Letters to the Editor

THE REACTION (α, t) ON Li^7, Be^9, *AND* Na^{23}

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Submitted to JETP editor July 23, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **39**, 1468-1470 (November, 1960)

SEVERAL reports[1-3] have appeared recently on the investigation of the reactions (p, α), (α, p), (d, α), etc. The angular distributions of the particles in these reactions recall in many cases the Butler curves, and it is therefore sometimes concluded that these reactions proceed via stripping or pickup. However, it is impossible to draw final conclusions concerning the mechanism of these reactions from the form of the angular distribution, which is the same for all direct processes. It may be that a comparison of the probabilities of excitation of the same states in the investigated reaction and in a reaction of known mechanism [for example (d, p) or (d, n)] is more sensitive to the mechanism of the process.

We have investigated the reaction (α, t) on the nuclei Li^7, Be^9, and Na^{23} at α-particle energies of 40 Mev over a broad interval of excitation energies. The residual nuclei Be^8, B^{10}, and Mg^{24} were obtained also in the stripping reaction (d, n),[4-5] and in the pickup reaction (d, t).[6-7] The reaction (α, t) has heretofore been investigated only in individual cases.[8-10]

The triton spectra were determined, as in the investigation of the (d, t) reaction[6] from the activity of the tritium accumulated in stacks of foils located around the target. The targets used were foils made of the investigated elements, 4 mg/cm² thick.

Figure 1 shows typical angular distributions of tritons in the reaction (α, t).

Figure 2 shows the triton spectra at small angles. In all three cases lines corresponding to many different states of the residual nuclei are observed. The angular distributions of most of the groups are well described by the square of the spherical Bessel function $[j_{l+\frac{1}{2}}(qR_0)]^2$, and the value of the orbital momentum of the captured proton is almost always in agreement with the values of the spins and parities of the investigated levels. The value used here for the radius R_0 coincides with that obtained from the stripping reaction on these nuclei.

In Figure 3 are compared the probabilities of excitation of the same levels of the final nuclei in the reactions (α, t), (d, n), and (d, t). A comparison of the reactions (α, t) and (d, n) on Na^{23} for levels with energy greater than 5 Mev must be made with caution, since transitions with $l = 0$, which are observed in this region in the reaction (d, n), may not be noticed in the reaction (α, t).

The great difference between the reaction (α, t) and (d, t) is not surprising, for in the (d, t) reaction it is the hole levels that are predominantly excited. But the spectra of the (α, t) reaction also differ greatly from the spectra of the reaction (d, n), in which, as in the (α, t) reaction a proton is captured. This means that in the (α, t) reaction the single-particle proton levels are not excited predominantly, as in the (d, n) reaction, and the mechanism of the (α, t) reaction differs appreciably from the stripping mechanism of the (d, n) reaction.

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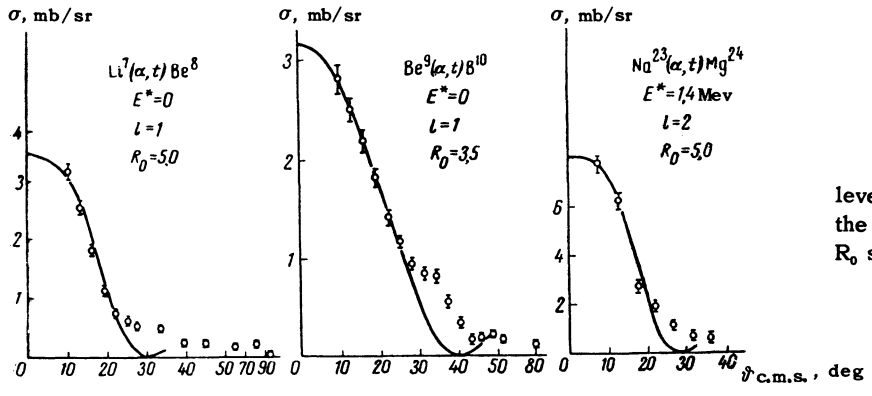

FIG. 1. Angular distributions of tritons. E* – level of residual nucleus. Solid curve – square of the spherical Bessel function for values of l and R_0 shown in the figure.

