



Status of evaluated data for neutron induced reactions on ^{238}U in the resonance region

*WPEC- CIELO
OECD/NEA, 20 May 2015*

Status before WPEC meeting



■ Resolved resonance region

- Problem of consistency between data of Olsen et al. and ENDF/B-VII.1 in particular "baseline"
- Previous evaluations based on biased capture data

■ Unresolved resonance region

- GMA analysis of transmission and capture data
- Evaluation by I. Sirakov (HF + WF)

■ Evaluated data file (I. Sirakov)

- LSSF = 0/1 (solved)
- Different versions based on modifications in compound infinitely dilute capture and/or inelastic cross section at the expense of the elastic one.

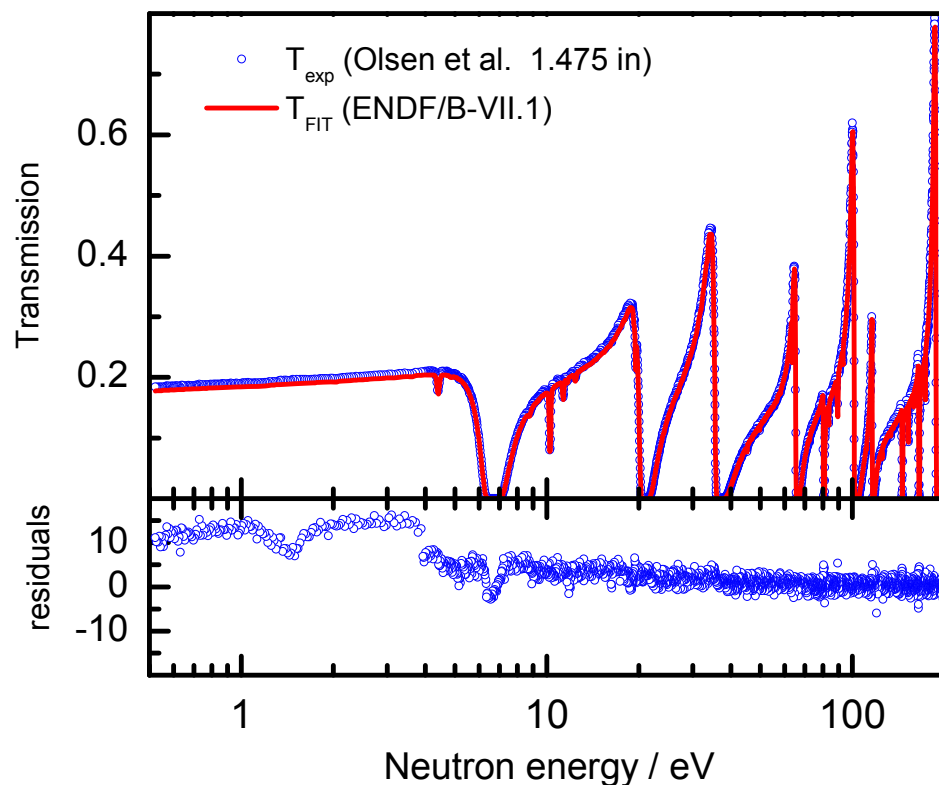
NG		INL	
– Calculated	Calculated		1
– Adopted	Calculated		2
– Calculated	Adopted		3
– Adopted	Adopted		4

- RRR/URR boundary (10 and 20 keV)

■ Integral benchmarks by IAEA (A. Trkov) + KAERI (H.D. Kim) + UPM (O. Cabellos)

