Cosmic-ray Transport Simulation in the Atmosphere

T. Sato[1] and K. Niita[2]

[1]*Research Group for Radiation Protection, Division of Environment and Radiation Sciences, Nuclear Science and Engineering Directorate, JAEA*

[2]*Research Organization for Information Science and Technology*

Estimation of cosmic-ray neutron spectra in the atmosphere has been an essential issue in the evaluation of the aircrew doses and the soft-error rates of semiconductor devices. We therefore performed Monte Carlo simulations for estimating neutron spectra, using the PHITS [1] code coupled with the nuclear data library JENDL-High-Energy [2] (JENDL/HE) file or the intra-nuclear cascade [3] (INC) model for simulating high-energy neutron and proton-induced nuclear reactions. Figure 1 shows the comparisons of the calculated atmospheric neutron spectra with the corresponding experimental data obtained by Goldhagen *et al.* [4]. The calculated spectra based on JENDL/HE agree with measured data very much for a wide altitude range even at the ground level. On the other hand, the calculation adopting INC generally overestimates the measured data, especially for lower altitudes. These tendencies indicate that JENDL/HE can play an important role not only in the cosmic-ray transport simulation, but also in the deep-penetration simulation for the shielding design of high-energy accelerator facilities, since the two simulations have a lot of similarities with respect to the source terms, shielding properties and so on. The detailed of the simulation procedure will be presented at the meeting, together with the results of the comparison between the calculated and experimental neutron spectra in the atmosphere.

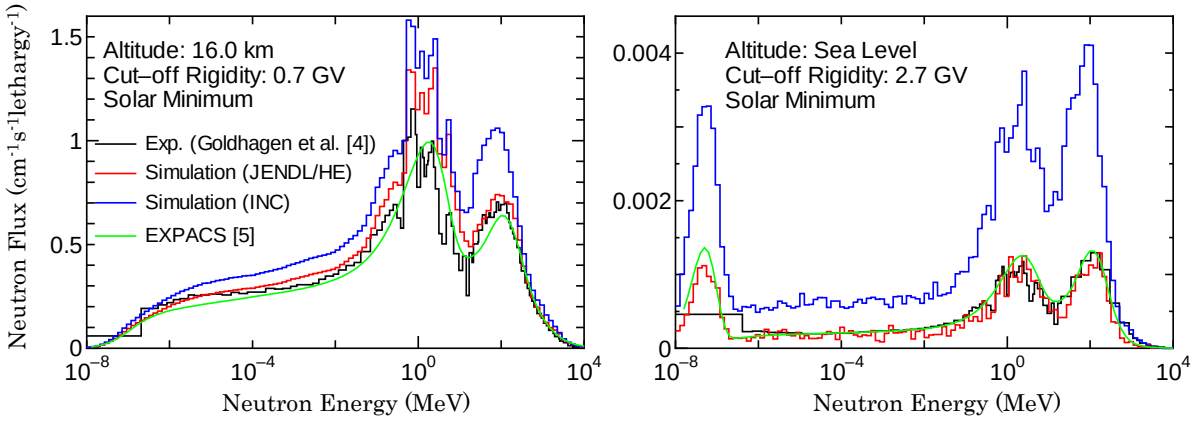

Figure 1 Calculated neutron spectra in the atmosphere in comparison with measured data [4]. EXPACS [5] is our developed software for calculating atmospheric neutron spectra based on analytical functions, which were proposed for reproducing the simulation results obtained by PHITS coupled with JENDL/HE, *i.e.* red lines drawn in this figure.

References

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EXPACS web site: http://www3.tokai-sc.jaea.go.jp/rphpwww/radiation-protection/expacs/expacs.html