2 - 25 Validation of Monte Carlo Simulation Codes of Proton Induced Neutron Production Cross Sections

Zhang Suyalatu, Chen Zhiqiang, Han Rui, Liu Xingquan, Lin Weiping
Jin Zengxue, Liu Jianli and Shi Fudong

We have studied the accuracy of the simulation of double differential(p, xn) cross sections for thin targets of different materials at incident proton kinetic energies between 113 MeV and 3 GeV, using both Fluka[1] and Geant4[2] with several physics models. In the earlier report[3], we have shown the results below 800 MeV of incident proton energy. In the present report, we have concentrate on double differential (p, xn) cross sections for Pb targets materials at incident proton kinetic energies between 800 MeV and 3 GeV.

For example, the level of agreement between simulated and experimental double-differential neutron production cross sections are shown in Fig. 1 for 800 MeV protons on lead at 30°, 60°, 120°, 150° and in Fig. 2 for 1, 1.6, 2 and 3 GeV protons on lead at 30°.

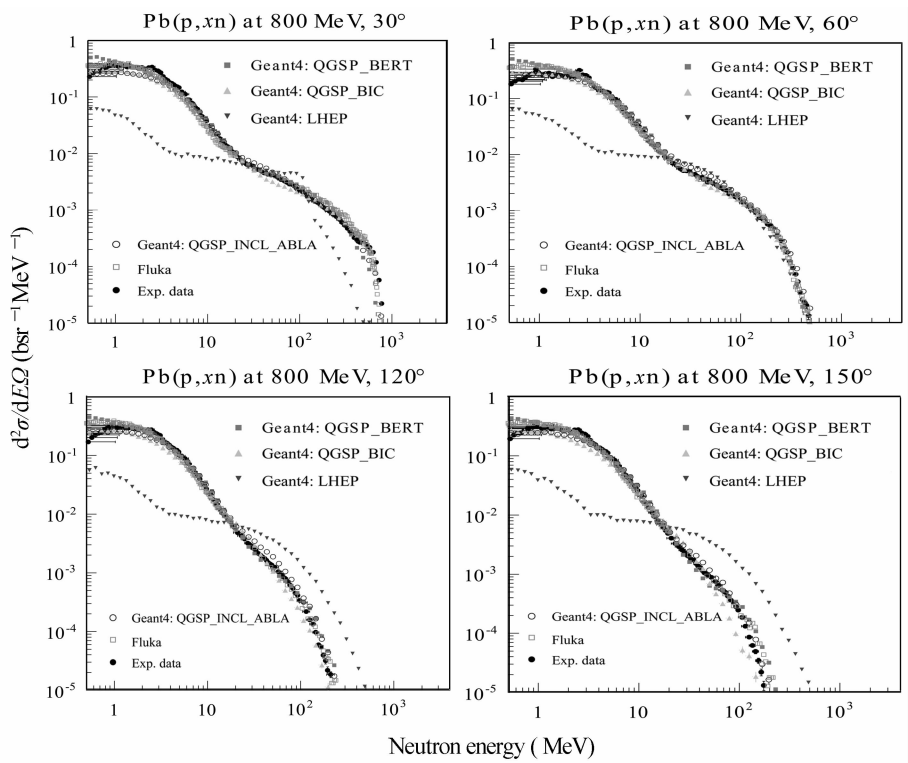

Fig. 1 Neutron-production double differential cross sections for 800 MeV proton on Pb.

From earlier report[3] and Figs. 1 and 2, we know that LHEP physics list is not suitable for this kind of simulation for energy range. The Binary Cascade model as implemented in the Geant4 QGSP_BIC physics lists can well reproduce experimental data below incident proton energy 800 MeV, while simulation results underestimate above 800 MeV. The QGSP_BERT and QGSP_INCL_ABLA physics lists as well as Fluka can well reproduce experimental data for incident proton energy up to 3 GeV.

The present results verified that both packages were suited for this kind of simulation.

