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[1)] The orbital d-state of the electron splits in the cubic field O_h into two levels of the e and t type, of which the e level (Γ_3^+) is the lower one in the case of eightfold ($8F^-$) coordination of the ion. When the electron spin is taken into account ($D^{(1/2)}$), the symmetry of the lower level is $F_3^+(e) \times D^{(1/2)} = \Gamma_8^+$.

PICKUP OF A DEUTERON AND AN α PARTICLE IN THE INTERACTION BETWEEN B^{10} AND O^{16}

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A rather large number of four-prong stars was observed in a study of the interaction between B^{10} ions and emulsion nuclei, three of the prongs being tracks of α particles and the fourth the track of a heavier particle.

Type NIKFI-D nuclear emulsions 400 μ thick were bombarded with B^{10} ions accelerated to 100 MeV in the linear multiply-charged-ion accelerator of the Ukrainian Physico-technical Institute. The B^{10} ions entered the emulsion in an angle of 25° to the surface. The emulsions made possible a reliable visual discrimination between tracks of singly-charged and doubly-charged particles and of heavier nuclei. Since the initial ion energy is known, it is possible to determine the energy at which the reaction took place by measuring the range of the B^{10} ion. The visual selection and subsequent detailed kinematic analysis, carried out with an "Ural-2" computer made it possible to identify 252 stars due to the reaction

$$O^{16} + B^{10} \rightarrow N^{14} + 3\alpha - 2.8 \text{ MeV}$$

The excitation function of this reaction is shown in Fig. 1. Not a single case of this reaction was found when the energy of the bombarding ions was less than 25 MeV. The cross section at the maximum reaches 111 mb.

The angular distributions of the N^{14} nuclei produced in the reaction, plotted in Fig. 2, has in the c.m.s. two rather well pronounced maxima in the region of small and large angles, reaching 20 and 14 mb/sr, respectively.

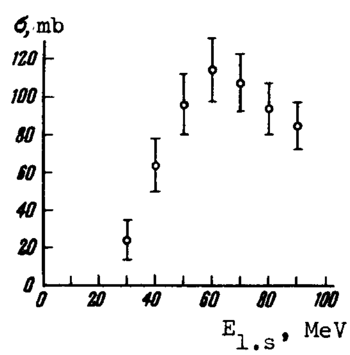

Fig. 1. Excitation function of the reaction $O^{16} + B^{10} \rightarrow N^{14} + 3\alpha - 2.8$ MeV (the B^{10} energy is in the laboratory system).

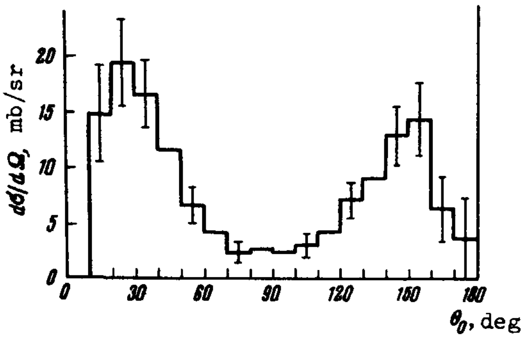

Fig. 2. Angular distribution of the nuclei N^{14} (in the c.m.s.), averaged over the bombarding ion energies from 25 to 95 MeV.

The maximum in the small-angle region is due to a reaction mechanism in which an α-particle complex is picked up from the O^{16} nucleus by the incident B^{10} ion. The α-particles are captured here in the ground state of the N^{14} nucleus. This reaction mechanism corresponds to the stars in which the N^{14} nucleus has a relatively large range in the emulsion while the α particles have relatively small ranges. The velocity of the N^{14} nucleus in these stars agrees with the velocity of the initial B^{10} ion.

The C^{12} nucleus produced when the O^{16} nucleus loses the α particle remains in this case in an excited state in the 10 - 20 MeV region and dissociates into three α particles. The decay of the C^{12} nucleus into three α particles proceeds principally via the ground and first-excited states of the Be^8 nucleus. In some cases the decay of C^{12} proceeds via the second excited state of Be^8.

The maximum in the large-angle region is apparently due to a reaction mechanism in which the incident B^{10} ion picks up a deuteron complex from the O^{16} nucleus. The N^{14} nucleus, which is in this case the remnant of the O^{16} nucleus, may remain unexcited. Like the O^{16} nucleus, it will move backward in the c.m.s. and may enter the angle region where a maximum is observed in the angular distribution. After picking up the deuteron, the B^{10} ion can form a strongly excited C^{12} nucleus, corresponding to an initial configuration (B^{10} + d) which dissociates into three α particles after the realignment of the nucleons. This reaction mechanism corresponds to stars in which the N^{14} nucleus has a relatively short range in the emulsion, while the α particles are relatively long-range.

The excitation energies of the C^{12} nuclei observed in these cases exceed 25 MeV as a rule, and reach 40 - 45 MeV. The C^{12} nucleus decays directly into three α particles without interaction between them, or else via Be^8 states with excitation energy larger than 20 MeV.

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