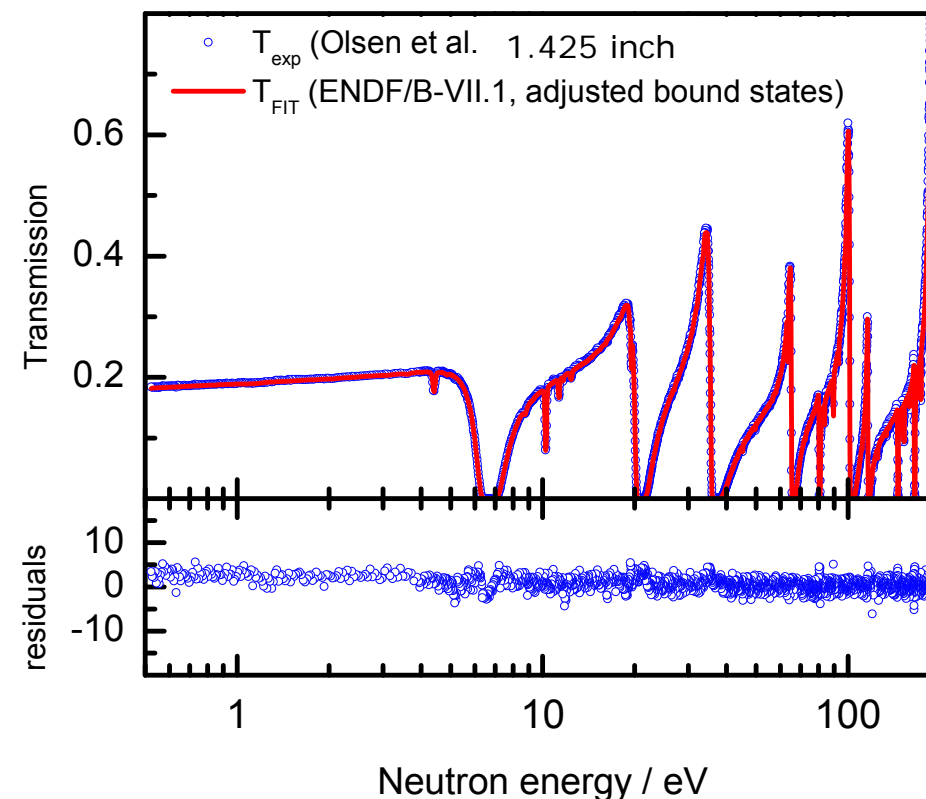
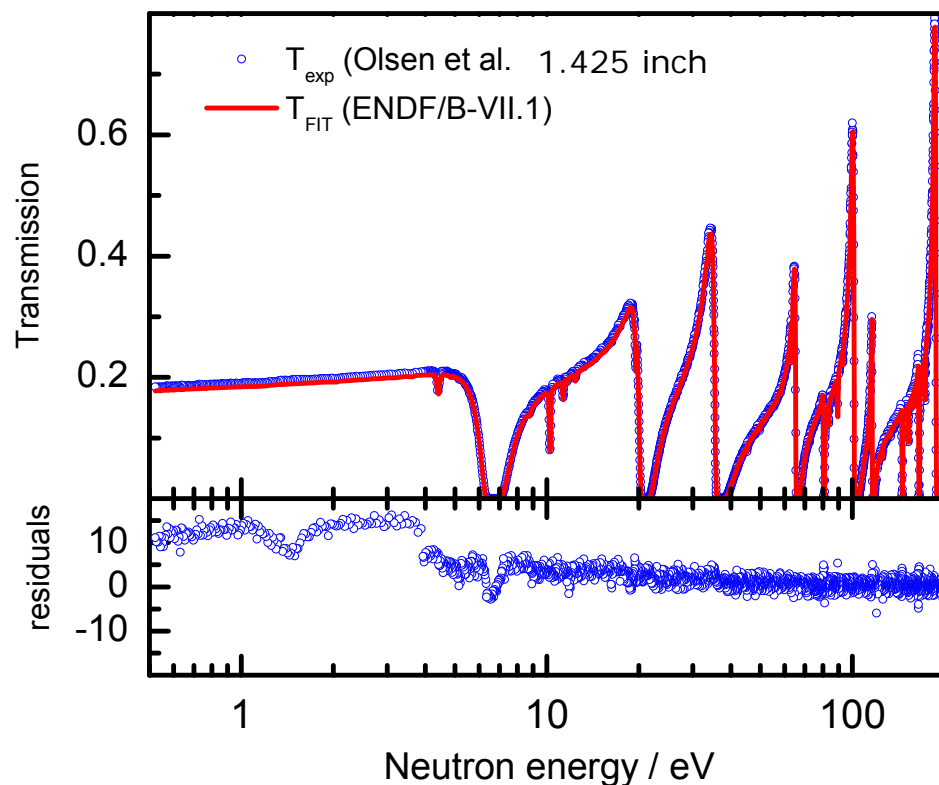
RRR: transmission of Olsen et al.

- Problem of transmission data of Olsen et al. \leftrightarrow ENDF/B-VII.1
 - Experimental data: normalization, scattering radius or external contribution?



RRR: transmission of Olsen et al.

- Problem of transmission data of Olsen et al. \leftrightarrow ENDF/B-VII.1
Can be solved by adjusting contribution of bound states



⇒ Requires experimental confirmation

RRR: ENDF/B-VII.1 limited capture data



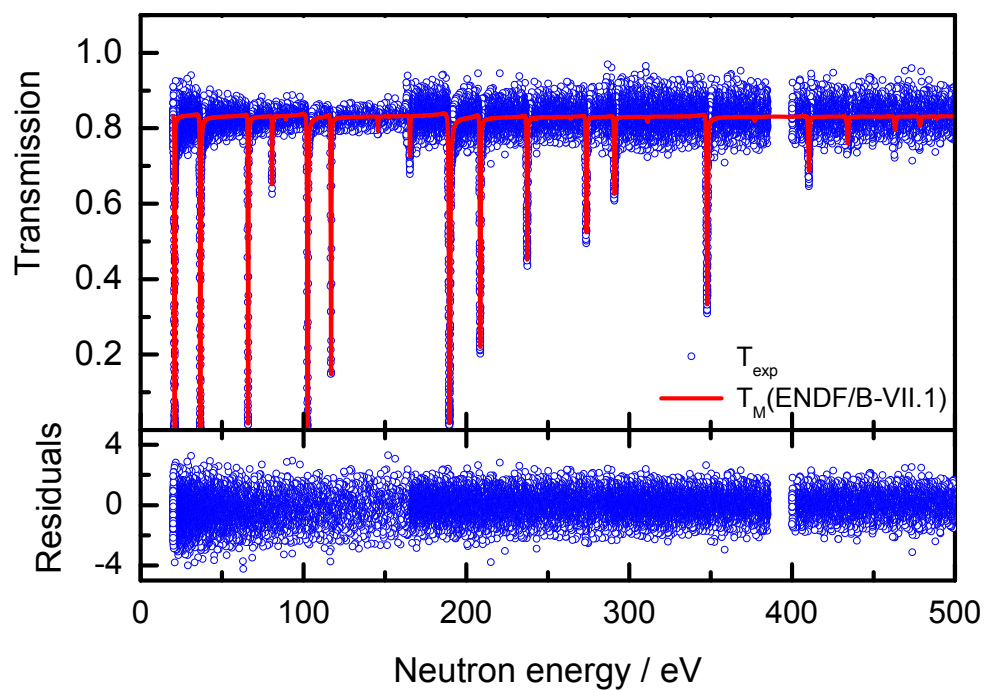
- **Problem of biased capture data of Macklin et al. and De Saussure et al.**
 - Only capture data included in evaluation (ENDF/B-VII.1)
 - Substantial normalization correction is required!
- **Additional transmission measurements**
 - Verify Olsen et al. data (basis of ENDF/B-VII.1)
- **Verify by capture data obtained at GELINA**

