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EXPERIMENTAL STUDY OF $^{10}B(p,\alpha)^{7}Be$ REACTION AT LOW ENERGIES

Abctract. Differential process sections of the $^{10}B(p,\alpha_0)^{7}Be$ have been measuredat the UKP-2-1 accelerator (Almaty, Kazakhstan) at the energy of incident protons from 300 to 1000 keV and $\theta_{lab.}$= 50°-140°inincrementsofabout 20°. The total error of the experimental data does not exceed 30%. Integral cross sections of the reaction $^{10}B(p,\alpha_0)^{7}Be$ at $E_{p,\ lab.}$=300-1000 keV were defined. S-factors for the $^{10}B(p,\alpha_0)^{7}Be$ reaction at $E_{p,\ lab.}$=300-1000 keV were calculated, which will be useful for reliable normalization of the experimental data obtained by the "Trojan horse" method in earlier works.

Keywords: differential cross sections, integral cross section, astrophysical S-factor.

Introduction. The $^{10}B(p,\alpha_0)^{7}Be$ breakup reaction occurring at low energies attracted much attention of researchers in recent yearsmostly due to the fact that it plays an important role in fields such as nuclear physics, fusion plasma physics and astrophysics.

Boron in the Earth crust consists of two isotopes ^{11}B (abundance of about 80%) and ^{10}B (abundance of about 20%). Both isotopes are candidates to alternative fuel for future fusion reactors, one of the main advantages of which is the absence of neutrons in output channels for reactions with these nuclei. On the other hand, the reaction product of $^{10}B(p,\alpha_0)^{7}Be$ is a radioactive element ^{7}Be with a sufficiently long half-life of 53.2 days, and this creates a certain safety problem. New precision measurement of $^{10}B(p,\alpha_0)^{7}Be$ reaction crosssectionsmay have a significant impact on the design features of future fusion power plants.

From the view of nuclear physicsthe $^{10}B(p,\alpha_0)^{7}Be$ reaction is of interest as it can be used to study in detail the level scheme of ^{11}C nucleus.

Experimental results for the $^{10}B(p,\alpha_0)^{7}Be$ reaction at low energies are very few and contradictory. Thus, in [1] the obtained integral section of the reaction at $E_{p,\ lab.}$=21-146 keV, in [2] – at $E_{p,\ lab.}$=60-180 keV, in [3] – to $E_{p,\ lab.}$=121-460 keV, in [4] – at $E_{p,\ lab.}$=531-1613 keV, in [5] – at $E_{p,\ lab.}$=330-530 keV and in [6] – at $E_{p,\ lab.}$=2790-6995 keV. And the cross sections of [1] and [3] differ 1.8 times [1] in the overlapping region.

The problem of solving the above mismatch between [1] and [3], as well as more reliable normalization of the experimental data obtained bythe"Trojan horse" method [7] require new measurement of the $^{10}B(p,\alpha_0)^{7}Be$ reaction cross sections in broad energy and angular range.

Experimental methods and measurement results. Measurements of the $^{10}B(p,\alpha_0)^{7}Be$ reaction differential cross sections were made on the proton accelerator UKP-2-1 at INP. Calibration of proton beam energy was carried out by using reactions with narrow, well-isolated resonances [8,9]. For this purpose the reactions $^{27}Al(p,\gamma)^{28}Si$ at $E_{p,\ lab.}$=632, 773, 992, 1089 keV and $^{19}F(p,\alpha\gamma)^{16}O$ at$E_{p,\ lab.}$=340 keV were used. Calibration accuracy in this case was ±1 keV. The energy spread of the proton beam did not exceed 1.2 keV.