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Neutron spectra emitted from the lead target irradiated by 660 MeV protons

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Abstract

Preliminary experimental results of research in distribution of the neutrons emitted at 60° from a lead target exposed to a 660 MeV proton beam are presented.

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Keywords: Phasotron; Proton beam; Neutron spectra

This work is part of the JINR programme for systematic research in the angular and energy distributions of the nucleons emitted from massive targets at energy of initial protons in the interval of (0.6–2.0) GeV [1,2]. The research of the spectra is needed to design nuclear reactors of new generation with a subcritical assembly driven by external proton beams of high energy and intensity.

Here, we present preliminary experimental results of research in distribution of the neutrons emitted at 60° from a cylindrical lead target ($80\varnothing \times 300\,mm^2$) exposed to a 660 MeV proton beam [3].

The measurements were done for the neutron spectra energy ranging from 50 to 200 MeV. In the experiment the neutrons emitted at 60° from the target were selected by collimator 1 (see Fig. 1), anti-coincidence counters A1, A2 and then they were scattered by an additional CH_2—target (T).

Secondary products of the interaction were registered with a neutron detector system *n*, A2, charge particle counters P1, P2 and a total energy absorption detector NaJ (Tl). All the detectors were arranged in accordance with the elastic np-scattering kinematics for the fixed energies of 50, 100, 150, and 200 MeV.

The results of the signal processing of these counters on flight time and amplitude allowed us to identify the registered particles on their mass, to determine the proton recoil energy and to select those scattering events corresponding to the kinematics of elastic scattering. That allowed us to reconstruct the initial energy of the neutrons scattered by the target.

The results of the neutron spectrum measurement are shown in Fig. 2 (by open circles). One can

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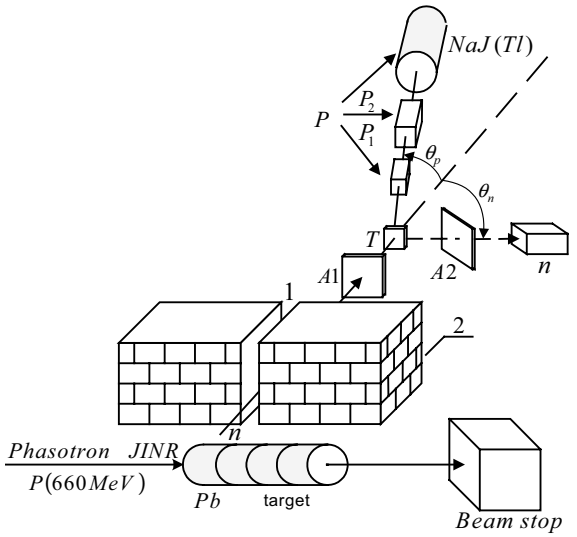

Fig. 1. The experimental set-up.

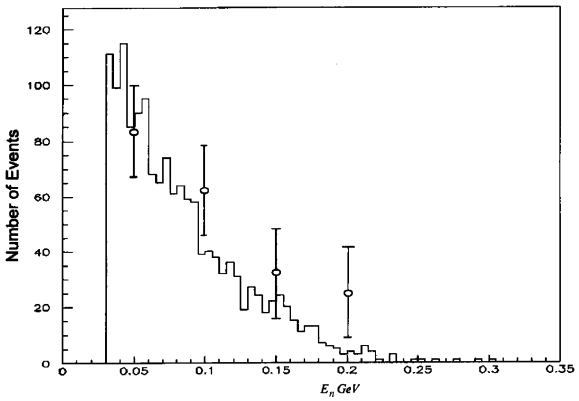

Fig. 2. Energy spectrum of fast neutrons emitted at 60 from a lead extended target. Open circles—experiment results, histogram—GEANT simulation.

see a qualitative agreement between experimental data and those calculated with the GEANT code (solid line). However, the experimental errors are enormous enough. We expect to continue our measurement and to reduce the experimental errors in the future.

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