

High-resolution evaluation of the $U5(n,f)$ cross section from 3 keV to 30 keV

Ignacio DURAN
Manuel Caamaño
Pablo Cabanelas
GENP-USC (Spain)

Carlos Paradela
IRMM-JRC (EU)

L. Tassan-Got
L. Audouin
IPN-O (France)

on behalf of the n_TOF Collaboration

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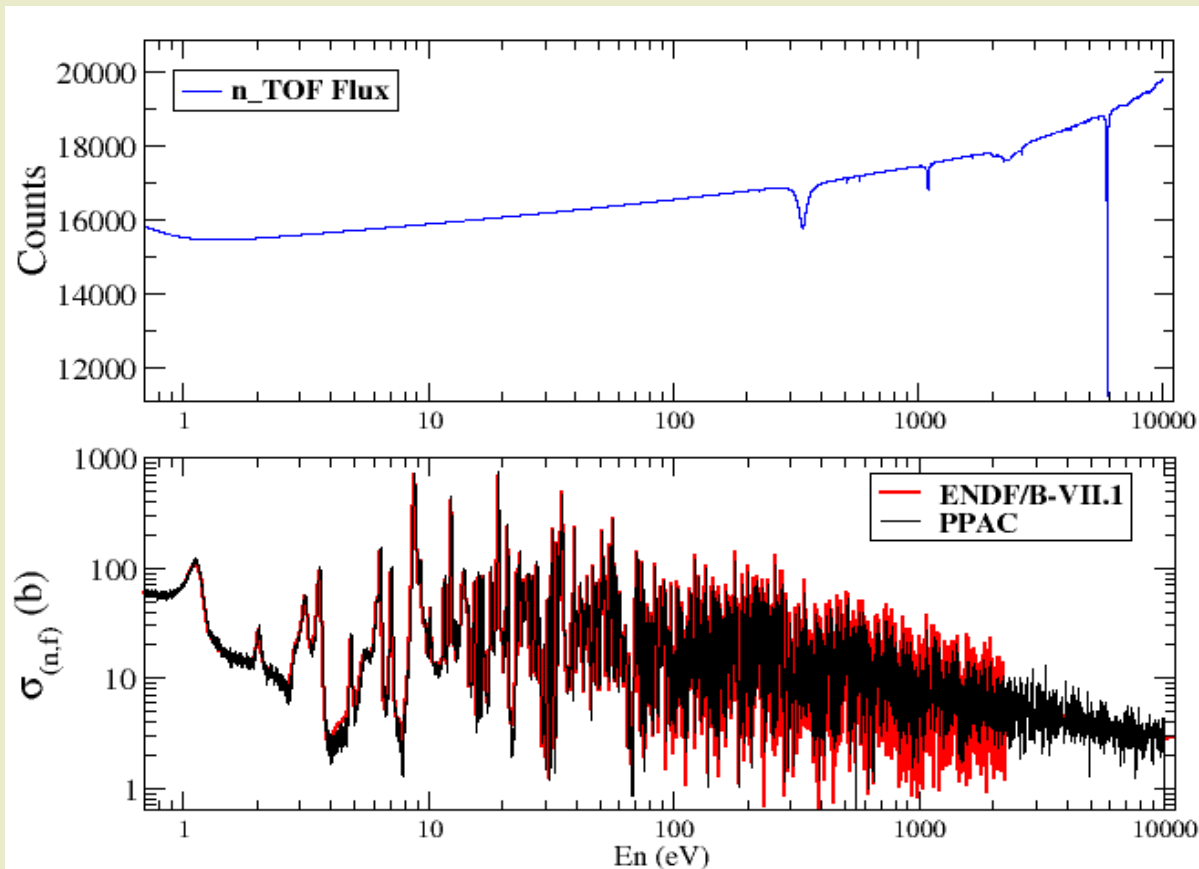
$U5(n,f)$ is customary used as reference and so any uncertainty in its XS evaluation is transmitted to other XSs

The goal is to go beyond the RRR (above 2.25 keV) and beyond the recent evaluations (10 keV) up to 30 keV, with high resolution.

