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Status of the IAEA-CIELO Evaluated Nuclear Data Files

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Scope: ^{239}Pu, ^{238}U, ^{235}U, Fe, ^{16}O, ^{1}H

New evaluations:

- ^{238}U, ^{235}U (co-ordinated at the IAEA)
- ^{56}Fe (in collaboration with BNL-NNDC)
- Other (adopt from CIELO partners)

In addition, corrections/improvements were made to other evaluations (^{233}U,^{239,240}Pu, Cu)

Leading Contributors:

^{238}U

– R. Capote, A. Trkov, P. Schillebeeckx, S. Kopecky, I. Sirakov, V.G. Pronyaev, M.Sin, E. S. Soukhovitskii, Y. Danon, A. Daskalakis, D.Bernard, G.Noguere

^{235}U

– A.Trkov, R. Capote, M. T. Pigni (L. Leal), V.G. Pronyaev, M.Sin, E. S. Soukhovitskii, G. Noguere

Isotopes Fe

– M.W. Herman, G. Nobre, D. Brown, R. Capote, A. Trkov

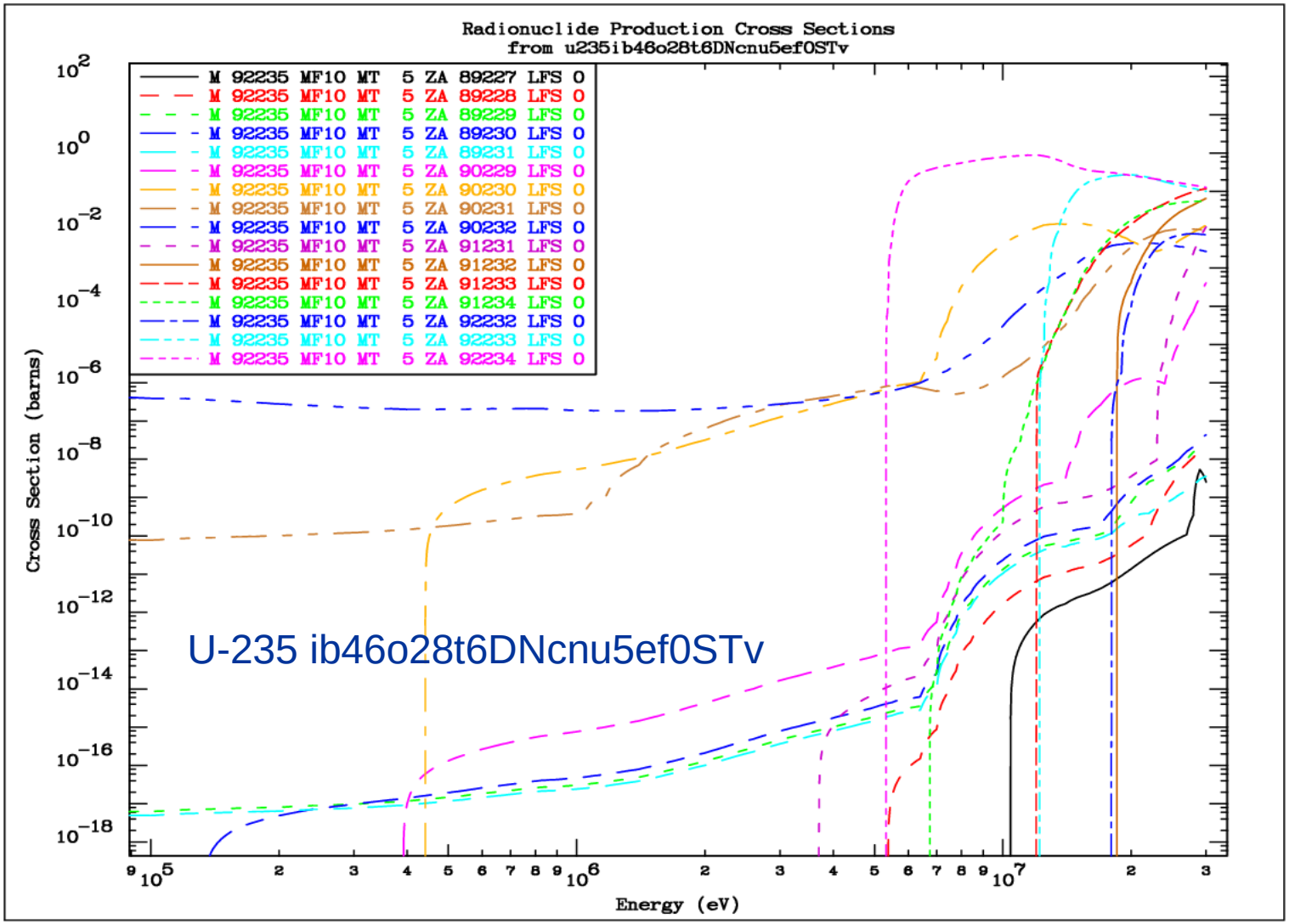
+ input from IAEA CRP on Standards, PFNS of Actinides, RIPL, IRDFF, etc.

