Our reported $Ni^{58}(n,p)Co^{58}$ cross sections are consistent with a continuously varying excitation function.

Cross-section calculations were made at this laboratory by applying the statistical theory of nuclear reactions.[7] Two different types of nuclear potential were used and the resultant excitation functions are given in Fig. 2 by dotted curves. The upper of the two refers to a diffuse-edge potential with the parameters proposed by Woods and Saxon,[8] and the lower to a square-well potential with $r_0=1.50$ fermi. Experimental level densities were used, which were slightly different from those described in an earlier paper.[1] In spite of the fact that diffuseness of the nuclear potential enhances the cross section considerably, the predicted cross sections are far too small at neutron energies below 3 Mev. In an attempt to obtain a better fit between observed and calculated cross sections, the exponential level density formula based on a degenerate Fermi gas model was applied to Co^{58} and Ni^{58} in a form suggested by Weinberg and Blatt.[9] Energy corrections were used to take account of both the pairing energy of the even number of protons and neutrons, and the proton shell closure in Ni^{58}. Recently, Kaufman[10] has successfully applied the formula to calculate (p,α), $(p,2p)$, and (p,pn) cross sections for Ni^{58} near threshold. The correction terms indicated by Kaufman were used to calculate $Ni^{58}(n,p)Co^{58}$ cross sections for a square-well potential and $r_0=1.50$ fermi, the result of which is given by the full curve in Fig. 2. Although the agreement with the experimental points is somewhat better, the calculated excitation function has a very different slope. In conclusion it can be stated that no satisfactory explanation can be given for the observed cross sections.

ACKNOWLEDGMENT

We would like to thank Mr. A. Trier who carried out numerous calculations.

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Decay of Si^{26}†

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A (2.1±0.3)-sec activity was observed when vacuum distilled magnesium was bombarded with 8-Mev He^3 ions. Half-life studies using NaI(Tl) scintillation counters yielded evidence that this activity was due to the decay of a positron emitting isotope with a maximum kinetic energy greater than 3.5 Mev. The features of gamma-ray spectrum with the exception of a weak line at 824±15 kev could be understood in terms the decay characteristics of known radioisotopes. An internally consistent argument based on the known decay characteristics of reaction products that may be expected from energy considerations, the results of half-life studies, experimental gamma spectra, and nuclear systematics can be made to support the conclusion that the (2.1±0.3)-sec half-life is that of Si^{26} produced in the reaction $Mg^{24}(He^3,n)Si^{26}$, and a consistent decay scheme can be proposed. The ground state of $Si^{26}(0+)$ decays by the emission of two positron groups to excited states of Al^{26}. The most intense transition, $E_0=3.76$ Mev, is to the 0.228-Mev state (0+) of Al^{26}. The second transition, $E_0=2.94$ Mev, is to the 1.05-Mev state (1+) of Al^{26}. The 1.05-Mev and 0.228-Mev states are then connected by a (824±15)-kev gamma transition. The energies of the positron transitions are derived from the known levels of Al^{26} and the Si^{26}-Al^{26} mass difference.

I. INTRODUCTION

TYREN and Tove[1] observed an activity with a half-life of 1.7 sec after bombarding aluminum targets with protons. Bombardments were made at proton energies of 23, 50, 80 or 100, 130, and 180 Mev. Twenty-three Mev was reported to be "the lowest energy at which the activity appears in appreciable amounts." The activity was attributed to the decay of Si^{26} produced in the reaction $Al^{27}(p,2n)Si^{26}$. Recently the ground-state Q value for the reaction $Mg^{24}(He^3,n)Si^{26}$ has been measured.[2] The mass excess of Si^{26} is given as 0.47±0.09 Mev. Using this value, the calculated Q value for the reaction $Al^{27}(p,2n)Si^{28}$ is −18.9 Mev. This indicates that the 23-Mev protons used were above the threshold energy. The published information concerning the decay of Si^{26} gives little information concerning the radiation detected and the characteristics of the spectra. In addition, there have to date been no reports of experimental results either in agreement of disagreement with results and interpretation of Tyren and Tove. Two recent compilations of nuclear data[3,4] cite the observation but present no additional experimental information that has any direct

