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III.

Experimentelle Ergebnisse der Kernphysik

Magnetic analysis of Disintegration products

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An annular magnet, in which use is made of 180-degree focusing, has been employed to study the charged particles from several nuclear reactions. The region of uniform field, in which the particles are deflected, is approximately 70 centimeters in mean diameter and 5 centimeters wide with a spacing of 1.5 centimeters between the pole faces. The magnetic field strength is measured with a sensitive null-type flux meter calibrated in terms of deflection of polonium alpha-particles. The energy of the incident particles is also determined in terms of this standard by measuring their deflection after they have been elastically scattered from various thin targets. Nuclear track plates have been used to detect the analysed particle groups. As the apparatus is normally employed, each plate is exposed at a different magnetic field strength, the incident bombarding voltage being held constant. Thus, each plate covers a certain interval in the energy spectrum of the particles resulting from the reaction, the width of the interval for a particular plate depending upon the field strength at which it was exposed. The high resolution of apparatus when used in conjunction with an electrostatic accelerator makes it particularly suitable for measuring reaction energies and for searching for particle groups that provide information regarding nuclear energy levels[1]).

Thus far, attention has been given mainly to proton groups from reactions produced by deuterons having energies in the range of 1.5 MeV. The energies of the first energy levels in Li^7, Be^{10}, C^{13}, and O^{17}, expected when these nuclei are produced in such reactions, have been found to be 0.483 ± 0.003; 3.375 ± 0.015; 3.098 ± 0.008; and 0.876 ± 0.009 MeV, respectively. A particular search has been made for particle groups that would indicate additional lower energy levels in Be^{10} and C^{13} to see whether any exist that might be correlated with known levels in the mirror nuclei B^{10} and N^{13}. While such correspondence would be expected for equal neutron-neutron and proton-proton forces, no such evidence for additional levels has been found. This lack of correlation between the energy levels of mirror nuclei appears also to be the case for Li^7 and Be^7. Studies of the various reactions in which Be^7 is produced[2][3][4]) show no indications of an excited state in Be^7 that would correspond to the well-known level in Li^7 at 480 MeV[5]).

The energy levels in N^{13} have been studied by the $C^{12}(p, \gamma) N^{13}$ reaction. A resonance has been found for both gamma-ray emission and for positron activity at a proton energy of 1.697 ± 0.012 MeV, the half-width of the resonance being 74 ± 9 KeV. This indicates that, in addition to the one at 2.383 ± 0.018 MeV[6]), there is an energy level in N^{13} at 3.523 ± 0.019 MeV. These measurements show that, in the range of proton energies from 0.6 to 2.1 MeV, there are no additional resonances with a peak intensity so large as 0.12 that of the one at 1.70 MeV. The existence of these levels has been confirmed by the recent work of Grosskreutz on the energy of the neutron groups from the $C^{12}(d, n) N^{13}$ reaction[7]).

The energies evolved in a number of reactions have been measured. The following values are for the reactions that lead to the formation of the residual nuclei in their ground states, the values being in MeV:

$Li^6(d, p)Li^7$:	5.006 ± 0.014	$Li^7(d, p)Li^8$:	-0.193 ± 0.008
$Be^9(d, \alpha)Li^7$:	7.145 ± 0.024	$Be^9(d, p)Be^{10}$:	4.576 ± 0.012
$C^{12}(d, p)C^{13}$:	2.729 ± 0.009	$O^{16}(d, p)O^{17}$:	1.925 ± 0.008

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Bibliography.

1) The apparatus is described in more detail in an article to appear in the December 1, 1949 issue of The Physical Review.

2) Freier, Lampi and Williams, Phys. Rev. **75,** 901 (1949).

3) Burcham and Freeman, Nature **163,** 167 (1949).

4) Mandeville, Swann and Snowden, Phys. Rev. **76,** 980 (1949).

5) Note added in proof: Recent work has indicated the existence of excited states in Be^7 at 0.205, 0.470, and 0.745 MeV. (W. A. Fowler, private communication; Grosskreutz and Mather, Bul. Amer. Phys. Soc., **24,** November 25, 1949.)

6) Fowler and Lauritsen, Phys. Rev. **76,** 314 (1949).

7) J. C. Grosskreutz, Phys. Rev. **76,** 482 (1949).