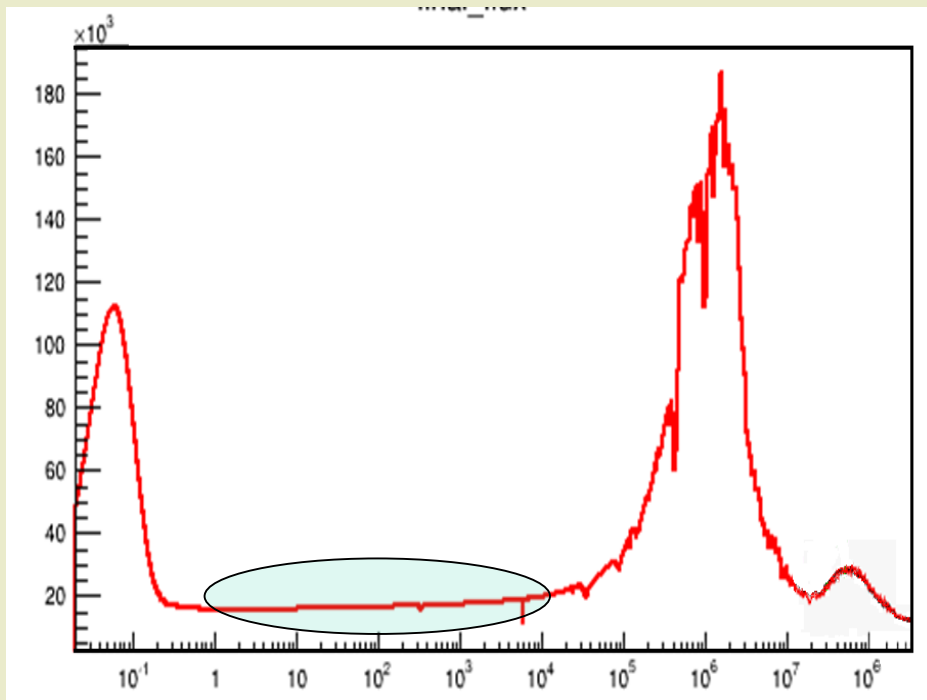
High accuracy can be attained combining different experimental setups, and improving both normalisation and energy calibration

The seminal work was presented at WONDER-2015:
C.Paradela et al. EPJ WoC 111(2016)02003

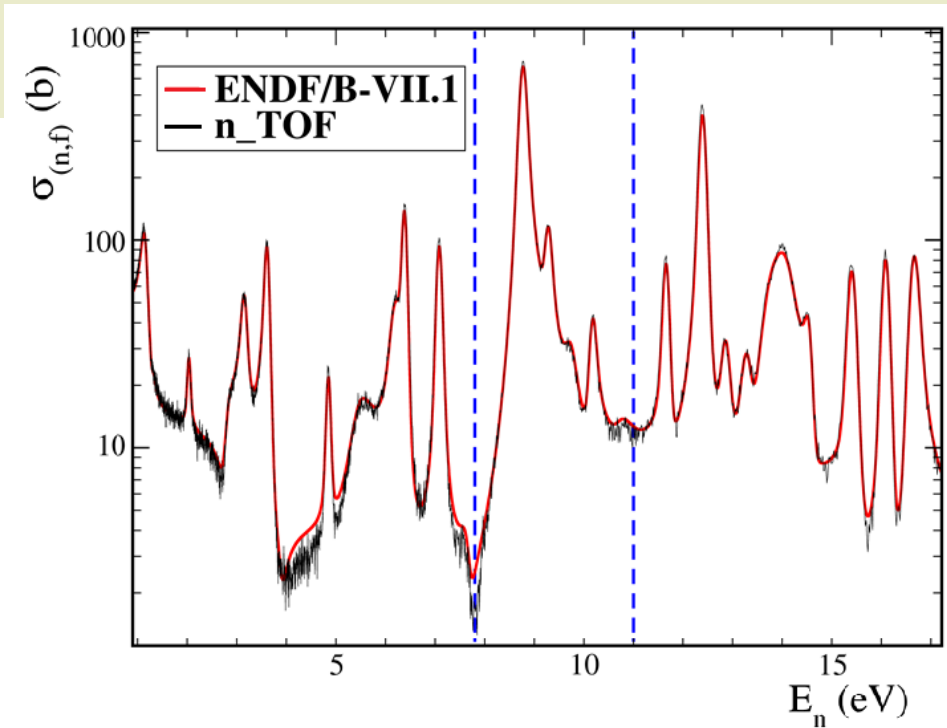
The absolute high-accuracy XS measurement was achieved based on the nTOF neutron flux and normalised to the 9.2 eV (7.8 - 11) big resonance peak.



nTOF neutron flux 100 b/d
with reference to ${}^6\text{Li}(n,t)$ and ${}^{10}\text{B}(n,\alpha)$



