Percolation-fission model study of the fragment mass distribution for the 1 GeV proton induced reaction

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Recently, nuclear engineering has needed researches of particle production in order to develop accelerator driven systems (ADS) for transmutation of radioactive nuclear wastes. From the viewpoint of radiation safety, it has also been necessary to estimate the amount of radiotoxicity due to rare-earth elements produced in various targets.

In this paper, the 1 GeV proton induced reaction is analyzed by using the percolation model [1, 2] combined with the Atchison fission model [3, 4]. This model will be called the percolation-fission (PF) model, below. The GSI experimental data [5] of the fragment mass distribution for spallation and fission products in the 1 GeV proton induced reaction will be compared with our calculated results.

Figure 1 shows the result of the fragment mass distribution for the 1 GeV proton induced reaction on ^{208}Pb targets. The solid histogram is the result obtained from the PF model calculation. In Fig. 1, one can see the characteristic shape in the experimental data and the calculated result. However, in the intermediate mass region, the peak value of the solid histogram is lower, compared with that of the experimental data. The dotted histogram is the result of the original percolation model calculation obtained with the same parameters as those of the solid histogram. Namely, the dotted histogram is the result without the fission model.

As shown in Fig. 1, the PF model can reproduce the trends of the fragment mass distribution for the 1 GeV proton induced reaction in some degree. This result means that the PF model would be a useful tool to analyze production cross sections in spallation and fission.

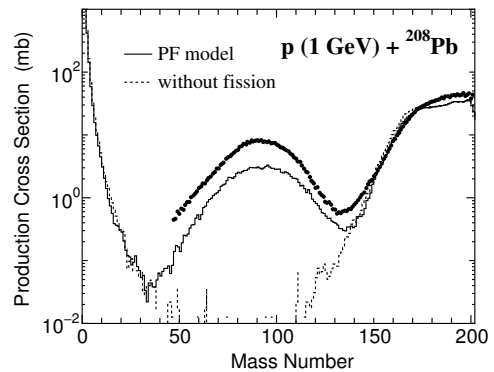This job was funded by Ministry of Education, Sports, Science and Technology.

Fig. 1: Fragment mass distribution for the 1 GeV proton induced reaction on ^{208}Pb targets.

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