer fit to the data. The height was allowed to vary so as to provide the best possible fit for each value of the stretching factor. The Kurie plot end points of ^{26}Na and ^{27}Na were also consistent with the ratio of 1.060, but since the Kurie plot analysis depends mainly on the points (having poor statistics) in the high-energy regions of the two spectra it was felt that the shape-fitting procedure comparing the entire spectrum was somewhat more reliable. We noted that changing the ^{26}Na corrections by 20% affects the calculated ^{27}Na mass by only 30 keV.

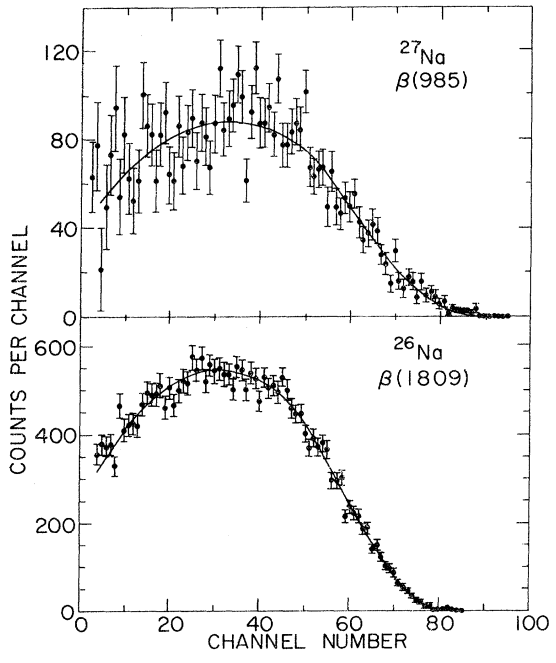

FIG. 3. Lower curve: β-ray spectrum of ^{26}Na in coincidence with 1809-keV γ rays corrected for inner β-ray branches and γ-ray summing effects. Upper curve: β-ray spectrum of ^{27}Na in coincidence with 985-keV γ rays. The curve giving the best fit to the ^{26}Na spectrum has been stretched by a factor of 1.060 giving the best fit to the ^{27}Na data.

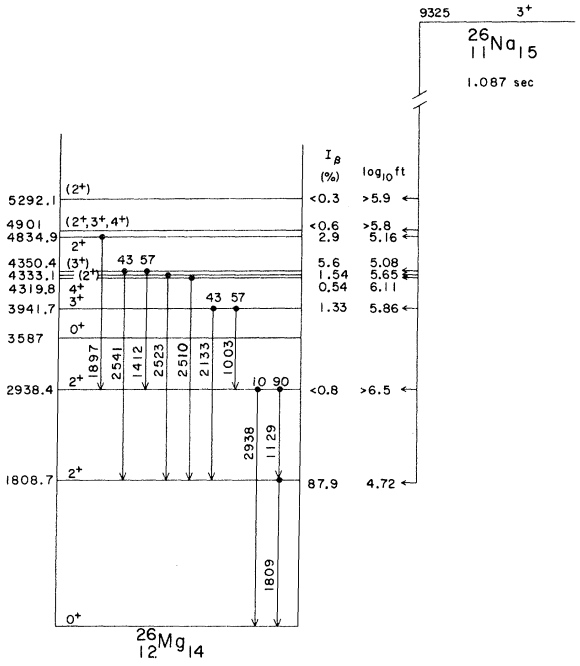

FIG. 4. Proposed decay scheme of ^{26}Na. The energies, spins, and parities of ^{26}Mg levels are from the literature. β- and γ-ray branches and the ^{26}Na half-life are from the present work. The total decay energy of ^{26}Na is based on the mean of two reaction Q-value measurements.

III. DISCUSSION

A decay scheme for ^{26}Na has been constructed based on the γ-ray data presented in Table I together with previously established information on the energy levels of ^{26}Mg. This is shown in Fig. 4 and β-ray branches are also listed in Table III. Spin and parity assignments of the ^{26}Mg levels in

TABLE III. β-ray branches in the decay of ^{26}Na.

^{26}Mg level [a] (keV)	β-ray branch (%)	log$_{10}ft$
1808.7	87.9 ± 0.4	4.72 ± 0.02
2938.4	<0.8	>6.5
3941.7	1.33 ± 0.40	5.86 ± 0.11
4319.8	0.54 ± 0.14	6.11 ± 0.10
4333.1	1.54 ± 0.14	5.65 ± 0.04
4350.4	5.6 ± 0.4	5.08 ± 0.03
4834.9	2.9 ± 0.2	5.16 ± 0.03
4901	<0.6	>5.8
5292.1	<0.3	>5.9

[a] Energies of the first two excited states are from E. A. Samworth, E. K. Warburton, and G. A. P. Engelbertink, Phys. Rev. C 5, 138 (1972). All others are from Ref. 15.