Same methodology as for $^{232}\text{Th}(n,\gamma)$ & $^{197}\text{Au}(n,\gamma)$ (see NDS 113, 3054 (2012))

 - Flux: $^{10}\text{B}(n,\alpha)$
 - C_6D_6 : weighting function
 - Normalization to saturated resonance

RRR: ENDF/B-VII.1 limited capture data

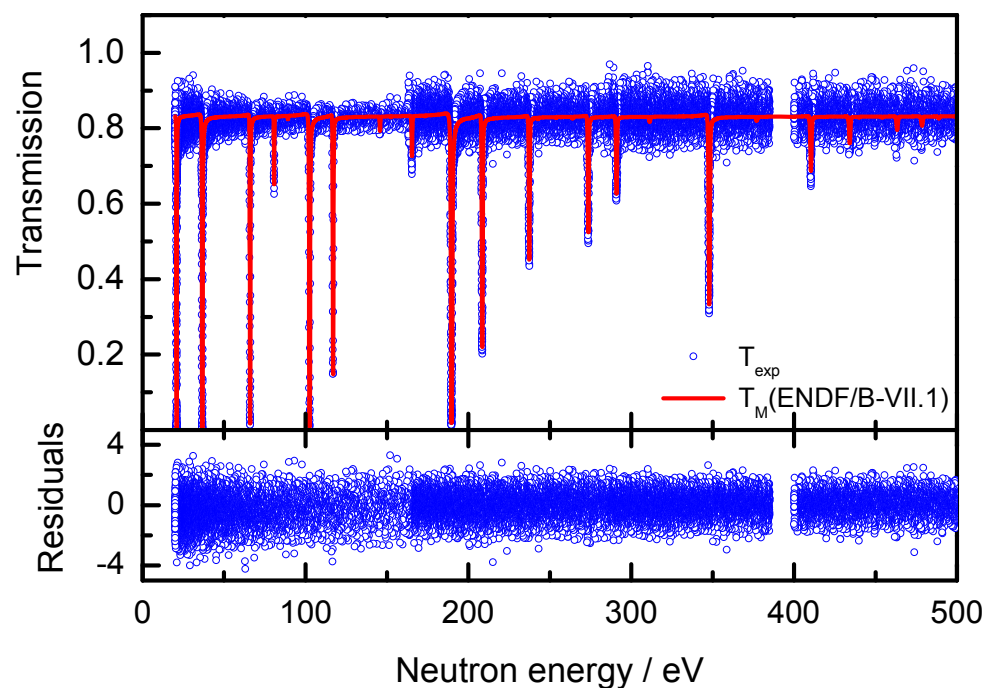
- ENDF/B-VII.1 confirmed by GELINA transmission data



