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.

Protons from the Disintegration of Lithium by Deuterons

It was found in this laboratory[1] that lithium bombarded with deuterons yields β-rays with a continuous distribution in energy extending to 10.5 ± 1.0 MEV and having a half-life of 0.5 ± 0.1 second. In order to account for these β-rays the following reactions were suggested:

$$_3Li^7+{}_1H^2\rightarrow{}_3Li^8+{}_1H^1, \quad (1)$$
$$_3Li^8\rightarrow{}_4Be^8+{}_{-1}\epsilon^0. \quad (2)$$

We have recently attempted to determine the range and energy of the protons accompanying the formation of radioactive Li^8. A target of lithium metal was so disposed that disintegration particles could be admitted through a copper foil into a cloud chamber operating at a pressure of three atmospheres. Diaphragms between the target and the window limited observation to particles making an angle of $90°\pm5°$ with the incident ions. Ethyl alcohol was employed in the chamber and the stopping power of the resulting air-vapor mixture was computed from the measured chamber pressure and the vapor pressure of alcohol at the operating temperature. A polonium alpha-particle source installed in the chamber served to check the computed results. The stopping power of the copper foil (9.6 mg/cm^2) was found to be 4.7 cm by measuring the residual range of the alpha-particles yielded by bombarding lithium with protons. The stopping power for alpha-particles and protons of other ranges was computed from the data given by Mano[2] and the necessary corrections incorporated in the ranges given in Fig. 1.

The distribution in range of the particles resulting from the disintegration of lithium by 700 kv (peak) deuterons is shown in Fig. 1. The "extrapolated" ranges of 31.7 ± 0.5 cm, 13.8 ± 0.7 cm, and 8.9 ± 1.0 cm, respectively, for the longer range protons and two alpha-particle groups are in good agreement with the ranges which have been measured at Cambridge.[3] The group of particles at 26 ± 1 cm has not been reported previously. The energy of protons of this range is 4.3 ± 0.1 MEV. If the particles are produced in the manner indicated by reaction (1) then the energy released in the disintegration is $Q=4.3$ MEV and the masses of Li^8 and Be^8 are on the Bethe scale:

$$Li^8=8.0185,$$
$$Be^8=8.0072=2He^4+0.5\pm1.0 \text{ MEV}.$$

Possible contamination effects could arise from the presence of protons in the ion beam or from oxygen, nitrogen, deuterium, or carbon in the target. No particles corresponding to the 26-cm group are known to be emitted in the transmutation of the last-named elements. We have found correspondence within a factor of two or three between the number of electrons from reaction (2) and this second proton group.

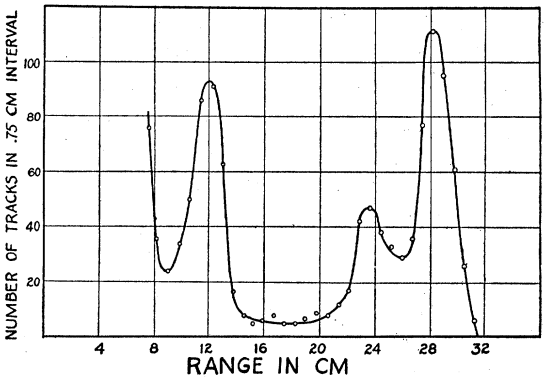

FIG. 1. Distribution in range of alpha-particles (short range groups) and protons (long range groups) emitted in the disintegration of lithium by 700-kv peak deuterons.

Oliphant, Shire and Crowther[4] employing 160-kv deuterons have reported protons from a thin Li^6 target but not from Li^7 targets of equal thickness. The fact that the yield with the latter targets would be but 2 percent of that from the former may account for their results. If the 26-cm protons are emitted in the transmutation of Li^6 then they may accompany the formation of excited Li^7 and the subsequent emission of a γ-ray. The 30.5 ± 1.0-cm protons observed by Cockcroft and Walton[5] at 500 kv extended over a range of 10 cm, a fact consistent with the existence of two unresolved groups of particles.

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[1] Crane, Delsasso, Fowler and Lauritsen, Phys. Rev. **47**, 971 (1935).
[2] Mano, J. de phys. et rad. **5**, 628 (1934).
[3] Oliphant and Cockcroft, Int. Conf. on Physics, 1934.
[4] Oliphant, Shire and Crowther, Proc. Roy. Soc. **A146**, 922 (1934).
[5] Cockcroft and Walton, Proc. Roy. Soc. **A144**, 704 (1934).

On Dirac's Equation in Rotating Systems

In a previous publication[1] two relations were given (Eqs. (25) and (35)) which expressed Dirac's equation in a rotating frame of reference. We now give a third one which is of interest. The matrices

$$\bar{\bar{\gamma}}_k=\mathring{\gamma}_k \ (k=1, 2, 3), \qquad \bar{\bar{\gamma}}_4=\mathring{\gamma}_4+i\omega'(y\mathring{\gamma}_1-x\mathring{\gamma}_2)$$

satisfy the commutation relations exactly, and lead to the equation

$$\bar{\bar{H}}\chi\equiv[-\pi_t+\alpha\cdot\pi+mc\beta-\omega' L_Z-\tfrac{1}{2}\hbar\omega'\sigma_Z]\chi=0.$$

$\bar{\bar{H}}'$ is connected with H' and $\bar{\bar{H}}'$ [2] by the spin transformations