The similarity between the total cross section of Marshall and Guth[6] and the experimentally determined $\sin^2\theta$ component, $8\pi B/3$, suggests that this component is largely accounted for by their calculations, while the isotropic component $4\pi A$ is mainly due to a specific mesonic effect. Figure 3 shows the difference between

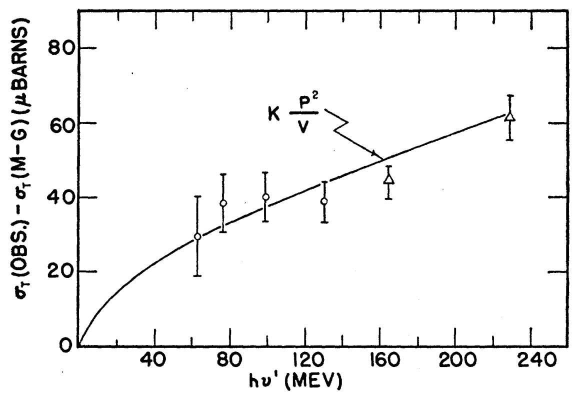

FIG. 3. Difference between the experimental total cross section and the total cross section calculated by Marshall and Guth. P is the momentum and V is the velocity of the photoproton in the center-of-mass system.

the observed total cross section and the total cross section of Marshall and Guth. The difference is a slowly rising quantity which is approximately proportional to the momentum of the emitted proton. This suggests that the matrix element for this part of the cross section is approximately constant. The lack of a distinct difference in the behavior of this component above and below the meson threshold indicates it does not compete with the low-energy photomeson production. This can be understood in terms of an argument of Wilson[7] concerning the absorption of a photon by the meson field in a small volume with a radius less than the pion Compton wavelength. If this volume is occupied by more than one nucleon, nucleons are emitted practically every time because of their much greater statistical weight.

Two more specific mesonic models also seem to show promise of explaining the observed cross sections. The first interaction is suggested by the well known electric dipole transition which is involved in low-energy photopion production. In this transition the photon is absorbed by one of the nucleons flipping its spin and producing an S wave meson. The meson is subsequently absorbed by the other nucleon accompanied by another spin flip producing a final odd-parity state. Such a state could be described as approximately a $^3P_0$ state and would account for the observed isotropic angular distribution.[8] The second interaction involves the interaction magnetic moment and has been considered by Nagahara and Fujimura[9] and also by Bruno and Depken.[10] In this case a P wave meson is emitted by one nucleon, which absorbs the photon. The meson is then absorbed by the other nucleon. These authors show that the magnitude of the observed cross section as well as the angular distribution can be accounted for by this process. A more definite interpretation of the experimental results seems to require more complete theoretical calculations.

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Energy Levels in Be^8 from $Li^7(d,n)Be^8$

CARROLL C. TRAIL* AND C. H. JOHNSON
Oak Ridge National Laboratory, Oak Ridge, Tennessee
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SEVERAL low-lying states in Be^8 have been reported in addition to a well-established broad level at 3 Mev.[1] In particular, Titterton[2] has discussed the evidence for levels in Be^8 at 4, 5.3 and 7.5 Mev. Existence of the 4-, 5.3-, and 7.5-Mev levels is suggested[3–9] from $B^{11}(\gamma,t)Be^8$, $B^{10}(\gamma,d)Be^8$, $Li^7(d,n)Be^8$, and $Li^7(p,\gamma\alpha)He^4$. Additional evidence for the 7.5-Mev level is given by the $\alpha-\alpha$ scattering experiment of Steigert and Sampson.[10] The neutron spectrum from $Li^7(d,n)Be^8$ has been obtained previously with photographic plates,[5–8] and the purpose of this investigation was to measure this neutron spectrum with good statistics with a spectrometer described elsewhere.[11]

In a recent article Kunz, Moak, and Good[12] reported the proton spectrum from $Li^6(He^3,p)Be^8$. The spectrum indicates only the 3.0-Mev excited state in Be^8 up to an excitation of 10 Mev. Malm and Inglis[13] observed the α-particle spectrum from $B^{11}(p,\alpha)Be^8$ and found only the 3-Mev excited state up to an excitation of 7 Mev. The $B^{10}(d,\alpha)Be^8$ reaction[14] was found to leave Be^8 in only the ground and 3.0-Mev states.

The spectrometer for this study contains a polyethylene radiator, two proportional counters, and a NaI scintillation counter. Protons which recoil in the forward direction from the radiator pass through the two proportional counters and terminate in the NaI crystal. Triple coincidences produced in this manner gate a twenty-channel pulse sorter which analyzes the pulses in the scintillation counter. The crystal was found to give three percent resolution from 15-Mev protons

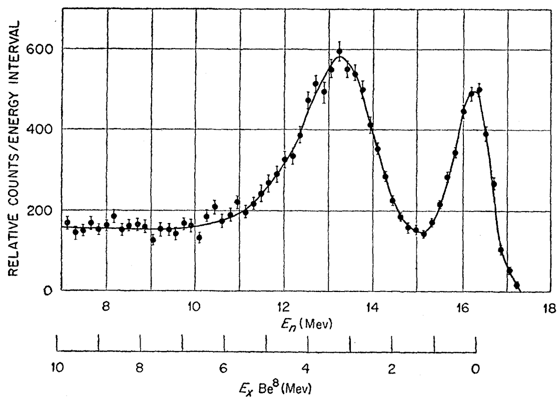

FIG. 1. Neutron spectrum at zero degrees from $Li^7(d,n)Be^8$. The energy of the incident deuteron is 2 Mev.

from the $He^3(d,p)He^4$ reaction. For the $Li^7(d,n)Be^8$ experiment 2-Mev deuterons from the 2.5-Mev Van de Graaff bombarded lithium targets having a stopping power of 300 kev. The targets were prepared from separated metallic Li^7.[15]

The resulting neutron spectrum at zero degrees corrected for the variation of the $n-p$ cross section is shown in Fig. 1. The statistical uncertainties are ten percent up to a neutron energy of 11 Mev and six percent for energies greater than 11 Mev. Backgrounds were determined by observing the difference in counting rates with the radiator in and the radiator out. The radiator was about eight percent thick to recoil protons in the 7-Mev to 11-Mev region and five percent thick to those in the 11-Mev to 17-Mev region.

Figure 1 shows two groups of neutrons corresponding to the formation of Be^8 in the ground state and in an excited state at 3 Mev. Neutron groups leaving Be^8 in an excitation of 4 Mev or 5 Mev would have been resolved if they were ten percent as intense as the group leaving Be^8 in the ground state. A group leaving Be^8 with an excitation of 7.5 Mev would have been observed if it were twenty percent of the ground state group. The spectrum is being studied at angles other than zero degrees.

* Graduate student from Texas A & M College working under an Oak Ridge Institute of Nuclear Studies fellowship.

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