2015/16 Status Report of China Nuclear Data Center

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1. General Information of China Nuclear Data Center

1-1. Staff and student information:

- 21 official staff + 5 students(Master 3, Ph.D 2).
- Director: Ge Zhigang.
- Deputy Directors: Dr.Chen Guochang and Dr.Wu Haicheng.

Evaluation Unit	Head: Dr. Huang Xiaolong	4 official staff
Theory Unit	Head: Dr. Xu Ruirui	6 official staff
Macroscopic Data Unit	Head: Dr. Liu Ping	4 official staff
Data Library Unit	Head: Dr. Shu Nengchuan	5 official staff
Secretary Office		1 official staff

1-2. Mainly Tasks of CNDC in 2015/2016:

- New evaluations and re-evaluations for neutron data file for CENDL.
- Methodological studies of nuclear data evaluation.
- Nuclear data processing code development.
- Nuclear structure and decay data evaluation.
- Update photonuclear data evaluations.
- Experimental data compilations for EXFOR
- The fundamental studies of nuclear data evaluations and measurements.
- The regular update and maintenance of IAEA/NDS mirror-site in China.
- Nuclear data services is providing to all the nuclear data users.

2. Nuclear Data Evaluation and Methodological Studies.

2-1 . New evaluation/re-evaluation neutron files CENDL project.

- **The neutron files evaluations:**

  The evaluation/re-evaluation activities are performing for the updating of CENDL, which contain the neutron files for ^{6,7}Li, ^{9}Be, ^{40}Ca, ^{56}Fe, ^{93}Nb, ^{108}Pd, ^{140,141,142,144}Ce, ^{234,236,237,239}U and ^{236}Np, etc. the evaluation of some activations and fission yields files are continued based the updated experimental data and the model studies. As some examples, following figs. show the new evaluations for the neutron files.