Fig. 4 are those adopted by Selin and Hardell.[15] Our result for the half-life of ^{26}Na is in agreement with previous work[9,11] but is more accurate. The log ft values of the observed β-ray branches are consistent with an assignment of $J^\pi = 3^+$ to ^{26}Na. Thus, the log ft of 6.11 for the branch to the 4320-keV 4^+ state is too low for a second-forbidden transition if ^{26}Na were to have a spin of 2^+. The absence of an observable β-ray branch to the 2^+ second excited state at 2938 keV and the consequent lower limit of log ft >6.5 is puzzling since this β-ray transition is certainly allowed for either ^{26}Na spin assignment.

In a recent unpublished report Klotz *et al.*[16] find a ^{26}Na β-ray branch to the 4.90-MeV state of ^{26}Mg with a log ft of 5.4. According to Canada, Bent, and Haskett[17] the 4.90-MeV state has $J^\pi = 4^+$ and thus if the branch of Klotz *et al.* were correct this would confirm the assignment of 3^+ to ^{26}Na. However, our upper limit on the β-ray branch to this state (log ft >5.8) is a factor of 2.5 lower than the preliminary result of Klotz *et al.*

Table IV shows the γ-ray branching results obtained in this work for several of the ^{26}Mg levels compared with previous information.[15] The agreement with earlier work seems to be reasonable.

The total decay energy adopted for ^{26}Na is 9325 ± 20 keV representing the weighted mean derived from the two reaction Q-value measurements.[13,14] As mentioned earlier the present result on the decay energy of ^{26}Na corresponds to a mass excess of −7004 ± 200 keV. This differs by only 116 keV from the mass excess of −6888 ± 20 keV from the reaction Q values.

Figure 5 shows the decay scheme proposed for ^{27}Na and the β-ray branching information is also listed in Table II. The close agreement of our measured γ-ray energies with the known levels of ^{27}Mg and the agreement of our half-life with the result of Klapisch *et al.*[9] leaves little doubt

TABLE IV. γ-ray branching of ^{26}Mg levels observed in the decay of ^{26}Na.

Initial state (keV)	Final state (keV)	Branch Present (%)	Branch Previous (%)
2938.4	1808.7	90.5 ± 1.6	89.8 ± 2.0 [a]
	0	9.5 ± 1.6	10.2 ± 2.0 [a]
3941.7	2938.4	57 ± 9	53 [b]
	1808.7	43 ± 9	47 [b]
4350.4	2938.4	57 ± 4	39 [b]
	1808.7	43 ± 4	61 [b]

[a] E. A. Samworth, E. K. Warburton, and G. A. P. Engelbertink, Phys. Rev. C 5, 138 (1972).
[b] Reference 15.

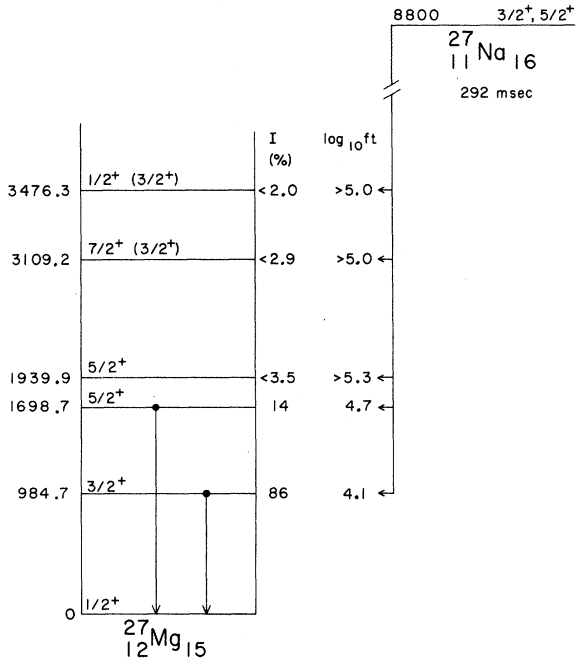

FIG. 5. Proposed decay scheme of ^{27}Na. Energies, spins, and parities of the ^{27}Mg levels are based on the values given in Ref. 17 and by B. Skaali, Phys. Norv. 4, 45 (1970). β-ray branches and the spin-parity of ^{27}Na are from the present work where it is assumed that the ground-state β-ray branching intensity can be neglected according to the evidence given in Ref. 8. The half-life and decay energy of ^{27}Na are weighted mean values based on Refs. 9 and 10 and on the present work.

that we are, in fact, observing radiations from the decay of ^{27}Na produced in the ^{11}B(^{18}O, 2p)^{27}Na reaction. β-ray branches are observed to the first two excited states of ^{27}Mg which have spin-parities of $\frac{3}{2}^+$ and $\frac{5}{2}^+$, respectively.[11] The β-ray branching intensity to the ground state is assumed to be small for the reasons discussed below.

