DISINTEGRATION OF ^{6}Li

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The disintegration of ^{6}Li nuclei was measured on silver targets at 22 MeV (lab). The measured total cross section of 175 ± 30 mb has to be compared with a theoretical value of 96 mb. The elastic scattering of ^{6}Li on Ag shows a large contribution of nuclear absorption.

The disintegration of ^{6}Li nuclei was the subject of recent experimental research at energies above the Coulomb barrier. The experimental results of the disintegration on gold[1] were explained from the theoretical point of view as a Coulomb break-up process.[2,3] It was assumed that the lithium nucleus is Coulomb excited and dissociates into its cluster components. Since the energy of the incident Li nuclei is higher than the Coulomb energy, a considerable contribution from nuclear break-up should be present. The same experimental results were explained by other authors as a nuclear break-up.[4] Measurements on target nuclei lighter than gold,[5] which were interpreted as mainly nuclear processes, show, however, somewhat different distributions.

The Coulomb break-up process was calculated by Wittern and Hansteen[6,7] using exact cluster wave functions for the ^{6}Li nucleus. They estimated absolute total cross sections for the break-up process on gold.

A beam of lithium ions is available at the tandem accelerator of the Max-Planck-Institut für Kernphysik at Heidelberg, covering the energy range between 5 and 26 MeV.[8,9] The break-up process of the ^{6}Li nucleus was investigated on silver. Alpha particles, deuterons, and protons were detected by means of a surface-barrier-detector telescope which limited the choice of targets. An α-particle spectrum measured at $\theta_{\text{lab}} = 110°$ and 22 MeV (lab) is shown in Fig. 1. Also, for the case of silver, estimates of the total cross sections were given.[10] To compare these estimates, an angular distribution is given in Fig. 2. The total cross section measured is 175 ± 30 mb, whereas the number given by Wittern is about 96 mb. The difference may be explained by the fact that our measurements, done at the Coulomb energy, were influenced by a considerable contribution of nuclear break-up. This influence is also shown for the elastic scattering of ^{6}Li from Ag, which deviates considerably from the Rutherford cross section (also shown in Fig. 2). We found that the sum of protons and deuterons, integrated over all angles, is about the same as the number of α particles detected. The shape of the angular distribution agrees well with the predictions for a Coulomb process,

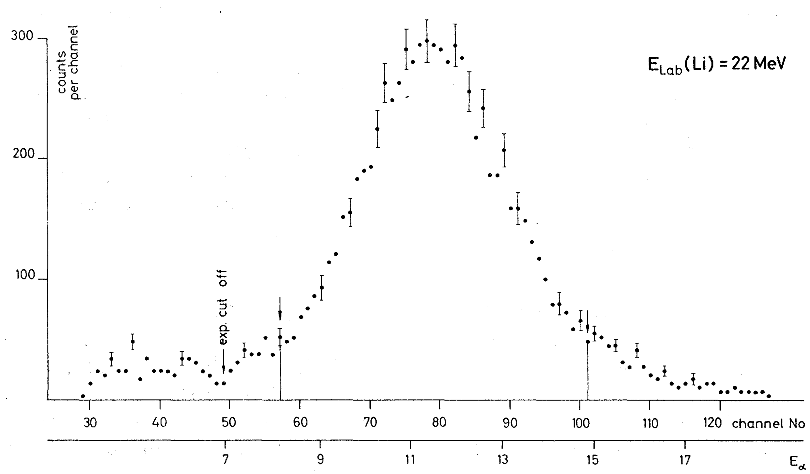

FIG. 1. Alpha-particle spectrum, measured at $\theta_{\text{lab}} = 110°$. The vertical bars show the kinematical energy range which were used to calculate the cross section. The point "experimental cutoff" marks the energy of α particles which do not penetrate the dE/dx detector.

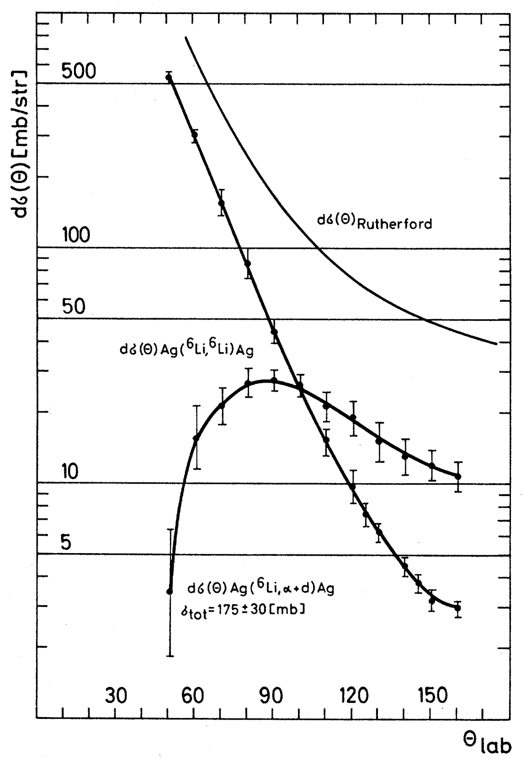

FIG. 2. Angular distribution of α particles from the break-up process of ^{6}Li on silver, angular distribution of elastically scattered ^{6}Li, and the calculated Rutherford cross section. The solid lines through the experimental points are connections only.

as shown earlier by Breit.[2]

The measurements will be extended to an energy range far below the Coulomb barrier to prove the theory on Coulomb break-up, which gives a tool to prove the cluster model of the nucleus.

We are greatly indebted to Professor Gentner for making the tandem facilities available, as well as to Professor Haxel for his kind support of our work. We also would like to express our thanks to G. Brommundt and H. Schmidt who operated the lithium ion source.

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MATTER, ANTIMATTER, AND THE ORIGIN OF GALAXIES*

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Baryon inhomogeneities in the early high-density universe may account for the origin of galaxies. Any such inhomogeneity is amplified by baryon-pair annihilation as the universe expands and can eventually result in the formation of galaxies and antigalaxies. This process is more efficient than the usual process which assumes that the initial conditions of a structured universe are density fluctuations.

Symmetry between particles and antiparticles has inspired the suggestion that there is a particle-antiparticle population symmetry and the universe consists equally of matter and antimatter.[1] A major difficulty with this suggestion is the problem of explaining how structures as large as stars or galaxies can form in a particle-antiparticle medium. Furthermore, Chiu[2] shows that as the universe expands only a negligible fraction of the baryons survive pair annihilation. Both these difficulties are overcome if we assume that in the early condensed state of the universe the particle composition is not perfectly homogeneous. It is then possible for separate regions of matter and antimatter to survive and form the foundations of a structured universe.

At very high density the particle-interaction