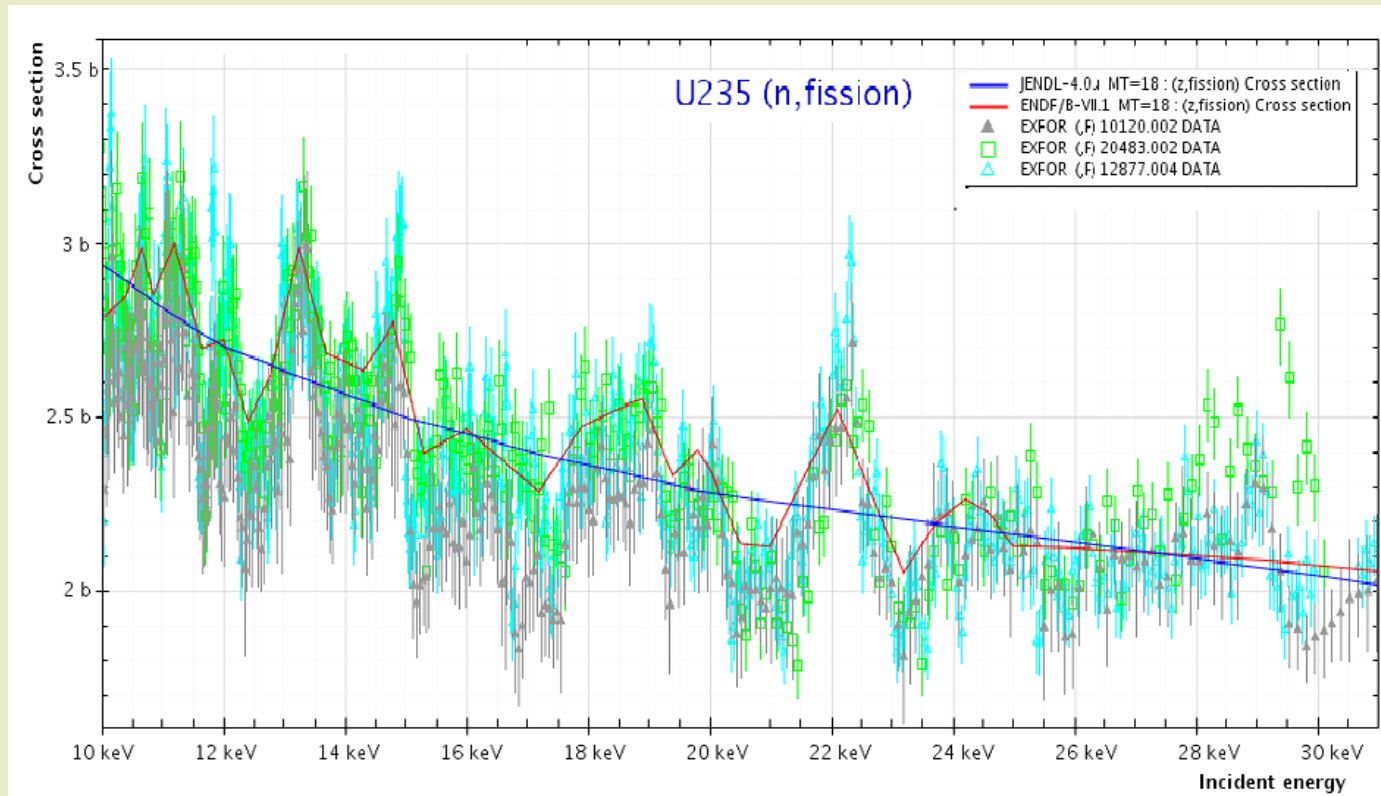
- M. Barbagallo *et al.*, Eur. Phys. J. A (2013) **49**: 12 - 24
- C. Guerrero *et al.*, Eur. Phys. J. A. (2013) **49**: 27- 42



