OAK RIDGE National Laboratory

International Nuclear Data Evaluation Network (INDEN) collaboration at the International Atomic Energy Agency

Roberto Capote[(i)] and Marco T. Pigni[(ii)]*

[(i)]Nuclear Data Section, International Atomic Energy Agency, Vienna, Austria

[(ii)]Nuclear Data, Oak Ridge National Laboratory, Oak Ridge, TN, USA

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*Presenter.

Background

- CIELO project (OECD/NEA WPEC SG-40) was created to test the scheme of broad international collaboration to improve evaluated nuclear data files of the major nuclides: ^{1}H, ^{16}O, ^{56}Fe, ^{235,238}U and ^{239}Pu
- CIELO project led to new evaluations of ^{235,238}U with strong input from the IAEA. Updates such as ^{235}U PFNS and thermal constants, new evaluations in the fast region were adopted for ENDF/B-VIII.0 release: significant impact on performance

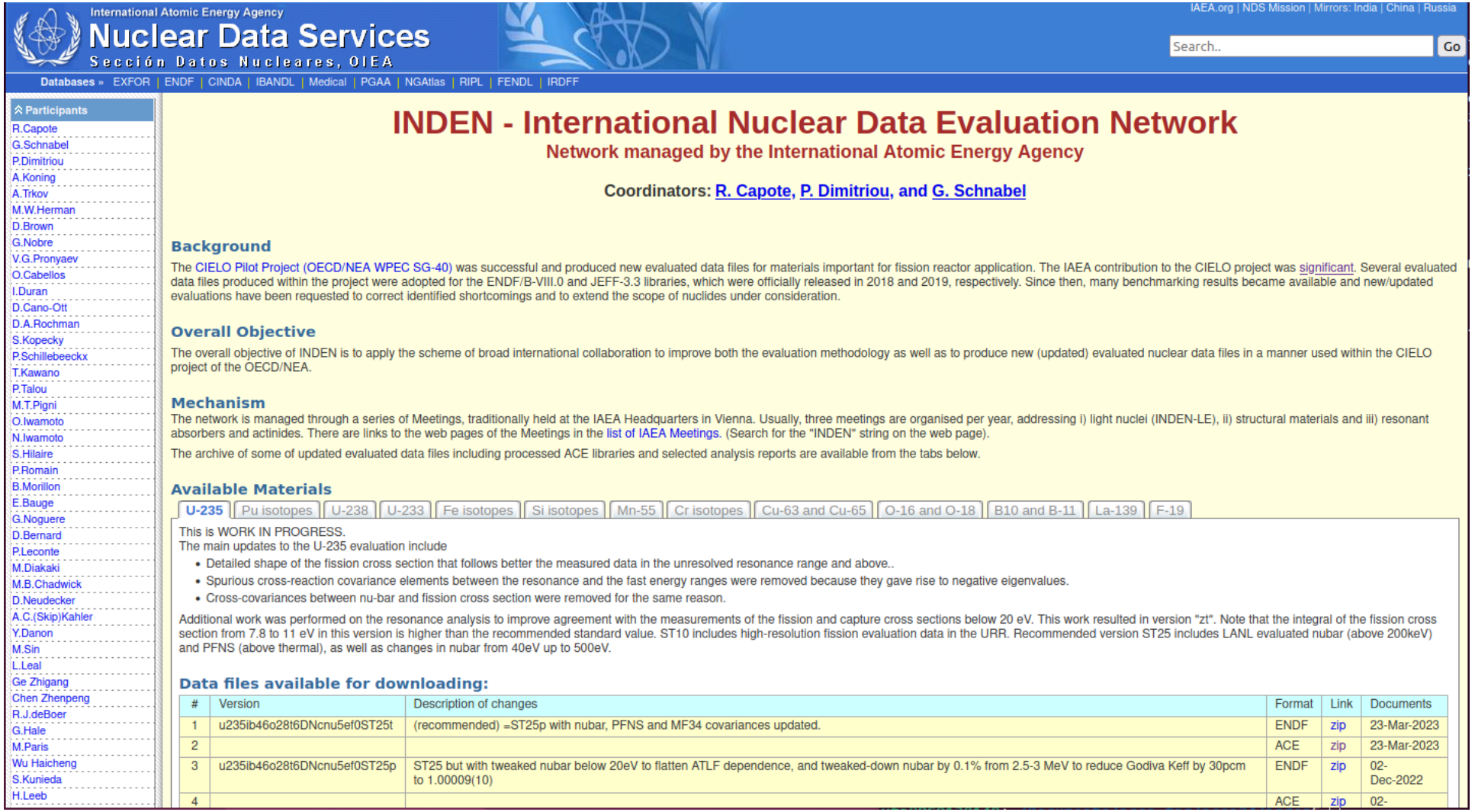
Overarching goal

- Following the ENDF/B-VIII.0 release guided by the CIELO collaboration, INDEN overall objective is to apply the broad international collaboration scheme similarly to the OECD/NEA CIELO project to improve both the evaluation methodology as well as to produce new (updated) ENDFs

