Cross sections of the ^{113}In$(\gamma, n)^{112m,g}$In reaction for the γ-process

Yevgen Skakun,[1] Igor Semisalov,[1] Anastasiia Chekhovska,[1,2] and Valentin Kasilov[1]

[1] *Institute of High Energy Physics and Nuclear Physics, NSC KIPT, Kharkiv, Ukraine*

[2] *V. N. Karazin Kharkiv National University, Kharkiv, Ukraine*

The vast majority of naturally abundant isotopes of trans-iron chemical elements were synthesized in the stellar scenarios of slow (s) and rapid (r) neutron capture of nuclear reactions. However there is a group of about 35 so-called p-nuclei which could not be made in these processes because of the relation of their masses with the masses of nuclei of neighboring isobars. The indium-113 (^{113}In) isotope is included in this group although could be additionally formed in the r-process in small amounts. To understand the stellar nucleosynthesis of the p-nuclei there is need to know a large set of certain nuclear data among which the very important ones are proton and photon induced nuclear reaction cross sections. In this work using the electron linear accelerator (LINAC-30) of the NSC KIPT (Kharkiv) and off-line high resolution gamma-ray spectrometry the photoactivation yields of the ^{113}In$(\gamma, n)^{112m,g}$In photonuclear reaction producing the isomeric and ground states of the residual ($T^m_{1/2} = 20.56m$, $J^\pi_m = 4^+$, $T^g_{1/2} = 14.97m$, $J^\pi_g = 1^+$) were measured in the bremsstrahlung end-point energy range from the threshold (9.44 MeV) to 14 MeV–the relevant one for the γ-scenario modeling. The individual yields for each member of the ^{112m,g}In isomeric pair production were defined from the intensities of the following γ-rays. The method of approximation of the experimental yield of a photonuclear reaction by a parametric function connecting it with the cross section was used to determine the latter. Analyzing the decay curve of the genetically coupled ^{112m,g}In isomeric pair we were able both to determine new values of the branching coefficients of the γ-rays following the ^{112g}In nuclide decay which turned out to be different from the currently accepted ones and to derive the correct values of the experimental reaction yields. The experimental data are compared with the predictions of the Hauser-Feshbach statistical theory of nuclear reactions implemented by computer codes NON-SMOKER and TALYS varying the models of nuclear level density and radiation strength function.