THE HALF-VALUE PERIOD OF $^{13}_{7}N$

By A. G. WARD

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In view of the existing disagreement amongst the published values of the half-value period of $^{13}_{7}N$, the writer has thought it worth while to publish the result of a determination of the period by a method not generally employed. It is a matter of practical importance that this period should be known accurately, since $^{13}_{7}N$ is produced in a variety of ways, and is often present as contamination in other radioactive substances produced by high-voltage bombardment.

The $^{13}_{7}N$ source was prepared by bombarding carbon in vacuum for 10 min. with 50μ A. deuterons of energy 900 k.e.V. The target was prepared by deposition of soot on a copper support. After bombardment, the upper layer of carbon containing the $^{13}_{7}N$ was scraped off and sealed with Apiezon Q in a cavity in an aluminium block, sufficiently thick to absorb all positrons from the source. The source was then placed 10 cm. from the face of an ionization chamber filled with argon at 8 atm. pressure and measurements of the ionization current due to quantum radiations from the source were begun 40 min. after the conclusion of the bombardment. The ionization chamber and FP-54 valve amplifier have been described previously(1).

The complete set of ionization measurements made on one source of $^{13}_{7}N$ is given in Table I. Analysis of the readings shows a strictly exponential decay over at least eleven half-value periods and yields a half-value period $T = 9{\cdot}93 \pm 0{\cdot}03$ min. The calculated values, given in Table I using a half-value period $T = 9{\cdot}93$ min., show that the experimental values are very consistent. The probable error of the first twelve readings in Table I was in fact determined by the accuracy of stop-watch measurements rather than by the statistical fluctuation of the ionization current.

Possible sources of error in this determination of the half-value period have been thoroughly investigated. The ionization chamber has been tested for lack of saturation, by the method of addition of sources, over the entire intensity range of the readings of Table I. The stop-watch has been standardized by comparison with an accurate chronometer.

In Table II some of the published values of the period of $^{13}_{7}N$ are given. A complete list is to be found in the report of Diebner and Grassmann(2). In general it is difficult to suggest possible causes of the variation shown by the values in

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Table I.

Time min.	Intensity Calc.	Intensity Obs.	Prob. error	Time min.	Intensity Calc.	Intensity Obs.	Prob. error	Time min.	Intensity Calc.	Intensity Obs.	Prob. error
0	$847._0$			15·21	$292._9$	$293._1$	0·7	46·78	$32·3_5$	$32·4_9$	$0·2_4$
0·18	$836._3$	$843._6$	$3._9$	16·69	$264._1$	$264._7$	0·7	48·54	$28·6_0$	$28·7_3$	$0·2_2$
1·12	$783._2$	$784._5$	$3._4$	18·31	$235._9$	$236._8$	0·6	50·42	$25·0_9$	$25·5_3$	$0·1_9$
1·88	$742._8$	$742._2$	$3._1$	21·62	$187._3$	$187._8$	0·5	51·85	$22·7_0$	$22·0_3$	$0·1_7$
2·76	$698._5$	$701._5$	$2._8$	23·77	$161._2$	$161._0$	0·4	53·88	$19·7_0$	$20·2_1$	$0·2_0$
3·66	$656._1$	$655._5$	$2._4$	26·11	$136._8$	$138._0$	0·5	55·03	$18·1_8$	$18·0_0$	$0·1_8$
4·54	$617._0$	$617._0$	$2._1$	27·72	$122._4$	$122._4$	0·4	56·20	$16·7_6$	$16·6_2$	$0·1_7$
5·42	$580._2$	$577._2$	$1._9$	29·51	$107._9$	$107._4$	0·4	57·59	$15·2_0$	$15·0_3$	$0·1_5$
6·22	$548._6$	$545._5$	$1._7$	31·59	$93·3_6$	93·3	0·3	58·95	$13·8_2$	$14·0_5$	$0·1_4$
7·11	$515._7$	$514._2$	$1._5$	35·00	$73·6_0$	$74·2_2$	$0·3_7$	80·97	$2·97_3$	3·04	0·06
8·06	$482._5$	$482._3$	$1._3$	36·47	$66·4_2$	$66·0_2$	$0·3_3$	85·64	$2·14_6$	2·07	0·05
9·05	$450._2$	$449._6$	$1._1$	38·12	$59·2_0$	$59·4_2$	$0·3_0$	91·12	$1·46_4$	1·44	0·05
10·26	$413._9$	$413._2$	$1._0$	39·91	$52·2_3$	$52·3_7$	$0·2_6$	113·42	$0·30_8$	0·32	0·05
12·57	$352._2$	$353._4$	0·9	41·98	$45·2_1$	$45·3_7$	$0·2_3$				
13·82	$322._8$	$323._4$	0·8	45·40	$35·6_1$	$35·8_5$	$0·2_7$				

Table II since details of the determinations are not always given. It is to be noted, first of all, that previous workers have used the effect of the particles rather than that of the quanta emitted by the source, and secondly, that the values which they have obtained for the period are fairly consistently higher than the value determined by the present writer. As a possible explanation it might be pointed out that measurements on the particle radiation are more likely to be affected by any weak contamination of extraneous activity than those carried out on the quantum radiations (the quantum radiations are relatively more intense with sources emitting positrons than with sources emitting negative electrons). On the other hand, the fact that the closest agreement with the writer's value occurs

Table II.

Method of preparation	Half-value period in minutes	Method of measurement	Radiations utilized	Reference
$^{12}C(p, n)\,^{13}N$	10·1 ± 0·2	Counter	$\beta+\gamma$	S. K. Allison (3)
$^{10}B(\alpha, n)\,^{13}N$	11·0 ± 0·1	Counter	$\beta+\gamma$	C. D. Ellis and W. J. Henderson (4)
	10·73 ± 0·15	Counter	$\beta+\gamma$	H. Fahlenback (5)
(Cyclotron)	10·3	Lauritzen electroscope	$\beta+\gamma$	L. N. Ridenour and W. J. Henderson (6)
$^{12}C(d, n)\,^{13}N$	10·4 ± 0·1	Lauritzen electroscope	$\beta+\gamma$	E. McMillan and M. S. Livingston (7)
	10·3 ± 0·3	Counter	$\beta+\gamma$	S. K. Allison (3)
	10·0 ± 0·1	Ionization chamber	$\beta+\gamma$	S. N. Van Voorhis (8)
	10·3	Ionization chamber	$\beta+\gamma$	H. R. Crane and C. C. Lauritzen (9)
	10·3	Ionization chamber	γ	
	9·93 ± 0·03	Ionization chamber	γ	Author

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in the results of Van Voorhis(8), who used a similar experimental technique (on the particle radiation rather than the quanta), suggests that the discrepancies may be chiefly instrumental.

Whatever the final decision on these questions may be, it may be pointed out that the accuracy of the present determination is at least three times as great as that of any determination quoted in Table II.

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Cavendish Laboratory
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