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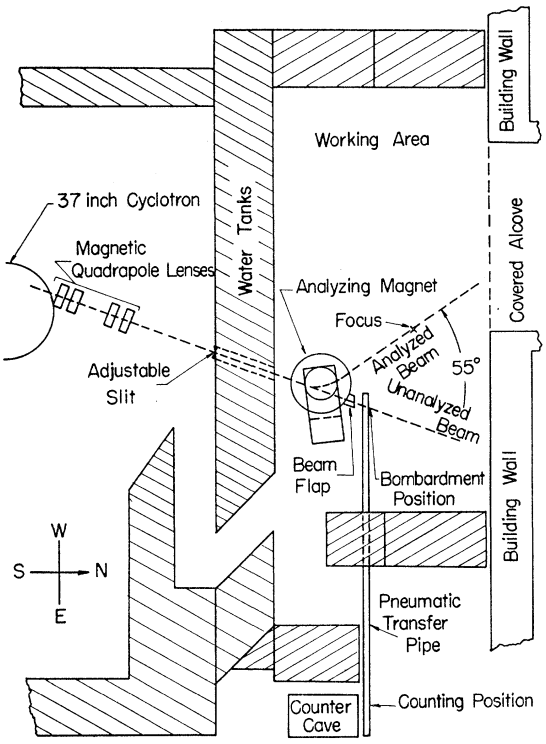

FIG. 1. The floor plan of the cyclotron experimental area and the experimental arrangement for measuring the half-lives and gamma-ray spectra of short-lived isotopes.

bearing on the assignment and/or observation of the 1.7-sec activity.

Using the mass excess for Si^{26} of 0.47 ± 0.09 Mev,[2] the $Si^{26}-Al^{26}$ mass difference is calculated to be ≈ 5.01 Mev. It follows that Si^{26} should beta decay to Al^{26}. The present investigation was undertaken in an attempt to observe the Si^{26} activity by bombarding magnesium targets with the He^3 ions from the Purdue University 37-in. cyclotron.

II. EXPERIMENTAL EQUIPMENT AND PROCEDURE

A. The Pneumatic Target Transfer System

A schematic diagram of the position of the pneumatic target transfer system, the rabbit system, relative to the cyclotron and other accessories is shown in Fig. 1. This system transports the targets attached to a 35 g target carrier, the rabbit, between the bombardment and counting positions, a distance of approximately 19 ft. The minimum rabbit travel time from the bombardment to the counting position is ≈ 0.15 sec. In this investigation a transit time of ≈ 0.25 sec was used. The rabbit system is the one described elsewhere[5] which has been extensively modified. The modifications resulted in increased versatility, shorter transit times, and improved over-all reliability. Control, programing, and timing is accomplished electronically. The transfer system itself is integrated with the circuit configurations used in half-life measurements as well as a gamma-ray scintillation spectrometer. The system may be operated automatically in any given number of identical cycles or in a one-shot mode as is dictated by the requirements of the experiment.

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B. The Gamma-Ray Spectrometer

The gamma-ray detector consisted of a 3×3-in. NaI(Tl) crystal optically coupled with Dow Corning 200 silicone fluid to a magnetically shielded DuMont 6363 photomultiplier tube. A stacked cathode follower of conventional design was used to drive 30 ft of cable. The detector was positioned in a lead cave having a minimum 2-in. lead wall thickness and was lined with a copper-cadmium absorber. The gamma radiation from the magnesium targets was incident on the scintillation crystal through a tapered lead collimator which also had a graded absorber lining. In the standard counting position, the crystal to source distance was approximately 10 cm. Provision was made for interposing various absorbers between the source and detector. The pulses from the detector were passed to the linear amplifier of a 256-channel differential pulse-height analyzer.

