Contribution ID: **104** Type: **not specified**

STUDY OF CONTINUOUS ENERGY SPECTRA FROM THE REACTIONS 60Ni(p,xp) AND (p,xα) AT A PROTON ENERGY OF 22 MEV

Experimental and theoretical studies of continuous energy spectra of secondary light particles formed as a result of the interaction of nuclei with nuclei in a wide range of energies make it possible to trace the dynamics of the formation and evolution of an excited system to a state of equilibrium, which remains an urgent problem in the theory of nuclear reactions [1]. It should be noted that such experimental data are in demand in many applied fields of science, in particular, for correct modeling of processes occurring in the structural materials of designed nuclear power plants. An example of such a facility is a hybrid electronuclear facility (Accelerator Driven System, ADS), consisting of a high-energy proton accelerator and a subcritical reactor [2, 3]. Such a system makes it possible to obtain sufficiently high neutron fluxes, which can be used to generate energy, transmutate radiotoxic isotopes, or produce tritium for thermonuclear sources.
Experimental data were obtained using the extracted proton beam from the U-150M isochronous cyclotron of the Institute of Nuclear Physics [2]. Charged ions of the required type are produced in a source located in the central part of the cyclotron chamber. Their acceleration occurs in the interpolar space of a 1.5-meter magnet at the moment the particles fly between the dees. The ion beam, accelerated in the cyclotron chamber, is then transported along the ion guide path to the reaction chamber. The energy of the incident protons was 22 MeV. A self-supporting isotope foil made of enriched 60Ni isotope was used as a target. To select the desired type of particles, the dE-E method was used, where two parameters of the detected particle are recorded: specific ionization and total energy.
Cross sections for nuclear reactions were obtained in the angular range of 300 −1350 known states of final nuclei. Systematic errors in the measured cross sections are caused mainly by errors in determining the target thickness (no more than 5%), calibration of the current integrator (no more than 1%), and the solid angle of the spectrometer (no more than 1.3%). The energy of the accelerated particle beam was measured with an accuracy of 1%. The total error of the measured cross sections did not exceed 15%.
The theoretical analysis of the experimental results obtained was carried out within the framework of the TALYS calculation code, which is based on a modified version of the excitonic model of pre-equilibrium nuclear decay [4]. Modern versions of this model, based on separate consideration of neutron and proton degrees of freedom, describe the entire process of relaxation of an excited nuclear system, starting from the simplest quasiparticle configurations and ending with the establishment of statistical equilibrium. From a comparison of experimental and theoretically calculated integral ones, the contribution of various nuclear reaction mechanisms to the formation of continuous spectra was determined.
This research was carried out with financial support from the Ministry of Energy of the Republic of Kazakhstan (BR23891530).

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Section

Nuclear physics (Section 1)

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Track Classification: The V International Scientific Forum "Nuclear Science and Technologies": Nuclear physics (Section 1)