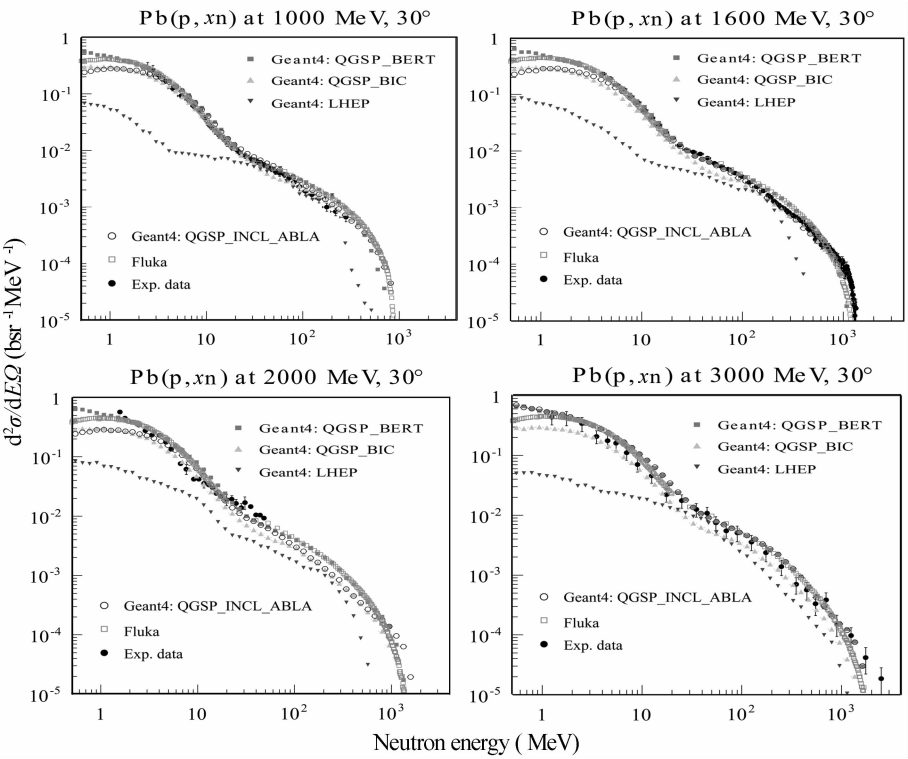

Fig. 2 Neutron-production double differential cross sections for 1, 1.6, 2 and 3 GeV proton on Pb.

References

[1] Fluka Reference Manual, available from http://www.fluka/org/.
[2] Geant4 Reference Manual, available from http://cern.ch/geant4.
[3] Zhang Suyalatu, et al., IMP & HIRFL Annual Report, (2011)57.

2 - 26 Simulation of Neutron-production Double Differential Cross Sections on Bi Target Bombarded with Energy Range Up to 3 GeV Protons

Zhang Suyalatu, Chen Zhiqiang, Han Rui, Liu Xingquan, Lin Weiping
Jin Zengxue, Liu Jianli and Shi Fudong

In recent years, the wide range applicationsof ADS in many fields[1], such as energy production, condensed matter physics, neutron sources for material irradiation, neutron scattering science, arouse worldwide range interest again. USA, Japan, Korea, Russia, Europe, et al. have developed ADS project[2] for their needs and are underway vigorously.

China has started to design ADS project[3] with according the situation of China sustainable development of nuclear energy from the end of last century. After many years of research and analysis, Chinese Academy of Sciences launched the ADS project at the 2011. This project mainly applied to high radioactive nuclear waste transmutation, nuclear fuel generation and clean energy production, etc.

Prophase research of ADS shows that there are many significant advantages use Pb-Bi as liquid spallation target[2, 4]. For the design of liquid Pb-Bi target of the ADS, nuclear data in the energy region up to a few GeV are required. These data mainly include the neutron production cross section, neutron production yield, neutron energy spectrum and angular distributiondata[2,5], etc. Monte Carlo simulations play