Study of the reactions between light nuclei at ultralow energies using high power plasma accelerators

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The investigation of strong interactions between light nuclei at keV energy level is of great importance for basic nuclear and astrophysical studies, because it could provide a direct verification of fundamental symmetries: such as charge symmetry, isotopic invariance, input of the meson currents, effect of nuclei screening, etc. It could also help in the solutions for the number of astrophysical problems.
For this reason it is necessity to measure the astrophysical S-factors and cross sections of the reactions between light nuclei (pd, dd, d ^{3}He and d ^{6}Li-reactions) with purpose of cleaning out many questions existing both in astrophysics and in nuclear physics.
Research of the given processes in the ultralow energy region is rather problematic since intensity of the beams of the accelerated particles produced by classical accelerators are extremely low ($I \approx 10^{12} - 10^{13}$ s^{-1}), and cross sections of these nuclear reactions in the astrophysical energy region are extremely small (10^{-39} - 10^{-33} cm^2).
An impetus to the current intensive study of indicated above reactions has become the possibility of for these purposes using pulsed high-current plasma accelerators [1]. Plasma accelerators with the liner plasma formation in the direct and inverse Z-pinch configuration and with closed Hall current pulse ion source allowed to receive the quantitative
information on the astrophysical S-factors and effective cross sections of the pd and dd reactions (pd$\rightarrow$ ^{3}He + γ; dd$\rightarrow$^{3}He +n) in the energy region 2 – 12 keV.
The results obtained indicate that, on the one hand, the technique proposed by us is worthy and can be effectively used to study nuclear reactions in the astrophysical energy region [2-4] and, on the other hand, can be considered as a basis of the nuclear-physics diagnostics of plasma processes.

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2. V.M. Bystritsky , V.V. Gerasimov, A.R. Krylov *et al.*, Physics of Atomic Nuclei 66 (2003) 1731.
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