The Present Status of JENDL Photonuclear Data File

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Evaluation task of photonuclear reaction cross sections is in progress as an activity under JNDC Photonuclear Data File Compilation Sub-Working Group which was organized in 1991. The goal of this working group is to construct an evaluated photonuclear reaction data file. The evaluated data is stored using ENDF6 high-energy format. The data file contains absorption, particle production and nuclide production cross sections up to 140 MeV, which is approximately corresponding to the threshold energy of (γ, π) reactions. In addition, energy-angle double differential cross sections of emitted particles are stored.

The photoabsorption and photoneutron cross sections in the giant dipole resonance(GDR) energy region are evaluated using measured data. Since there exists great difference in absolute values as well as resonance shapes between the measured cross sections using the quasi mono-energetic photons and those using the bremsstrahlung photons, most evaluators of the group mainly adopts the former cross sections. The photoabsorption cross sections in energy above the GDR region are theoretically evaluated by employing a quasi-deuteron model cross sections.

From the viewpoint of a microscopical nuclear theory, the excitation process of GDR through photoabsorption is considered as production process of a particle–hole excited state. The quasi-deuteron model assumes that the incident photon excites one neutron and one proton above the Fermi energy and leaves two holes. It is therefore thought that the exciton plus evaporation model can describe the de-excitation process of the photonuclear reaction. Thus the energy spectra and nuclide production cross sections can be obtained from exciton-evaporation theoretical model codes if we have evaluated photoabsorption cross sections. However, we can scarcely obtained those cross sections for the lack of the measured data. On the other hand, since there exists many measured photoneuton cross sections, the evaluated photoneutron data can be determined comparatively easy. Hence, we derived photoabsorption cross sections from evaluated photoneutron crossections and reaction branching ratios to be caculated with some exciton-evaporation model codes. Enery-angle double differential cross sections of emission particles were evaluated using Chadwick's systematics.

At present, we have evaluated the cross sections for D, ^{9}Be, ^{12}C, ^{14}N, ^{16}O, ^{23}Na, $^{24, 25, 26}$Mg, ^{27}Al, $^{28, 29, 30}$Si, $^{40, 48}$Ca, $^{46, 48}$Ti, ^{51}V, ^{52}Cr, ^{55}Mn, $^{54, 56}$Fe, ^{59}Co, $^{58, 60}$Ni, $^{63, 65}$Cu, ^{64}Zn, ^{90}Zr, $^{92, 94, 96, 98, 100}$Mo, ^{93}Nb, ^{133}Cs, ^{181}Ta, ^{182,184,186}W, ^{197}Au, $^{206, 207, 208}$Pb, ^{209}Bi and $^{235, 238}$U.