Evaluation of n + ^{235}U reaction

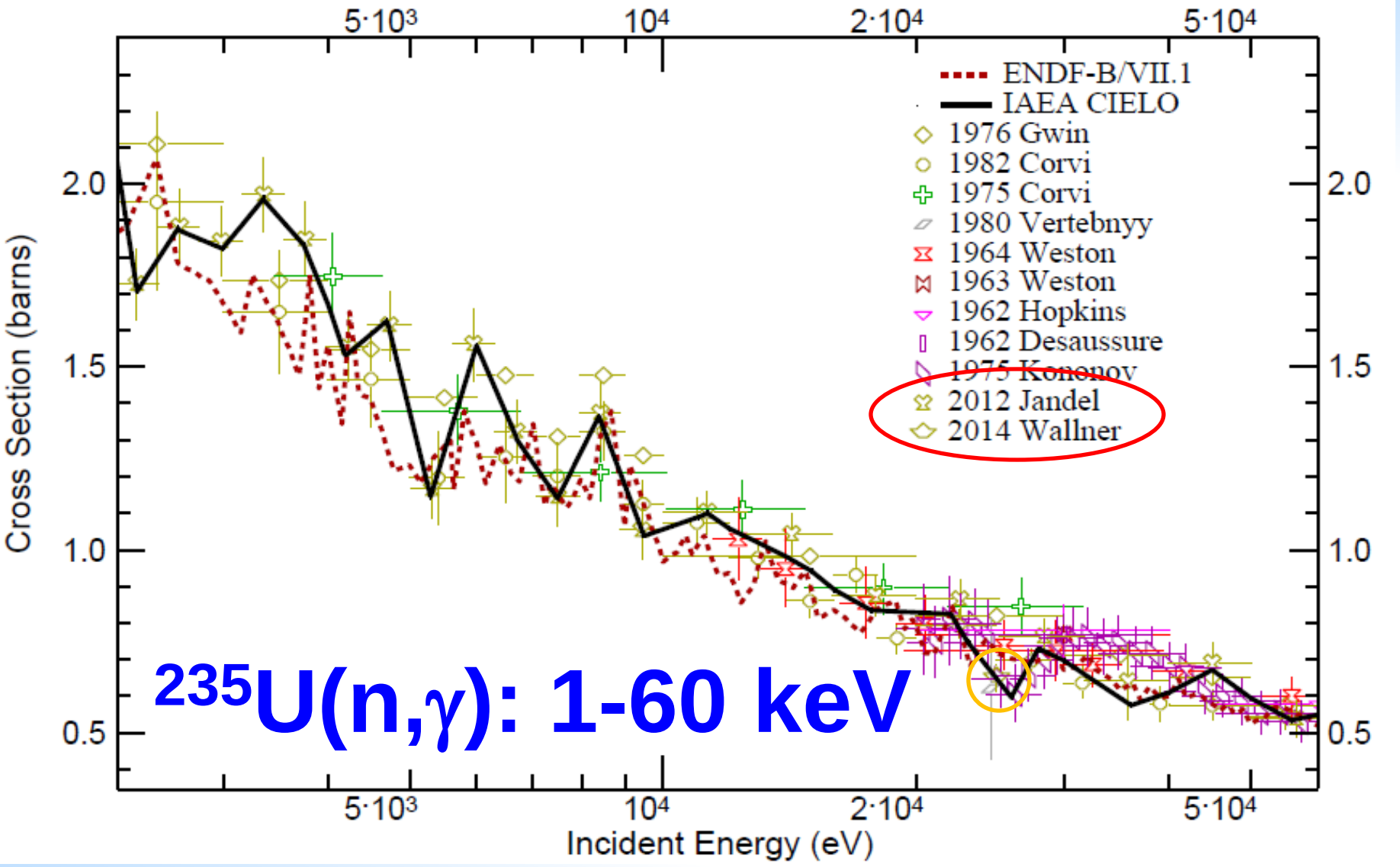
RRR (n,γ) : Pigni et al., E_n<1keV
Leal et al., 1 keV <E_n<2.25 keV
Fast (E_n>2.25 keV): this work