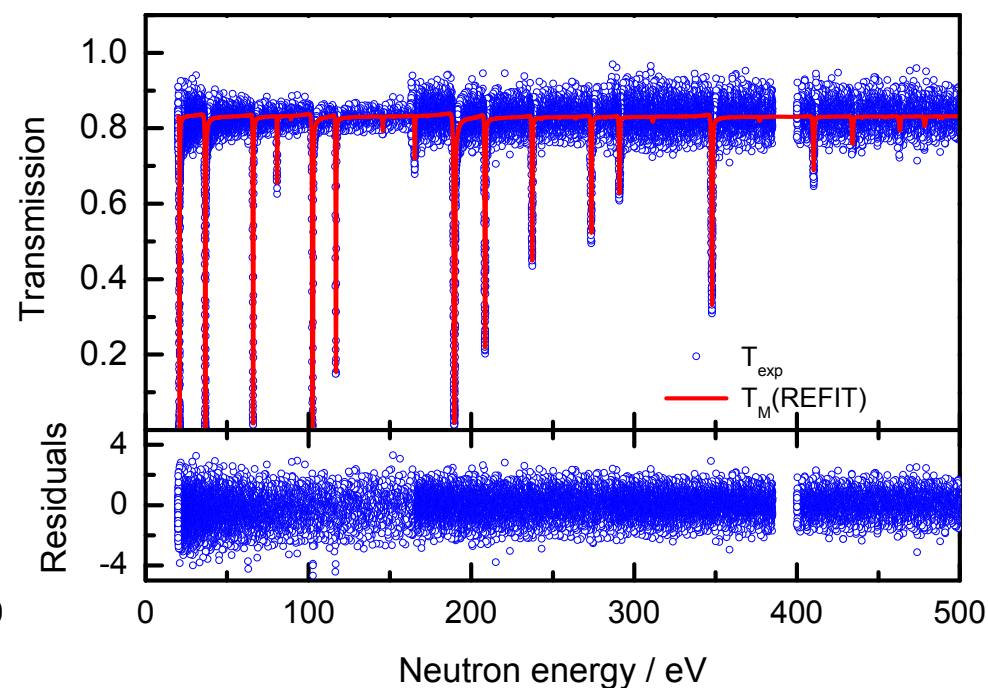
No systematic difference

RRR: ENDF/B-VII.1 limited capture data

- Problem of biased capture data of Macklin et al. and De Saussure et al.
- ENDF/B-VII.1 confirmed by GELINA transmission data (JRC, KAERI)



