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Registration of the neutron flux in the experiment on particle acceleration by a laser field

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The problem of diagnostics of electron reaction products obtained in experiments on particle acceleration by a laser field was solved. Accelerated electrons were obtained by the interaction of a laser pulse with a flowing gas target. The central wavelength of the laser pulse is 800 nm, the duration is about 50 fs, and the repetition rate is 10 Hz. The energy on the target reaches 60 mJ. Due to the fact that the diagnosis by registering gamma quanta is difficult due to the multiple nature of the particles huge number birth within a short period of time (50 fs), the diagnosis was carried out through the photoneutron birth channel from the target-converter by the time-of-flight method. Neutrons were recorded using cylindrical scintillation detectors based on crystalline trans-stilbene with dimensions of 20x20 mm (1 piece) and 40x40 mm (2 pieces), located at distances from 1.5 to 2.7 m from the converter target.

Data accumulation was carried out synchronously with the laser operation. The response of all three detectors was recorded for each pulse. Next, neutron events were selected by analyzing the detectors response according to the pulse shape and the time of the pulse registration relative to the laser pulse. To increase the threshold for neutron energy registration, digital signal processing was used, which made it possible to detect a response from neutrons against the background of a decrease in the overload of the detector with a primary pulse of gamma quanta. This made it possible to reduce the time threshold for neutron registration to 200 ns on a fixed detector base, which is equivalent to the threshold for neutron registration of 250, 450, 1050 keV, respectively.

Distributions of candidate events by registration time were constructed taking into account the released energy, which makes it possible to estimate the spectrum of registered neutrons, which makes it possible to estimate the energy of processes during particle acceleration by a laser field.

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