Neutron Deficient Isotopes of Lanthanum

M. M. GRANSDEN AND W. S. BOYLE
Radiation Laboratory, McGill University, Montreal, Canada
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A BARIUM target bombarded by protons with energies up to 90 Mev has been found to yield the new isotopes La^{132} (4.5 hr) and La^{131} (58 min) which were isolated by a 180° mass spectrograph.

The filament of the thermal ion source in the mass spectrograph was coated with the chemically separated La, and the isotopes were collected on a thin Dural foil. Transfer plates were made with x-ray no-screen film; and the new products, which were identified with reference to known active La isotopes,[1] were then cut from the foil and studied separately. These individual strips showed activities from 10,000 to 40,000 cpm, sufficient to permit not only good values for the half-lives but also absorption experiments to determine the energy of the γ-rays and the positrons which had been identified in a rough magnetic analysis. Results are given in Table I.

The time interval between bombardment and counting would prevent the observation of half-lives of less than about 20 min.

Owing to the large number of Ba isotopes in appreciable abundance, the energy of proton bombardment for best yield of any particular isotope is not sharply defined. The ratio La^{132}/La^{133} increases by a factor of 20 between 20 and 90 Mev.

TABLE I. Observed half-lives and energies.

Isotope	Half-life	Radiation
La^{132}	4.5 hr	β^+ 3.5 Mev γ 1.0 Mev
La^{131}	58 min	β^+ 1.6 Mev

Whereas the period of La^{131} fits into the steadily decreasing series of half-lives for La isotopes of even neutron number, that of La^{132} (4.5 hr) might be expected to be measured in minutes, in view of the corresponding series of known isotopes of odd neutron number. Indeed, the energy of the positron suggests that this isotope may have a complex decay scheme involving an isomeric state. This point is being investigated.

We express our best thanks to Professor J. S. Foster for his interest in this work.

[1] Naumann, Reynolds, and Perlman, Phys. Rev. **77**, 398 (1950).

Absorption of 280-Mev Photons*

J. W. DEWIRE, A. ASHKIN, AND L. A. BEACH
Cornell University, Ithaca, New York
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TOTAL cross sections for 280-Mev photons in various elements have been determined by measuring the transmission through samples placed in the bremsstrahlung beam from the 300-Mev synchrotron. The photons above 250 Mev were detected by an electron pair spectrometer,[1] in order to avoid effects due to degradation of the photon energies in the absorbers. The results are given in Table I, together with the ratio of the calculated values to the experimental results. The theoretical values are based on the Bethe-Heitler theory[2] for pair production in the nuclear field, the Wheeler and Lamb calculations[3] on pair production in the electronic field, and the Klein-Nishina formula for Compton scattering.

TABLE I. Total cross sections for 280-Mev photons.

Absorber	Experimental cross section (cm^2/g)	Probable statistical error (%)	Ratio of theory to experiment
Be	0.01060	1.2	0.982
Al	0.0284	1.2	0.988
Cu	0.0528	0.9	1.011
Sn	0.0776	1.0	1.032
Pb	0.1069	1.2	1.105
U	0.1148	1.4	1.114

The results show a relation to the theoretical cross sections which is similar to the results of Lawson[4] at 88 Mev and of Adams[5] and Walker[6] at still lower energies. The beryllium cross section agrees with the theory, in contrast to the disagreement found by Lawson.[4]

Further details will be given in a paper to be published later.

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[3] J. A. Wheeler and W. E. Lamb, Phys. Rev. **55**, 858 (1939).
[4] J. L. Lawson, Phys. Rev. **75**, 433 (1949).
[5] G. D. Adams, Phys. Rev. **74**, 1707 (1948).
[6] R. L. Walker, Phys. Rev. **76**, 527 (1949).

Erratum: A Canonical Transformation in the Theory of Particles of Arbitrary Spin

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W. A. HEPNER
Department of Mathematics, Imperial College of Science and Technology, London, England

THE equations in the first line of Eq. (2) should have the letters (a), (b), (c) attached to them, and those in the second line (d), (e), (f), respectively. Also, insert "assuming that S^2 anticommutes with β_k" before Eq. (5), and add "as assumed," after Eq. (7).

Note on Total Yield of Alphas from $Li^6(d, \alpha)\alpha$

ROBERT RESNICK
Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania
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THE fit of the theoretical curves[1] of angular distribution of alphas in $Li^6(d, \alpha)\alpha$ with experiment[2] and the reasonable values of the parameters required for such a fit suggest that the assumptions of one sharp state and one broad state are valid in the energy range investigated (0 to 4 Mev). The rise in the $Y(E, 90°)$ curve beyond the observed resonance at $E\cong\frac{3}{4}$ Mev is attributed to increasing penetrability of the $l=2$ wave at higher energies. Attempts to fit the $Y(E, 90°)$ curve with these assumptions, using values of the parameters determined from the angular distribution curves, fail to give good results for a range of reasonable values of E_2 and γ_2, the resonant energy and half-width of the sharp state. One obtains $Y(\frac{3}{4}\text{ Mev})/Y(2\text{ Mev})=6.1$, compared with the experimental value 2.3, for the best fit. The choice of a nuclear radius smaller than the assumed $R=1.83e^2/mc^2$ improves the situation somewhat.

Hence, the existence of a second resonant state around 4 Mev seems necessary to account for the high minimum in $Y(E, 90°)$ beyond the first resonance. Such an assumption in the theory results in an increase in the number of arbitrary parameters and more complicated relationships between these parameters and the interaction matrix elements.[1] A good fit to all experimental results thus becomes possible but less significant than in the simpler theory. Extension of the energy range of the experiments is necessary to determine whether such a resonance exists, and the conditions imposed by the total yield and angular distribution over this increased range may reduce the arbitrariness sufficiently to allow unique assignment of the parameters involved.

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[2] Heydenburg, Hudson, Inglis, and Whitehead, Phys. Rev. **74**, 405 (1948).