

Compilation and Evaluation of Photonuclear Data for Applications – Contract N0. 8833

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The main goals of the Coordinated Research Program are producing an IAEA Technical Document (TECDOC) on Photonuclear Data for Application and developing an IAEA Photonuclear Data Library. According to the main goals mentioned above, CNDC joined the CRP program. In this project China group has engaged in the study on the method used for producing evaluated libraries in terms of the evaluations of experimental data and theoretical calculations.

1 Status of activities for the CRP in CNDC

According to the contract N0.8833, the evaluation of photonuclear neutron data up to 30 MeV for $^{54,56,57,58}\text{Fe}$, $^{63,65}\text{Cu}$ and ^{209}Bi nuclides and developing code GUNF were performed, and reported in first CRP meeting in 1996.

According to the CNDC commitments, in the second period the improvement of the code GUNF and methods used for producing evaluated libraries have been performed, the recommended data for $^{180,182,183,184,186}\text{W}$, $^{90,91,92,94,96}\text{Zr}$ and ^{51}V in ENDF/B-VI format were carried out, and sent to IAEA. The comparisons with other evaluated data were given in the second CRP meeting in 1998.

The undertaken works of evaluations of ^9Be , ^{27}Al and $^{50,52,53,54}\text{Cr}$ and the code GLUNF for $\gamma + ^9\text{Be}$ data calculation were performed in 1999. Based on the comparison in the second CRP Meeting, the re-evaluation for $^{54,56,57,58}\text{Fe}$, $^{63,65}\text{Cu}$ and ^{209}Bi have been revised and the new recommended data were issued.

The nuclides evaluated photonuclear data in CNDC under the contract N0.8833 during 3 year are as following:

^9Be , ^{27}Al , ^{51}V , $^{50,52,53,54}\text{Cr}$, $^{54,56,57,58}\text{Fe}$, $^{63,65}\text{Cu}$, $^{90,91,92,94,96}\text{Zr}$, $^{180,182,183,184,186}\text{W}$, ^{209}Bi
The evaluated photonuclear data files include (γ, n) , (γ, p) , (γ, α) , $(\gamma, ^3\text{He})$, (γ, d) , (γ, t) , $(\gamma, 2n)$, (γ, np) , $(\gamma, n\alpha)$, (γ, pn) , $(\gamma, 2p)$, $(\gamma, \alpha n)$, $(\gamma, 3n)$ and the outgoing particle spectra.

2 Analysis of Experimental Data and Theoretical Calculation

The experimental data stored in CNDC were obtained from EXFOR master file of IAEA, which was revised each half year. The various available measured data of photonuclear reaction were retrieved, collected and analyzed. These measured photonuclear reaction data are from threshold to 30 MeV for CNDC group.

In the calculation the photonuclear data, the giant dipole resonance parameters are obtained by fitting the experimental of the photoabsorption cross section in code

GUNF . Meanwhile, the neutron optical potential parameters can be obtained fitting (γ, n) cross section. The optical potential parameters for particle p, α , ^3He , d and t were taken from concerned references.

Using the code DREAM, a set of discrete level, pair correction parameter and level density parameters and concerned ground state mass and $J\pi$ of the levels used for theoretical calculation can be formed from Chinese Evaluated Nuclear Parameter Library (CENPL). Then the photonuclear reaction data can be calculated by the code GUNF.

The total photonuclear reaction cross section is given by the summation over every reaction channels. Since the calculated results for many channels are in pretty agreement with existed experimental data, therefore the cross sections without experimental data have been predicted.

3 Recommended Photonuclear Data in ENDF/B-VI Format

At low energies (< 30 MeV), the giant-dipole resonance is the dominant excitation Mechanism, in this energy region a simple approximation of isotropy is used to the angular distribution for outgoing particles.

Beside MF=1,3,4, the MF=6 is also given by Chine group, but only spectra. Taking $\gamma+^9\text{Be}$ as an example, in file-6 there are

MF=16 for ($\gamma, 2n$) reaction, the spectra of neutron and ^7Be are given;

MF=28 for (γ, np) reaction, the spectra of neutron, proton ^7Li and gamma as well as the gamma-Multiplicity are given;

MF-29 for ($\gamma, n2\alpha$) reaction, the spectra of neutron and alpha-particles are given.

The check and test of the recommended data were carried out with computer programs in CNDC, including format, the consistence between the total and partial cross sections, the physics characterization and the energy balance.

4. Conclusion

Under Research Contract N0.8833 during 3 year, the research program was finished on time. Beside the recommended data, evaluation method, the codes GUNF for structure material nuclei. In particular a new model has been developed for light nuclei, which has been employed in the calculation of neutron and gamma induced reactions.

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