No systematic difference

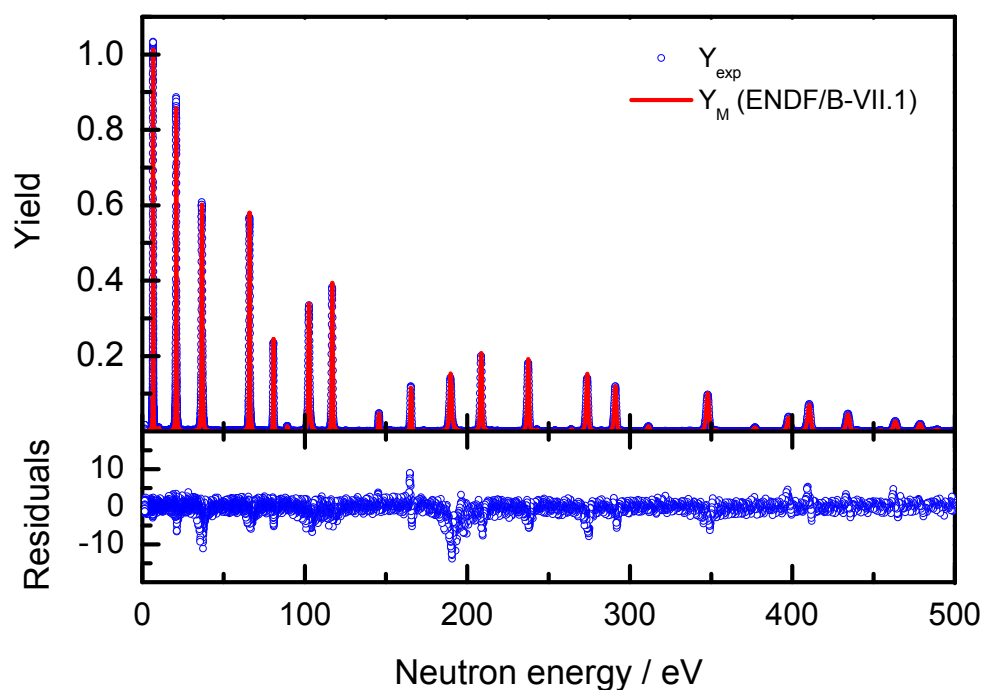


Only small adjustments are required

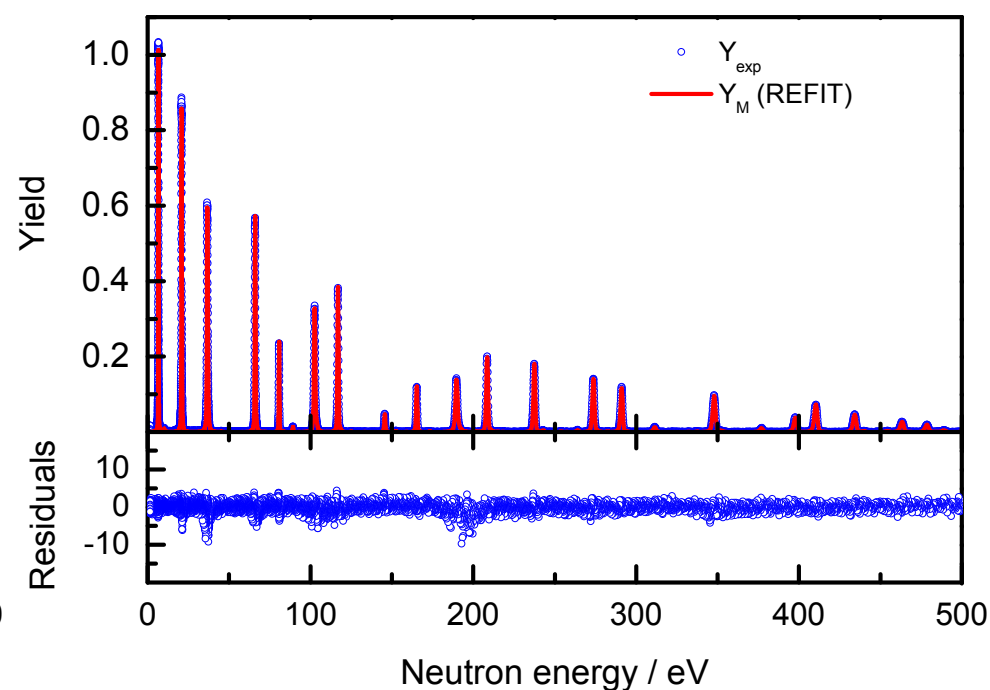
- **Resonance energies**

RRR: ENDF/B-VII.1 limited capture data

- Problem of biased capture data of Macklin et al. and De Saussure et al.
