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by

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NUCLEAR REACTIONS PRODUCED BY 2 MeV Li^6 ON Be^9

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ABSTRACT. We have studied the reactions produced by 2 MeV Li^6 on Be^9.

Measurements with scintillators have shown that the most intense gamma rays are those from the first excited state of Li^7 and B^{10}.

Measurements with plates and junctions have shown several groups of alpha particles from the double stripping reaction $Li^6 + Be^9 = \alpha + B^{11}$.

Coincidences between the junction spectra and the 479 keV gamma ray indicate that the double stripping reaction leading to a higher state is the primary reaction followed by break up of B^{11} in $\alpha + Li^7$ or $N + B^{10}$.

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INTRODUCTION

The nuclear reactions produced by Li^6 ions on Be^9 have been the subject of several works. In a previous paper[1] we reported the observations of the gamma rays coming from this reaction. It was found that the most intense rays were those from the first excited states of Li^7 and B^{10}.

Leigh and Blair[2] have studied tha alpha particles produced in the double stripping reaction $Li^6 + Be^9 = \alpha + B^{11}$ and they identified and measured the angular distribution of α_0, α_1 and α_{2+3}. The sub-index denotes the corresponding state or states in B^{11}.

We report here the results that we have obtained in the study of this reaction during the last year.

MEASUREMENTS WITH SCINTILLATORS

We have studied the excitation function of the rays of 479 keV and 717 keV as a function of the energy of the Li^6. The yield increases rapidly and an analysis of the results showed that both were compatible with the Gamow factor.

We have measured the ratio of the yield of these two rays for a given energy in the same energy interval. This ratio can be measured with great precision because the two rays are registered at the same time in the 100 channel analyser. We found that this ratio was constant within 3 percent while the energy was changed from 1 to 2 MeV and the yield changed by more than a factor of 1000.

We have measured the Doppler-Fizeau effect of the 479 keV ray.

The scintillation counter was placed at 0° and 90° with respect to the beam. We found a positive displacement giving in the laboratory $\beta_L = (0.77 \pm 0.14) \times 10^{-2}$. The average energy of the Li^6 was of 1.8 MeV which corresponds to a speed of the center of mass of $\beta_o = 1.02 \times 10^{-2}$. As a result the Li^7 is emitted in the center of mass with a small mean velocity $\beta_c = -(0.25 \pm 0.14) \times 10^{-2}$.

MEASUREMENTS WITH NUCLEAR PLATES

Several measurements were made with nuclear plates. The irradiations were made with 13 plates evenly distributed between 17° and 108°.

The histograms have shown peaks corresponding to α_o, α_1, α_2, α_3, α_{4+5}, α_6 and α_7 produced in the reaction of double stripping of Li^6. We did not see the peaks corresponding to α_8, α_9 and α_{10}. In the region where α_{11} should appear, there is already a large background from the two-step reaction that will be described later and from the two peaks produced by the spurious reaction $Li^6 + H^1 = He^3 + He^4$.

MEASUREMENTS WITH JUNCTIONS

We have made observations of the charged particles with junctions.

The groups α_o, α_1, α_2 and α_3 have been identified. The energy resolution was enough to separate the last two. This is in agreement with the results of Leigh and Blair[2].

In the low energy region, the observations were masked by the

two strong peak of He^3 and He^4 coming from the spurious reaction.

Measurements were made of the charged particles in coincidence with the 479 keV gamma ray. These measurements were made from 30° to 115°. It was found that, at all the angles observed, there was a continuous spectrum of roughly constant intensity. This spectrum ended abruptly. The end point energies were transformed to the center of mass and gave a constant value of 3.94 ± 0.18 MeV. This is compatible with a mechanism taking place in two steps. First, there is the double stripping of the Li^6

$$Li^6 + Be^9 = \alpha + B^{11*}$$

where the B^{11*} is a highly excited state which can disintegrate either in $\alpha + Li^7$ or $n + B^{10}$.

If this mechanism is correct, we can calculate that the B^{11*} is left in an excited state of 12.5 MeV. This value is compatible, within the experimental error, with the known level at 13.16 MeV.

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