- (n,f) from 2017 Standards
- PFNS: GMA thermal + Rising/Neudecker (Chi-nu) above
- Dispersive optical model RIPL 2408 (with 8 CC from gsb)
- (n,γ) 1-500keV based on Jandel & Wallner (AMS)
- (n,f) model: 3H fission barrier with absorption (EMPIRE) used to guarantee proper competition
- Elastic, inelastic and (n,xn) from modelling with scarce data constrains (except unitarity)

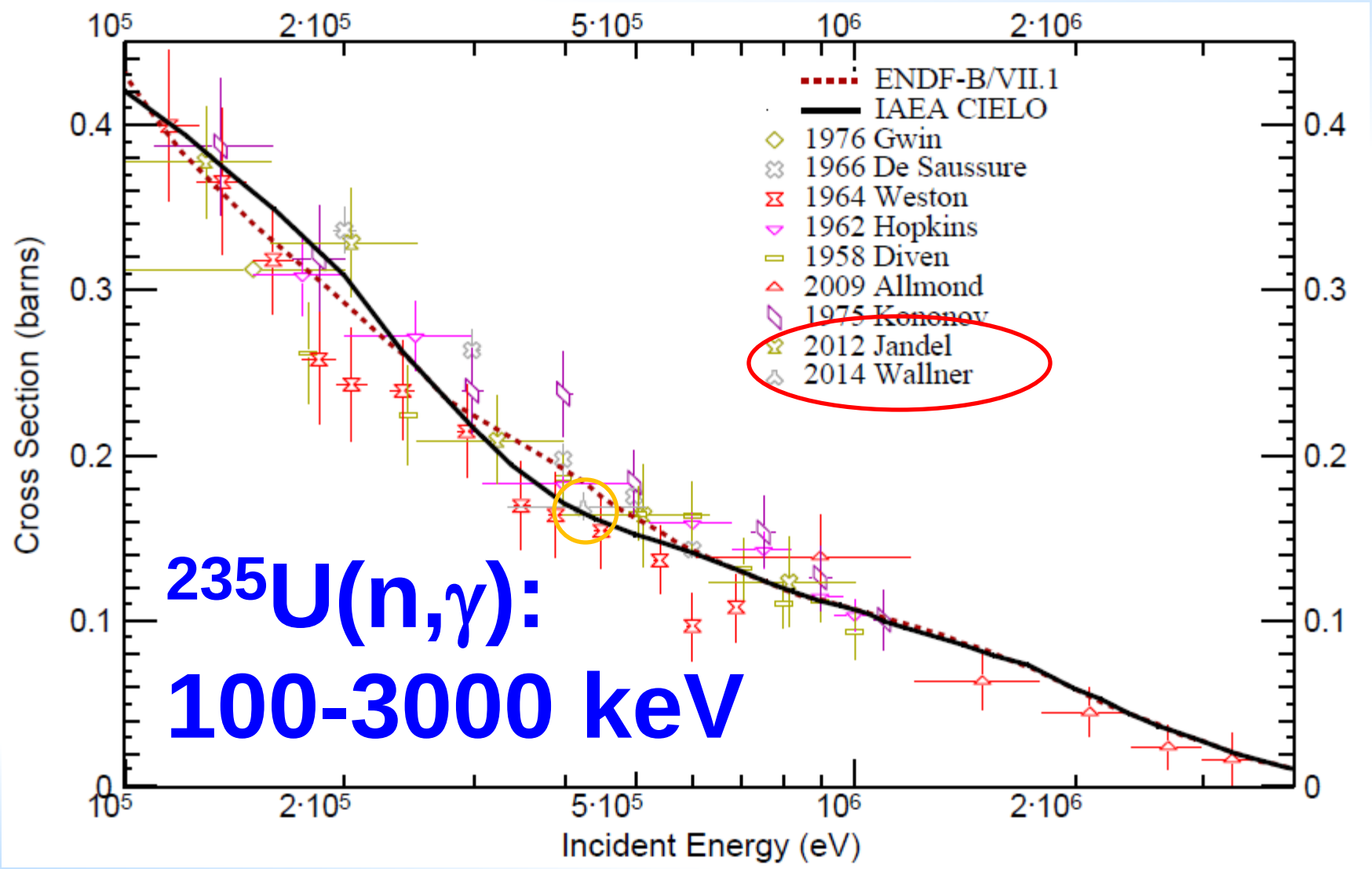
Radionuclide production



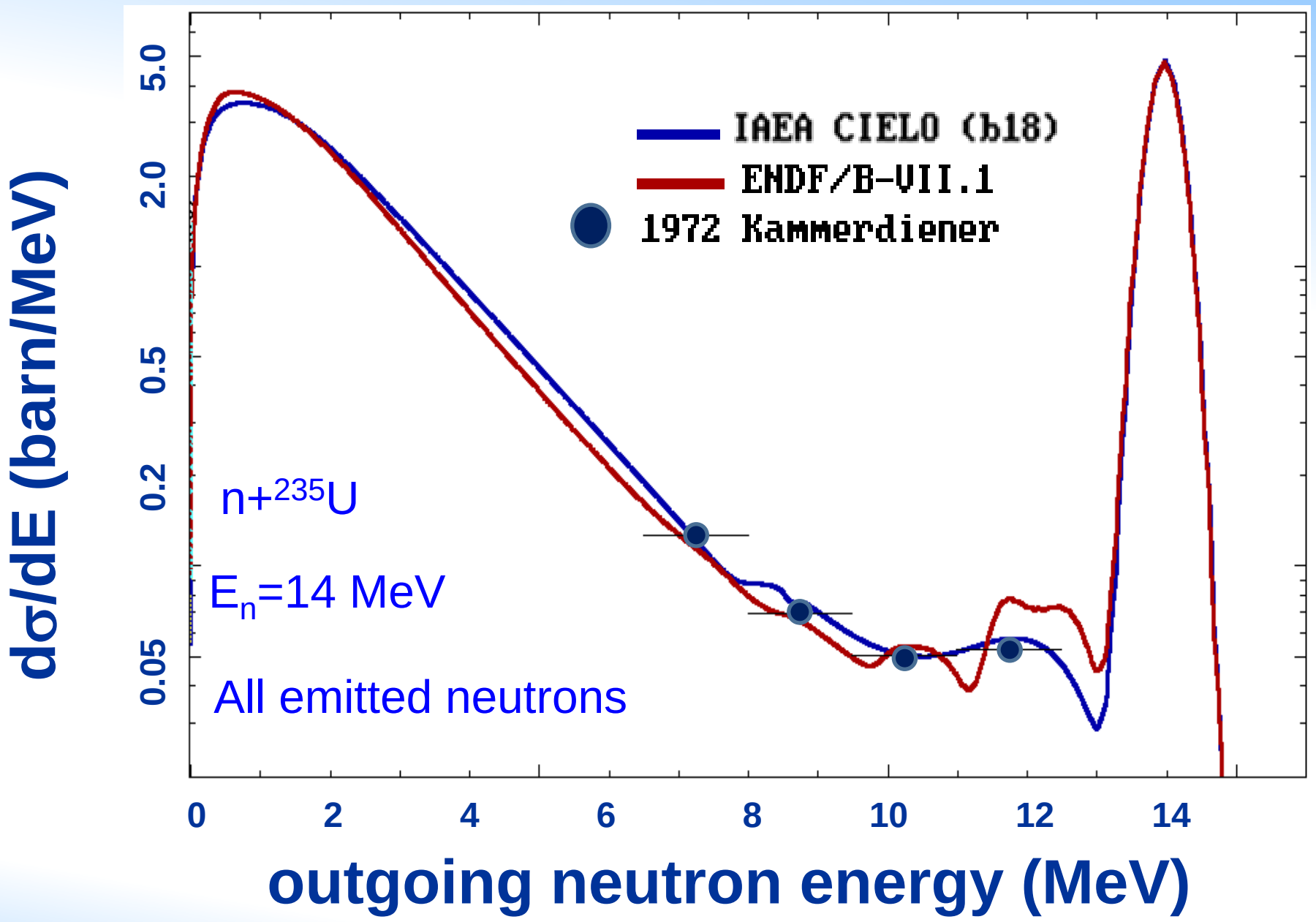
Capture fluctuations



Capture fluctuations



^{235}U(n,γ): 100-3000 keV


IAEA CIELO (b18)
ENDF/B-VII.1
1972 Kammerdiener
n+235U
En=14 MeV
All emitted neutrons
dσ/dE (barn/MeV)
0.05
0.2
0.5
2.0
5.0
0
2
4
6
8
10
12
14
outgoing neutron energy (MeV)

