

WPEC Subgroup proposal

Title

“CIELO (Collaborative International Evaluated Library Organization) Pilot Project”

Justification for a Subgroup

Outstanding progress has been made around the world in nuclear data evaluation. The quality of the main evaluated data libraries is high and they all perform reasonably well in neutronics simulations for usual fission and fusion energy applications. However, not all users' needs in term of accuracy and completeness are fulfilled yet. This is generally true for non-energy applications (e.g. accelerator, astrophysics) and for innovative energy applications (e.g. new energy range, new materials), but also for current fission and fusion systems (e.g. covariance data). In addition, it is recognised that significant error compensations are still present in all files.

A stronger and wider international collaboration is proposed to foster evaluated nuclear data advances and provide improved data for fission, fusion, and other nuclear applications.

This proposed joint initiative on general purpose nuclear reaction data evaluated files will benefit from a coordinated, vigorous, international collaboration to produce recommendations for more complete and more accurately determined neutron evaluated cross sections. In addition, participants will document reasons for discrepancies between the existing main evaluated files, resolve some of the discrepancies, and advance our understanding of the underlying cross sections and covariances through advances in experiment, theory, simulation, and integral validation testing.

The goal is to provide evaluations that perform in integral simulations (k_{eff} , spectral indices, etc.) as well, or better, compared to existing evaluations, whilst using more accurate fundamental cross-section and spectra data. CIELO data will not be adjusted in the formal sense, but we recognize that some aspects of CIELO will include evaluation choices based on feedback from simulations of integral experiments.

By pooling our resources, and with careful coordination, we believe we can make rapid advances to our nuclear data evaluations. The CIELO pilot project will focus on 6 important isotopes initially – ^1H , ^{16}O , ^{56}Fe , $^{235,238}\text{U}$, ^{239}Pu . Future evolution of this pilot effort could lead to an increasing number of isotopes considered.

Some of the motivations for this subgroup are:

- The reasons for the discrepancies between the latest evaluated files of the selected nuclides should be identified and documented. Recommendations on how to reconcile these discrepancies and further improve the files should be made;
- The product should be of higher quality, benefiting from the combined effort of the world's experts in the field of nuclear data measurement, modelling/evaluation, processing and integral validation;
- Collaborations of world's experts are less likely to unintentionally omit key measured differential/integral data, or physical insights, in their considerations;

- Errors, and the possibility of poor evaluation decisions, will be minimized through increased peer-review. This is particularly important for areas where expertise resides in just one person in each regional project;
- The scope, and detail, of evaluated cross section libraries has become so large that we should consider sharing responsibilities, and resources, for developing improved nuclear data.

Subgroup Monitor(s)

R.A. Forrest (IAEA), T. Fukahori (JENDL), M. Herman (ENDF), A. Ignatyuk (BROND),
R. Jacqmin (JEFF)

Subgroup Coordinator

M.B. Chadwick (ENDF)

Subgroup Participants

Due to the large size of the proposed subgroup, activities will be organized by teams led by key technical people under the coordination of the Subgroup coordinator, who will report to the Working Party. As for all Subgroups, the role of the monitors is to represent WPEC members. The Appendix contains proposals of key technical leaders and possible participants for actinides, ^{56}Fe , ^{16}O and ^1H . It remains to be determined by each institution the time that these people can devote to this collaboration.

Definition of the project and proposed activities

See the CIELO paper to be published in Nuclear Data Sheets and the associated list of tasks, which describes the body of CIELO work we plan on doing for the 6 key isotopes. This document was created following a decision at the WPEC meeting, May 2012, to proceed by identifying current discrepancies and areas where our understanding needs to be improved. This subgroup proposal is the next step with the objective to resolve these discrepancies, to produce improved evaluations whenever possible, as well as associated documentation, and to share feedback on this pilot project. In addition, this subgroup will provide recommendations on how to proceed to extend the CIELO project.

Relevance to Evaluated Data Files

As described above, the product from the CIELO pilot project will be (a) advances in our understanding of key neutron reaction cross sections, spectra, angular distributions, and covariances; (b) updated ENDF-6 formatted files and associated documentation that embody the diagnostics and physics described in (a) with the ultimate goal to respond to the users' needs for improved nuclear data.

The various regional evaluation projects – JEFF, JENDL, ENDF, BROND, CENDL, TENDL... would have the option to adopt part, or all, of the CIELO files in the future evaluated libraries.

Time-Schedule and Deliverables:

Background

- Nov 2011: IAEA consultant's meeting where Chadwick proposed the CIELO concept.
- May 2012: First NEA/NSC/WPEC discussions on CIELO. Agreement to proceed to "Phase I", where current discrepancies were to be identified for 6 key isotopes.
- Nov 2012: NEA meeting where "Phase I" results were presented, and the CIELO concept was discussed briefly, with many participants. There was a general sense of optimism to proceed with a formal WPEC Subgroup to proceed to "Phase II".
- Nov – Dec 2012: email interactions defining possible CIELO participants.
- March 2013: CIELO discussions with broad nuclear data community during ND2013 in New York.

This proposal

It is expected that experts of this subgroup could complete and document the proposed activities within 3 years.

