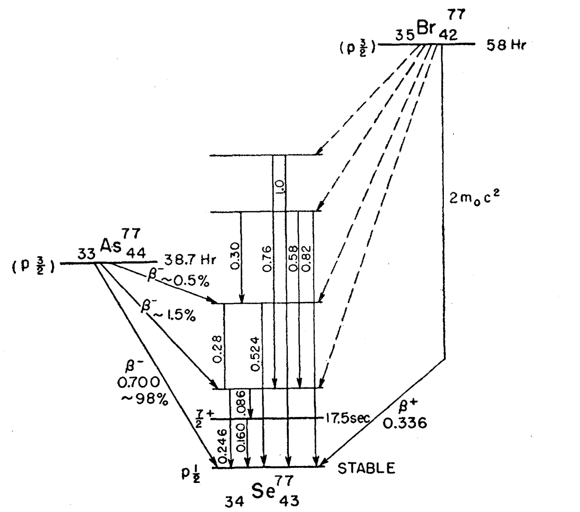

FIG. 3. Tentative partial decay scheme for As^{77} and Br^{77}.

that the γ_6 peak of the Br^{77} spectrum is actually composed of more than one component. The only other evidence that this may be true is the rather large energy discrepancy between the value reported here for γ_6 and the values reported previously[3,6] on the basis of conversion electron energies.

Another troublesome feature of the Br^{77} spectrum is the lack of a strong peak at about 6 volts. It seems likely that the ground-states of both As^{77} and Br^{77} are $p_{\frac{3}{2}}$ states; hence, one would expect any level of Se^{77} excited in the decay of As^{77} to also be excited in the decay of Br^{77}. Although there is evidence in Fig. 2 for a peak at about 23 kev, it is quite weak.

Additional gamma rays of energy 0.30, 0.524, 0.58, 0.76, 0.82, and 1.0 Mev were observed in the decay of Br^{77}. There is no evidence of the 0.641-Mev gamma ray reported previously.

A tentative partial decay scheme is shown in Fig. 3. Most of the gamma cascades have been verified by gamma-gamma coincidence measurements.

A more complete account of these experiments will be published later.

During the course of this investigation, it was learned that investigators at both Oak Ridge National Laboratory and the Bartol Research Foundation have also made measurements on the gamma rays from As^{77}.

† Work done under the auspices of the U. S. Atomic Energy Commission.

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The Reactions $He^3(He^3, p)Li^5$ and $T(He^3, p)He^5$

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THE ground states of Li^5 and He^5 are unstable against heavy particle emission with a lifetime of the order of 10^{-21} second. Their properties can therefore only be inferred from a study either of the scattering of protons and neutrons by helium, or of two-body nuclear reactions in which the emitted particle escapes beyond the range of nuclear forces before the dissociation of the residual Li^5 or He^5 nucleus. Two reactions of this type, $He^3(He^3, p)Li^5$ and $T(He^3, p)He^5$, have been observed in the course of a photographic plate study of He^3 induced reactions.

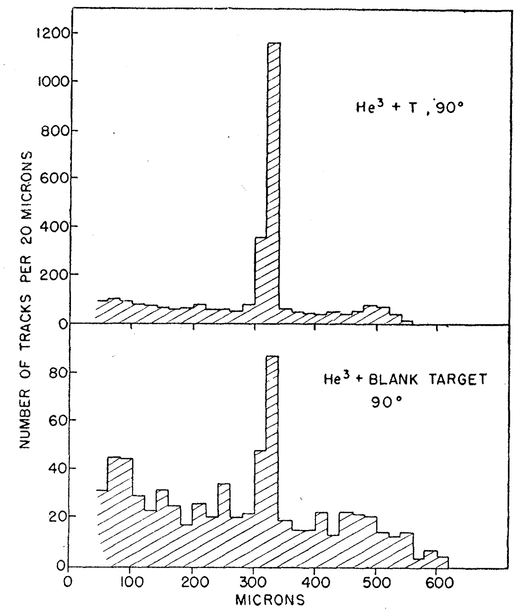

FIG. 1. Range distributions in Ilford C2 emulsions of charged particles resulting from He^3 reactions.

