Korea Nuclear Data Center (KNDC)

Progress Report for period 2022-2023

Technical Meeting on the International Network of Nuclear Reaction Data Centers (NRDC 2023)
9 - 12 May, 2023

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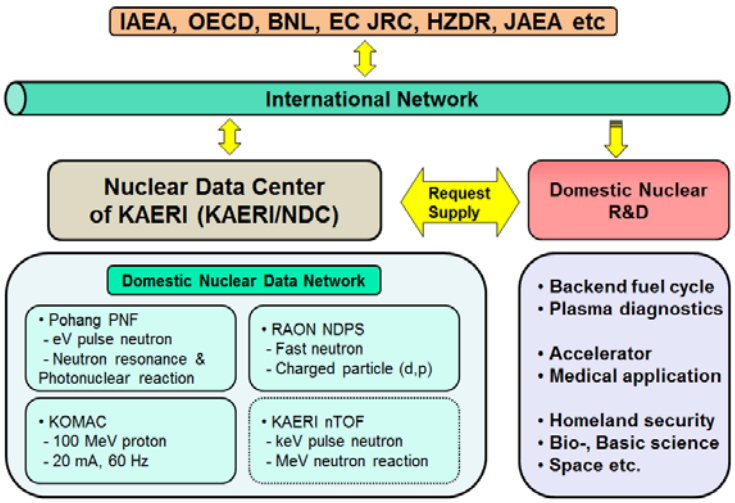
1. General

Korea Nuclear Data Center (KNDC, formerly 'Nuclear Data Evaluation Lab.') was established in 1997 to start research on nuclear data in Korea and joined the International Network of Nuclear Reaction Data Centers (NRDC) in 2000. KNDC at Korea Atomic Energy Research Institute (KAERI) performs the following main tasks:

- Evaluation and method development for nuclear reaction data
- Establishment of processing and validation system of nuclear reaction/covariance data
- Measurement of nuclear reaction data and establishment of measurement facility
- Production and validation of atomic/molecular collision data

The mission of our center includes disseminating the outcomes of cooperation with international networks as well as promoting nuclear data research activities and supporting nuclear/radiation R&Ds in Korea. KNDC is also coordinating the measurement activities using domestic accelerators for producing various nuclear reaction data.



KNDC continues to cooperate with the international nuclear data network as follows:

- Participating in IAEA CRP, TM, and CM on nuclear data evaluation, nuclear data processing and validation, atomic/molecular data network, etc.
- Collecting nuclear reaction measurement data in Korea for EXFOR compilation under the guidance of IAEA/NDS
- Participating in the JEFF and WPEC subgroups of OECD/NEA
- Conducting joint research on evaluation, measurement, and validation of nuclear data with foreign research institutes

As of 2023, KNDC consists of 8 regular staffs, 2 post-retirement researchers, a post-doctoral researcher, and 2 Ph.D. students. The latest staff changes include:

- Dr. Jounghwa LEE joined as a regular staff in July 2022.
- Dr. Young-Ouk LEE retired in December 2022 and joined as a post-retirement researcher in January 2023.
- Dr. Haewon SHIN joined as a post-doctoral researcher in January 2023.
- Mr. Changmin SHIN joined as a Ph.D. student in April 2023.

They are working in the following fields:

- Nuclear data evaluation: 2 regular staffs
- Nuclear data measurement: 2 regular staffs and a post-retirement researcher
- Nuclear data processing/validation/application: 2 regular staffs, a post-retirement researcher, and a Ph.D. student
- Atomic/molecular data production: 2 regular staffs, a post-doctoral researcher, and a Ph.D. student

2. EXFOR Activity

The compilation of nuclear reaction data obtained in Korea continues to be carried out under the guidance of IAEA/NDS. Since the last meeting in 2022, 8 entries were registered in the EXFOR DB and 10 entries were transmitted after compilation. (See Table 1.)

