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[P15] Study on JQMD and INCL models for α particle incident neutron production

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At RIKEN, new beam line of generating ^{211}At for targeted alpha therapy is being constructed. Astatine-211 is produced via the ^{209}Bi(α, 2n)^{211}At reaction at the beam line. The energy of incident α beam is chosen to be 7.2 MeV/u to avoid producing ^{210}Po, a toxic nucleus. For the radiation shielding of the new beam line, the neutron production thick target yields were measured. The measured data was compared with the INCL and JQMD models implemented in PHITS. Through the comparison, it is found that the prediction accuracy of INCL is better than that of JQMD. Better agreement between INCL and measured data could be explained by "Local E procedure". In the INCL calculation, a target nucleus is created under the well potential of 45 MeV depth. Near the target nucleus surface, the depth of the well potential is greater than that of Woods-Saxon (WS) potential. Thus, nucleons with higher energy than the depth of the WS potential stays in the well potential. Nucleons with higher energies leads to underestimation of reaction cross section. This underestimation is corrected by the "Local E procedure"from INCL-4.5. In the "Local E procedure", energy of nucleons in the target nucleus is recalculated under an approximately phenomenological potential. In the JQMD calculation, beam and target nuclei are prepared under the Fermi gas model, in which the depth of the nuclear force potential is equal to the Fermi energy. However, the Fermi energy and the depth of the potential for the α nucleus as the incident particle is not the same. Due to the difference, the energy distribution of the nucleons of α nucleus does not satisfy the condition of the Fermi gas model. This means that the initial condition is not described properly in the JQMD calculation. Thus, it is concluded that the improvement of the initial conditions is required to improve the prediction accuracy of JQMD.

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