- ENDF/B-VII.1 confirmed by GELINA capture data (JRC, KAERI)



No systematic difference



Only small adjustments are required

- Resonance energies
- Reduction in average radiation width

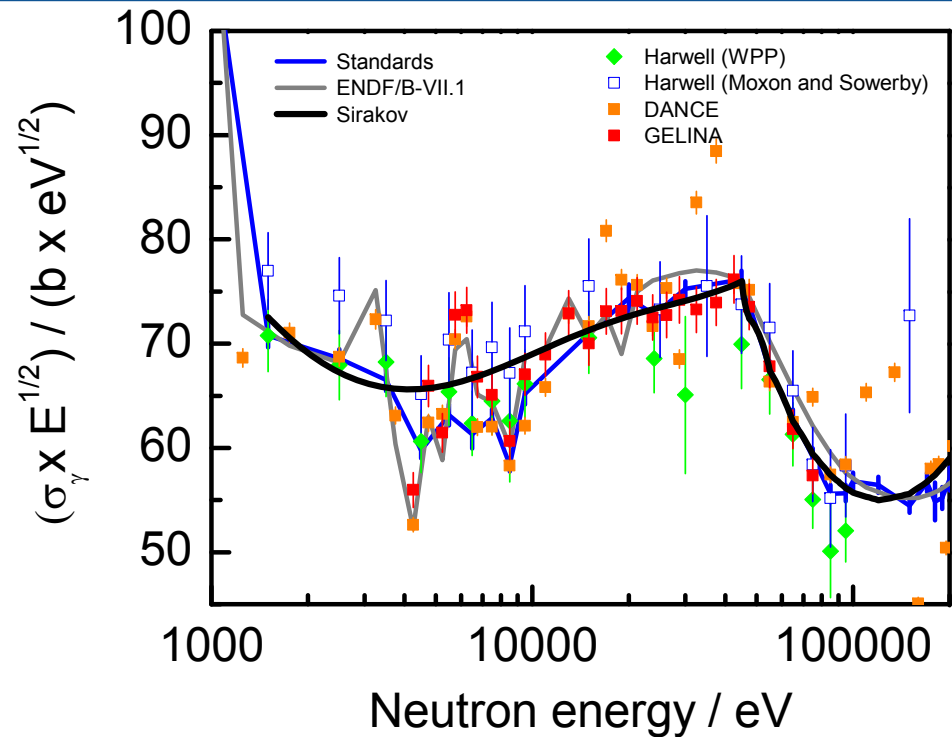
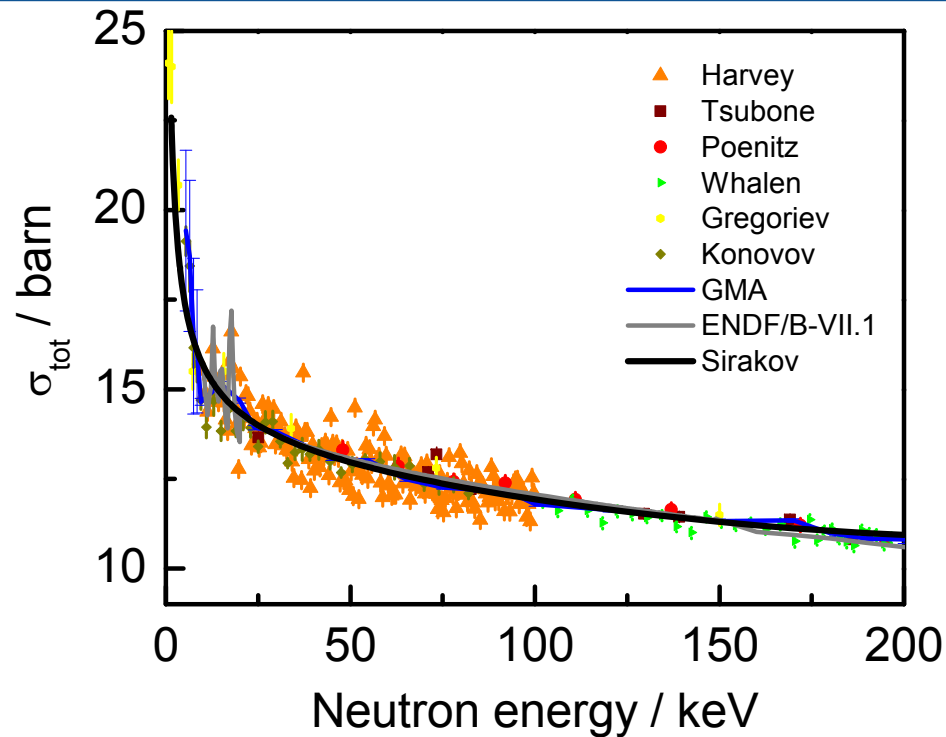
RRR: conclusions based on RSA