The energy calibrations of the gamma-ray spectrometer were made using gamma radiations from Mn^{54}, Zn^{65}, Sn^{113}, Cs^{137}, Na^{22}, In^{114}, and Bi^{207}. The over-all internal consistency of the gamma-ray energy calibrations was about 1%. The resolution obtained with this spectrometer system and counting geometry was $\approx 9\%$ for the 0.662-Mev gamma-ray associated with the decay of Cs^{137}. Well known gamma-ray spectra were measured in the standard geometry and compared with those obtained in a geometry where scattering is less likely. No pronounced differences in the spectra were found. This result supports the conclusion that the heavy shielding and counting geometry did not cause major distortion in the measured spectra.

The 256-channel analyzer could be gated on for various periods of time through external circuitry that was in turn controlled by signals derived from the arrival of the rabbit in the standard counting position. Consequently, it was possible to measure the gamma spectrum of a target for an accurately known interval of time starting at any selected time greater than 0.25 sec after bombardment. A spectrum could be accumulated over a large number of cycles or on a one-shot basis. A Co^{60} gamma source was attached to a rabbit and spectra were measured using various cycling programs. Comparisons among these spectra and the spectrum measured with the source stationary in the standard counting position were made. No major differences were found, supporting the conclusion that the timing schedule and/or gating could lead to no troublesome distortions in the pulse height distribution.

C. The Half-Life Measuring System

The gamma-ray detector and the counting geometry used in the half-life measuring system is the same as was described above, (see Sec. II-B). However, in this case the pulses from the stacked cathode follower were passed to an A-1 linear amplifier. The amplified pulses were then passed into a combination integral and single-channel differential discriminator. The discriminator provided shaped constant amplitude pulses corresponding to both the integral and differential spectra as determined by the variable base-line and window-width settings. Either the integral or differential pulses were fed into the modified and reprogramed control and computer sections of a 256-channel, magnetic-core-memory, pulse-height analyzer.[6] The input-pulses were scaled in the data register for a predetermined time interval at the end of which the count was stored at a given address in the memory. The count scaled during the next interval of time was stored at the next address in the memory. This sequence continues, stops and/or resets as is dictated by the external program and rabbit control. The time interval for each time-channel was determined by prescaling the output of a crystal controlled Tektronix 180-A Time-Mark Generator. A 24-μsec period at the end of each time interval is required for information storage. The data stored in the memory can be printed on tape using the normal print-mode of the analyzer.

D. Magnesium Targets

The targets were essentially cylinders ($\frac{3}{4}$-in. diameter $\times\frac{3}{8}$-in. height) of vacuum distilled magnesium. The spectroscopic analysis of the magnesium was as follows: Al$<$0.001%; Ca$<$0.001%; Fe$<$0.0015%; Mn $<$0.001%; Ni$<$0.0005%; Pb$<$0.001%; Si$<$0.01%; Sn$<$0.01%; Zn$\approx$0.006%; and N$\approx$0.0045 to 0.0050%. The isotopic constitution of the targets is presumably the isotopic abundance of natural magnesium: Mg^{24}, 78.9%; Mg^{25}, 10.13%; and Mg^{26}, 11.7%.[7] A series of four similar targets and programed bombardments were used to avoid the build-up of relatively long-lived activities. The various targets could be interchangeably mounted on three different target carriers. The rabbits alone were checked for radioactivity which could lead to a misinterpretation of the experimental results. Only after continuous use for extended periods of time was activity found due to the rabbit itself, and even then the activity was so weak that its effect was negligible.

E. The He^3 Beam

The 14.5-Mev, external He^3 beam of the Purdue University 37-in. cyclotron was focussed by a set of quadrupole magnets; collimated; passed through a 1-mil aluminum window, 1.5-in. of air, 2-mil Mylar window; and was recollimated before impinging on the magnesium target. The nominal beam energy in this geometry was about 8 Mev. A beam-stopping shutter was actuated by the rabbit control system and determined the length of the bombardment period. In the arrangement used in these investigations no provision was made to accurately measure the beam current.