**IAEA recommended an integral mean
value of 246.4 +- 1 b · eV**

for the range 7.8 to 11.0 eV

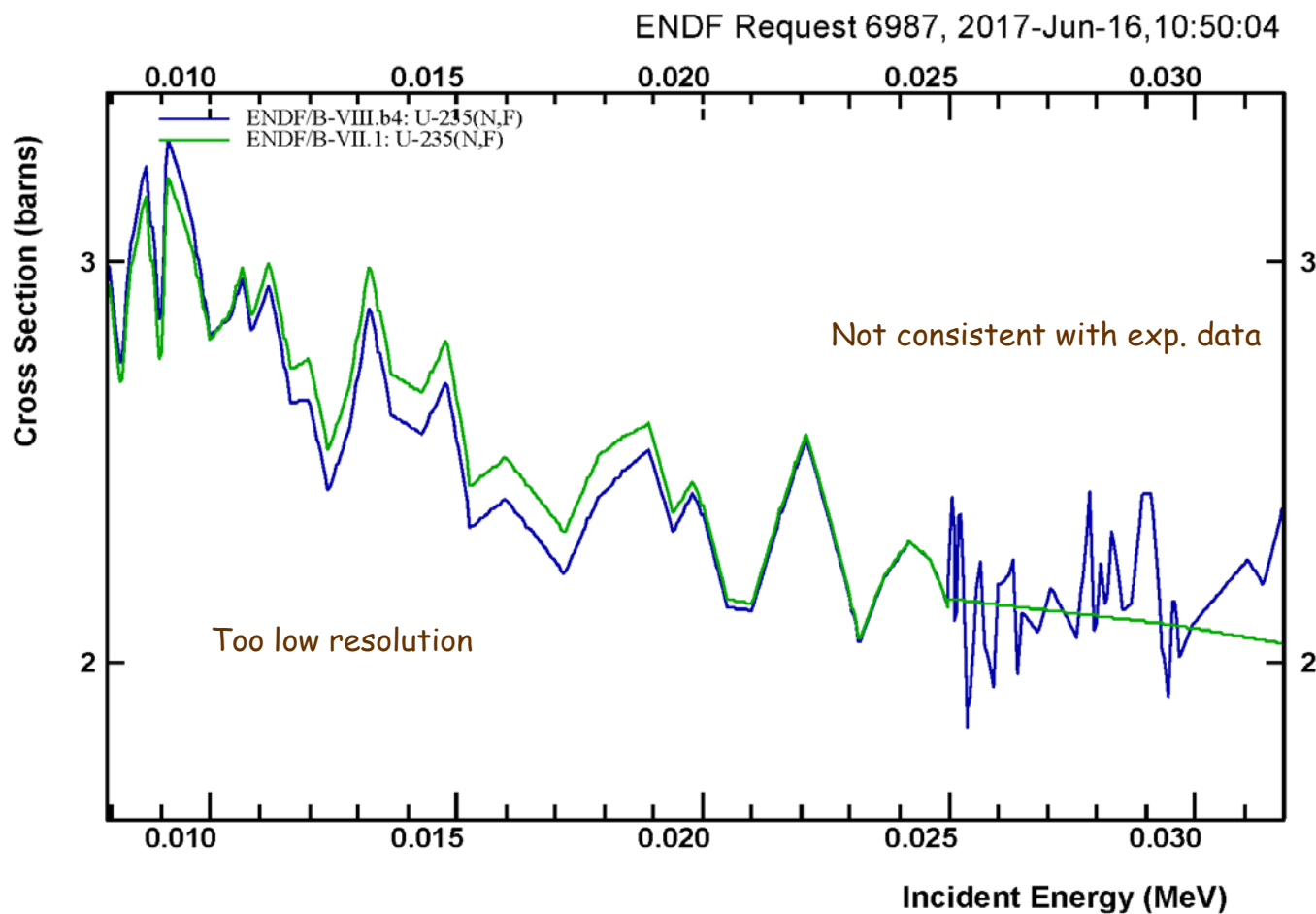
NEW Standard is 247.5 +- 3 b · eV



Besides nTOF (few datasets), Weston, Bowman, Lemley and Blons performed too experiments with good resolution.