A beam of 0.24-Mev He^3 ions was allowed to bombard in turn a target of tritium occluded in titanium and a polished copper block. Ions from the beam were deposited in the copper block, which then acted as a He^3 target.[1] The tracks of long-range charged particles emitted at 90 degrees and 135 degrees to the beam were recorded in 200 micron Ilford C_2 emulsions. The plates exposed to the tritium target had about 10 tracks per sq mm while those exposed to the blank target with ten times the irradiation had only about 1 track per sq mm excluding the tracks of long-range protons from the $He^3(d, p)He^4$ reaction which are always present. Thus the background of disintegration particles from the He^3+He^3 reactions was negligible in the He^3+T plates. The range distribution of particles emitted at 90° to the beam are shown in Fig. 1. Energy measurements with a calibrated KI(Tl) crystal and photomultiplier combined with the range measurements allow the peak at 330 microns range to be identified as deuterons from the $T(He^3, d)He^4$ reaction.[2] The presence of this peak in the plate exposed to the *blank* target is not surprising as the H.T. set and recovery system had been used for some time to accelerate tritium so that some contamination tritons were inevitably present in the beam. However, by normalizing the distributions to the same intensity of the deuteron peak, the contribution of the He^3+T reactions was subtracted from the distribution obtained with the blank target. The resulting distribution of protons emitted at 90° from the He^3+He^3 reactions, together with that from the He^3+T reactions, is shown in Fig. 2 transformed to an energy scale.

Each of the curves in Fig. 2 consists of a group of particles superimposed on the high-energy end of a continuum. These groups are attributed to protons from the reactions $He^3(He^3, p)Li^5$ and $T(He^3, p)He^5$. The Q values for these reactions, calculated from the measured proton energies, are 10.86 ± 0.15 Mev and 11.18 ± 0.07 Mev, respectively.

Using the mass scale of Li *et al.*,[3] these Q values lead to masses of 5.01414 ± 0.00016 and 5.01382 ± 0.00007 for Li^5 and He^5. The former exceeds the combined mass of He^4+n by 0.90 ± 0.07 Mev. The width of the ground state of Li^5 is greater than that of He^5 and probably exceeds 1 Mev. These results are in agreement with other data given in a recent review article.[4]

Classical phase-space considerations lead to elliptical energy distributions for the protons from the three-body break-up.[5]

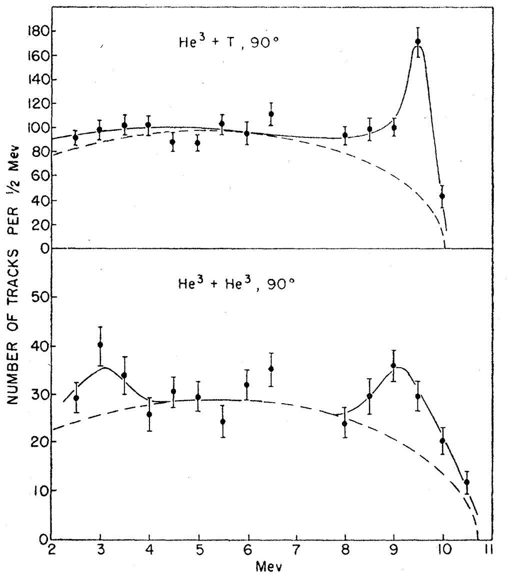

FIG. 2. Energy distribution of protons from He^3+T and He^3+He^3 reactions.

These theoretical curves are represented by the dashed lines in Fig. 2. In Fig. 2(b) there is some evidence for an increase in the intensity of protons below 4 Mev. This is attributed to protons from the decay in flight of the Li^5 nucleus. These protons may take energies up to a maximum of ~3.8 Mev, depending on the energy and width of the Li^5 ground state.

It is a pleasure to acknowledge our indebtedness to Miss H. B. Burrows and Miss M. P. M. Robinson of the University of Liverpool for their careful photographic plate measurements. We are also grateful to the U. S. Atomic Energy Commission for making available to us the He^3 gas used in these experiments. A detailed account of this work is in preparation.

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Positive Photomesons from Hydrogen at 0°

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HYDROGEN gas has been bombarded in a high pressure, low temperature target[1] by 322-Mev bremsstrahlung from the Berkeley synchrotron to produce π^+ mesons at 0±4 degrees to the beam. The mesons were bent out of the beam with a magnetic field. The mesons then passed through a lead channel and lead absorbers and were detected in Ilford C-2 200-micron emulsions (see Fig. 1). Data has been obtained for a photon energy of 278±4 Mev (corresponding to a meson kinetic energy of 135±4 Mev in the laboratory system). The absolute differential cross section in the center-of-mass system for the reaction $\gamma+p\rightarrow\pi^++n$ is

$$(d\sigma/d\Omega)(0°, 278\text{ Mev}) = (6.2_{-1.9}^{+2.6})\times10^{-30}\text{ cm}^2\text{ sterad}^{-1}\text{ quanta}^{-1}\text{ proton}^{-1}.$$