III. EXPERIMENTAL RESULTS AND DISCUSSION

The reactions which are energetically allowed when a magnesium target with its three stable isotopes is bombarded with 8-Mev He^3 ions are numerous. The multiplicity of reaction products itself complicated the search for an activity which could be assigned to the decay of Si^{26}. In Table I, the pertinent data concerning some of the possible He^3-induced reactions and reaction products are shown. The approximate Q values have been obtained from a recent tabulation[8] except where specifically noted otherwise. The relevant characteristics concerning the decay of the reaction products were obtained from recent complications of nuclear data.[3,4] The tabulated information is presented solely for the purpose of convenient reference in the discussions to follow. Only one of the listed reactions can be clearly ruled out by energy considerations, the reaction $Mg^{24}(He^3,t)Al^{24}$. The half-life of Al^{24} is $\approx$2.1 sec. As will be seen later it is extremely fortunate that this activity can be excluded from consideration, since the activity assigned to Si^{26} in these investigations has a period of $\approx$2 sec.

Examination of Table I reveals that a number of the product radioisotopes have half-lives which are short, 1 to 137 sec, emit strong position groups with end-point energies in the range from 2.8 to 3.76 Mev, and have only very weak gamma rays, if any, associated with their decay. These features serve to complicate the consistent and unambiguous interpretation of the results of the various experimental approaches used in these studies.

A series of half-life measurements were made by counting the amplified pulses from a 3$\times$3-in. NaI(Tl) crystal in a differential pulse-height interval corresponding to a 460 to 600 kev gamma-ray energy interval. A $1\frac{5}{32}$-in. Lucite absorber was placed between the detector and the target. The magnesium target was bombarded for 1 sec with $\approx$8-Mev He^3 ions. The travel time from bombardment to counting position was 0.25 sec, and the activity measurements were started promptly when the target reached the counting position. Each experimental measurement represented the number of counts accumulated in a 0.1-sec time interval. At the end of 25.6 sec, 256 time channels, the data

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TABLE I. Summary of some of the possible He^3-induced reactions using magnesium targets along with approximate Q values,[a] reaction products, and their pertinent decay features.[b,c]

Target	Reaction	Product	Q value (Mev)	Half-life	Beta end point (Mev)	Gamma radiation[d] (Mev)
Mg^{24} (78.8%)	(He^3,γ)	Si^{27}	+13.29	4.46 sec	3.76	None
	(He^3,n)	Si^{26}	+0.13[e]	1.7 sec?	?	?
	(He^3,p)	$Al^{26,26m}$	+5.93	6.55 sec 5×10^4 yr	3.21 1.14	None 1.14, 1.83*W*, 2.97*W*
	(He^3,d)	Al^{25}	−3.22	7.62 sec	3.24, 1.63*W*	1.61*W*
	(He^3,t)	Al^{24}	−14.07[f]	2.09 sec		
	(He^3,α)	Mg^{23}	+4.04	11.9 sec	2.97	None
Mg^{25} (10.1%)	(He^3,γ)	Si^{28}	+23.23	Stable	...	...
	(He^3,n)	Si^{27}	+6.06	4.46 sec	3.76	None
	(He^3,p)	Al^{27}	+11.64	Stable	...	...
	(He^3,d)	$Al^{26,26m}$	+0.82	6.55 sec 5×10^4 yr	3.21 1.14	None 1.14, 1.83*W*, 2.97*W*
	(He^3,t)	Al^{25}	−4.30	7.62 sec	3.24, 1.63*W*	1.61
	(He^3,α)	Mg^{24}	+13.24	Stable	...	...
Mg^{26} (11.1%)	(He^3,γ)	Si^{29}	+20.59	Stable	...	...
	(He^3,n)	Si^{28}	+12.12	Stable	...	...
	(He^3,p)	Al^{28}	+8.25	2.28 min	2.87	1.78
	(He^3,d)	Al^{27}	+2.75	Stable	...	...
	(He^3,t)	$Al^{26,26m}$	−4.03	6.55 sec 5×10^4 yr	3.21 1.14	None 1.14, 1.83*W*, 2.97*W*
	(He^3,α)	Mg^{25}	+9.46	Stable	...	...