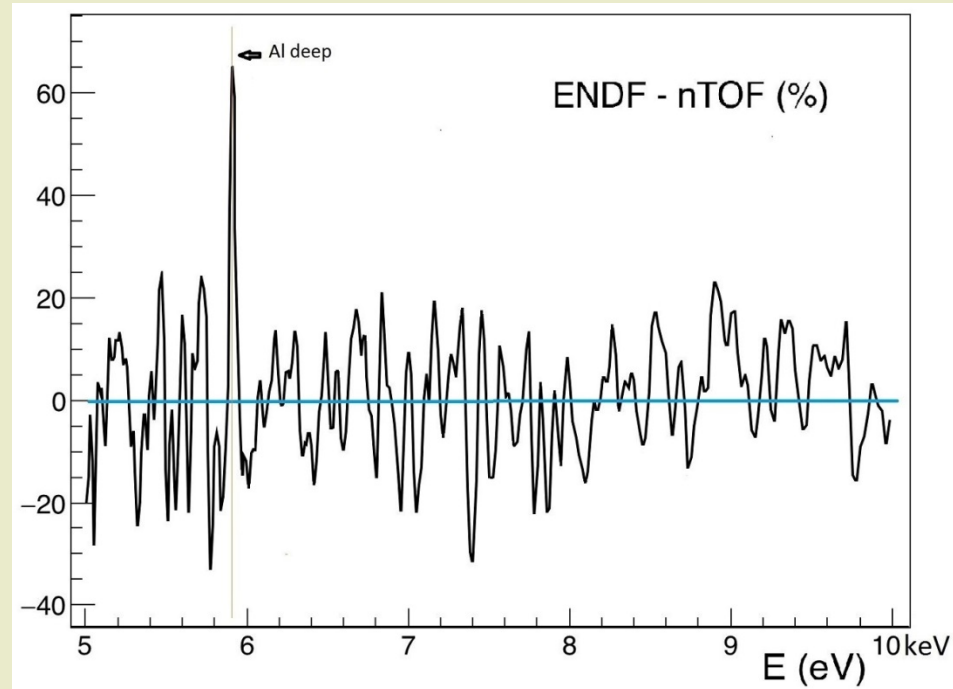
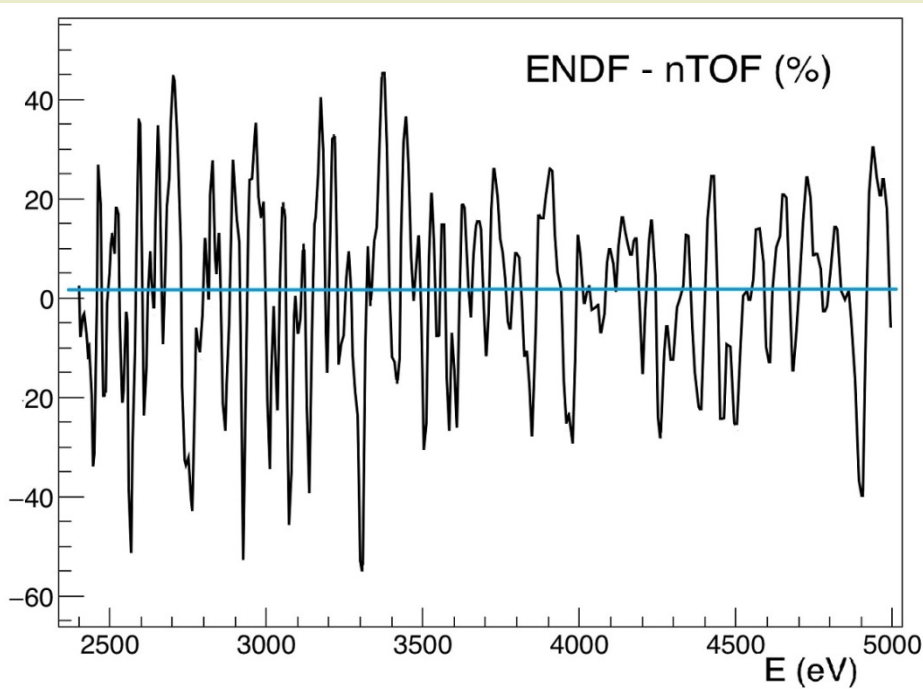
ENDF/B-VII and JENDL-4.0 use it for its former evaluations.

The result was not satisfactory!



ENDF/B-VII and CIELO-1 (ENDF/B-VIII) evaluations.
The result is neither satisfactory!