- May-June 2013: Review and approval by WPEC and NSC of this Subgroup proposal on a CIELO pilot project.
- May 2013: at WPEC, discuss and adopt Governance Model for how CIELO will be coordinated and planned, how collaborations will occur (meetings, and email), and how internal peer-review and decisions will be made.
- January – summer 2013: define detailed scope and goals for CIELO (building on the CIELO paper and associated list of tasks).
- CIELO workshop, Santa Fe, Autumn 2013 (TBC), possibly in conjunction with SG33 follow-up subgroup meeting (TBC) to further discuss and finalize the list of tasks that will need to be undertaken to meet subgroup objectives in 2016.
- 2013-2015: detailed collaborations (i) to study discrepancies and whenever possible improve cross sections and covariances for 6 isotopes, including specific validation testing and feedback, and also insights from other WPEC subgroups (e.g. SG33 follow-on) and from IAEA CRPs, especially Standards, PFNS...; and (ii) to identify future work needed to further improve the evaluations.
- 2015-2016: integral validation of these isotopes and companion isotopes (e.g. $^{240,241}\text{Pu}$, ^{52}Cr).

Deliverables (May 2016)

- Report containing,
 - Experts' conclusions on the evaluated file discrepancies and their recommended actions to resolve these discrepancies.
 - Various validation testing, feedback on impact of proposed data.
 - Lessons learned from the collaborative work in the pilot project and recommendations on possible extension of the CIELO project, including possible governance model.
- Updated evaluations for 6 isotopes, including covariance data.

Appendix – Potential participants

Due to the large size of the proposed subgroup, activities will be organized by teams led by key technical people under the coordination of the Subgroup coordinator, who will report to the Working Party. As for all Subgroups, the role of the monitors is to represent WPEC members. The Appendix contains proposals of key technical leaders and possible participants for actinides, ^{56}Fe , ^{16}O and ^1H . It remains to be determined by each institution the time that these people can devote to this collaboration.

Actinides

Fast energy: T.Kawano, P.Romain, O.Iwamoto and R.Capote, with responsibility for updating evaluated files as follows – ^{239}Pu (T.Kawano), ^{235}U (P.Romain), ^{238}U (R.Capote, O.Iwamoto). These efforts will adopt the standard evaluations of ^{235}U and ^{238}U fission cross sections, as well as the standard committee recommendations for ^{239}Pu fission and ^{238}U capture cross sections.

Resonances: L.Leal, G.Noguere and P.Schillebeeckx, with responsibility for updating evaluated files as follows – ^{239}Pu (G.Noguere), ^{235}U (L.Leal), ^{238}U (P.Schillebeeckx)

Prompt Fission Neutron Spectra (PFNS): a team will address this led by P.Talou and R.Capote.

Delayed neutrons: a review of discrepancies and possible improvements could be coordinated by V.Piksaikin (TBC).

^{56}Fe

Fast energy: team includes M.Herman, A.Trkov, A.Koning, N.Iwamoto with co-responsibility for updating the evaluated file on M.Herman and A.Trkov.

Resonances: L.Leal, A.Plompen, P.Schillebeeckx, with responsibility for updating the evaluated file on L.Leal.

^{16}O

Team includes S.Kunieda, C.Lubitz, D.Roubtsov, A.Plompen, G.Hale, L.Leal, S.Kopecky, with co-responsibility for updating the evaluated file on S.Kunieda and A.Plompen.

^1H

G.Hale, M.Paris, A.Carlson and IAEA standards team, with responsibility on G.Hale.

Below is a draft list of participants that already expressed some interest to contribute to this subgroup. We expect the above listed key leads to engage all potential participants as they undertake their work.

Actinides

ENDF: Kawano, Talou, Leal, Herman, Brown, Thompson, Vogt, Kahler, Roubtsov, Danon, Mughabghab

JEFF: Romain, Bauge, Noguere, Plompen, Sublet, Rochman, Koning, De Saint Jean, Schillebeeckx, Sirakov, Kodeli, Bernard, Bouland, Ware, Moxon, Morillon
Trkov (IAEA, ENDF, and JEFF collaborations),
Kim (S. Korea)

IAEA: Capote, Forrest, Simakov, Sin, and standards team

JENDL: O. Iwamoto
 Russia: Pronyaev, Ignatyuk, Piksaikin, Manokhin, Blokhin
 China: Chen Guochang, Yu Baosheng

⁵⁶Fe

ENDF: Herman, Brown, Leal, MacFarlane, Kawano, Danon
 IAEA: Capote
 JEFF: Plompen, Koning, Vaglio-Gaudard, Sublet, Kodeli, Schillebeeckx, Sirakov, Archier, Trkov (IAEA, ENDF, and JEFF collaborations), Y.S. Cho (S. Korea)
 JENDL: N. Iwamoto
 China: Xu Ruirui, TBD
 Russia: Pronyaev, Blokhin

¹⁶O

ENDF: Hale, Lubitz, Roubtsov, Leal, Kahler, Paris, Kawano, Quaglioni, Mughabghab
 JEFF: Plompen, Sublet, Kodeli, Noguere, Bouland, Moxon
 JENDL: Kunieda
 Russia: Pronyaev
 China: TBD
 IAEA: Simakov

¹H

Standards team: Hale, Carlson...
 ENDF: Kahler, Lubitz, Trumbell, Roubtsov
 JEFF: Noguere

Integral validation and discussion of benchmarking procedure

The possible participants listed below have some expertise in integral validation. They should help focus the effort on the relevant part of the differential data and contribute to the testing of each nuclide.

Ishikawa (TBC), Palmiotti, van der Marck, Jacqmin, Kahler, Wu Haicheng, Bernard, Santamarina