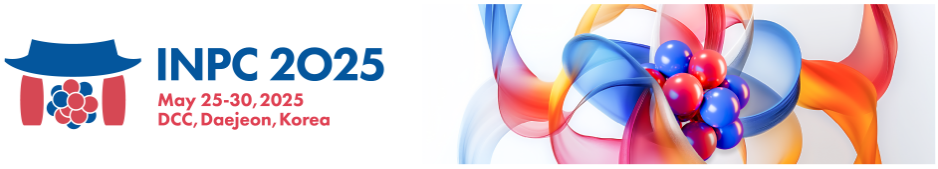

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Pre-compound Emission Modeling for Alpha Induced Reactions via Machine Learning and Bayesian Algorithm

Tuesday, 27 May 2025 09:40 (15 minutes)

Pre-equilibrium or Pre-compound emission plays an important role in the dynamics of nuclear reactions, particularly, in light-ion-induced nuclear reactions, where it significantly influences the cross-section of reaction products [1-4]. This study presents a novel approach to model the pre-compound emission using machine learning techniques combined with Bayesian algorithms. By leveraging the probabilistic framework of Bayesian analysis, in the present paper a predictive model capable of estimating pre-compound emission yields with high accuracy, considering various entrance channel parameters is presented. The model is trained on extensive data from alpha-induced nuclear reactions, incorporating factors such as atomic mass and number of interacting partners, excitation energy, reaction Q-value, and other nuclear structure effects.

In the present work, the experimentally measured pre-equilibrium fraction, which is the contribution of pre-equilibrium emission, for 14 projectile-target combinations from ref. [3] have been used. In the model, 10 entrance channel parameters with 190 data points have been utilized to train the neural network. A feed-forward Levenberg-Marquardt network of one hidden layer with 20 neurons along with 10 input neurons and one output neuron is used. For the estimation of contribution of pre-compound emission 80% of data points were used for training and several attempts have been made to minimize the R2 values. The model could satisfactorily predict the preequilibrium cross-section, which satisfactorily matched with the experimental one. The details of the model and calculations will be presented during the conference.

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Consent

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