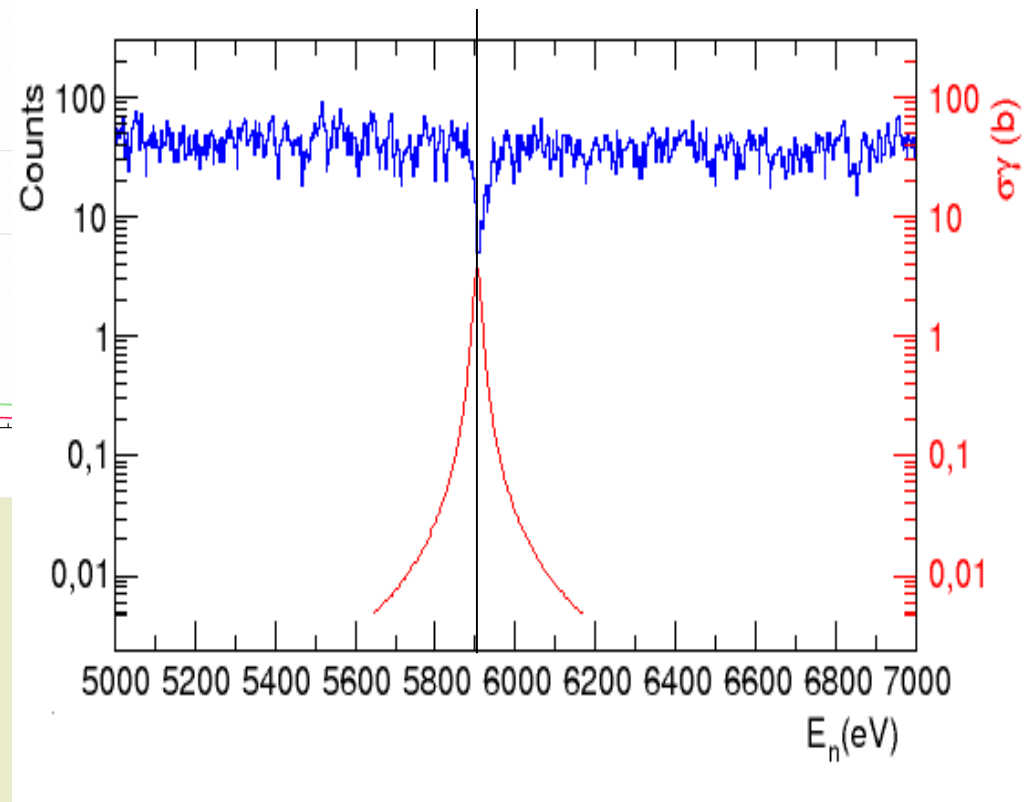
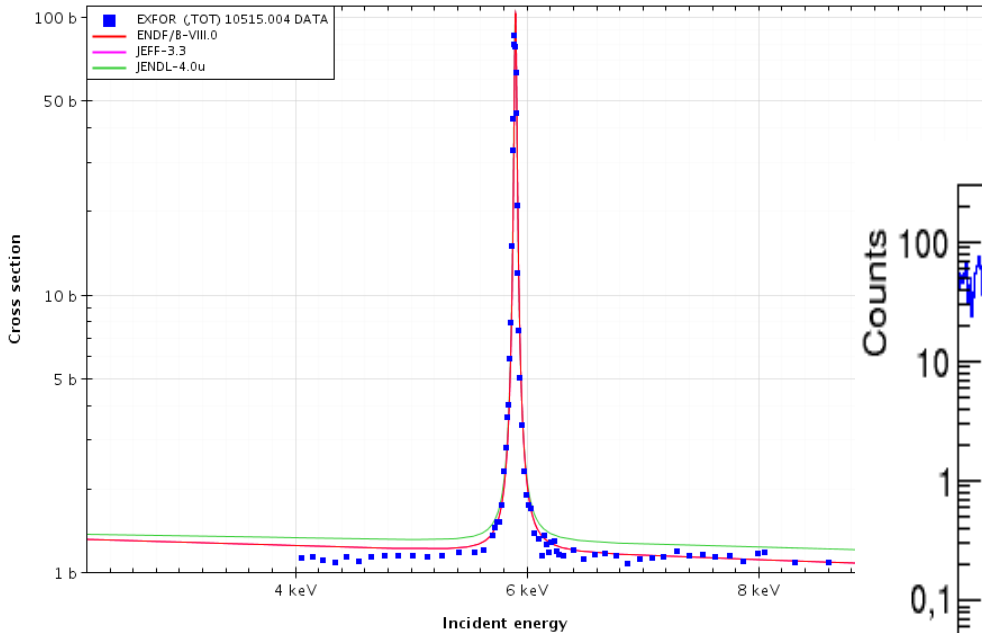
Comparing the new ENDF/B-VIII reference with high-resolution nTOF data