Previous results obtained by Costa and Beck[18] on the electromagnetic matrix elements in ^{27}Mg have been interpreted by them in terms of the Nilsson model. In particular the ground state is suggested to be the head of a $K = \frac{1}{2}^+$ band based

TABLE V. Experimental ratios of ft values in the decay of ^{27}Na compared to calculated ratios based on the Nilsson model.

^{27}Mg level (keV)	J^π	K assumed	$\frac{ft\,(985)}{ft\,(\text{level})}$ Calculated	$\frac{ft\,(985)}{ft\,(\text{level})}$ Experimental
0	$\frac{1}{2}^+$	$\frac{1}{2}$	1.25	...
985	$\frac{3}{2}^+$	$\frac{1}{2}$	1.00	1.00
1699	$\frac{5}{2}^+$	$\frac{1}{2}$	0.25	0.256 ± 0.058

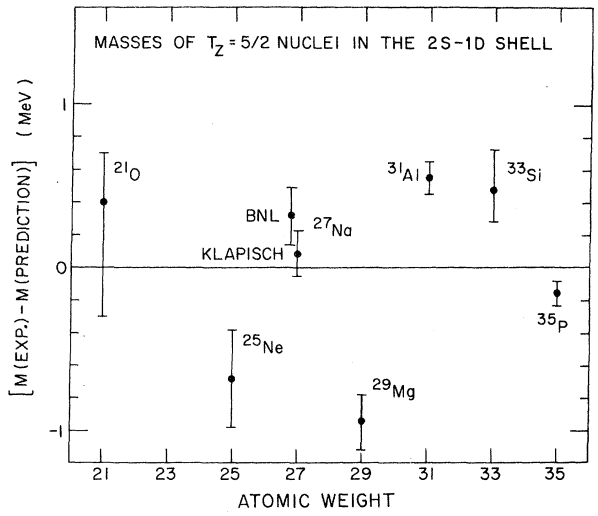

FIG. 6. Comparisons of the masses of $T_z = +\frac{5}{2}$ nuclides with predictions of the Garvey-Kelson t relation. For ^{27}Na the present result and that of Klapisch *et al.* (Ref. 10) are both shown. The points for ^{25}Ne, ^{31}Al, ^{33}Si, and ^{35}P are from Refs. 1–5. ^{21}O is due to A. G.Artukh, G. F. Gridnev, V. L. Mikheev, V. V. Volkov, and J. Wilczynski, Nucl. Phys. A192, 170 (1972) and ^{29}Mg is from a measurement of the ^{26}Mg(^{11}B, ^{8}B)^{29}Mg reaction by D. K. Scott, C. U. Cardinal, P. S. Fisher, P. Hudson, and N. Anyas-Weiss, in *Atomic Masses and Fundamental Constants 4*, edited by J. H. Sanders and A. H. Wapstra (Plenum, New York, 1972), p. 54.

upon Nilsson orbit No. 9. The $\frac{3}{2}^+$ member of this band is assigned to the 985-keV level and the $\frac{5}{2}^+$ member to either the 1699- or 1940-keV levels. ^{27}Na decays to $\frac{3}{2}^+$ and $\frac{5}{2}^+$ levels of ^{27}Mg and hence it must have $J^\pi = \frac{3}{2}^+$ or $\frac{5}{2}^+$. In the unmixed Nilsson model this would correspond to $J = \frac{3}{2}^+ = K$ with a deformation between -1.8 and $+6$. Deformations of <-1.8 are excluded since this would require $J = \frac{1}{2}^+$ for ^{27}Na. Since the ^{27}Na$\rightarrow^{27}$Mg decay would be a $K = \frac{3}{2}$ to $K = \frac{1}{2}$ band transition, the ratios of ft values to members of the same ^{27}Mg band are given simply by the ratios of the squares of the appropriate Clebsch-Gordan coefficients, and the calculations are independent of deformation. The predicted ft value ratios are shown in Table V. The calculation assumes that the $K = \frac{1}{2}$, $J = \frac{5}{2}$ member is the 1699-keV level, since our results show no evidence for β decay to the 1940-keV level.

As may be seen in Table V the calculation predicts that the strongest ^{27}Na β-ray branch should be to the ground state of ^{27}Mg. We have no measure of this branch, but the β-ray singles endpoint energy of 7.6 ± 0.5 MeV reported by Klapisch *et al.*[8] corresponds to the decay of ^{27}Na to states in ^{27}Mg with a minimum excitation energy of 1.2 ± 0.5 MeV, which would rule out any strong ground-state β branch. This would invalidate the model discussed above.

