LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

The Nuclear Spin of Deuterium

The relative intensities of 29 lines have been measured in the α-bands of the molecular spectrum of deuterium. They correspond to the transition $3p\pi^3\Pi_u \rightarrow 2p\sigma^3\Sigma_u^+$ and their analysis was kindly given us by Professor G. H. Dieke. The bands lie between 5939 and 6291A and were photographed in the second order of a 21-foot grating by using the usual type of discharge tube with a potential of about 4100 volts and a current of 0.75 ampere. The gas was prepared from heavy water containing more than 90 percent deuterium for which we wish to thank Professor H. C. Urey.

Density marks of known relative intensity were put on each plate by means of a tungsten filament lamp burning with constant current of 0.85 ampere and a set of eight neutral wire screens. By means of a system of slits placed directly in front of the photographic plate we were able to have a separate set of density marks for each band and thus we could correct for the change in sensitivity of the plate with wave-length. The density marks were 0.5 mm wide which corresponded to the slit-width in photographing the molecular spectrum. Under these conditions complete resolution of some of the lines was not obtained and where such was the case these lines were not used in determining the alternation of intensities.

The usual type of photographic density curves were plotted and from these the intensities of the molecular lines were determined. With the equation $\ln I/i = \ln Cg - BJ(J+1)/kT$, we have obtained values for g_s and g_a, the statistical weight due to nuclear spin for the symmetric and antisymmetric levels by a least squares solution for each branch. The measured intensity of the line is I. i is the transition probability and the other quantities have their usual significance.

The results from the Q and R branches of the (0,0), (1,1), (2,2) and (3,3) bands on two different plates gave 1.95 ± 0.06 and 2.02 ± 0.04 for the ratio g_s/g_a. Since the symmetric levels are more intense, the nucleus obeys Bose-Einstein statistics and the nuclear spin of deuterium is 1. A more detailed report will appear shortly.

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Transmutation of Lithium by Deutons and Its Bearing on the Mass of the Neutron

It has been recognized for some time that one of the most direct methods of obtaining the mass of the neutron is by a calculation of the mass-energy relations in the reaction

$$Li^7 + H^2 \rightarrow 2\ He^4 + n^1. \quad (1)$$

Although there is perhaps some justification for assuming that γ-rays are not involved as a product of this reaction, an experimental test has not hitherto been available. Hence, calculations of the mass of the neutron which have been made without certain knowledge as to the presence of γ-rays are to be considered strictly valid only as an upper limit.

Due to the large intensity obtainable with our apparatus, we have been able to make absorption measurements of the radiation (neutrons, plus γ-rays, if present) produced in the above reaction out to large thicknesses of both lead and paraffin, and in that way to analyze the radiation into its components for the purpose of determining whether or not γ-rays are present. It was desirable first to eliminate protons from the ion beam as far as convenient, because protons, in disintegrating lithium produce γ-rays, of the order of one quantum per disintegration, and of hardness about equal to that of the γ-rays from radium after 2 to 3 cm lead filtration.[1] This was accomplished by using rather pure (approximately 90 percent H^2 gas, and for economy it was diluted with an equal amount of helium.* It will be seen later than an effect produced by the relatively small number of protons still present appears, but can readily be identified, in the final results. During all the measurements the tube was run at 900,000 volts, with a total ion current of 5 microamperes, 3 to 4 microamperes of which it is estimated was due to deutons. The intensity of radiation obtained under these conditions was

[1] Lauritsen and Crane, Phys. Rev. **45**, 63 (1934).

* It was first made certain that helium alone produced no measurable effect.