[a] See reference 8.
[b] See reference 3.
[c] See reference 4.
[d] *W* indicates that the radiation is very weak.
[e] See reference 2.
[f] Not produced with 8-Mev He^3 ions.

was printed out of the analyzer memory and the apparatus was reset to continue following the decay for another 25.6 sec. This program was repeated until the source activity was comparable to the background rate. A 2.5±0.2 min activity was observed, presumably due to Al^{28}. This assingment to Al^{28}, $t_{\frac{1}{2}}=2.28\pm0.02$ min,[9,10] is supported by measurements of gamma-ray spectra to be discussed later. In addition, conventional decomposition of the decay-curves yielded activities with half-lives of 7.9±0.3 sec and 2.1±0.3 sec. Since the energy interval under observation bracketed a large fraction of the full-energy peak for the 511-kev annihilation radiation, all those positron emitting isotopes produced by the He^3 bombardment contributed to the observed activity. In the He^3 bombardment there was enough energy available to produce the isotopes Al^{25}, 7.6 sec[4,11–13]; Al^{26m}, 6.6 sec[13–16]; Si^{27}, 4.5 sec[17–19]; and Mg^{23}, 11.9 sec.[4,19–22] The analysis of the decay-curves yielded a half-life of 7.9±0.3 sec which was most likely a composite of the activities indicated above. In particular, the features of the decay of the two aluminum isotopes are so nearly identical that even in the absence of Mg^{23} and Si^{27} it would be practically impossible to accurately determine their relative contribution to the 7.9-sec activity. It should be emphasized that the purpose of these investigations was to observe the decay of Si^{26} and determine the characteristics of this decay. Toward this end, the length of bombardment and general counting program were set such that the features of the decay of Si^{26} could be studied under the most favorable experimental conditions possible with the facilities at hand. Similar measurements with an increased bombardment time and 1-sec time channels show very clearly the presence of a (4.3±0.3)-sec activity and another presumably composite activity of 9.3±0.3 sec. On the other hand, in these particular measurements the presence of a shorter-lived activity was barely visible.

In Table II the program used in a series of half-life measurements of a slightly different type is presented. The data in each time channel at the end of a cycle represented all those amplified pulses from a 3×3-in. NaI(Tl) crystal which were larger than a predetermined minimum size, an integral count, and were accumulated in 0.1-sec time-channels. There was no absorber between

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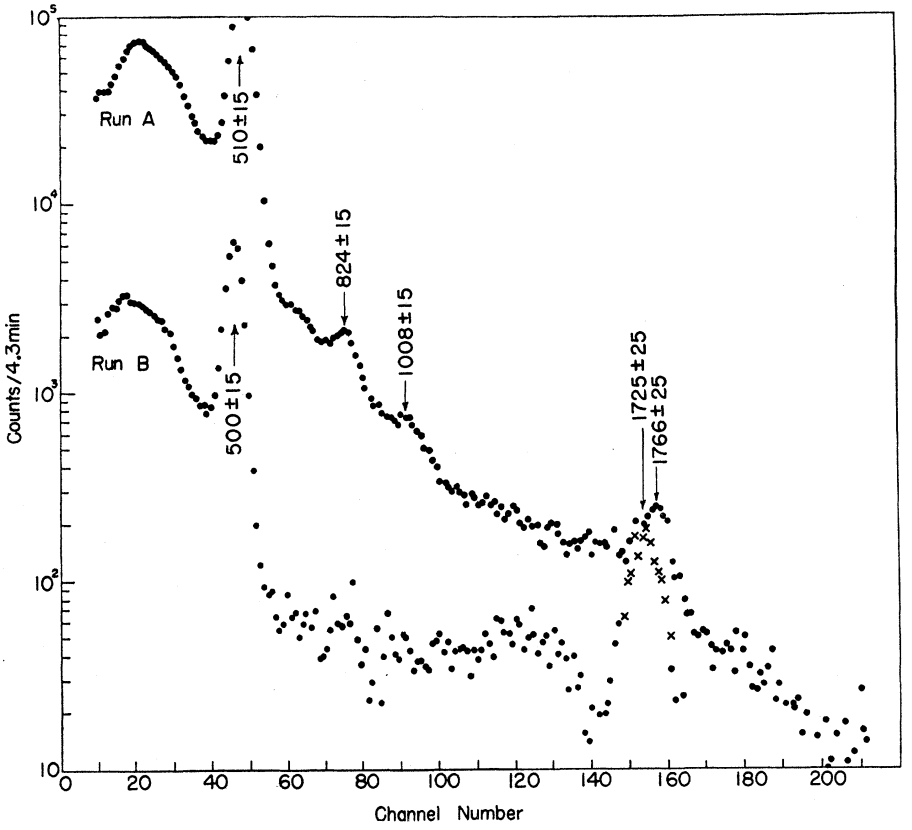