Table 1. Compilation statistics of KNDC

No.	TRANS	ENTRY	SUBJECT	STATUS
1	D136	D7031	Proton	EXFOR
2	D136	D7032	Proton	EXFOR
3	D136	D7033	Proton	EXFOR
4	D137	D7034	Proton	EXFOR
5	D137	D7035	Proton	EXFOR
6	D137	D7036	Proton	EXFOR
7	D137	D7037	Proton	EXFOR
8	D137	D7038	Proton	EXFOR
9		D7039	Proton	Compiled
10		D7040	Proton	Compiled
11		D7041	Proton	Compiled
12		D7042	Proton	Compiled
13		D7043	Proton	Compiled
14		30851	Neutron	Compiled
15		30852	Neutron	Compiled
16		30853	Neutron	Compiled
17		30854	Neutron	Compiled
18		30855	Neutron	Compiled

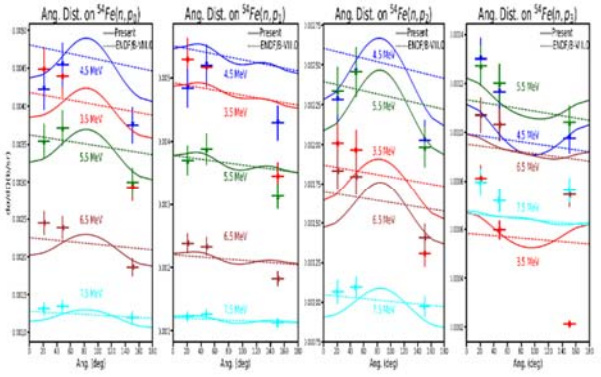
- **Checking Code**

The draft was checked through a tool of JCPRG. (http://www.jcprg.org/exfor/tool/)

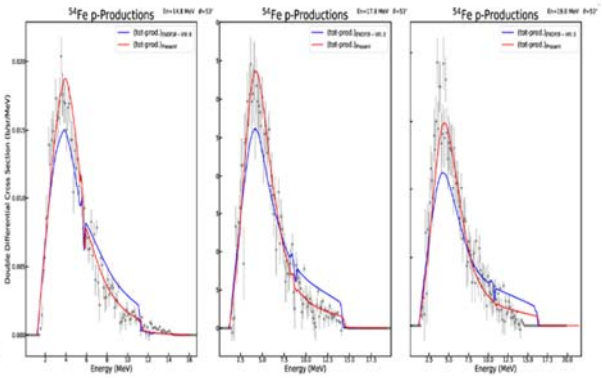
3. Nuclear Data Activities

3.1 Evaluation

A research on improving angular distributions and energy spectra of neutron-induced charged particle was completed in 2022 through the International Nuclear Energy Research Initiative (I-NERI) project with Los Alamos National Laboratory (LANL). We evaluated angular distributions and energy spectra of discrete and continuum levels for Fe, Ni, Zn based on the experimental (n,p) and (n,α) reaction cross sections. Additionally, we predicted angular distributions and energy spectra of (n,p) and (n,α) reactions for unmeasured nuclides, such as Cr, Mn, Co, Cu, and so on. Eventually, it was decided that the new evaluations on angular distributions and energy spectra of neutron-induced charged particle reactions would be incorporated into the next ENDF/B release. In conclusion, we have submitted the evaluated files for a total of 58 nuclides to the repository of the ENDF/B-VIII.1-β1 version.

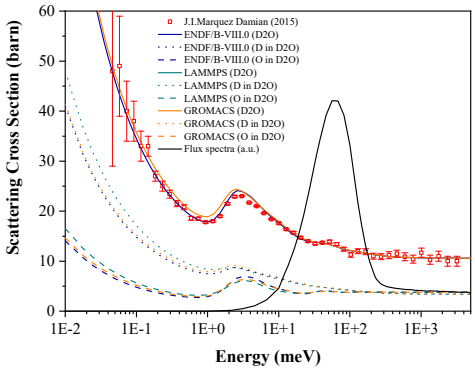


Angular Distribution of ^{54}Fe(n,p)

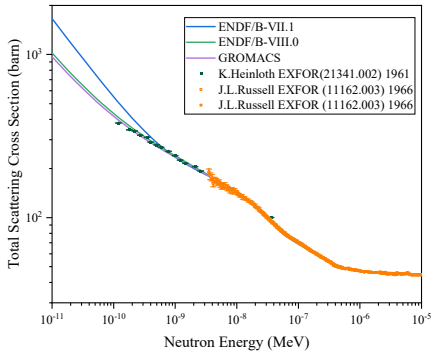


Energy Spectrum of ^{54}Fe(n,p)

A research on producing thermal neutron scattering data based on molecular dynamics code simulation has been conducted since 2022. Preliminary TSL data of D_2O and H_2O were produced using the frequency spectrum and/or Sköld correction factor obtained by GROMACS and LAMMPS code simulations with TIP4P/2005f or SPC/E water models. It was confirmed that the TSL data showed comparable performances to those of ENDF/B-VIII.0 through validation calculation using criticality benchmark problems taken from ICSBEP.