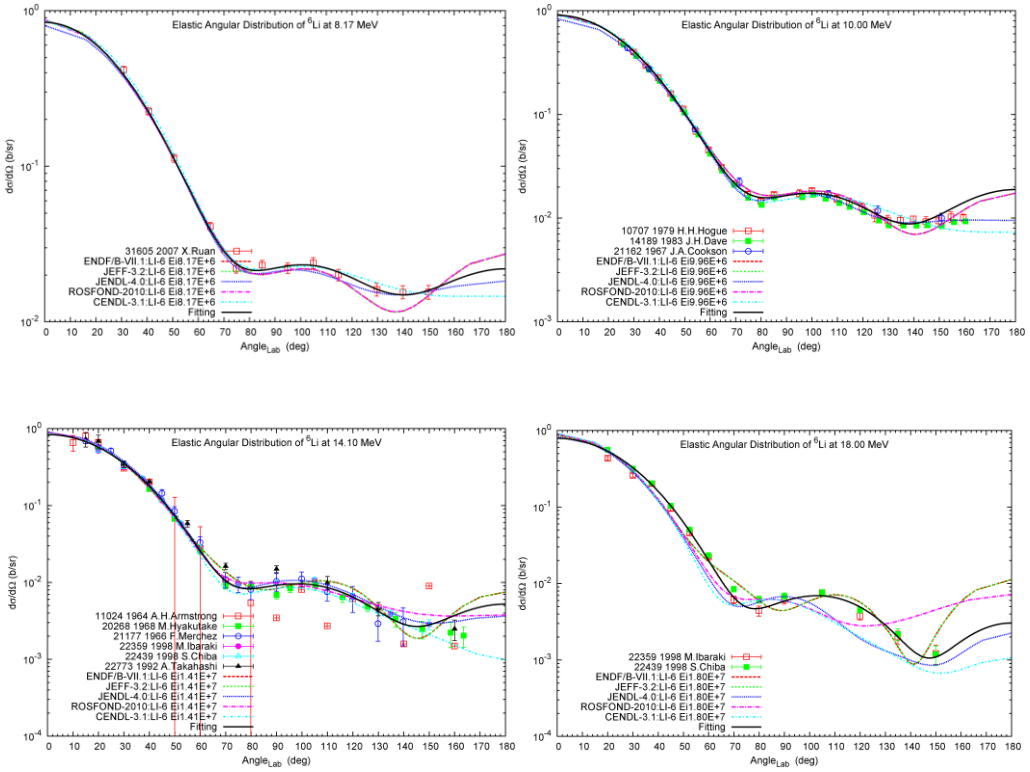


Fig.1 New results of the elastic angular distribution of ^{6}Li

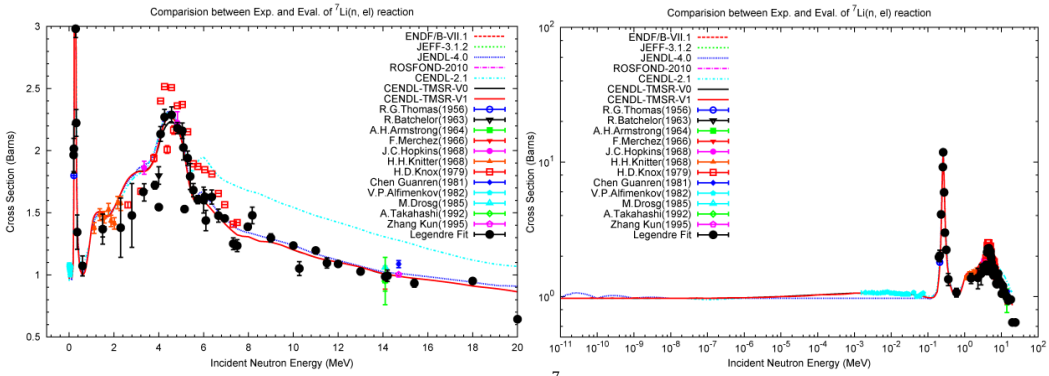


Fig.2 New results of the elastic cross sections ^{7}Li comparison with exp. and other files.

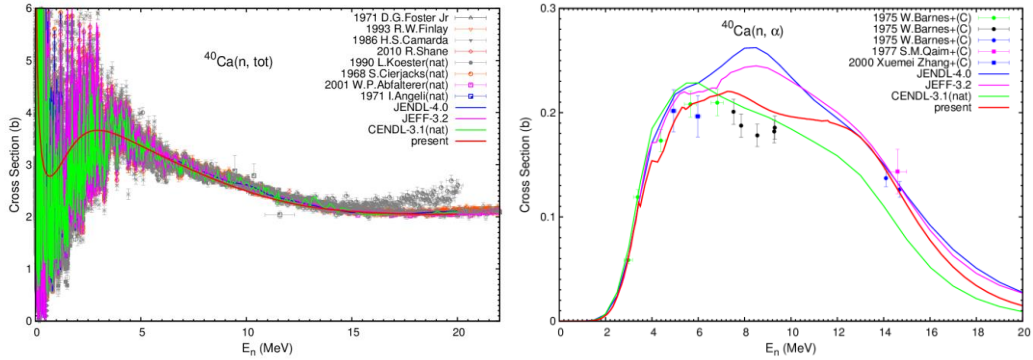


Fig.3 New evaluations of (n,tot)(left) and (n,α)(right) for ^{40}Ca comparison with exp. and other files.

- **Program of photonuclear data study:**

The photonuclear data of light and middle-heavy nuclei are being evaluated recently, and the new experimental data evaluation and theoretical source codes compilation are being carried out.

The recommended data files would be include the calculation results by GLUNF for light nuclei; GUNF and GMEND for middle-heavy nuclei.

28 nuclei are planned to evaluate which are: ^{6,7}Li, ^{9}Be, ^{10,11}B, ^{27}Al, ^{51}V, ^{50,52,53,54}Cr, ^{54,56,57,58}Fe, ^{63,65}Cu, ^{90,91,92,94,96}Zr, ^{180,182,183,184,186}W, ^{209}Bi,;

The microscopic prediction for the photon strength function are performed by QRPA simultaneously.

2-2 . Methodological Studies

- **For light nuclei evaluation:**

A full and diagonal reduced R-matrix theory (FDRR code) is under development to generate cross sections, and LUNF code is planned to apply in producing the double differential cross section.

Based on the few body theory, Faddeev method for 3N reactions, which can be used for calculation of the n+d scattering, elastic scattering, etc. Some preliminary results have been carried out.