Mechanism

- The network is managed through a series of meetings, traditionally held at the IAEA Headquarters in Vienna
- Three topical meetings are organized per year addressing i) light nuclei (INDEN-LE), ii) structural materials and iii) resonant absorbers and fissile actinides (INDEN-act)

INDEN Website



International Atomic Energy Agency
Nuclear Data Services
Sección Datos Nucleares, OIEA

IAEA.org | NDS Mission | Mirrors: India | China | Russia

Search.. Go

Databases » EXFOR | ENDF | CINDA | IBANDL | Medical | PGAA | NGAtlas | RIPL | FENDL | IRDFF

Participants
R.Capote
G.Schnabel
P.Dimitriou
A.Koning
A.Trkov
M.W.Herman
D.Brown
G.Nobre
V.G.Pronyaev
O.Cabellos
I.Duran
D.Cano-Ott
D.A.Rochman
S.Kopecky
P.Schillebeeckx
T.Kawano
P.Talou
M.T.Pigni
O.Iwamoto
N.Iwamoto
S.Hilaire
P.Romain
B.Morillon
E.Bauge
G.Noguere
D.Bernard
P.Leconte
M.Diakaki
M.B.Chadwick
D.Neudecker
A.C.(Skip)Kahler
Y.Danon
M.Sin
L.Leal
Ge Zhigang
Chen Zhenpeng
R.J.deBoer
G.Hale
M.Paris
Wu Haicheng
S.Kunieda
H.Leeb

INDEN - International Nuclear Data Evaluation Network

Network managed by the International Atomic Energy Agency

Coordinators: R. Capote, P. Dimitriou, and G. Schnabel

Background

The CIELO Pilot Project (OECD/NEA WPEC SG-40) was successful and produced new evaluated data files for materials important for fission reactor application. The IAEA contribution to the CIELO project was significant. Several evaluated data files produced within the project were adopted for the ENDF/B-VIII.0 and JEFF-3.3 libraries, which were officially released in 2018 and 2019, respectively. Since then, many benchmarking results became available and new/updated evaluations have been requested to correct identified shortcomings and to extend the scope of nuclides under consideration.

Overall Objective

The overall objective of INDEN is to apply the scheme of broad international collaboration to improve both the evaluation methodology as well as to produce new (updated) evaluated nuclear data files in a manner used within the CIELO project of the OECD/NEA.

Mechanism

The network is managed through a series of Meetings, traditionally held at the IAEA Headquarters in Vienna. Usually, three meetings are organised per year, addressing i) light nuclei (INDEN-LE), ii) structural materials and iii) resonant absorbers and actinides. There are links to the web pages of the Meetings in the list of IAEA Meetings. (Search for the "INDEN" string on the web page).

The archive of some of updated evaluated data files including processed ACE libraries and selected analysis reports are available from the tabs below.

Available Materials

U-235 | Pu isotopes | U-238 | U-233 | Fe isotopes | Si isotopes | Mn-55 | Cr isotopes | Cu-63 and Cu-65 | O-16 and O-18 | B10 and B-11 | La-139 | F-19

This is WORK IN PROGRESS.
The main updates to the U-235 evaluation include

- Detailed shape of the fission cross section that follows better the measured data in the unresolved resonance range and above..
- Spurious cross-reaction covariance elements between the resonance and the fast energy ranges were removed because they gave rise to negative eigenvalues.
- Cross-covariances between nu-bar and fission cross section were removed for the same reason.

Additional work was performed on the resonance analysis to improve agreement with the measurements of the fission and capture cross sections below 20 eV. This work resulted in version "zt". Note that the integral of the fission cross section from 7.8 to 11 eV in this version is higher than the recommended standard value. ST10 includes high-resolution fission evaluation data in the URR. Recommended version ST25 includes LANL evaluated nubar (above 200keV) and PFNS (above thermal), as well as changes in nubar from 40eV up to 500eV.

Data files available for downloading:

#	Version	Description of changes	Format	Link	Documents
1	u235ib46o28t6DNcnu5ef0ST25t	(recommended) =ST25p with nubar, PFNS and MF34 covariances updated.	ENDF	zip	23-Mar-2023
2			ACE	zip	23-Mar-2023
3	u235ib46o28t6DNcnu5ef0ST25p	ST25 but with tweaked nubar below 20eV to flatten ATLF dependence, and tweaked-down nubar by 0.1% from 2.5-3 MeV to reduce Godiva Keff by 30pcm to 1.00009(10)	ENDF	zip	02-Dec-2022
4			ACE	zip	02-

Evaluation achievements within INDEN effort[†]

Light nuclei: ^{16,18}O, ^{19}F

Structural materials: $^{28–30}$Si, $^{50–54}$Cr, ^{55}Mn, ^{54,56,57}Fe, ^{63,65}Cu

