IEC-103

Status Report
NEANSC Working Party on International Evaluation Cooperation
Subgroup 13 (Intermediate Energy Data)

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1. History

Establishment of NEANSC/WPIEC Subgroup 13 (Intermediate Energy Data) was approved in the 5th Meeting of Working Party held on the 16th and 17th June, 1993 in Aix-en-Provance, and I was nominated its Monitor. After consulting with Drs. T. Fukahori (JAERI), J. Kopecky (ECN), D. Larson (ORNL), E. Menapace (ENEA), A. Mengoni (ENEA), P. Young (LANL) and H. Vonach (IRK), who gathered at JAERI for the IAEA FENDL Meeting, and Dr. C. Dunford (IAEA), an invitation letter was sent to selected candidates in November 1993.

It took considerable time to confirm their interest particularly with Russian candidates. Finally the subgroup was established in March 1994 and first actions started.

It is planned to hold the start-up meeting in the evening of the 11th May, 1994 at the Park Vista Hotel in Gatlinburg.

2. Scope of the Subgroup

See attachment 1.

3. Subgroup members

See attachment 2.

4. On-going actions

a) Needs inquiry

An inquiry form (attachment 3) was distributed to the members. Some answers are coming.

b) Critical Review of Two ECN-report by Dr. A. Koning

- Review of High Energy Data and Model Codes for Accelerator-based Transmutation, ECN-C-93-005 (1993).
- Requirements for and Evaluated Nuclear Data File for Accelerator-based Transmutation, ECN-C-93-041 (1993).

c) Compilation of Experimental Data

All members are required to inform the coordinators of available experimental data base. In JAERI, CHESTOR system is already working. (See attachment 4).

November, 1993

NEANSC Working Party on International Evaluation Cooperation

Subgroup 13 "Intermediate Energy Nuclear Data Evaluation"

Yasuyuki Kikuchi
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1. Background

It is well known that many applications, such as accelerator-driven radioactive waste managements, medical applications like radiation therapy and RI production, research of cosmic-ray effects on spaceship and astronauts, require the intermediate energy nuclear data; 20 MeV - a few GeV. The evaluation works, however, have been just started as case-studies, and little experience for the intermediate energy nuclear data evaluation is available.

On the other hand, some experimental data are available for those purposes, for instance, those measured by LAMPF group and KFA group. Several theoretical codes have also developed, such as ALICE, GNASH, LAHET, HETC, NMTC, EXIFON. Under such a situation, a few benchmark calculations by several codes have been performed by Nagel (NEADB, NEANSC task force) and Fukahori et al. (JNDC, to be published as JAERI-M report). Those works are good examples to make a foundation on the evaluation in this energy region.

Since the reaction mechanism is quite different in the intermediate energy range from the conventional energy range below 20 MeV, further fundamental researches are essential such as development of new models and production of innovative codes. These fundamental researches should be performed individually. On the other hand, however, there exist many problems which can be resolved more effectively with the international collaboration, such as inquiry of the data needs, conception of intermediate energy data, format, experimental database, intercomparison of the existence methodology etc. It is also important to avoid unnecessary format conversion and the duplicated evaluation work.

Considering such a situation, the NEANSC Working Party on International Evaluation Cooperation decided, at its fifth meeting held on the 16th and 17th June, 1993 in Aix-en-Provence, to form a new subgroup to solve the common problems of the intermediate nuclear data.

2. Major Tasks

1) Needs
- What kinds of applications are really required, and how are their priorities?
- Make an inquiry to the potential users (transmutation, medical, space etc.).

2) Conception of Intermediate Nuclear Data
- Which kind of data (reactions and nuclides) should be provided?

3) Formats for Intermediate Nuclear Data
- Different formats for different energy ranges?

4) Compilation of Experimental Data
- Survey of existing database (for example, CHESTOR in Japan).
- Build world-unified database.

5) Survey of Existing Evaluated Data

6) Methodology
- Intercomparison of the existing theories, models and codes (Joint task with other NEANSC tasks).
- Identify the necessary parameters.
- Compilation of the parameter database.

7) Resources
- Potential evaluators.
- Role of NEA Data Bank.

8) Pilot Evaluations (to be started later)

3. Starting Actions

1) General

Some of the tasks were already done by Dr. A.J. Koning. He wrote two excellent reports:

① Review of High Energy Data and Model Codes for Accelerator-based Transmutation, ECN-C-93-005 (1993), and

② Requirements for an Evaluated Nuclear Data File for Accelerator-based Transmutation, ECN-C-93-041 (1993).

These two documents should be reviewed carefully by all the subgroup members. Dr. Koning is required to send them upon request.