Summary: ^{235}U fast region

- Fission in fast region from Neutron Standards 2006/2017

(a non-model Bayesian evaluation based on <u>EXP. DATA</u>)

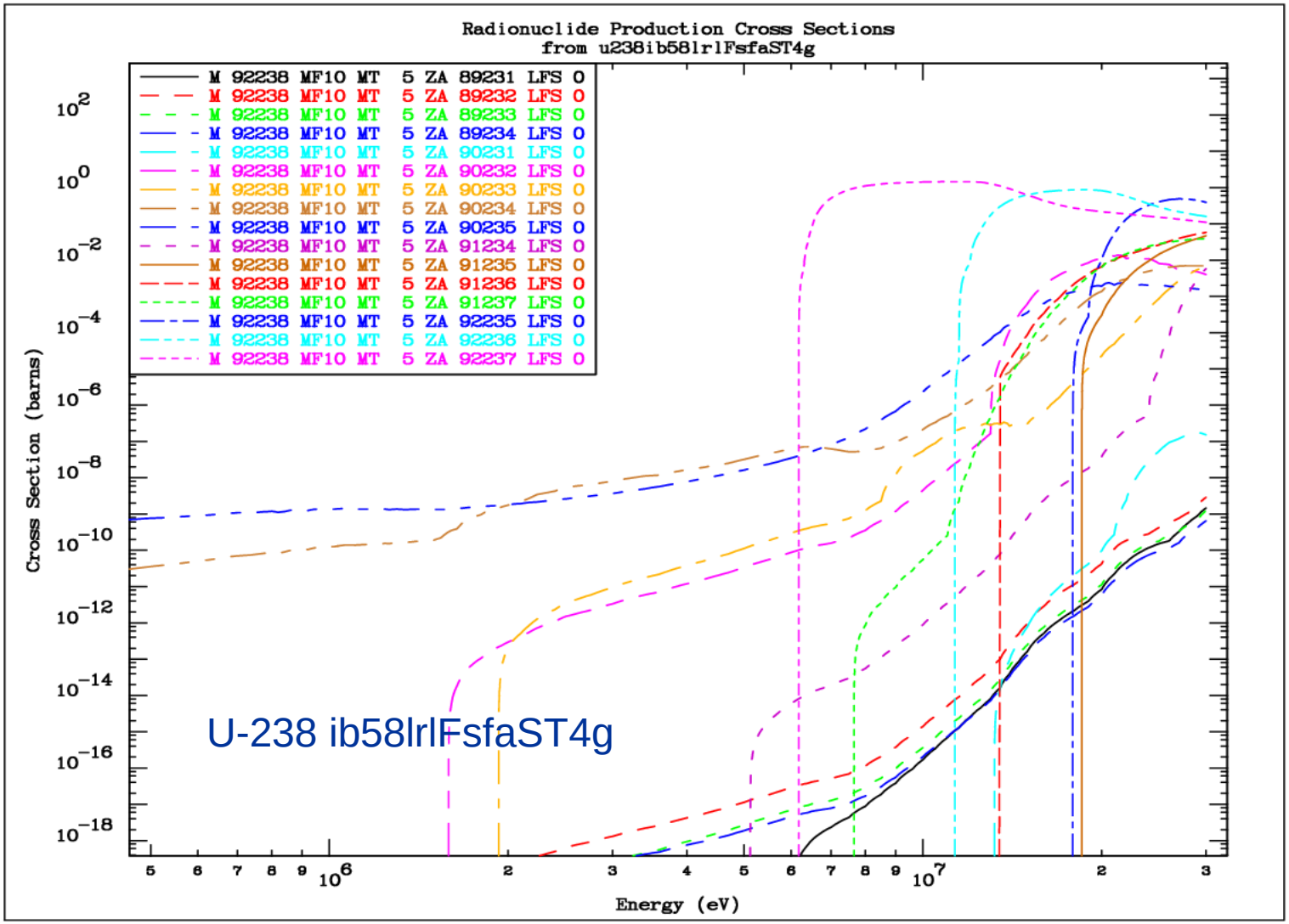
- New fast evaluation with **fission** cross sections (3H) **consistent with IAEA Standard** leading to elastic/inelastic and (n,xn) **consistent** changes
- Collective continuum levels to describe Kammerdiener (& LPS)
- PFNS thermal from Standards_2017 (E_{av}=2.00±0.01 MeV)
- PFNS fast from Neudecker et al. evaluation + Chi-nu (2016)
- Capture in fast region updated based on Jandel and Wallner experimental data