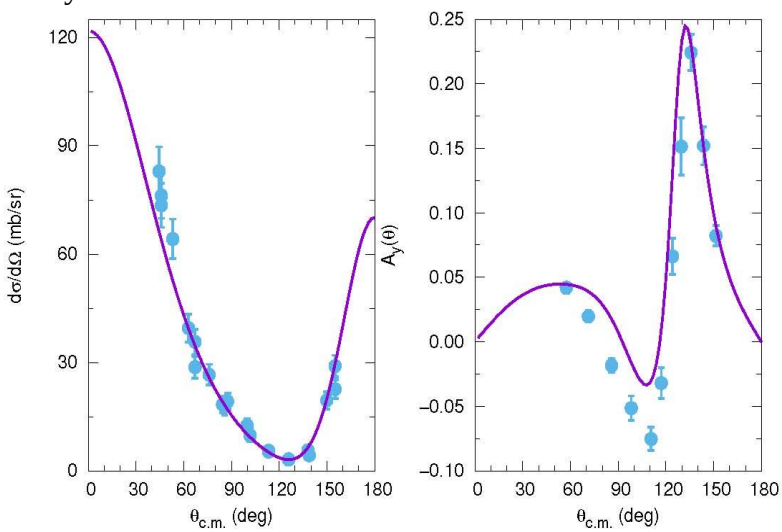


Fig. 4 The calculated elastic scattering and analyzing power for n+d scattering(En=21 MeV) comparison with experimental data.

- **Fission Model Study:**

A primary code has been created for computing the potential surface. Improved Strutinsky shell correction model was adopted. And the Myser-Swiatechi and LSD formulae were used in the macro model; the Woods-Saxon and Folded-Yukawa potential were used in micro model. We calculated the surfaces for U and Pu isotopes, Fig. 5 showed the preliminary results of fission barriers.

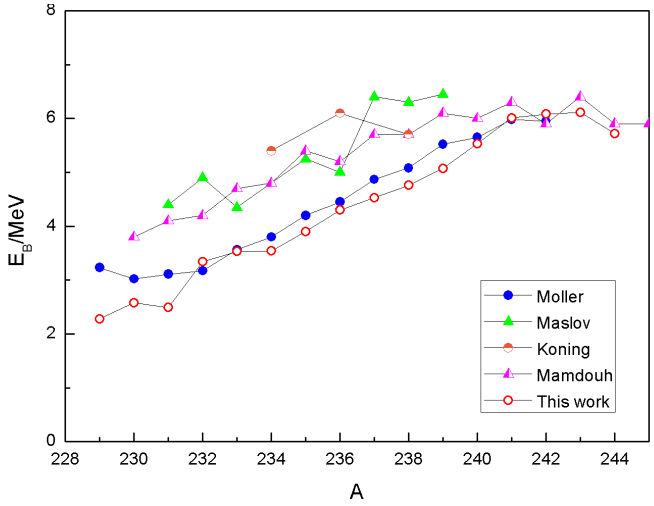


Fig. 5 The calculated inner barriers for U isotopes and compared with other works.

- **Semi-empirical Model for FYD**

A semi-empirical model is developed for calculating the yield mass distributions and energy dependence of n+238U fission. The system potential energy included the macro-energy and 2 shell corrections, corresponding to the SL, SI and SII fission channels. Multi-chance fissions of (n,nf) and (n,2nf) were considered. The yield was expressed with a five-Gaussian-like formula with 13 parameters, which were determined by fitting to experimental. The results showed the model could well describe the mass distribution with variant incident energy and some of the yield energy-dependences .