- **Analysis of old data**
 - New thick transmission data needed to define contribution of bound states
 - Resonance energies need some adjustment to have them fully consistent with high resolution transmission data of Harvey et al. at ORLEA_200m
- **Analysis of GELINA data**
 - ENDF-BVII.1 parameters confirmed by GELINA capture data (without renormalization)
 - Average $\langle \Gamma_\gamma \rangle = 23$ meV in ENDF/B-VII.1, seems a bit overestimated
 - Final validation of file by capture data: MC are required.

- **Experimental data (V. Pronayev, JRC, KAERI)**
 - **Update GMA capture data using new capture data (GELINA, nTOF, LANSCE)**
 - **Produce GMA total cross section data using data in literature**
- **Evaluation (I. Sirakov, JRC)**

Parameterization of $^{238}\text{U} + n$ in URR



Average parameters



Scattering radius $R'(E=0) = 9.483 \text{ fm}$

Neutron strength functions at $E = 0$

$$S_0 : 1.064 \cdot 10^{-4}$$

$$S_1 : 1.641 \cdot 10^{-4}$$

$$S_2 : 1.376 \cdot 10^{-4}$$

Gamma transmission coefficients at $E = 0$

$$T_\gamma(J^\pi = 1/2^+) = 6.652 \cdot 10^{-3}$$

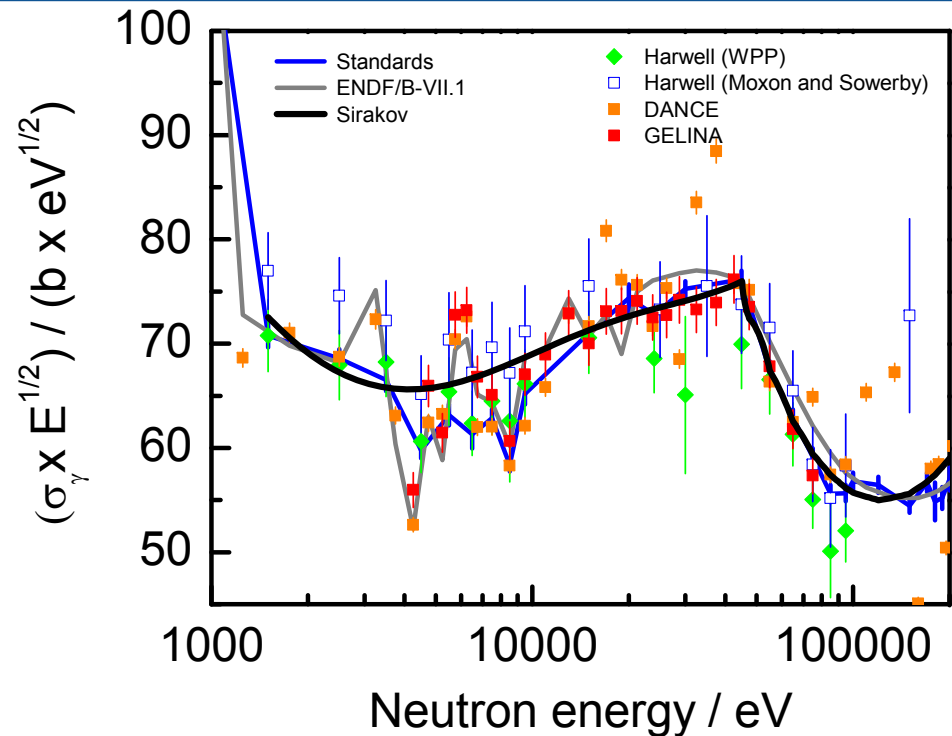
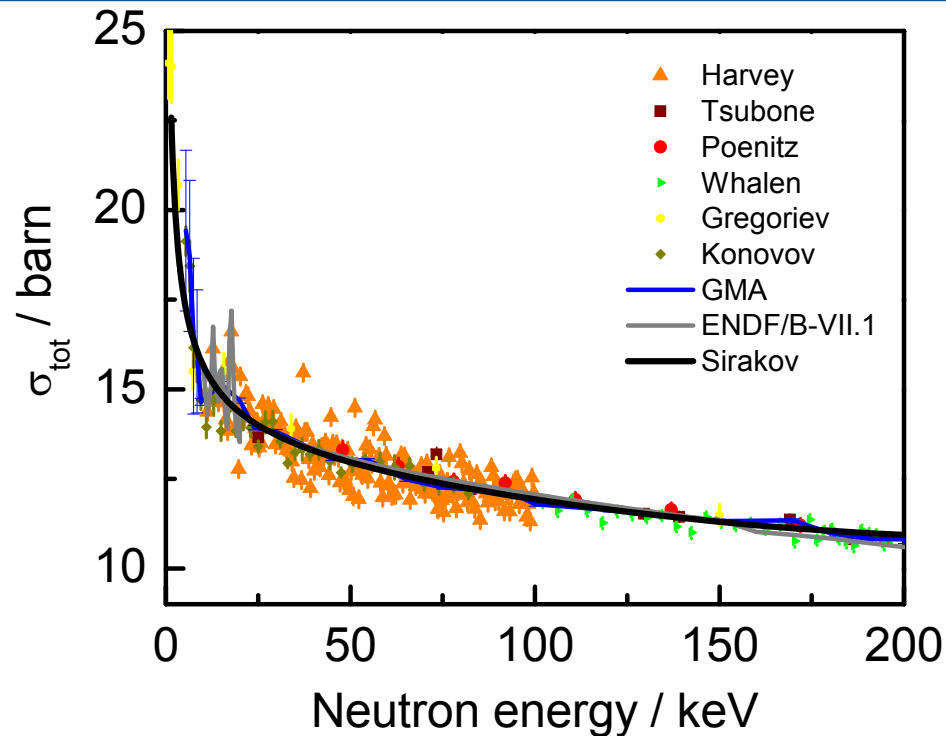
$$T_\gamma(J^\pi = 1/2^-) = 6.372 \cdot 10^{-3}$$