FIG. 2. Gamma-ray spectra, background corrected, measured from magnesium targets after He^3 bombardment. Run *A* is the spectrum obtained when the measurement starts 0.25 sec after bombardment while the start of Run *B* was delayed 90.25 sec. A $\frac{5}{8}$-in. Lucite absorber was placed between the detector and the target. The energies are given in kev.

the target and the detector in these measurements. In this type of measurement the target was bombarded once each cycle and the data was not removed from the analyzer memory after each cycle. Measurements were made with the integral discriminator level at settings corresponding to gamma-ray energies of 2.8, 3.8, and 4.0 Mev. In each instance, the presence of a short-lived activity was clearly evident. The relatively poor counting statistics as well as other experimental factors are included in the estimated probable error for each measurement. The discriminator levels and measured half-life values were 2.8 Mev, 2.1±0.2 sec; 3.8 Mev, 2.2±0.3 sec; 4.0 Mev, 2.1±0.2 sec. Since the only strong gamma radiation present is annihilation radiation, it may be concluded that there is an isotope produced in the He^3 bombardment which decays such that either E_0 or $(E_0+0.511)$ Mev is greater than 4.0 Mev.

A half-life of 2.1±0.3 sec is assigned to the short-lived activity produced in the bombardment of magnesium targets with 8-Mev He^3 ions. This value is based on a study of all the various half-life measurements made during the course of this investigation. The assigned error is a limit of error determined from statistical considerations as well as an appraisal of both the experimental techniques and the methods used to analyze the experimental data.

In Fig. 2 are shown gamma-ray spectra, corrected for background, measured from two different magnesium targets after He^3 bombardment. These spectra were measured using a 3×3-in. NaI(Tl) crystal with a $\frac{5}{8}$-in. Lucite absorber over the target. The pertinent details concerning the programing of the two measurements are shown in Table III. The beam intensity was not accurately monitored during the two runs, therefore quantitative comparisons cannot be made. The programing of Run *A*, a prompt measurement, would tend to favor the observation of those radiations associated with short-lived isotopes. It is seen in the *A* spectrum that there is a large amount of bremsstrahlung with a prominent peak at 510±15 kev corresponding to the full-energy peak of the annihilation radiation. In addition, weak peaks are seen at 824±15, 1008±15, and 1766±25 kev. The programing of the Run *B* would tend to favor the observation of radiation associated with the longer-lived reaction products. The *B* spectrum

TABLE II. Cycling and counting program for half-life measurements as determined using an integral counting arrangement.

Bombardment period	≈1.5 sec
Rabbit travel time	0.25 sec
Total counting time	25.6 sec
Counting interval/time channel	0.1 sec
Number of time channels	256
Total cycle time	32 sec
Total number of cycles	42

TABLE III. Timing schedule used in the prompt and delayed measurements of gamma-ray spectra from magnesium targets after He^3 bombardment.

	Run *A*	Run *B*
Bombardment time/cycle	≈1 sec	≈1 sec
Rabbit travel time	0.25 sec	0.25 sec
Delay between arrival at counting position and start of counting period	0	90 sec
Counting time/cycle	10 sec	10 sec
Cycle period	110 sec	110 sec
Number of cycles	26	26

shows a marked reduction in bremsstrahlung, a strong line at 500±15 kev, and a prominent peak at 1725±25 kev. The interpretation consistent with the assigned error is that the peaks measured at 1766±25 kev in the *A* run and 1725±25 kev in the *B* run are one and the same. The energy calibration was made using sources more comparable to the source intensity encountered in Run *A* and the time lapse between the calibration and the Run *A* was the shortest. For these reasons the energy measurement of 1766±25 kev is believed to be more reliable. This conclusion is further supported by the low value of 500±15 kev measured for the annihilation radiation full-energy peak in Run *B*. The peaks at 824 and 1008 kev in the *A* spectrum do not appear in the *B* spectrum. It may be concluded that these weak peaks are either associated with the short-lived activities or summing due to the greater effective source intensity in Run *A*, estimated to be a factor of ten greater than in Run *B*.