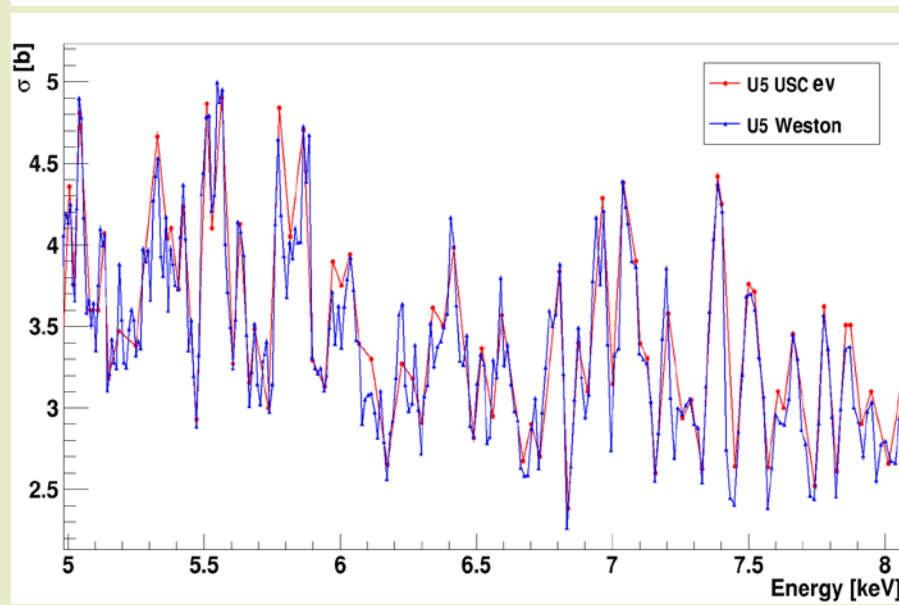
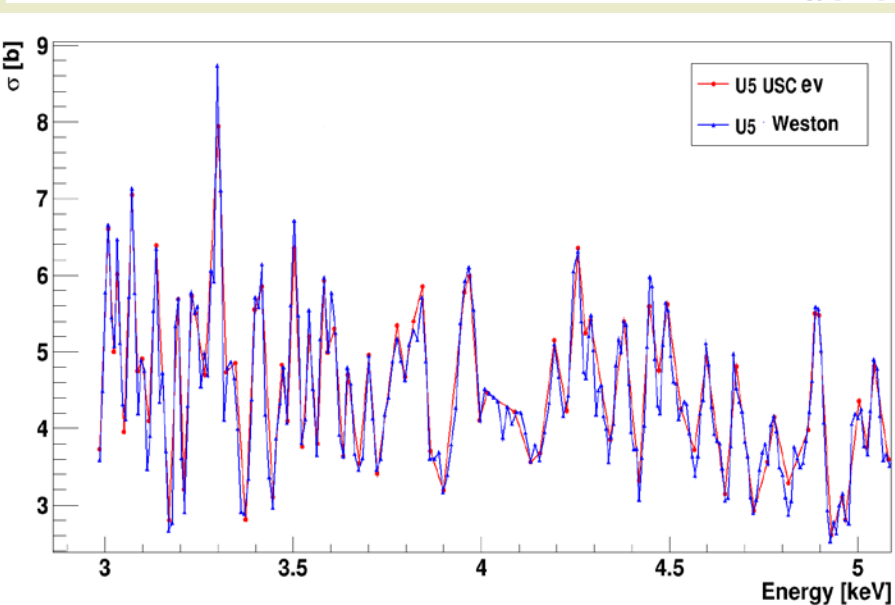
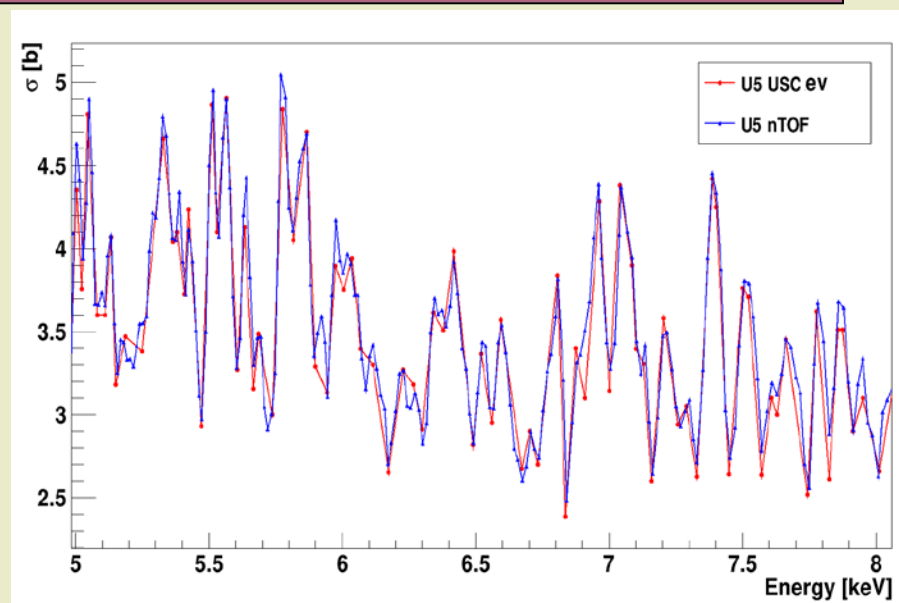
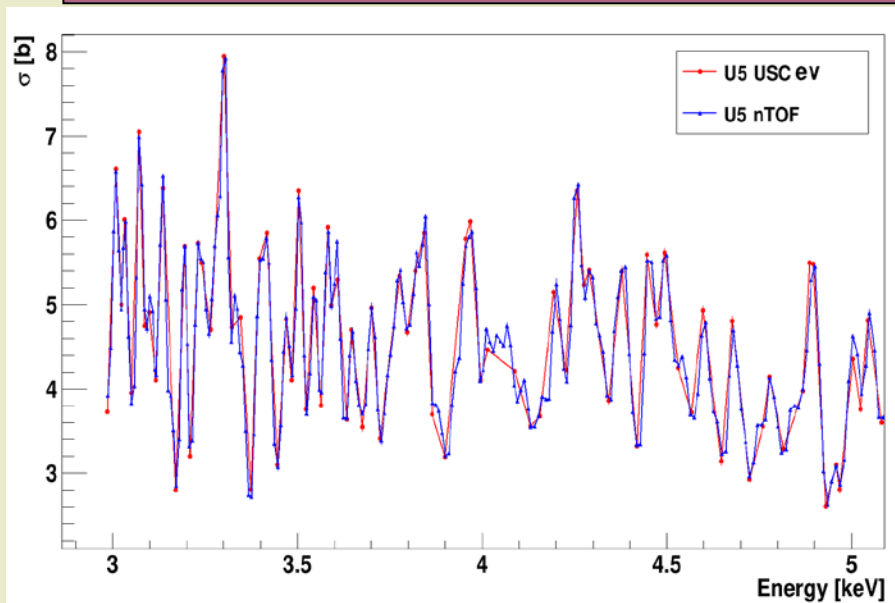
CONCLUSION: There is a very good mean-value agreement, but the high-resolution XS shape is not reflected in the ENDF evaluations and the errors so introduced exceeds 40%