Heavy Nuclei: ^{139}La

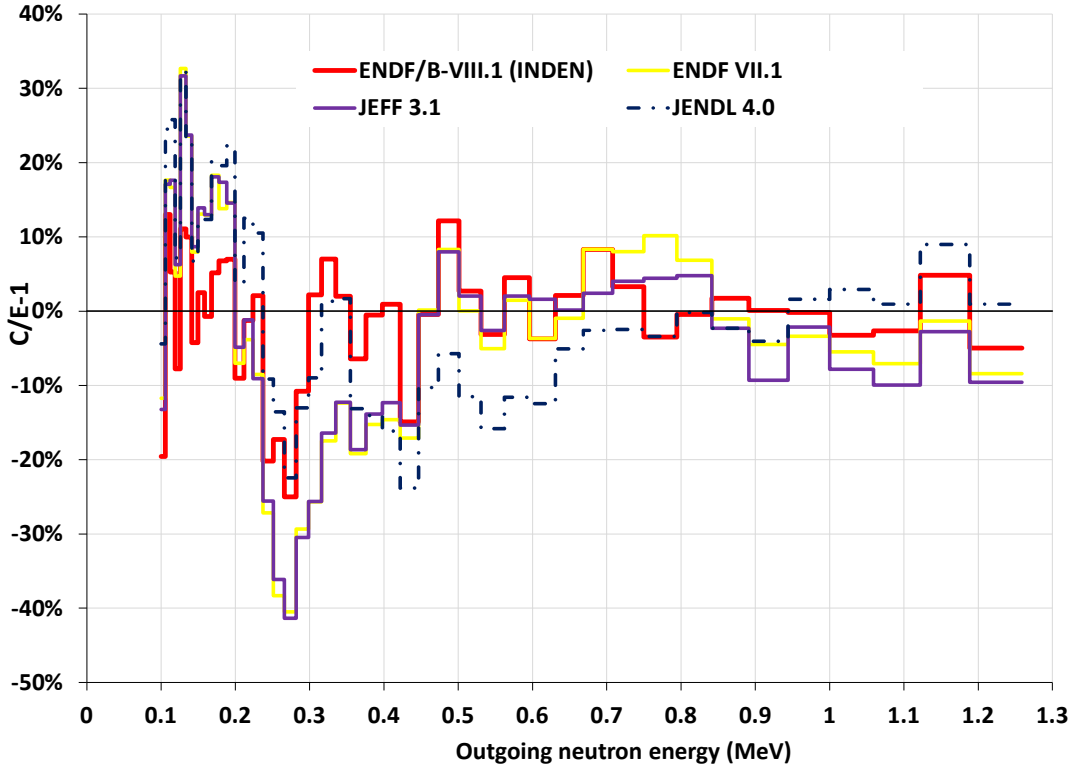
Actinides: ^{233,235,238}U, ^{239,240,241}Pu

- 10 materials, 24 nuclides over different energy regions
- All of them within NCSP overlapping needs (5-year plan APPENDIX B)

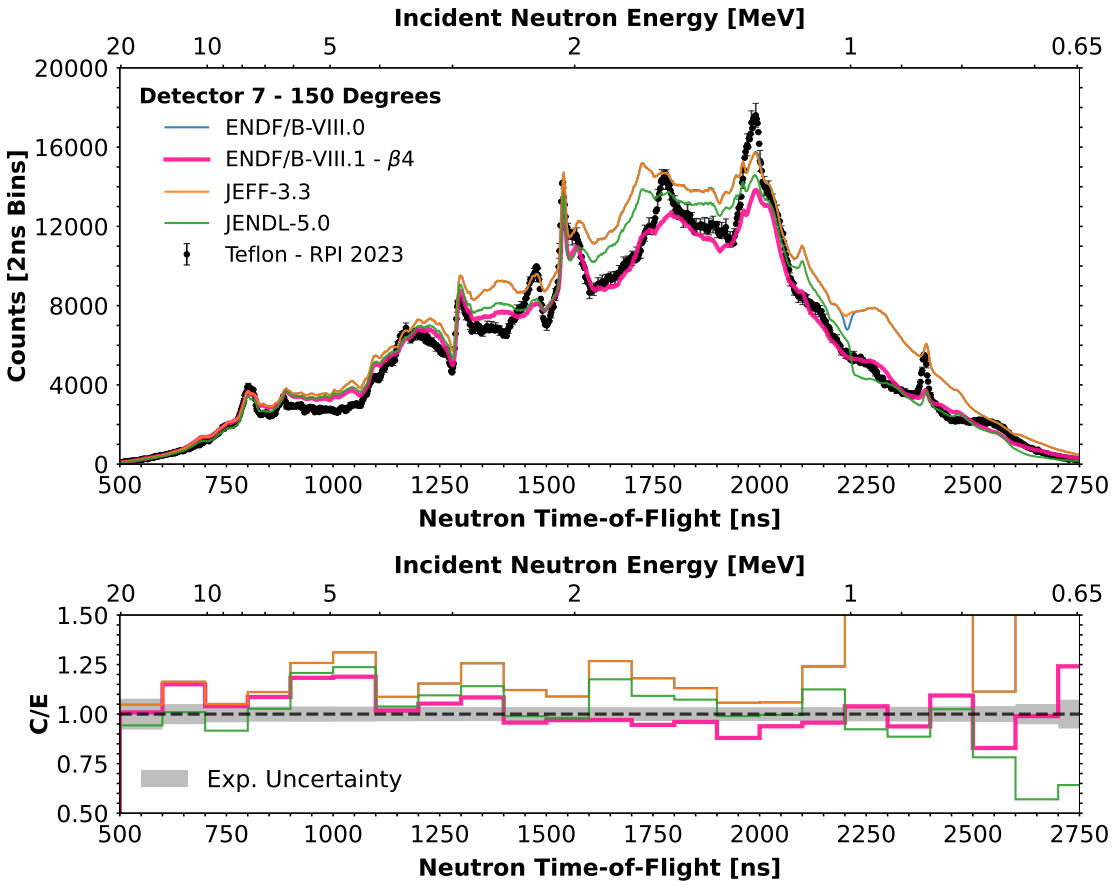
- Impact on criticality benchmarks but also on ...
- Neutron leakage experiments
- Quasi-differential measurements
- Reactor applications such as depletion calculations