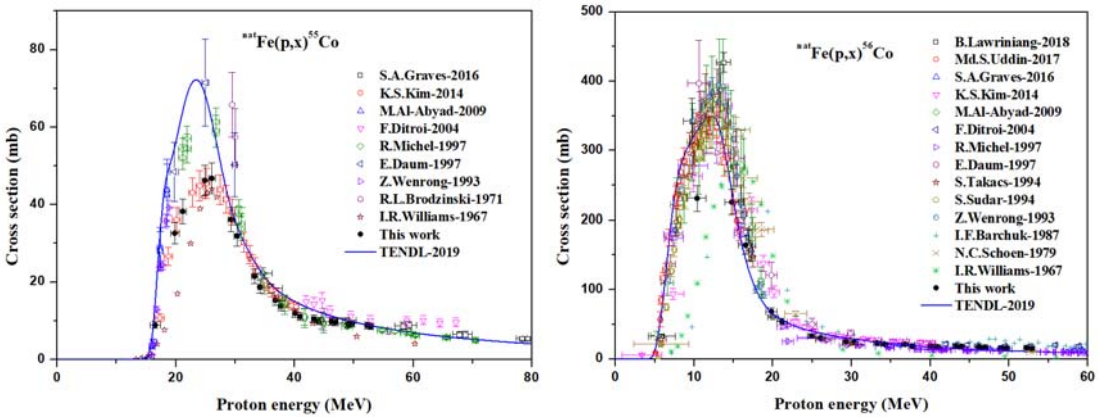
Scattering Cross Sections for D_2O



Scattering Cross Sections for H_2O

3.2 Measurement

The production cross sections for the proton induced reactions of ^{nat}Fe were measured using a stacked-foil activation technique with a proton energy of 57 MeV at the proton LINAC of the Korea multi-purpose accelerator complex (KOMAC). The measured values were compared with the experimental data of the literature and the data from the TENDL-2019 library.



3.3 Cooperation

We continue to cooperate with the following experimental groups for nuclear data production in Korea:

- Kyungpook National University (KNU)
- Sungkyunkwan University (SKKU)
- Institute for Basic Science (IBS)

Since the last meeting, some events have been held in cooperation with KNDC.

- "The 11th Korea-Japan Joint Summer School on Accelerator and Beam Science, Nuclear Data, Radiation Engineering and Reactor Physics" was held in Gyeongju, Korea from August 1 to 4, 2022. This event was organized by KOMAC of KAERI and supported by KNDC. The purpose of this event is to introduce the latest research activities on accelerators, reactor physics, nuclear data, etc. in Korea and Japan to graduate students and to inspire their research motivation.

- The “Workshop on Low Energy RI Research” was held in Daejeon, Korea from July 20 to 21, 2022. This workshop was organized by RAON of Institute for Basic Science (IBS). The EXFOR database and nuclear data measurement in Korea was introduced in this workshop.
- The “Reactor Physics Asia 2023 (RPHA23)” conference is being organized to resume in Gyeongju, Korea from October 24 to 26, 2023. This conference is hosted by the Reactor Physics and Computational Science Division of the Korean Nuclear Society, cosponsored by the counterpart divisions of the Chinese Nuclear Society and the Atomic Energy Society of Japan.

3.4 Web Service

KNDC provides the following three main web services. These websites are constantly being updated.

- Nuclear Data Chart (http://atom.kaeri.re.kr/nuchart/): nuclide information, nuclear reaction data, cross section data plot and comparison
- Application Library (http://atom.kaeri.re.kr/NDVG/): processed nuclear data library for Monte Carlo (ACE) and deterministic (MATXS) neutron transport codes, processed covariance data (COVFIL), fission product yield and decay data for SCALE
- Atomic Data (http://pearl.kaeri.re.kr/pearl/): atomic database including photoionization cross section, electron impact ionization (EII) rate coefficient, and dielectronic recombination (DR) rate coefficient

3.5 Support for Nuclear/Radiation R&Ds

KNDC supports domestic and foreign nuclear/radiation R&Ds by providing nuclear data related information, how to process nuclear data, working libraries for application, etc. The main support details for 2022 were as follows:

- Technical advice on the utilization of D_2O thermal neutron scattering data of ENDF/B-VIII.0 for Hanaro research reactor (KAERI)
- ACE-format TSL library (with 18 temperatures) of O-in-D_2O for Hanaro research reactor (KAERI)
- Energy spectrum analysis data of existing nuclear data libraries (LANL)