THE (p, d) REACTION AND INELASTIC SCATTERING OF PROTONS ON Be^9

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Submitted to JETP editor December 13, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) 38, 1663-1664 (June, 1960)

Angular distributions of protons inelastically scattered by Be^9 nuclei and of deuterons from the $Be^9(p, d)Be^8$ reaction were measured for incident proton energies of 6.8 Mev.

DESPITE the many measurements of the angular distribution of inelastically scattered particles which have been made on Be^9 nuclei[1-7] and the other experiments to determine the spin and parity of the level in Be^9 at 2.43 Mev, these parameters are still not established uniquely. At the same time, they play a decisive role in the choice of a model for the Be^9 nucleus. We have carried out measurements in the external beam of the cyclotron of the Physics Institute of the Ukr. S.S.R. Academy of Sciences for a proton energy of 6.8 Mev and with the same geometry as in reference 8. The difference was that in place of deuterons, hydrogen molecular ions were brought to the target and the ionization chamber was replaced by a scintillation spectrometer. The thickness of the beryllium target was 1.4 mg/cm^2. The target was prepared by vacuum deposition.

In Fig. 1 we show the angular distribution obtained for the inelastically scattered protons (solid curve 1). It is characterized by a broad maximum in the region of angles 80 — 90° and an increase of the reaction cross section at small angles; the latter shows that the direct reaction mechanism plays an important part.

The dashed curve 2 in Fig. 1 shows the results of computations for the case of direct interaction of the incident proton with a nucleon in the nucleus[9] for $r_0 = 4 \times 10^{-13}$ cm. Calculations for the case of direct excitation of rotational levels in the alpha particle model[10] are shown in the same figure by the dashed curve 3 (assuming $r_0 = 5.6 \times 10^{-13}$ cm). In the first case the parity of the 2.43-Mev level must be positive while for the second it must be negative. In both cases the comparison of the theoretical and experimental results can hardly be considered satisfactory and consequently the parity of the state cannot be established uniquely. In addition, neither theory explains the increase in cross section at small angles. This is apparently related to electrical interaction of the proton with the nucleus.[11]

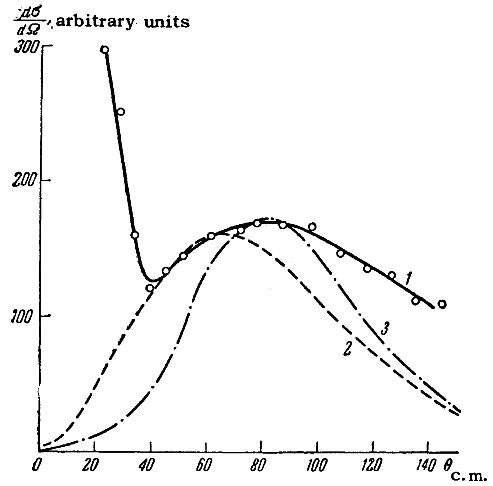

FIG. 1

The angular distribution of deuterons from the $Be^9(pd)Be^8$ reaction is shown in Fig. 2 by the solid curve 1. Here also for comparison we give the results of calculations for the case when the incident proton interacts only with the unpaired neutron[12] (dashed curve 2) and the results of computations in the Born approximation[13] (curve 3); the curves are adjusted at 20°. In both cases the orbital angular momentum of the neutron was taken equal to unity in accordance with the known values of the spins of the ground states of Be^9 and Be^8 ($3/2^-$ and 0^+).

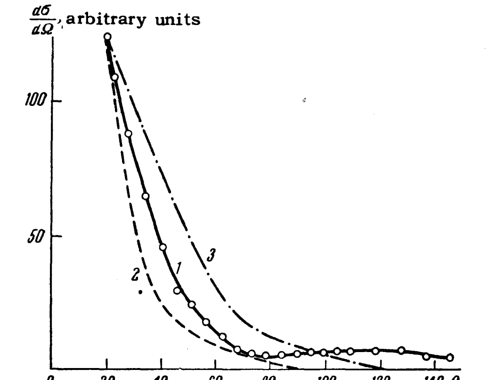

FIG. 2

The angular distribution found for the deuterons is in agreement with the results of work carried out for other proton energies.

The authors take this opportunity to express their gratitude to Professor M. V. Pasechnik for his interest in the work, to Yu. A. Bin'kovskii for preparing the target and to the personnel of the cyclotron laboratory for making possible uninterrupted operation of the apparatus.

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Translated by M. Hamermesh
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