[†]https://nds.iaea.org/INDEN

Evaluation achievements within INDEN effort (^{19}F)

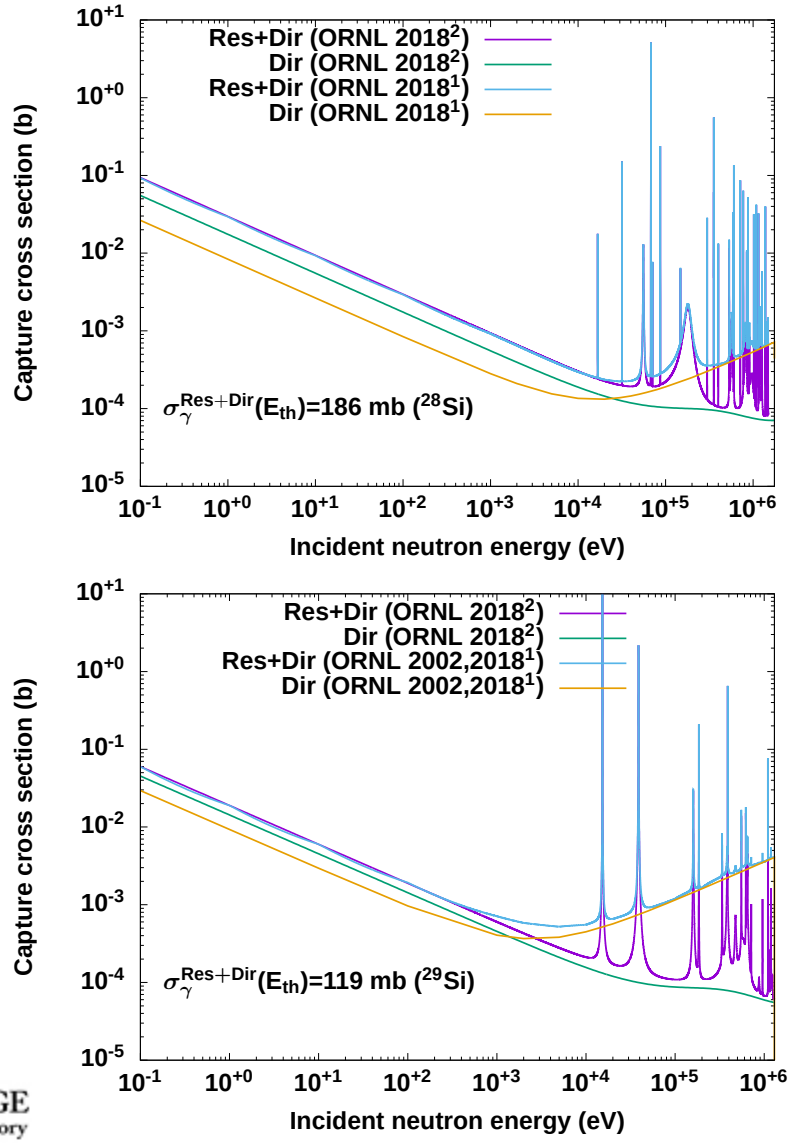


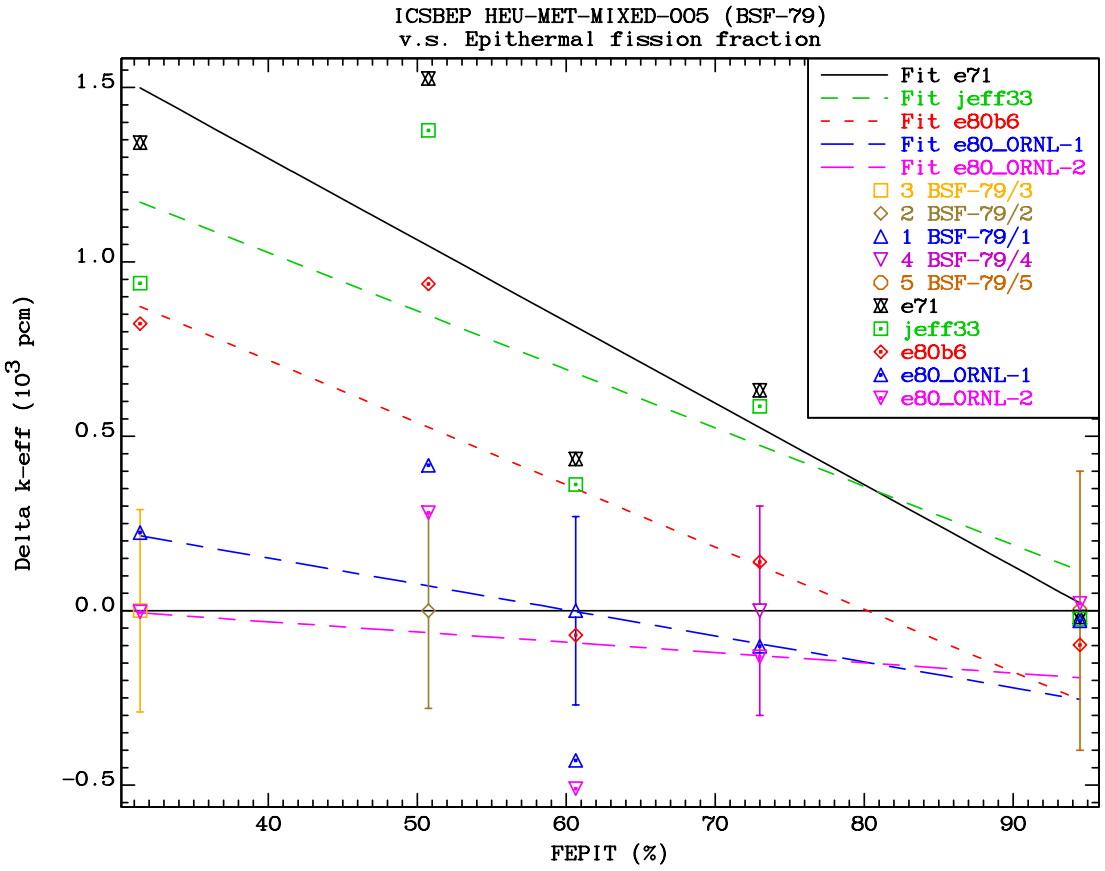