Evaluation of n + ^{238}U reaction

RRR (*n*,γ) : Schillebeeckx et al., E_n<20 keV
URR (*n*,γ) : Schillebeeckx et al., E_n:20-149 keV

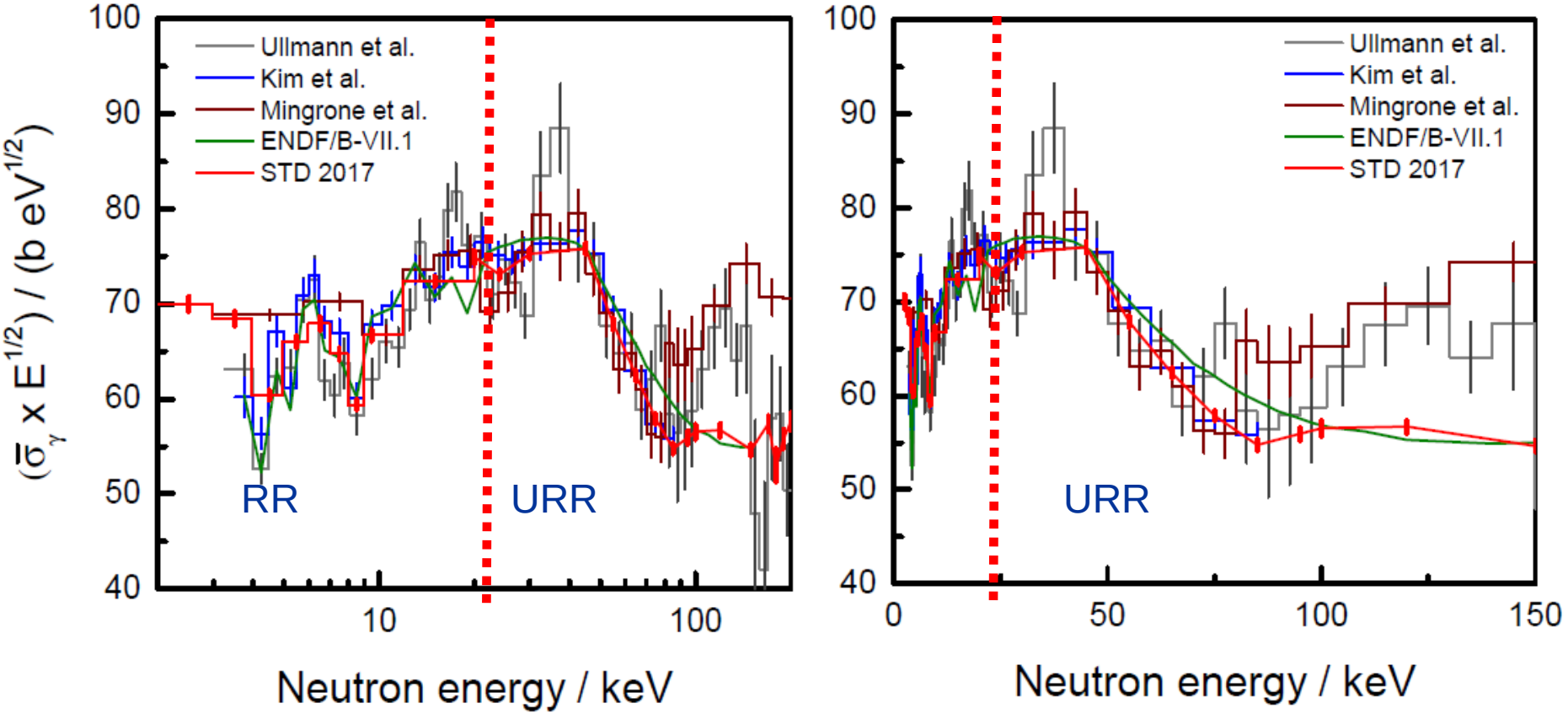
- **(*n*,f), (*n*,γ) from <u>2017 Neutron Standards</u>**
- **PFNS** adopted from Rising et al analysis (JENDL above 8)
- **Elastic and inelastic** cross sections based on modelling guided by RPI “quasi-integral” data and integral benchmarks (BIG-10,JEMIMA,Flaptops)
- **(n,2n)** integral benchmark feedback from PROFIL-2(B81) (CEA Cadarache)
- **(n,2n)** TUNL new data (Krishichayan et al.)