This value has been corrected for nuclear interaction in the gas and in the lead absorber, and for decay in flight. The bremsstrahlung spectrum used was corrected for synchrotron target thickness, collimation, and the energy variation in a circulating

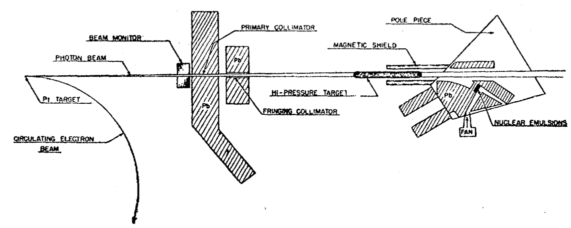

FIG. 1. Schematic diagram of experimental arrangement.

electron pulse. The pair production background at the detector was reduced by the use of a thick lead absorber that presented many shower lengths to the positrons. The beam monitor was carefully calibrated by the method of Blocker, Kenney, and Panofsky.[2]

This cross section may be combined with data at other angles for a 275-Mev photon[1] (see Fig. 2) to evaluate the constants in

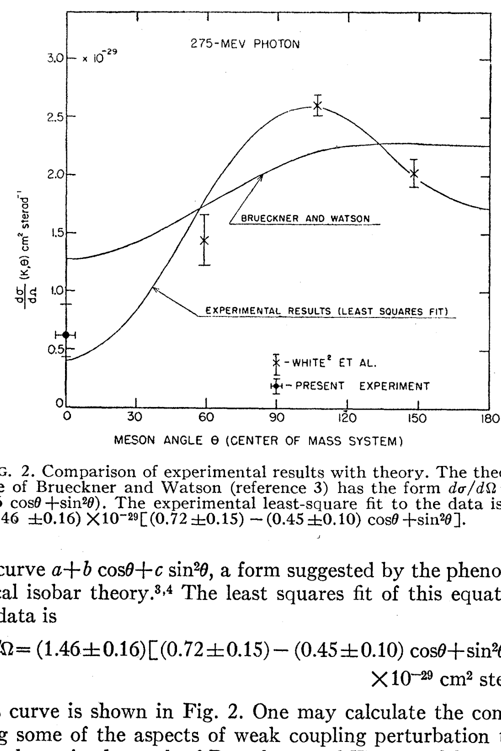

FIG. 2. Comparison of experimental results with theory. The theoretical curve of Brueckner and Watson (reference 3) has the form $d\sigma/d\Omega=C(5.5-1.6\cos\theta+\sin^2\theta)$. The experimental least-square fit to the data is $d\sigma/d\Omega=(1.46\pm0.16)\times10^{-29}[(0.72\pm0.15)-(0.45\pm0.10)\cos\theta+\sin^2\theta]$.

the curve $a+b\cos\theta+c\sin^2\theta$, a form suggested by the phenomenological isobar theory.[3,4] The least squares fit of this equation to the data is

$$d\sigma/d\Omega=(1.46\pm0.16)[(0.72\pm0.15)-(0.45\pm0.10)\cos\theta+\sin^2\theta]\times10^{-29}\text{ cm}^2\text{ sterad}^{-1}.$$

This curve is shown in Fig. 2. One may calculate the constants using some of the aspects of weak coupling perturbation theory as is shown in the work of Brueckner and Watson.[3] The result of this is also shown in Fig. 2. Integration of the experimental curve gives a total cross section of

$$\sigma(278\text{ Mev})=(2.5\pm0.5)\times10^{-28}\text{ cm}^2.$$

If one follows the work of Feld[4] and Brueckner and Watson,[3] and assumes that the process goes only by the admixture of a magnetic dipole photon into a total angular momentum state of $\frac{3}{2}$ and an electric dipole photon into a $\frac{1}{2}$ state (also assuming conservation of isotopic spin), the experimental data gives a value of 0.3 for the ratio of $\frac{1}{2}$ to $\frac{3}{2}$ states. A *P* state of the meson-nucleon system could also be formed by the absorption of an electric quadrupole photon. Mixing in this state would not change the form of the equation, $d\sigma/d\Omega=a(b+c\cos\theta+\sin^2\theta)$, but might