C/E from Leakage experiments



Quasi-differential measured data

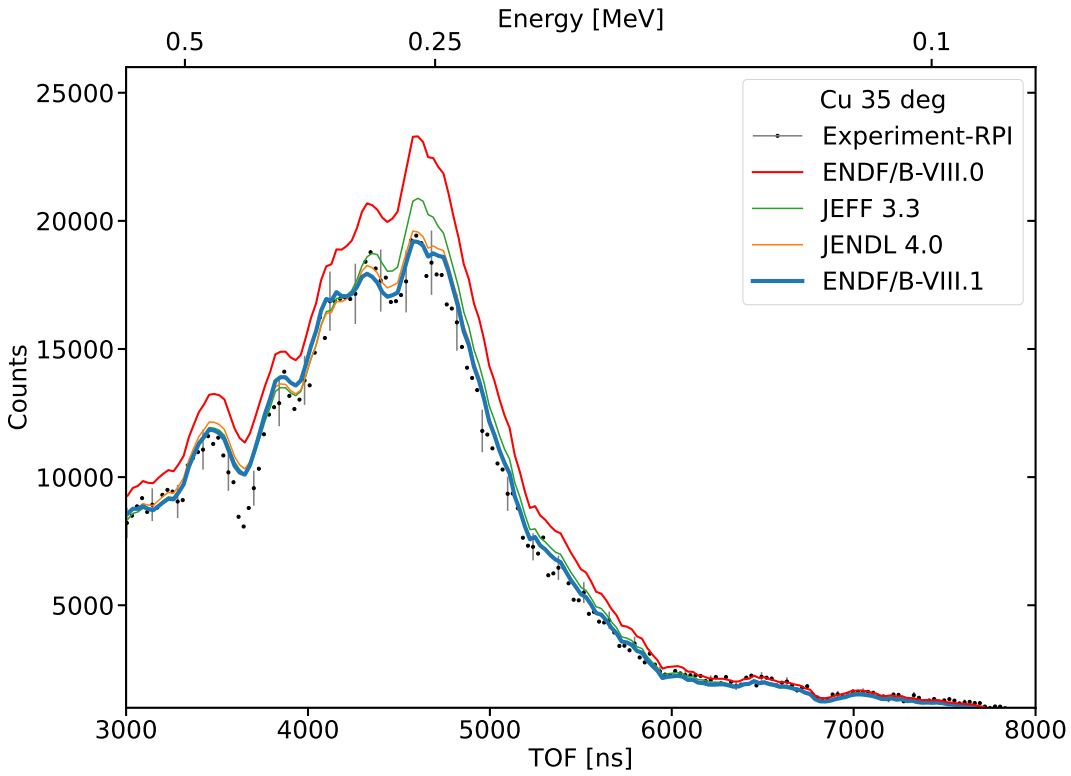
Evaluation achievements within INDEN effort ($^{28-30}$Si)