The (1766±25)-kev peak is assigned to the gamma transition from the 1.78-Mev state of Si^{28} to its ground state. The 1.78-Mev state of Si^{28} is populated by the electron decay of Al^{28}(E_0=2.89 Mev, $t_{\frac{1}{2}}$=2.28±0.02 min[9,23]). The results of the half-life measurements discussed previously are consistent with this assignment. The measured gamma-ray energy 1766±25 kev is consistent with the two best energy determinations 1782±10 kev[24] and 1769±10 kev.[25]

The small peak at 1008±15 kev in the *A* spectrum is interpreted as a sum-line arising from the accidental coincident detection of two unrelated annihilation quanta. This conclusion is supported by the absence of this line in other measurements at reduced beam intensity and consequently reduced effective source intensity.

In order to facilitate the remaining discussion, in Fig. 3 is shown the level structure of Al^{26} as compiled by Endt and Braams.[4] The source of the remainder of the figure will be apparent from the text to follow. The ground state of Si^{26}, an even-even nucleus, would be expected to have zero spin and even parity. The *Q* value for positron decay from the ground state of Si^{26} to that of Al^{26} is 3.99 Mev as calculated using the mass excesses of Si^{26} and Al^{26}. The spin and parity of the ground state of Al^{26} is known to be 5^+, consequently one would not expect a transition which is this highly forbidden to compete with the allowed transition which is possible. In particular, positron branching to the 0+, 0.228-Mev state of Al^{26} is expected. It has been argued and supported with evidence that the 2.1±0.3 sec activity is associated with positron decay for which either E_0 or (E_0+0.511) Mev is greater than 4.0 Mev. An allowed positron transition (ΔI=0, no) to the 0+, 0.228-Mev state of Al^{26} would have E_0=3.76 Mev which would be consistent with this requirement. Furthermore, the small peak at 0.824±0.015 Mev (see Fig. 5) may be interpreted as the full-energy peak of a gamma transition between the 1.052-Mev state[26] and 0.228-Mev state of Al^{26}.

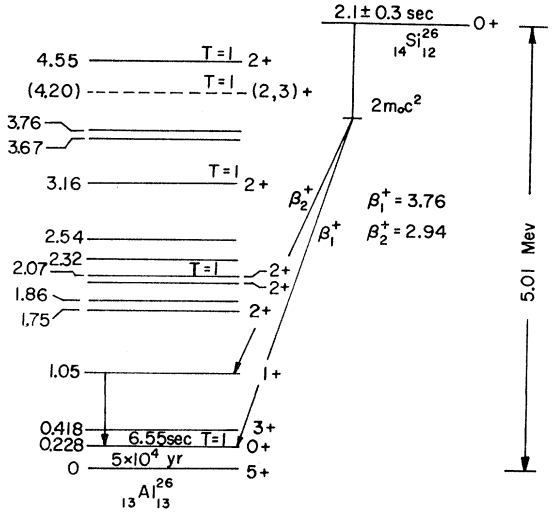

FIG. 3. Level structure of Al^{26} as compiled by Endt and Braams[4] and the proposed decay scheme of Si^{26} based on the results of the present investigation. See the text for details.

These two states have been observed to be connected by a gamma transition[27] which means that if 0+ is accepted as the spin and parity of the 0.228-Mev state then 0+ cannot be the assignment for the 1.052-Mev state. Since no other gamma transitions are apparent in the experimental spectra, a second positron branch, E_0=2.94 Mev, from the ground state of Si^{26} to the 1.052-Mev state of Al^{26} is suggested. A probable spin assignment for the 1.052-Mev level of 1+ has been made on the basis of intensity considerations.[4] A positron group populating the 1.052-Mev state, an allowed transition (ΔI=1, no), followed by a 0.824-Mev gamma transition to the 0+, 0.228-Mev state would be consistent with the assignment of 1+ for the 1.052-Mev state, and the experimental results.