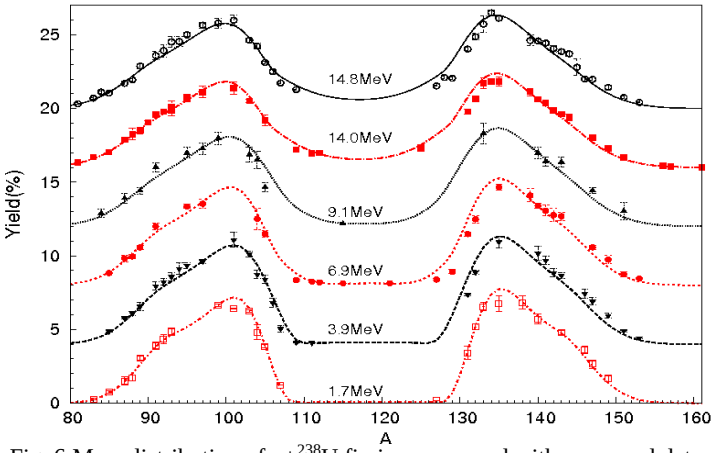


Fig. 6 Mass distribution of n+^{238}U fission compared with measured data

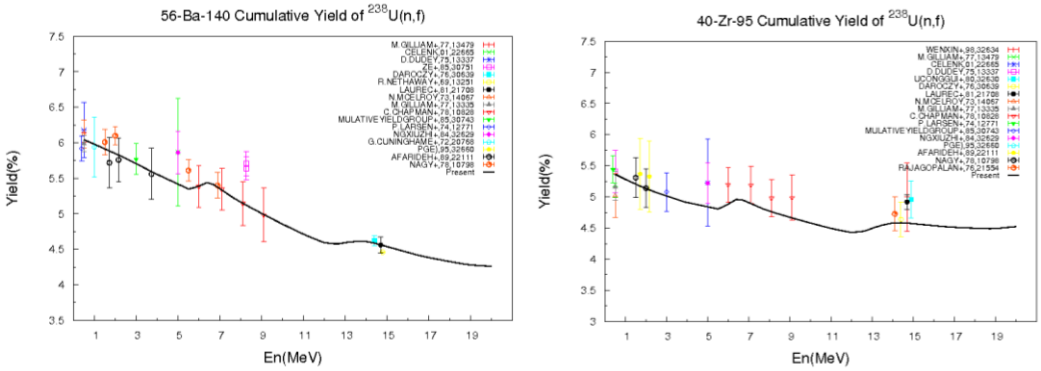


Fig. 7 ^{140}Ba, ^{95}Zr yield energy-dependence of n+^{238}U fission

3. Nuclear Data Processing Code Development

A nuclear data processing code RULER is developing, which can be used for producing multigroup constants from ENDF/B files. RULER consists of 11 modules show as following:

