

# Comparative study of PHITS code and NJOY for recoil cross section spectra under neutron irradiation

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Because primary knock-on atoms (PKAs) create point defects and clusters in materials that are irradiated with neutrons, it is important to validate the calculations of recoil cross section spectra that are used to estimate radiation damage in materials. Here, the recoil cross section spectra of fission- and fusion relevant materials were calculated using the Event Generator Mode (EGM) of the Particle and Heavy Ion Transport code System (PHITS) and also using the data processing code NJOY2012-SPKA-6C with the nuclear data libraries TENDL2015, ENDF/BVII.1, and JEFF3.2. Heating numbers were also calculated using PHITS-EGM and compared with data extracted from the ACE files of TENDL2015, ENDF/BVII.1, and JENDL4.0. In general, the differences between the recoil cross section spectra of PHITS-TENDL2015 and NJOY-SPKA-6C-TENDL2015 were relatively small. From analyzing the recoil cross section spectra extracted from NJOY2012 + SPKA-6C, we found that the energy and angular recoil distributions for  $^{72}\text{Ge}$ ,  $^{75}\text{As}$ ,  $^{89}\text{Y}$ , and  $^{109}\text{Ag}$  are incorrect in ENDF/B-VII.1, and those for  $^{90}\text{Zr}$  and  $^{55}\text{Mn}$  are incorrect in JEFF3.2. From analyzing the heating number, we found that the data in the ACE file of TENDL2015 for all nuclides are problematic in the neutron capture region because of incorrect data regarding the secondary gamma energy. Details are described in our paper [Y. Iwamoto and T. Ogawa, NIMB 396 (2017) 26-33.].

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