Radionuclide production



Neutron capture cross section measurements for ^{238}U in the resonance region at GELINA

H. I. Kim[1,2], C. Paradela[3], I. Sirakov[4], B. Becker[3], R. Capote[5], F. Gunsing[6], G.N. Kim[2], S. Kopecky[3], C. Lampoudis[6], Y.-O. Lee[1], R. Massarczyk[7], A. Moens[3], M. Moxon[8], V. G. Pronyaev[9], P. Schillebeeckx [a3], and R.Wynants[3]



URR - EPJ A52(2016)170

IAEA CIELO evaluations vs Wallner AMS
^{238}U(n,g), ^{235}U(n,g)

^{238}U(n,g)

kT=25 keV
Wallner: 0.391±0.017 b (4.3%)
✓ IAEA CIELO (β2): 0.391
✓ IAEA CIELO (β4): 0.394

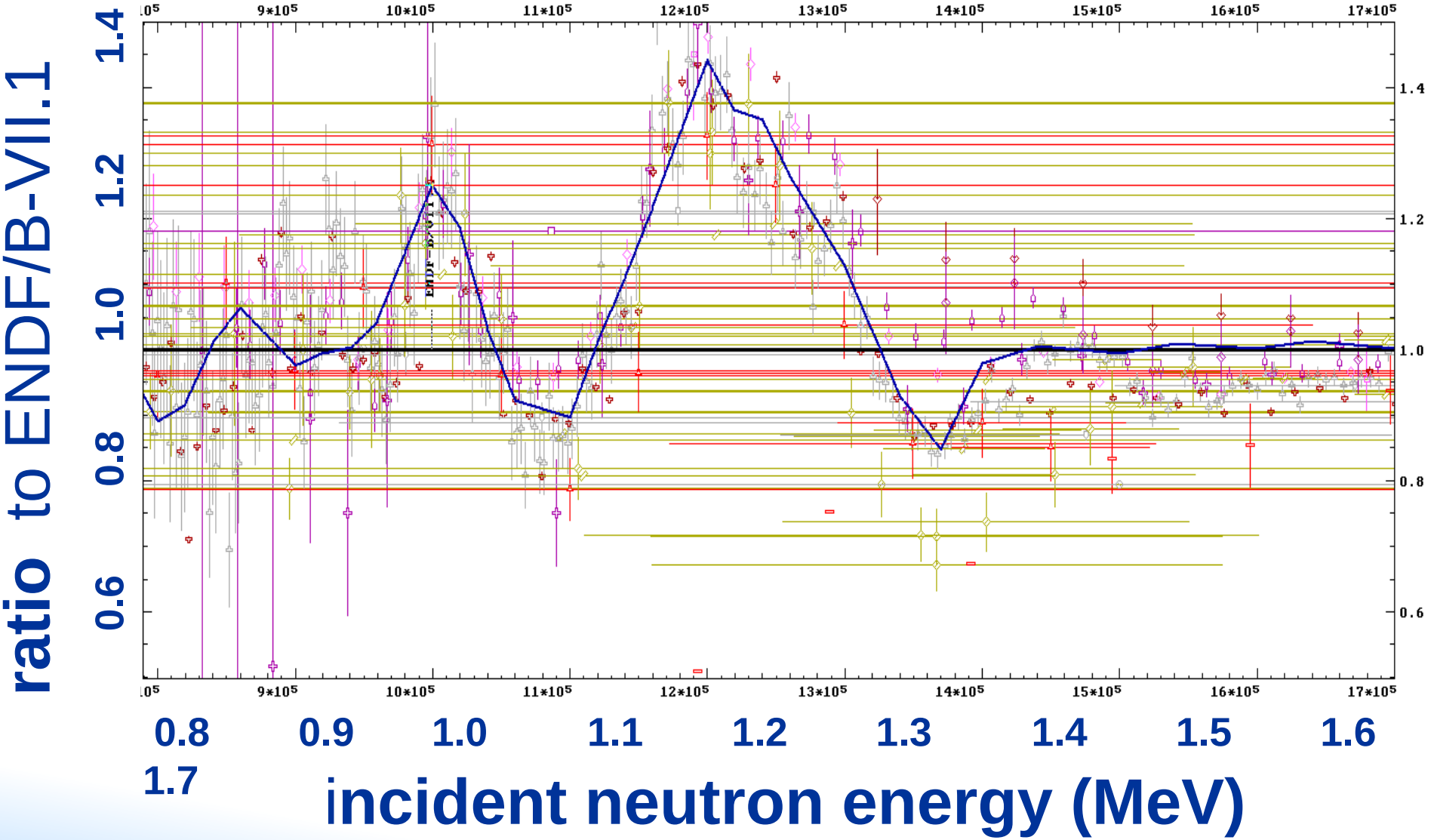
kT=426 keV
Wallner: 0.108±0.004 b (3.7%)
✓ IAEA CIELO (β2): 0.109
✓ IAEA CIELO (β4): 0.108