2) Needs inquiry

Kikuchi will provide an inquiry form and all the members should send the inquiry to the potential users around them.

3) Compilation of Experimental Data

All members should inform to the coordinators of available experimental database.

All the starting actions should be finished by the end of March, 1994 and the results will be discussed at the next Working Party Meeting in May, 1994.

NEANSC International Evaluation Cooperation Working Party
Subworking Group No.13 (Intermediate Energy Data)
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April 11, 1994

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Inquiry on
Intermediate Energy Nuclear Data (IEND) Needs
for Various Applications

1. Participant's Information

- Name of Participant:
- Affiliation:
- Address:
- Phone No.:
- FAX No.:
- E-mail Address:

2. Application Necessary IEND

- Related to

  - ☐ accelerator:
  - ☐ medical use:
  - ☐ space use:
  - ☐ astrophysics:
  - ☐ others:

- Please write how to use IEND in your application, actually.

3. Required Physical Quantities in Your Applications

- Incident particle(s):
- Physical quantity of:

  - ☐ individual isotope production cross sections
    product nuclei:
  - ☐ double differential particle or photon production cross sections
    - ☐ n, ☐ p, ☐ d, ☐ t, ☐ ^{3}He, ☐ α, ☐ γ
  - ☐ double differential primary knock-on atom (PKA) spectra
  - ☐ others

4. Nuclides Necessary for Your Applications

5. Effective or Preferable Expression of IEND

- Data library for

  - ☐ ENDF type format
  - ☐ spread sheet type
  - ☐ others

- Data type

  - ☐ group constants ---- type:
  - ☐ averaged value with certain energy bin
  - ☐ point wise
  - ☐ others

6. Comments on Evaluation Works for IEND

Thank you.

Status Report of JENDL Charged Particle Data

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1. Experimental Database

In order to use in the evaluation work of the charged particle and gamma-ray induced nuclear data, the charged particles and gamma-ray induced experimental data storage and retrieval system (CHESTOR) has been developed by converting from EXFOR data. The considered charged particles were proton, deuteron, triton, He-3 and alpha as well as gamma-ray.

The experimental data of thick target neutron and proton yields for proton and alpha-particle induced reactions on several elements were collected and stored in EXFOR format. The considered elements were C, Al, Fe, Cu, W, Pb and U.

2. Evaluation of Data

The nuclear data of charged particle induced reactions were originally considered for the JENDL High Energy File. The lower energy data are also evaluated, since JENDL does not have the charged particle induced data. Though the charged particle spectra are not included in JENDL-3 General Purpose File, this problem is solved in JENDL Fusion File.

The JENDL High Energy File considers only proton induced reactions at this time. The results of proton-induced isotope production cross sections calculated by several codes were compared with each other as well as experimental data. The considered codes were EGNASH, EXIFON, ALICE-F, ALICE/85, MCEXCITON, NUCLEUS and HETC/3-STEP. It was found that the codes using statistical theory with preequilibrium correction could reproduce the experimental data of isotope production cross sections better than the others.

The proton nuclear data have been evaluated for Cr-50,52,53,54, Fe-54,56,57,58, Ni-58,60,61,62,64, and Cu-63,65 up to 15 MeV mainly by using EGNASH-2 code. For the proton optical potential parameter, Perey's and Walter-Guss's potential parameters were combined. The (p,n) reaction is a main part of reaction, because of incident proton energy. The evaluated results are almost in good agreement with the experimental data. The incident energy will be expanded up to 50 MeV by using similar method.

The proton incident nuclear data up to 1 GeV have been calculated for Al, Pb and Bi isotopes by using the ALICE-F code. These data are now under reviewing to be final evaluated results.

3. Others

The primary knock-on atom (PKA) is produced through various nuclear reactions. Estimation of PKA spectra is necessary to the KERMA factor calculation and the material design applications, especially for the fusion application. ESPERANT code, which creates the PKA/KERMA file from the evaluated nuclear data file, was developed. For the lighter nuclei, it is difficult to create the PKA/KERMA file by using ESPERANT because of its approximating limitation. Consequently, the SCINFUL/DDX code, which is modified from

the detector response function calculation code, SCINFUL, is under development so as to calculate both nuclear data and PKA spectra, simultaneously.

The calculation methods of charged particle stopping power were compared to estimate its transportation in the actual materials and to calculate thick target yields. The preliminary version of code calculating thick target yields of neutron emission from the evaluated nuclear data files was developed.

The (α,n) reaction data for several nuclei have been evaluated to check the criticality and heating safety of storing spent fuel. The data related to fusion reactions were researched. The reaction channels and reaction rates for nuclear fusion are investigating to perform an plasma analysis with measuring the fusion products.