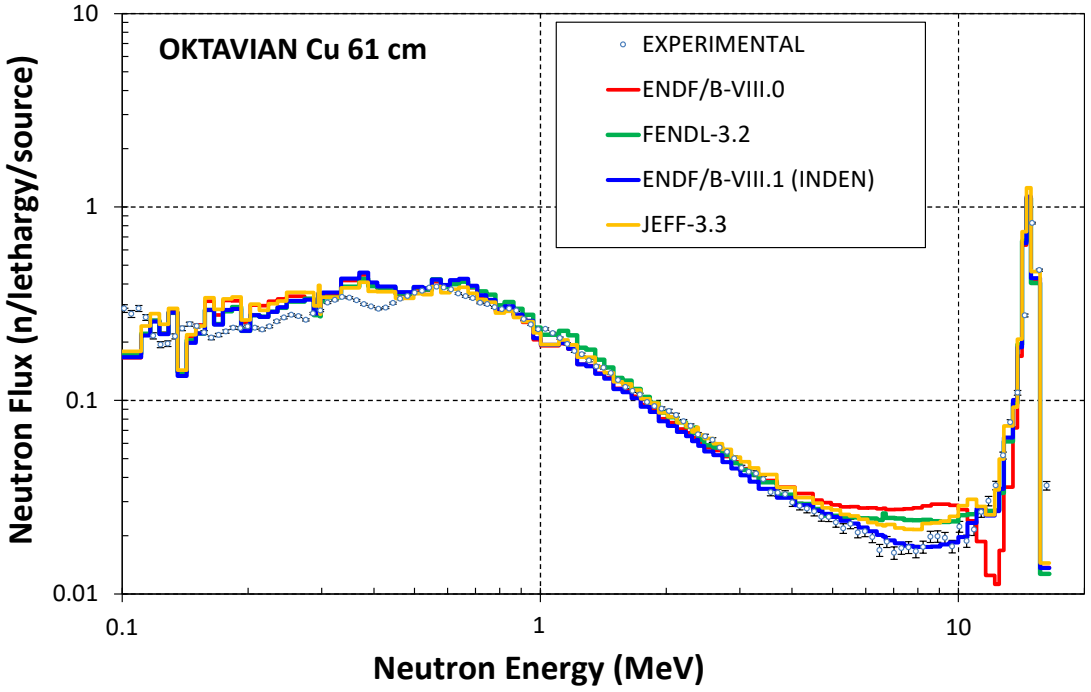


HEU-MET-MIXED experiments from ICSBEP compilation

Evaluation achievements within INDEN effort (^{63,65}Cu)

