

B3 Three-Body Break-up of Light Elements Induced by Low Energy Hydrogen and Helium Ions

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This report presents a part of the experimental and theoretical study of low-energy proton, deuteron and ^3He induced reactions on light elements, being conducted in the Nuclear Reactions Laboratory of our Institute.

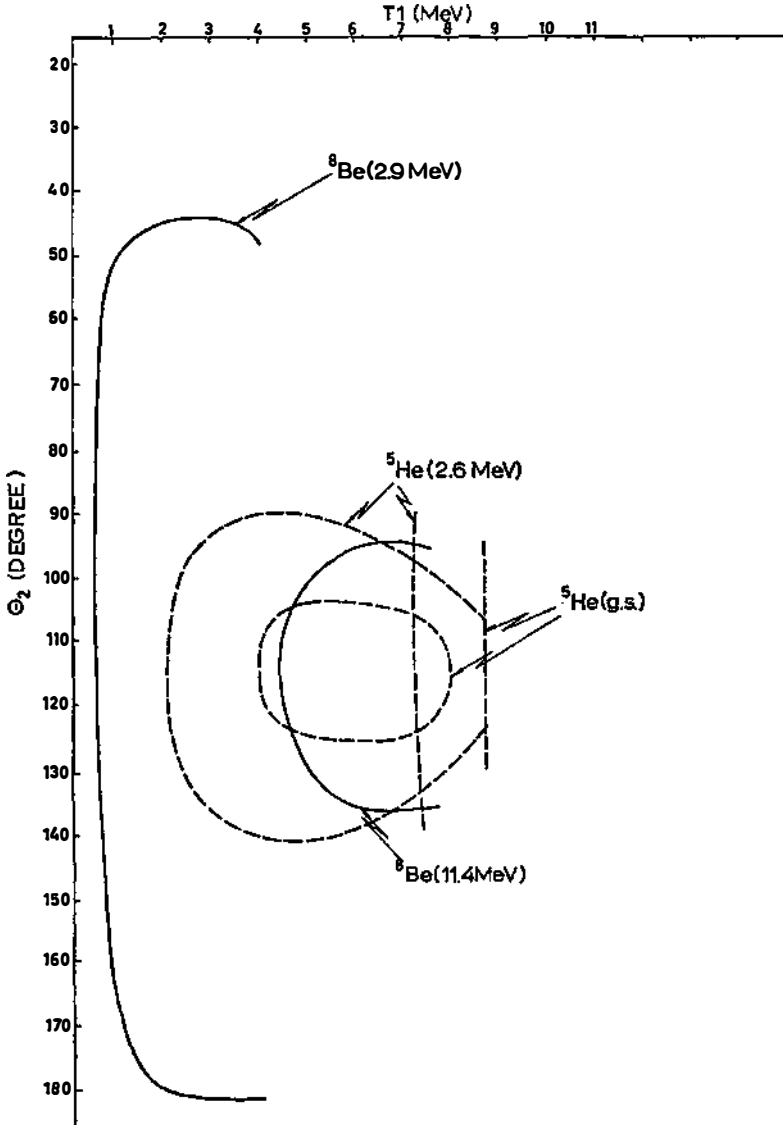


Fig. 1. The position of the resonances in the intermediate α - α (solid line) and α - n (broken line) system for the $d + {}^7\text{Li}$ reaction.

A scattering chamber for the coincidence measurement of the momenta of two outgoing particles was constructed. Three surface barrier detectors were mounted in the chamber allowing simultaneous measurement of three pairs of coincidences. The electronic circuit was a standard fast-slow coincidence arrangement, while a $100 \times 100 \times 100$ channel analyser was used to analyse the data. Special attention was paid to energy and angular calibration for which