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The nuclei Mg^{26}, Al^{26}, and Si^{26} are in the same charge multiplet and the positron decay of the 0+, 0.228-Mev state of Al^{26} to the 0+ ground state of Mg^{26} is well known.[4] The analogous transition in the Si^{26} decay is the one connecting the 0+ ground state of Si^{26} and the 0^+, 0.228-Mev state of Al^{26}. On the reasonable assumption of the charge independence of nuclear forces the comparative half-life of the two transitions should be the same and the square of the Fermi matrix element for the $0+ \rightarrow 0+$ transition has a model-free value of 2. Using these facts along with the half-life, 6.55 sec,[4] and end-point energy, 3.2 Mev,[4] for the Al^{26m} decay; the measured Si^{26} half-life, 2.1 sec, and end-point energy, 3.76 Mev[2,4]; the experimental ratio of the beta decay coupling constants, ≈ 1.22; and the tabulated f functions the branching ratio and the square of the Gamow-Teller matrix element of the 2.94-Mev transition in Si^{26} may be calculated. The branching ratio is 1.46 with the 3.76-Mev transition more intense in agreement with the qualitative experimental results. The calculated square of the Gamow-Teller matrix element is 2.63. A value of 2.8 was obtained when a j-j coupling model was assumed. The calculated partial log ft values are 3.51 and 3.22 for the 3.76-Mev and 2.94-Mev transitions, respectively.

The observation of this relatively weak activity with a measured half-life of 2.1 ± 0.3 sec could be explained by the presence of Ne^{18}, $E_0 \approx 3.2$ Mev, $t_{\frac{1}{2}} = 1.6 \pm 0.2$ sec.[28] It was not unlikely that a thin surface layer of MgO_2 be present on the magnesium targets. The reaction $O^{16}(He^3,n)Ne^{18}$, $Q = -2.96$ Mev, could then be expected. It follows then that the subsequent positron decay of F^{18}, $t_{\frac{1}{2}} \approx 1.87$ hr, should be observed. The fact that a 1.87 hr activity was not observed suggests that the effect is small. To obtain more evidence to support the conclusion that Ne^{18} was not responsible for the 2.1 ± 0.3 sec activity, a pure water target was bombarded with He^3 ions. An activity having a measured half-life of 1.6 ± 0.3 sec, presumably due to Ne^{18}, was clearly seen. It should be recalled that the short-lived activity associated with the magnesium targets was observed when radiation of energy greater than that associated with the Ne^{18} decay was counted. The gamma spectra measured from water targets after He^3 bombardment showed no structure that would lead to a misinterpretation of the spectra from the magnesium targets. Reasonable estimates of the oxygen available for the production of Ne^{18} in the magnesium targets, and a comparison of the yields of the short-lived activity in the case of the water and magnesium targets lead to the conclusion that there is insufficient oxygen available on the magnesium targets to account for the 2.1 ± 0.3 sec activity.

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IV. CONCLUSIONS

In the preceding section supporting experimental evidence has been presented for the following conclusions: (1) A radioisotope with a half-life of 2.1 ± 0.3 sec is produced in the bombardment of pure magnesium targets with 8-Mev He^3 ions. (2) The observed half-life of 2.1 ± 0.3 sec is that of Si^{26} produced in the reaction $Mg^{24}(He^3,n)Si^{26}$. (3) Among the decay modes of the 0+ ground state of Si^{26} there are two positron branches. One positron transition, $E_0 = 2.94$ Mev, populates the 1+, 1.05-Mev state of Al^{26} followed by a (0.824 ± 0.015)-Mev gamma transition to the 0.228-Mev state. A second positron branch, $E_0 = 3.76$ Mev, more intense than the one above, connects the ground state of Si^{26} to the 0.228-Mev state of Al^{26}. These conclusions are shown graphically in Fig. 3. The positron end-points are not a result of measurements in this investigation but depend on a knowledge of the levels of Al^{26} and the Si^{26}-Al^{26} mass difference.

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