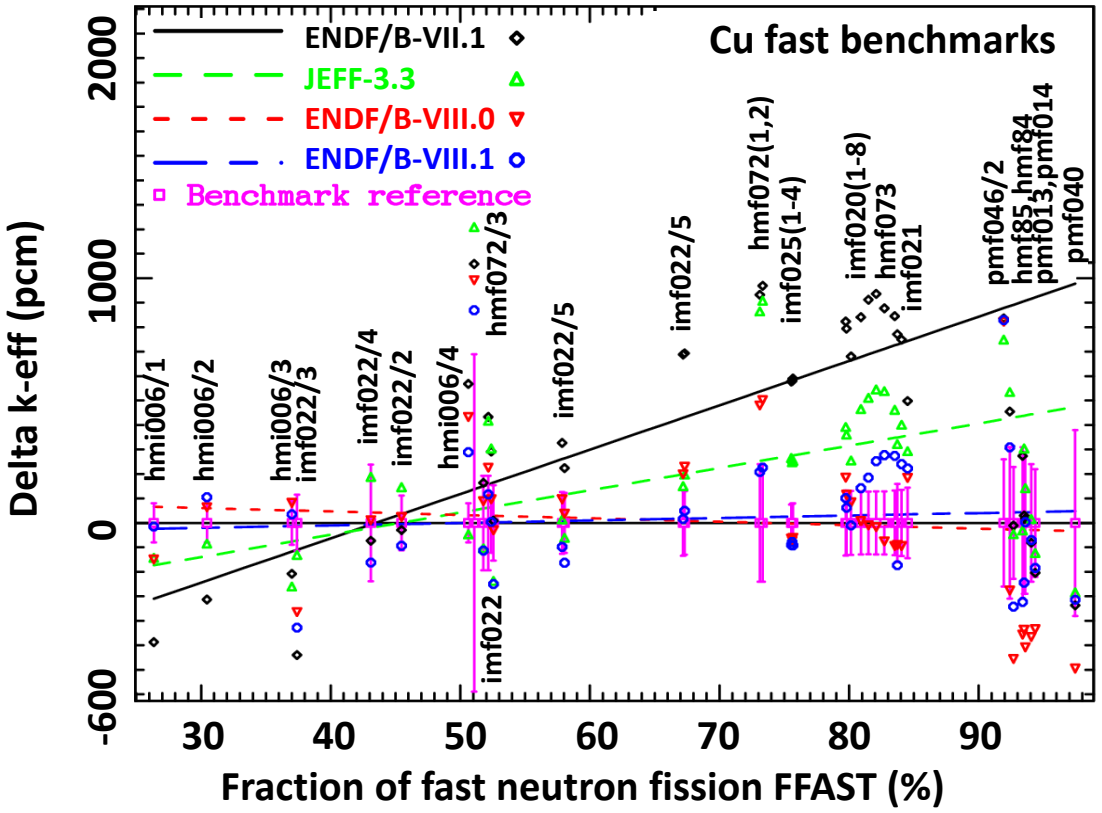


Quasi-differential measured data

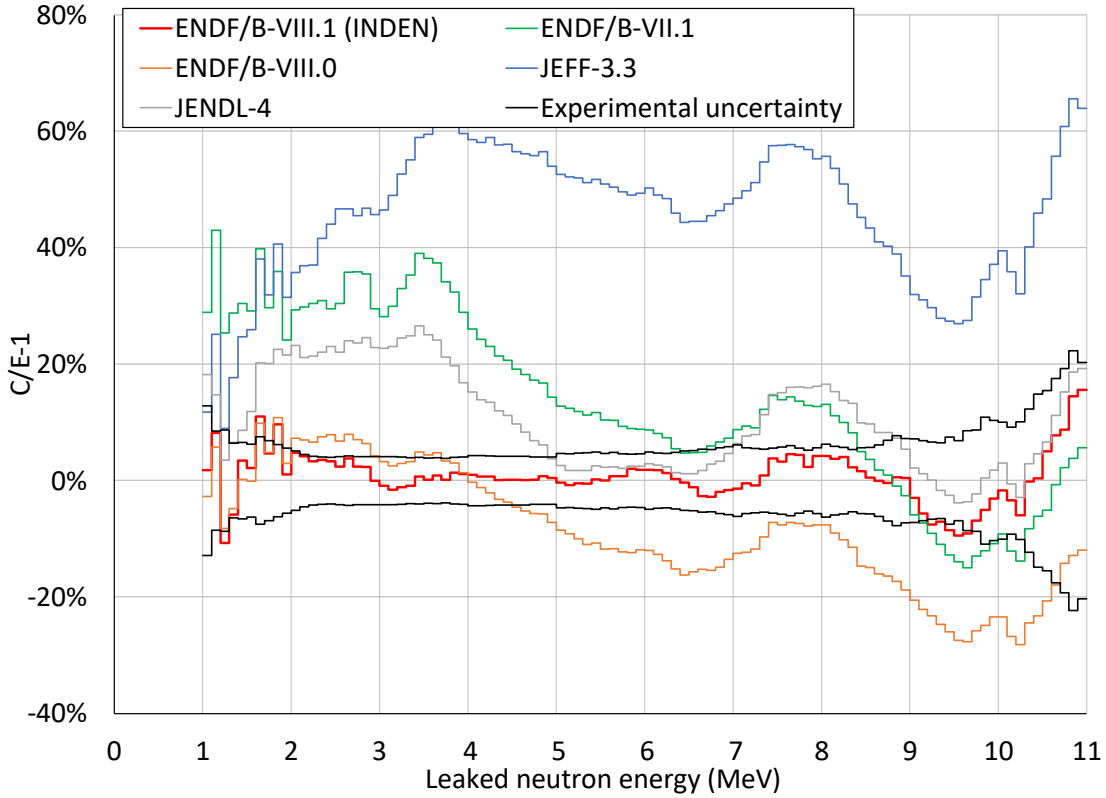


Neutron leakage data from copper assembly from Octavian facility

Evaluation achievements within INDEN effort (^{63,65}Cu)



