

PROMPT GAMMA AND NEUTRON SPECTROMETRY OF INTENSE NANOSECOND ION BUNCHES COLLECTIVELY ACCELERATED IN A LUCE DIODE

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Instantaneous time-of-flight spectrometry of neutrons (nToF) and γ -spectrometry from nuclear reactions generated by nanosecond proton and ^{12}C ion bunches collectively accelerated in a Luce diode at a voltage across the diode of 250-300 kV has been thoroughly researched. A two-channel γ -spectrometer with time resolution of 2.5 ns enables a prompt control of number and energy of collectively accelerated protons in their separate bunches dumped into a sustainable and refractory B_4C target. Combination of nuclear reactions $^{10}\text{B}(p,\alpha\gamma)^7\text{Be}$, $^{12}\text{C}(p,\gamma)^{13}\text{N}$, and $^{11}\text{B}(p,\gamma)^{12}\text{C}$ was used to characterize the intense nanosecond (≤ 5 ns) proton bunches with energy and number per shot in excess of 500-750 keV and $6 \cdot 10^{14}$, respectively. The simultaneous control of signals from two organic scintillators shielded with lead layers of 1 and 7 cm was used to reliably separate contributions of the analytical reactions. The radioactivity of ^7Be and ^{13}N radionuclides produced in the reactions is measured with a conventional HP Ge detector to calibrate the prompt technique [1].

The threshold nuclear reactions $^{11}\text{B}(p,n)^{11}\text{C}$ and $^2\text{H}(^{12}\text{C},n)^{13}\text{N}$ were used to perform nToF spectrometry of high-energy proton bunches (up to $3 \cdot 10^{11}$ per shot) with energy higher than 3.02 MeV [2] and ^{12}C ion bunches of $0.5\text{-}25 \cdot 10^{12}$ per shot and energy of 4-7 MeV [3]. The nToF spectrometry was also used to study the collective acceleration of deuterons [4] and helium-4 ions by use of nuclear reactions $^{10,11}\text{B}(d,n)^{11,12}\text{C}$, $^{12}\text{C}(d,n)^{13}\text{N}$ and $^{10,11}\text{B}(\alpha,n)^{13,14}\text{N}$, respectively.

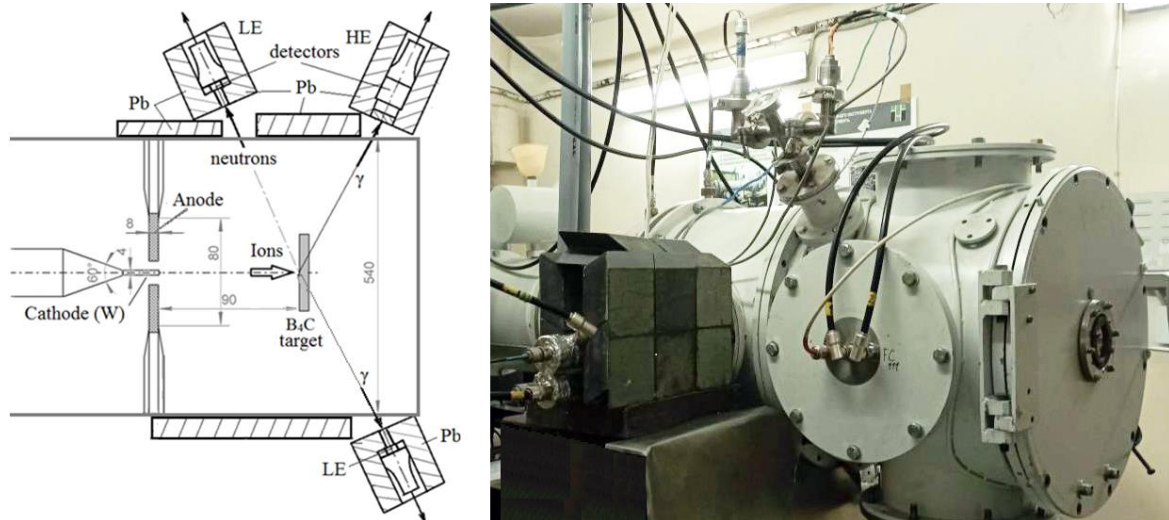


Fig.1. Scheme of registration of γ -rays and ToF neutrons from the threshold nuclear reaction $^{11}\text{B}(p,n)^{11}\text{C}$

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