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Neutron Capture Cross Sections and Strength Functions on 147Sm Nucleus

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Capture processes of neutrons, starting from thermal region up to 14 MeV, on 147Sm, with emission of charged particles, were analyzed. Cross sections for (n,a) reactions, from slow neutrons resonance neutrons up to some MeV's, in the frame of Hauser –Feshbach formalism (HFF), were evaluated using computer codes realized by authors. The main element of HFF is represented by the transmission coefficients for incident and emergent channels. Transmission coefficients were calculated by applying a quantum-mechanical approach based on reflection factor.
Starting from 0.5 MeV up to 14 MeV, a separation in the contribution of different nuclear reaction mechanisms related to discrete and continuum states were realized with the help of Talys computer codes. It was demonstrated that the main contribution to the cross sections is given by compound nucleus processes followed by direct processes. Also, nuclear data, as parameters of optical potential, nuclear states densities and others were extracted.
The computed cross sections and strength functions are compared with experimental data in order to explain possible nonstatistical effects reported previously by some authors on the distributions of alpha widths.
Cross sections, asymmetry effects and strength functions at the EG-5 and IREN basic facilities of FLNP - JINR by using a double gridded ionization chamber were measured. By recent measurements cross sections for 5 and 6 MeV of 147Sm(n,a) reaction were obtained. Because the values of cross sections are very low (hundreds of microbarns) their measurements are very difficult. The cross sections experimental data are very well described by the performed theoretical model evaluations. A high forward-backward asymmetry effect was also measured but it was not yet confirmed by the theoretical models computations.
Strength functions, as prescribed by theory, are expected to be constant. In the neutron energy range of some hundred of eV's the strength functions were measured and a significant decreasing was evidenced. A qualitative explanation suggested by authors is based on the following suppositions: a) nuclear reaction is going only through compound processes b) a radius modification in the emergent channel is possible. Considering these two suppositions, our theoretical model approach describes satisfactorily the experimental data obtained for strength functions.
This year further measurements on cross sections neutron energy dependence in a wide energy range with the extraction of new nuclear data are proposed to be accomplished. The experiments are possible to be effectuated at JINR basic facilities. The theoretical analysis realized in this study is representing a new proposal for 147Sm experiments at IREN neutron resonance facility.

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