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Interaction of 22 MeV protons with a nucleus of 90Zr

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Experimental data on the double differential and integral cross-sections of reactions induced by nucleons in the energy range of 20-200 MeV plays a major role in the field of radioisotope production, radiation safety and protection, development of libraries of evaluated nuclear data and models of nuclear reactions. At the same time, the study of such reactions will help to better understand the dynamics of the contribution of pre-equilibrium processes to the overall energy spectrum of secondary particles.
In this paper, we present the first measured double-differential cross-sections of the reactions (p,xp) and (p,xα) formed during the interaction of 22 MeV protons with the 90Zr nucleus. Zirconium is one of the promising materials for various applications due to its high melting point (2125 K) and small cross-section for the capture of slow neutrons.
The experiment was carried out at the U-150M cyclotron of the Institute of Nuclear Physics (Almaty, Republic of Kazakhstan). The reaction products were identified by the (ΔE–E) method using a multidimensional programmable analysis system based on ORTEC spectrometric electronics. Silicon and scintillation detectors CsI(Tl) were used to register the reaction products. As a target, a thin metal foil of 90Zr with a thickness of 2.13 mg/cm2 was used.
The theoretical analysis of the experimental results was performed within the framework of the exciton model of pre-equilibrium decay of nuclei using the TALYS program [1]. Satisfactory agreement was obtained between the experimental and calculated values in the energy range corresponding to the pre-equilibrium mechanism.
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Primary author: Prof. ZHOLDYBAYEV, Timur (Institute of Nuclear Physics, Almaty, Kazakhstan)

Co-authors: TEMIRZHANOV, Alisher (Institute of Nuclear Physics, Almaty, Kazakhstan); SADYKOV, Bakhtiyar (Institute of Nuclear Physics, Almaty, Kazakhstan); Mrs USSABAYEVA, Gulnaz (Institute of Nuclear Physics, Almaty, Kazakhstan); Mrs MUKAN, Zhuldyz (Institute of Nuclear Physics, Almaty, Kazakhstan)

Presenter: Mrs USSABAYEVA, Gulnaz (Institute of Nuclear Physics, Almaty, Kazakhstan)

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