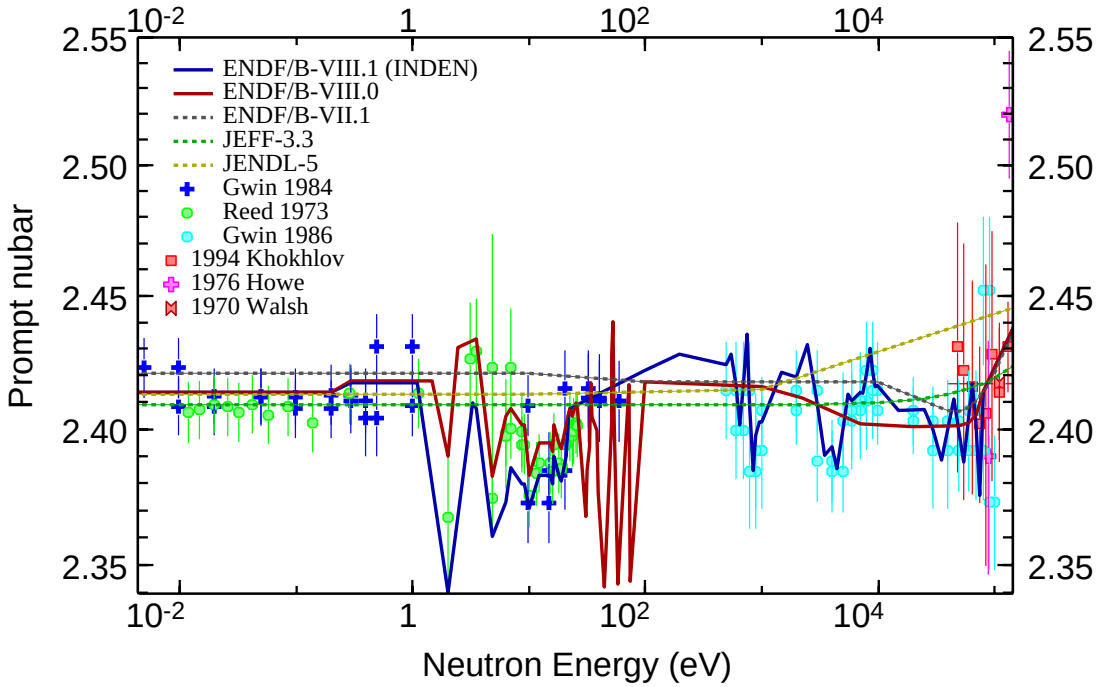
Fast Zeus Cu benchmarks



Copper ^{252}Cf(sf) leakage shielding benchmark

Evaluation achievements within INDEN effort (^{235}U)

From Thermal experiment:							
E1	E2	Fission yield			Capture yield		
(eV)	(eV)	B7.1	B8.0	B8.1	B7.1	B8.0	B8.1
0.01	0.0206	1.01	1.00	1.00	1.02	1.01	1.01
0.02	0.03	1.00	1.00	1.00	0.99	0.99	0.99
0.0206	0.0623	1.00	1.00	1.00	0.98	0.99	0.99
0.0623	0.6	0.99	1.01	1.01	0.99	1.05	1.03
0.6	7.8	0.97	0.99	1.00	0.99	1.05	1.02
0.0253	9.4	0.98	0.99	1.01	0.99	1.06	1.02
7.8	11.	0.98	0.98	1.01	1.00	1.10	1.02
From Epithermal experiment:							
E1	E2	Fission yield			Capture yield		
(eV)	(eV)	B7.1	B8.0	B8.1	B7.1	B8.0	B8.1
9.4	150	1.02	1.01	1.01	1.04	1.03	1.03
150	250	1.02	1.00	1.00	1.07	1.03	1.03
250	350	1.04	1.02	1.02	1.06	0.96	0.96
350	450	1.03	1.04	1.04	1.12	0.99	0.99
450	550	1.02	1.02	1.02	1.17	1.00	1.00
550	650	1.03	1.01	1.01	1.18	1.00	1.00
650	750	1.03	1.02	1.02	1.17	1.02	1.02
750	850	1.03	1.03	1.03	1.17	1.03	1.03
850	950	1.00	1.01	1.01	1.17	1.07	1.07
950	1500	1.02	1.00	1.00	1.25	1.02	1.02



^{235}U prompt $\overline{\nu}$ below 100 keV

ACKNOWLEDGMENTS

Special thanks to all INDEN network contributors

Thank you!

ACRONYMS AND LABELS

CIELO	Collaborative International Evaluation Library Organization
ENDF	Evaluated Nuclear Data File
IAEA	International Atomic Energy Agency
INDEN	International Nuclear Data Evaluation Network
NEA	Nuclear Energy Agency
NCSP	Nuclear Criticality Safety Program
ORNL	Oak Ridge National Laboratory
PFNS	Prompt Fission Nuclear Spectrum
SG	Sub Group
WPEC	Working Party on International Nuclear Evaluation Co-operation