For $D_0 = 22.2 \text{ eV}$

$$\langle \Gamma_\gamma \rangle (\ell = 0) = 23.5 \text{ meV}$$

$$\langle \Gamma_\gamma \rangle (\ell = 1) = 22.5 \text{ meV}$$

Parameterization of $^{238}\text{U} + n$ in URR

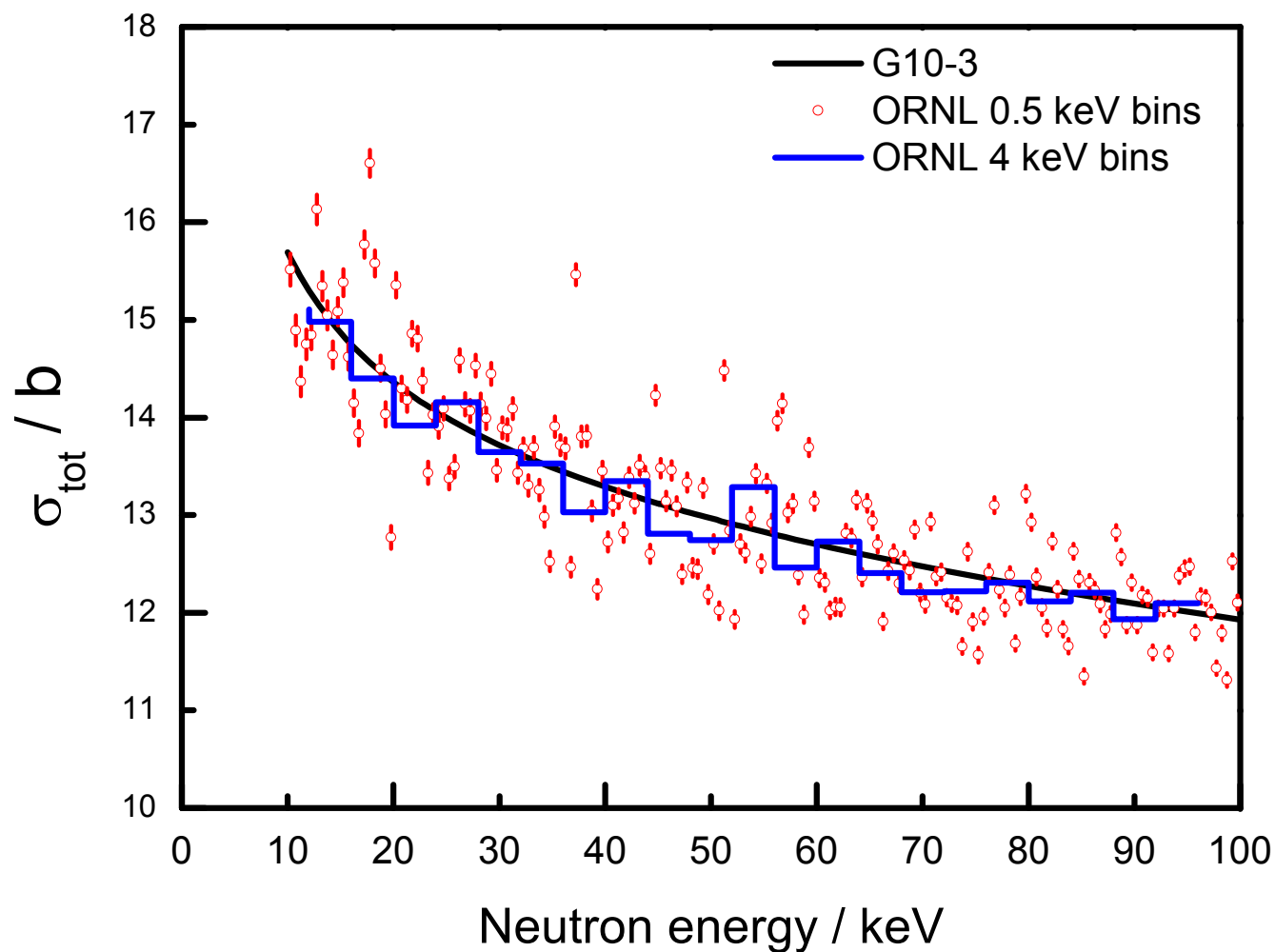


- **LSSF = 0/1 (solved)**
- **Different versions , RRR/URR Boundary (10 and 20 keV)**

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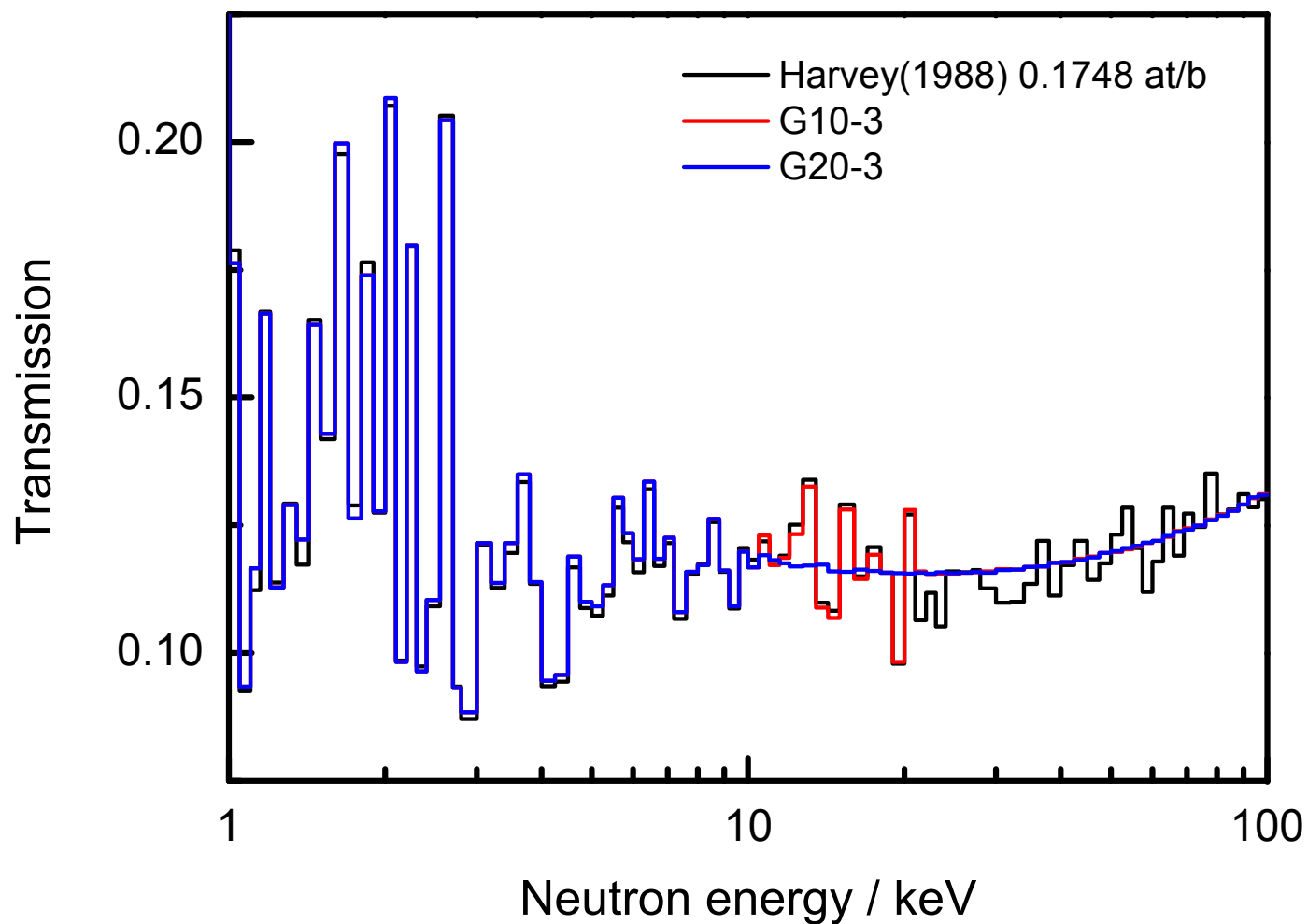
Transmission data Harvey et al.

- Use boundaries for dosimetry applications



Transmission data Harvey et al.

- Use boundaries for dosimetry applications



Future activities



- **Resolved resonance region**
 - Transmission on thick sample
 - Adjust resonance energies
 - Finalize RRR (include GELINA 60 m data)
- **Unresolved resonance region**
 - finalized
- *Results of integral benchmarks*