Contribution ID: **143** Type: **not specified**

STUDYING THE INTERACTION OF DEUTRONS WITH 13C NUCLEI AT AN ENERGY OF 18 MEV

The states of the p-shell nucleons of the ¹³C nucleus of negative parity and the sd-shell nucleons of positive parity, taking into account their connection with the ground and first excited states of the ¹²C nucleus, are correctly described within the framework of the shell model. Some alpha cluster levels appear at higher excitation energies in the region of the corresponding thresholds. Available detailed information on ¹³C energy levels up to 10 MeV is presented in [1].
Hoyle states studied in detail on "Nα"nuclei, for example, the second excited state ¹²C (0₂⁺ at E* = 7.65 MeV) [2], can also exist on neighboring nuclei [3]. In the case of the ¹³C nucleus, the valence neutron can be associated with the ¹²C core, which is the Hoyle state. Such states have spin ratios of 1/2⁻ and 1/2⁺, lie near the «¹²C(0₂⁺) + n» (12.60 MeV) threshold and can exhibit features characteristic of this cluster configuration.
To carry out such studies, the differential cross sections of nuclear reactions ¹³C(d,d)¹³C, ¹³C(d,t)¹²C and ¹³C(d,p)¹⁴C were measured at the U-150M isochronous cyclotron of the Institute of Nuclear Physics (Almaty) at an energy of 18 MeV.
After processing the measured energy spectra of the above reactions, differential scattering cross sections were obtained for the following levels of the ¹³C nucleus: Jπ = 1/2⁻, 0.0 MeV; Jπ =1/2⁺, 3.09 MeV; Jπ = 3/2⁻, 3.68 MeV and Jπ = 3/2⁺, 6.86 MeV. The differential cross sections ¹³C(d,t)¹²C were obtained for the following levels of the ¹²C nucleus: Jπ = 0⁺, 0.0 MeV; Jπ = 2⁺, 4.44 MeV and Jπ = 0⁺, 7.6 MeV. The differential cross sections ¹³C(d,p)¹⁴C were obtained for the following levels of the ¹⁴C nucleus: Jπ = 0⁺, 0.0 MeV; Jπ = 1⁻, 6.09 MeV; Jπ = 3⁻, 6.72 MeV and Jπ = 2⁻, 7.34 MeV.
The analysis of data on elastic scattering of deuterons on ¹³C nuclei at an energy of 18 MeV was carried out within the framework of the optical model of the nucleus. Three sets of optical potentials have been established (shallow, medium and deep), which describe the experimental data equally well.
In the future, using these sets of optical potentials, a comprehensive analysis of the differential cross sections for the nuclear reactions ¹³C(d,d)¹³C, ¹³C(d,t)¹²C and ¹³C(d,p)¹⁴C will be performed within the framework of the coupled channel method.
Acknowledgments. This work is funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant# BR24992891 "Integrated research in nuclear, radiation physics and engineering, high energy physics and cosmology for the development of competitive technologies").

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Section

Nuclear physics (Section 1)

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Track Classification: The V International Scientific Forum "Nuclear Science and Technologies": Nuclear physics (Section 1)