The simple shell model predicts that $J^\pi = \frac{5}{2}^+$ for ^{27}Na, and that the ground-state β-ray branch should be zero. There are no detailed mixed shell-model calculations available as yet for this decay and it is hoped that the present results might stimulate such efforts.

Our result for the mass excess of ^{27}Na, -5650 ± 180 keV, is in fair agreement with that of Klapisch *et al.*,[10] -5880 ± 140 keV. The difference of 230 keV lies within the sum of the errors. Both results are included in Fig. 6 which compares the measured masses of $T_z = +\frac{5}{2}$ nuclides with predictions derived in Ref. 5 using the Garvey-Kelson t relationship.[19] Deviations from the predicted masses are generally $\lesssim 600$ keV. We now have evidence[20] that the value for ^{29}Mg shown in Fig. 6 is considerably in error.

Note added. Details of the work of Klotz *et al.* (Ref. 16) on the decay of ^{26}Na have now been published.[21] Our ^{26}Na decay scheme is generally consistent with theirs except for the β-ray branch to the 4350-keV level of ^{26}Mg. We find this branch to be 5.6% per decay while Klotz *et al.* quote 2.7% with an additional feeding of this level of 2% per decay due to γ rays from levels at 5.72 and 6.12 MeV. Due to the strong ^{28}Al activity present in our sources we would not have been able to detect the underlying peak due to the 6.12→4.35 transition. Since this γ-ray line would account for much of the difference in our respective results it is probable that Klotz *et al.* are more nearly correct on the β-ray branching intensity to the 4350-keV state, as well as on the existence of the weak β branches to the 5.72- and 6.12-MeV levels. If the β-ray branches of Klotz *et al.* to the 4.35-, 5.72-, and 6.12-MeV levels were to be adopted, the effect on our mass excess derived for ^{27}Na would be less than 20 keV.

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[1]D. R. Goosman and D. E. Alburger, Phys. Rev. C 5, 1252 (1972).

[2]D. R. Goosman and D. E. Alburger, Phys. Rev. C 6, 820 (1972).

[3]D. R. Goosman and D. E. Alburger, Phys. Rev. C 6, 825 (1972).

[4]D. R. Goosman, D. E Alburger, and J. C. Hardy, Phys. Rev. C 7, 1133 (1973).

[5]D. R. Goosman and D. E. Alburger, Phys. Rev. C 7, 2409 (1973).

[6]A. P. Kabachenko, I. B. Kyznetzov, K. Sivek-Vilchinka,

E. A. Skakun, and N. I. Tarantin, Joint Institute for Nuclear Science, Dubna Report No. D7-5769, 1971 (unpublished), p. 204.

[7]A report of the present results on both ^{27}Na and ^{26}Na was presented at the Washington Meeting of the American Physical Society, Bull. Am. Phys. Soc. 18, 678 (1973).

[8]R. Klapisch, C. Thibault-Philippe, C. Détraz, J. Chaumont, R. Bernas, and E. Beck, Phys. Rev. Lett. 23, 652 (1969).

[9]R. Klapisch, C. Thibault, A. M. Poskanzer, R. Prieels, C. Rigaud, and E. Roeckl, Phys. Rev. Lett. 29, 1254 (1972).

[10]R. Klapisch, R. Prieels, C. Thibault, A. M. Poskanzer, C. Rigaud, and E. Roeckl, Phys. Rev. Lett. 31, 118 (1973).

[11]P. M. Endt and C. Van der Leun, Nucl. Phys. A105, 1 (1967).

[12]E. L. Robinson, B. T. Lucas, and O. E. Johnson, Phys. Rev. 122, 202 (1961).

[13]G. C. Ball, W. G. Davies, J. S. Forster, and J. C. Hardy, Phys. Rev. Lett. 28, 1069 (1972).

[14]E. R. Flynn and J. D. Garrett, to be published.

[15]E. Selin and R. Hardell, Nucl. Phys. A139, 375 (1969).

[16]G. Klotz, J. P. Gonidec, P. Baumann, and G. Walter, in Centre de Recherches Nucléaires Annual Report for 1972, Strasbourg, France (unpublished).

[17]T. R. Canada, R. D. Bent, and J. A. Haskett, Phys. Rev. 187, 1369 (1969).

[18]G. Costa and F. A. Beck, Nucl. Phys. A181, 132 (1972).

[19]G. T. Garvey, W. J. Gerace, R. L. Jaffe, I. Talmi, and I. Kelson, Rev. Mod. Phys. Suppl. 41, S1 (1969).

[20]D. R. Goosman, C. N. Davids, and D. E. Alburger, Phys. Rev. (to be published).

[21]G. Klotz, J. P. Conidec, P. Baumann, and G. Walter, Nucl. Phys. A205, 90 (1973).