

# FRENDY Ver.2



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## A nuclear data processing code

### ➤ Nuclear data processing

Nuclear data processing is an important interface between an evaluated nuclear data and nuclear transport calculation codes as shown in Fig. 1. The transport codes require a cross section library which is generated by a nuclear data processing code.

The nuclear data processing code is not just a converter. It performs many processes, e.g., linearization, reconstruction of the resonance region, Doppler broadening, etc.

### ➤ Development of FRENDY

Japan Atomic Energy Agency (JAEA) developed the new nuclear data processing code FRENDY<sup>1, 2)</sup> (**FR**om **E**valuated **N**uclear **D**ata **l**ibrar**Y** to any **a**pplication) to process evaluated nuclear data files. Features of FRENDY are as follows:

- ✓ Simple input format
- ✓ Extensible & Modular
- ✓ Open source software under the 2-clause BSD license

FRENDY will help users who want to generate cross section libraries, process evaluated nuclear data files for their own code, or modify evaluated nuclear data files or cross section libraries.

### ➤ How to get FRENDY?

Everyone can download FRENDY from the following website:

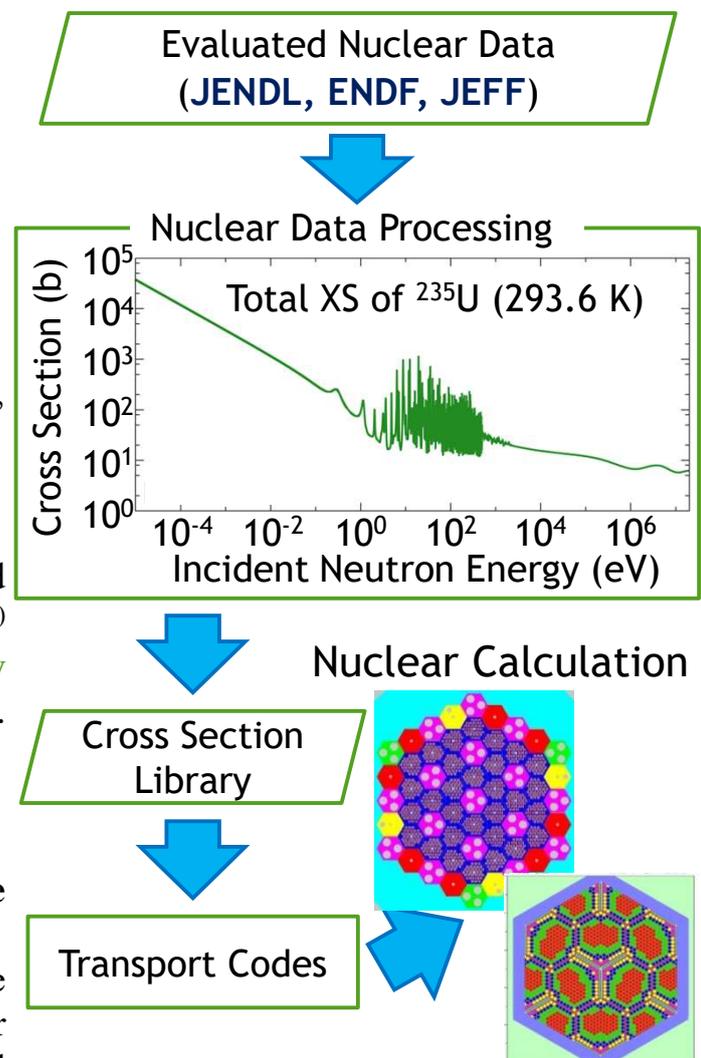
[https://rpg.jaea.go.jp/main/en/program\\_frendy/](https://rpg.jaea.go.jp/main/en/program_frendy/)

Some introduction articles are also found in the above website.

Input instructions and overview of FRENDY are written in Ref. 2 and the manual in the FRENDY package.

### ➤ References

- 1) K. Tada, et al., "Development and verification of a new nuclear data processing system FRENDY," *J. Nucl. Sci. Technol.*, **54** [7], pp.806-817 (2017).
- 2) K. Tada, et al., "Nuclear Data Processing Code FRENDY Version 1," JAEA-Data/Code 2018-014 (2019). (<https://doi.org/10.11484/jaea-data-code-2018-014>)
- 3) R. Kondo, et al., "Implementation of random sampling for ACE-format cross sections using FRENDY and application to uncertainty reduction," *Proc. M&C2019*, Aug. 25-29, (2019).
- 4) A. Yamamoto, et al., "Multi-group neutron cross section generation capability for FRENDY nuclear data processing code," *J. Nucl. Sci. Technol.*, **58**, pp.1165-1183 (2021).