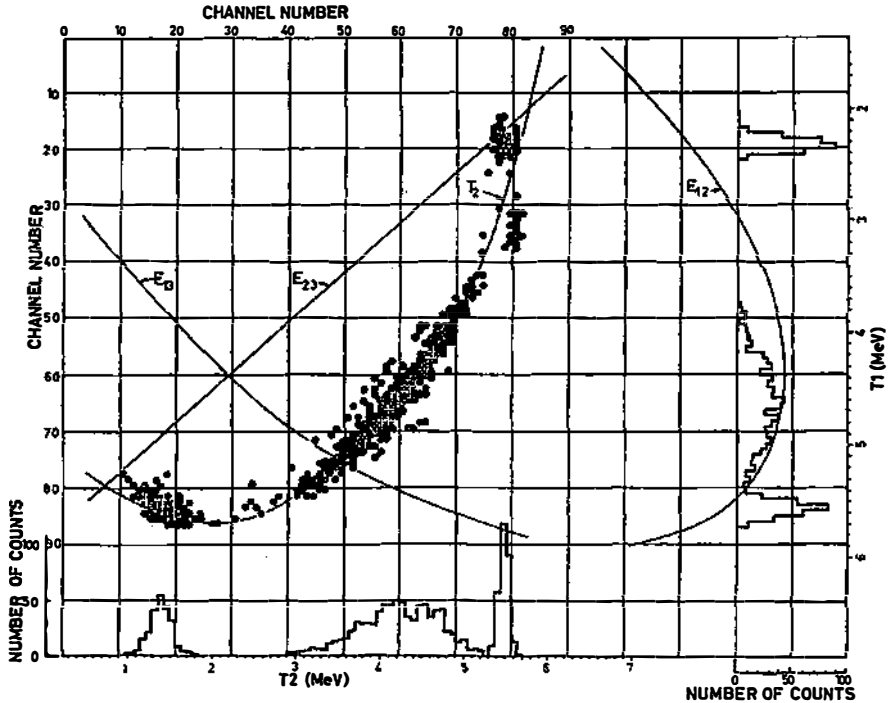
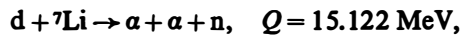


Fig. 2. Two-parametar spectra for the $p + {}^{11}\text{B}$ reaction for $\theta_1 = 90^\circ$ and $\theta_2 = 85^\circ$ with both detectors in the plane containing the beam axis.

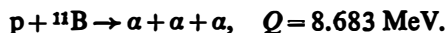
several two-body reactions: $d + d \rightarrow p + t$, $p + {}^7\text{Li} \rightarrow \alpha + \alpha$, $d + {}^6\text{Li} \rightarrow \alpha + \alpha$ were used. A computer programme was devised to search five-dimensional space under the experimental conditions to isolate any specific effects in reactions with 3 particles in final state. For example, Fig. 1 shows one of the outputs for the reaction



which indicates the position of the resonances in the intermediate $\alpha-\alpha$ and $\alpha-n$ systems, assuming that the reaction proceeds as a sequential decay. This

reaction was studied in detail at higher energies³⁾ and further study was recommended. A number of specific experimental problems had to be solved, including the preparation of Li targets. Our preliminary data indicate a strong sequential decay through ^5He and ^8Be states.

There is a large number of experimental studies and theoretical discussions (see ref.⁴⁾) on the reaction



Most of the experiments suggest that it proceeds through ^8Be intermediate states.

A typical two-parameter spectrum for $\theta_1 = 90^\circ$ and $\theta_2 = 85^\circ$ obtained in our measurement is shown in Fig. 2. The spectrum is dominated by peaks corresponding to the sequential decay through ^8Be states. A detailed study should be made of the measured spectra to obtain information on the mechanisms involved. Several previous analyses⁴⁾ have suggested the influence of ^{12}C resonances on spectrum shape. However, several other mechanisms need to be included. Work on clarifying the three-body break-up reactions on light nuclei starting from the cluster structure of light nuclei and graph summation method⁵⁾ is in progress.

References

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- 3) V. Valković, W. R. Jackson, Y. S. Chen, S. T. Emerson, and G. C. Phillips, *Nucl. Phys.* A96 (1967) 241;
- 4) Conference on Correlations of Particles Emitted in Nuclear Reactions, *Rev. Mod. Phys.* 37 (1965) 327;
- 5) G. V. Skornyakov and K. A. Ter-Martirosyan, *JETP* 31 (1965) 775; V. V. Komarov and A. M. Popova, *Nucl. Phys.* 54 (1964) 278.

B4 Nucleon-Nucleon Interaction in the Scattering of Deuterons, ^3He and ^4He
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