^{238}U(n,g)/^{235}U(n,g)

kT=25 keV
Wallner: 0.60±0.03 (4.7%)
❖ IAEA CIELO (β2): 0.55 (-8.4%)
✓ IAEA CIELO (β4): 0.57

kT=426 keV
Wallner: 0.64±0.03 (3.9%)
❖ IAEA CIELO (β2): 0.60 (-6.3%)
✓ IAEA CIELO (β4): 0.63

^{238}U(n,f) below the STD range



Summary: ^{238}U IAEA CIELO

- RRR & URR: New Geel measurements and REFIT analysis
- Fission and capture from **Neutron Standards 2006/2017**
  (a non-model Bayesian evaluation based on EXP. DATA)
- PFNS adopted from Rising et al, 2013 (LAM) + JENDL-4 (E>8)
- New fast evaluation with elastic/inelastic improvements
- RPI quasi-diff. data - a big help for fast region scattering
- CEA/EXCALIBUR feedback on (n,n')
- Better multiple neutron emission (CEA Cadarache feedback,
  LANL feedback, inelastic + diff. TUNL data)
- Collective cont. levels to describe Kammerdiener (& LPS)

https://www-nds.iaea.org/CIELO/

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CIELO Project (WPEC-SG40)

IAEA Data Development Project within the
International Pilot Project of the OECD/NEA

IAEA DDP Coordinators: R.Capote and A. Trkov

Overall Objective

The overall objective of the CIELO Pilot Project (OECD/NEA WPEC SG-40) is to test the scheme of broad international collaboration to improve evaluated nuclear data files of the major nuclides: H-1, O-16, Fe-56, U-235, U-238 and Pu-239. The collaboration scheme is similar to that employed in the IAEA CRP on Evaluated Nuclear Data for the Th-U Fuel Cycle, which resulted in a very successful new evaluation of Th-232 and improvements to the evaluations for other relevant nuclides. Production of improved and validated evaluated nuclear data files is the main goal of the project.

IAEA CIELO transport files as of 9 May 2017

U-235 (09May2017) Version: u235ib46o28t6DNcnu5ef0STv
compressed ENDF file and compressed ACE file includes revised multiplicities for the PFGS in MF12; the rest is identical to version u235ib46o28t6DNcnu5ef0STu
compressed ENDF file and compressed ACE file which differs again only in the fission gamma production from the previous version u235ib44o28t6DNcnu5ef0STt dated 23APR2017 compressed ENDF file and compressed ACE file.
Updated gamma yields and spectra were provided by Ionel Stetcu from LANL. The new file also supersedes version u235ib44o28t6DNcnu5ef0STt from 10APR2017 compressed ENDF file and compressed ACE file and earlier version u235_CIELO20170217 from 17FEB2017 (internal IAEA designation u235ib36o28t6DNcnu5ef0STt) compressed ENDF file and compressed ACE file. The performance on integral experiments remains practically unchanged.

U-238 (08May2017) Version: u238_ib58lrlFsfaST4h
compressed ENDF file and compressed ACE file supersede the previous version u238_CIELO20170215 (internal IAEA designation u238ib54lrlFsfaST4d) from 15 February 2017

Thanks !

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