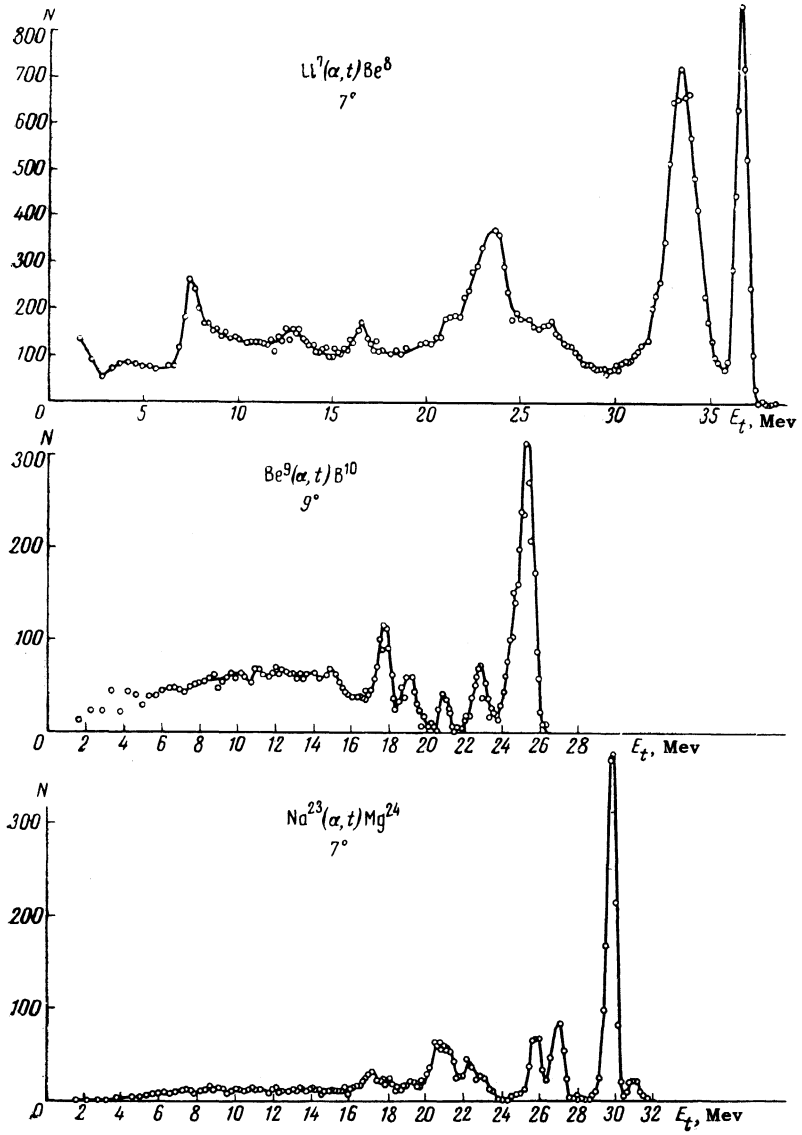

FIG. 2

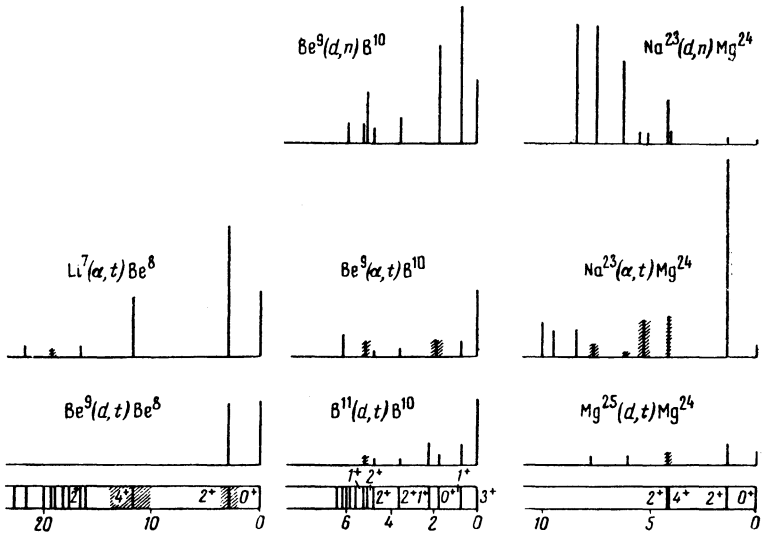

FIG. 3. Probabilities of excitation of the levels of the nuclei Be^8, B^{10}, and Mg^{24} in the reactions (d, n), (α, t), and (d, t). The ordinates represent the values of the differential cross section at the maximum [for the reactions (α, t) and for Na^{23}(d, n)Mg^{24}], and the reduced widths [for the reactions (d, t) and Be^9(d, n)B^{10}].