**Fig. 1 Calculation flow from evaluated nuclear data to nuclear calculation**



# Features of FRENDY



## ➤ Simple input format

FRENDY does not require the expertise of the nuclear data processing as shown in Fig. 2. The other input parameters are automatically set from the evaluated nuclear data file. User can also specify the parameters in the input file if they want to change them.

FRENDY has an alternative capability of reading ordinary NJOY inputs without any modifications.

```
ace_fast_mode // Processing mode
nucl_file_name U235.dat
ace_file_name  U235.ace
temp          296.0 // [K]
```

Fig. 2 Sample input of FRENDY

## ➤ Extensible & Modular

FRENDY is developed not only to process evaluated nuclear data files but also to apply the modules to other codes. FRENDY is written in C++ and all the modules are encapsulated. Users can easily reuse many modules shown in Fig. 3 into their own codes. For example, a program for random sampling from ACE files is realized by using these modules.<sup>3)</sup> This program is applied to the uncertainty quantification using a continuous energy Monte Carlo code and now included in FRENDY.

There is no restriction to introduce the FRENDY modules into other codes since this code is an open source software under the 2-clause BSD license.

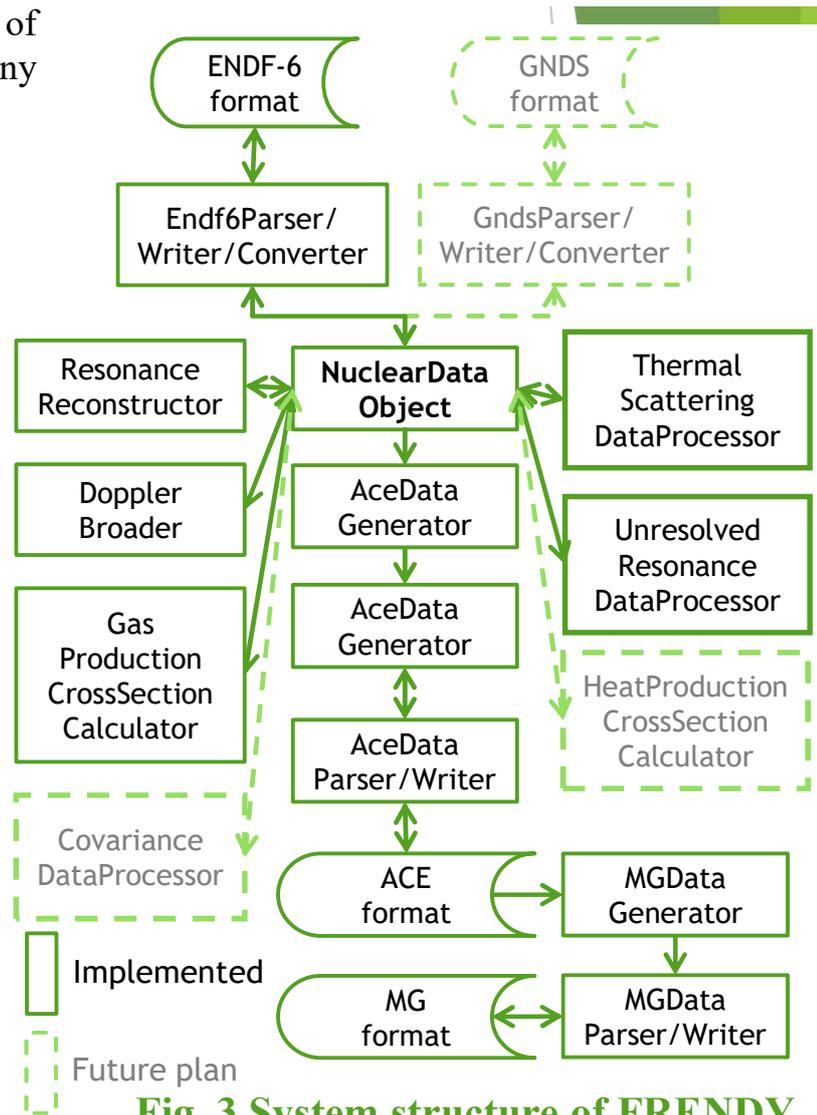


Fig. 3 System structure of FRENDY

## ➤ Future plan

FRENDY version 2 generates the ACE files which are used for continuous energy Monte Carlo codes such as PHITS, MCNP, Serpent, and Open MC and the multi-group cross-section files (GENDF and MATXS) for deterministic code. As shown in Fig. 3, the covariance data processing module (Covariance DataProcessor), the heating production cross-section calculation module (HeatProductionCross SectionCalculator), and the treatment of GND format (GndsParser/Writer/Converter) will be also implemented.

## ➤ Contact information

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