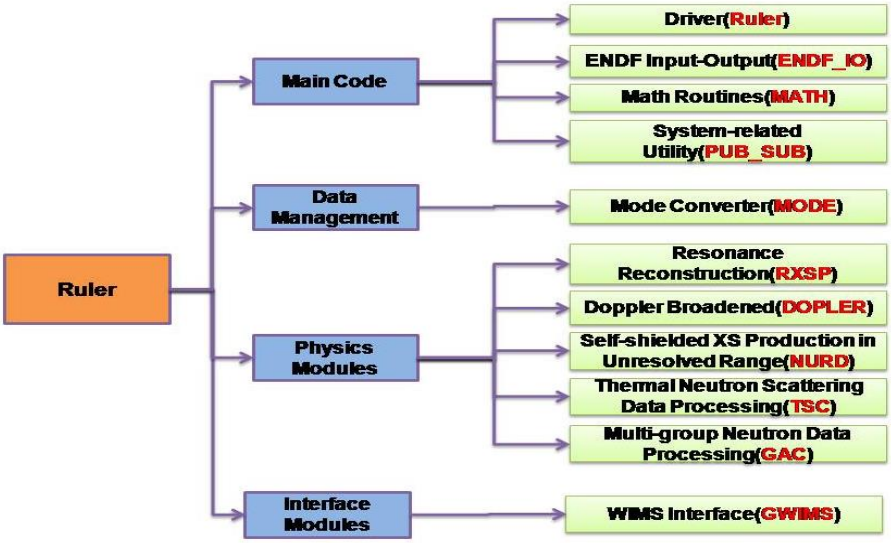


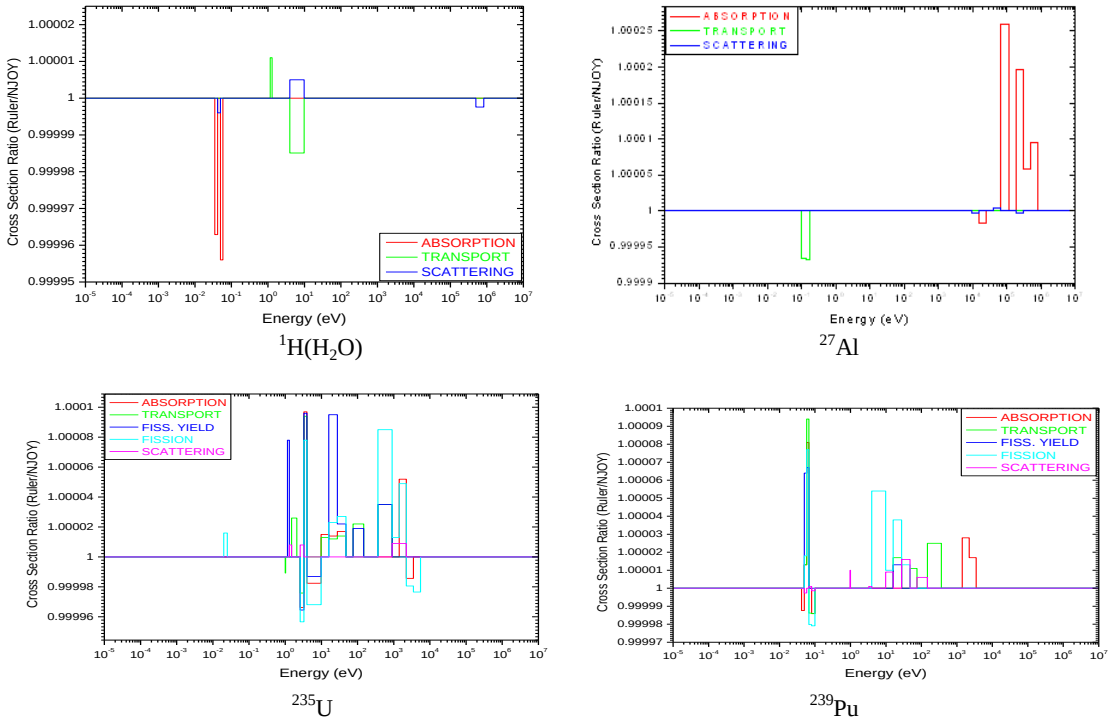
Fig 8. RULER modules scheme.

The characteristics of RULER: Independent ENDF I/O module/library; Easy for maintenance and extension; Less computation time comparison with NJOY code. The multigroup cross sections generated by RULER are in good agreement with NJOY results.(See Fig.9)

Nuclide	Running time (second)		Speed-up ratio
	NJOY	Ruler	NJOY/Ruler
1-H-H_2O	152.7	104.2	1.47
1-H-ZrH	410.2	365.9	1.12
1-D-D_2O	157.6	101.6	1.55
6-C	84.4	61.7	1.37
8-O-16	25.9	14.9	1.74
13-Al-27	7.0	4.3	1.63
26-Fe-56	23	19.9	1.16
36-Kr-83	5.7	3.1	1.84
42-Mo-95	7	5.7	1.23
92-U-235	247.3	187.0	1.32
92-U-238	448.6	225.3	1.99
94-Pu-239	136.7	67	2.04

Table 1. Running time of RULER comparison with NJOY

The future development of RULER will be continued, which includes the photon processing, heating processing and more interface modules. The modification of ENDF_IO module for new data format will be considered.



$^{1}H(H_2O)$ ^{27}Al

^{235}U ^{239}Pu

Fig.9 Multigroup cross sections show good agreement with NJOY

4. EXFOR Compilation.

During the 2015-2016 EXFOR compile group at CNDC have finished following tasks:

- Scan all articles about the charged particles introduced reactions published during 1978-2008 in the 《High Energy Physics and Nuclear Physics》, and find there 215 articles can be compiled for X4 database.
- Scan journal 2009-2015, Compiled 118 entries (charge particle: 68, neutron: 50), feedback & correction performed for more than 20 entries, more than 30 entries are compiling and more than 5 entries for checking.

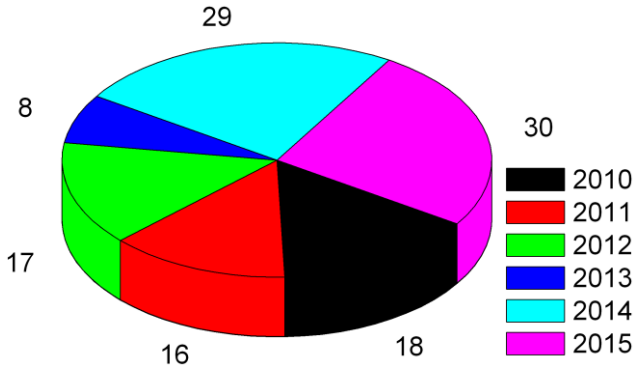


Fig. 10 The number of the compiled entries for EXFOR during 2010-2015