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Translated by J. G. Adashko
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ANISOTROPY OF THE EVEN PHOTOMAGNETIC EFFECT IN n-TYPE GERMANIUM AT LOW TEMPERATURES

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Submitted to JETP editor August 20, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **39**, 1471-1473 (November, 1960)

THE anisotropy of the even photomagnetic emf observed in germanium[1] is at room temperatures satisfactorily described by the phenomenological equations of Kagan and Smorodinskiĭ[2] right up to magnetic fields of 20,000 oe.

A study of the temperature dependence of the even photomagnetic effect showed that at low temperatures its anisotropy becomes anomalous. The investigation was performed on single crystal specimens of n-type germanium.

The orientation of the crystal axes and the direction in which the even photomagnetic emf was measured were chosen in such a way that only the anisotropic component was measured.[3] In order to do this the specimen which was cut in the form of a circular disc was mounted such that the [111] axis coincided with the normal **n** to the illuminated surface. If we take the direction of the magnetic field H to be along the x axis, and the direction of the light ray along the y axis, we measured the even photomagnetic emf in the z direction. The odd photomagnetic emf which occurs along the same direction was eliminated by measuring for two opposite directions of the magnetic field. Under those conditions the expression for the even photomagnetic emf E_q is of the form (see also reference 3)

$$E_q = \frac{1}{3\sqrt{2}} LH^2 \sin^2\theta \cos 3\varphi, \qquad (1)$$

if we assume that the above mentioned phenomenological equations can be applied; in Eq. (1) φ is the angle over which the specimen is turned around the normal **n**, θ the angle between the normal **n** and z (the direction of the magnetic field), and L a material constant.

The specimen studied could be rotated both in its own plane around the normal **n** (to change the angle φ) and also around the z axis (to change the angle θ).

The dependence of the even photomagnetic emf on the angle φ (which at the same time determines the anisotropy) which was obtained at liquid nitrogen temperatures agreed completely with Eq. (1), as it does at room temperatures. As far as the dependence of this emf on the angle θ is concerned, at a temperature of 78°K it is essentially different from that at room temperature ($\sin^2\theta$). The dependence is depicted in Fig. 1 where along the ordinate axis the extremum values of the even photomagnetic emf are given which correspond to $\varphi = \pi/3, 2\pi/3, \ldots$. The different

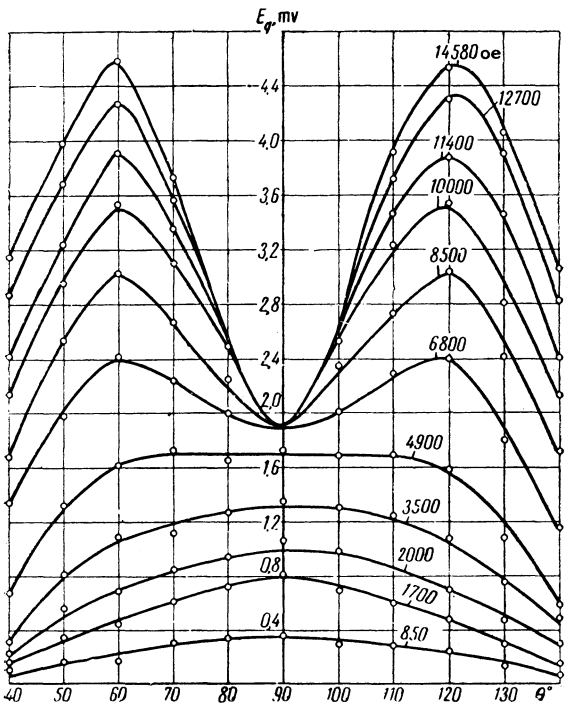

FIG. 1