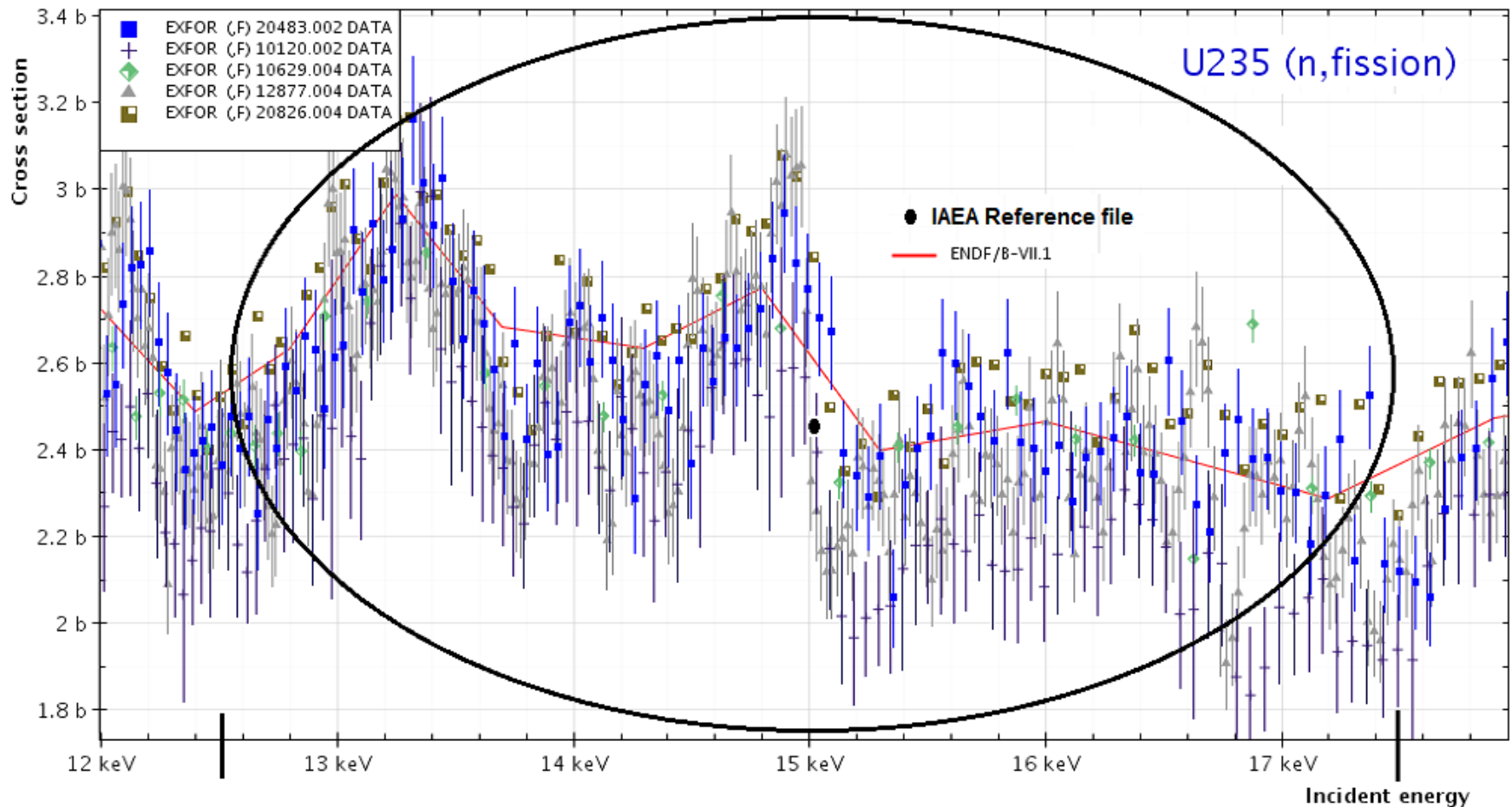
Note the effect of a bad corrected Al dip.

Al27 (n,total)



The 5.903(8) keV peak with a FWHM around 20 eV



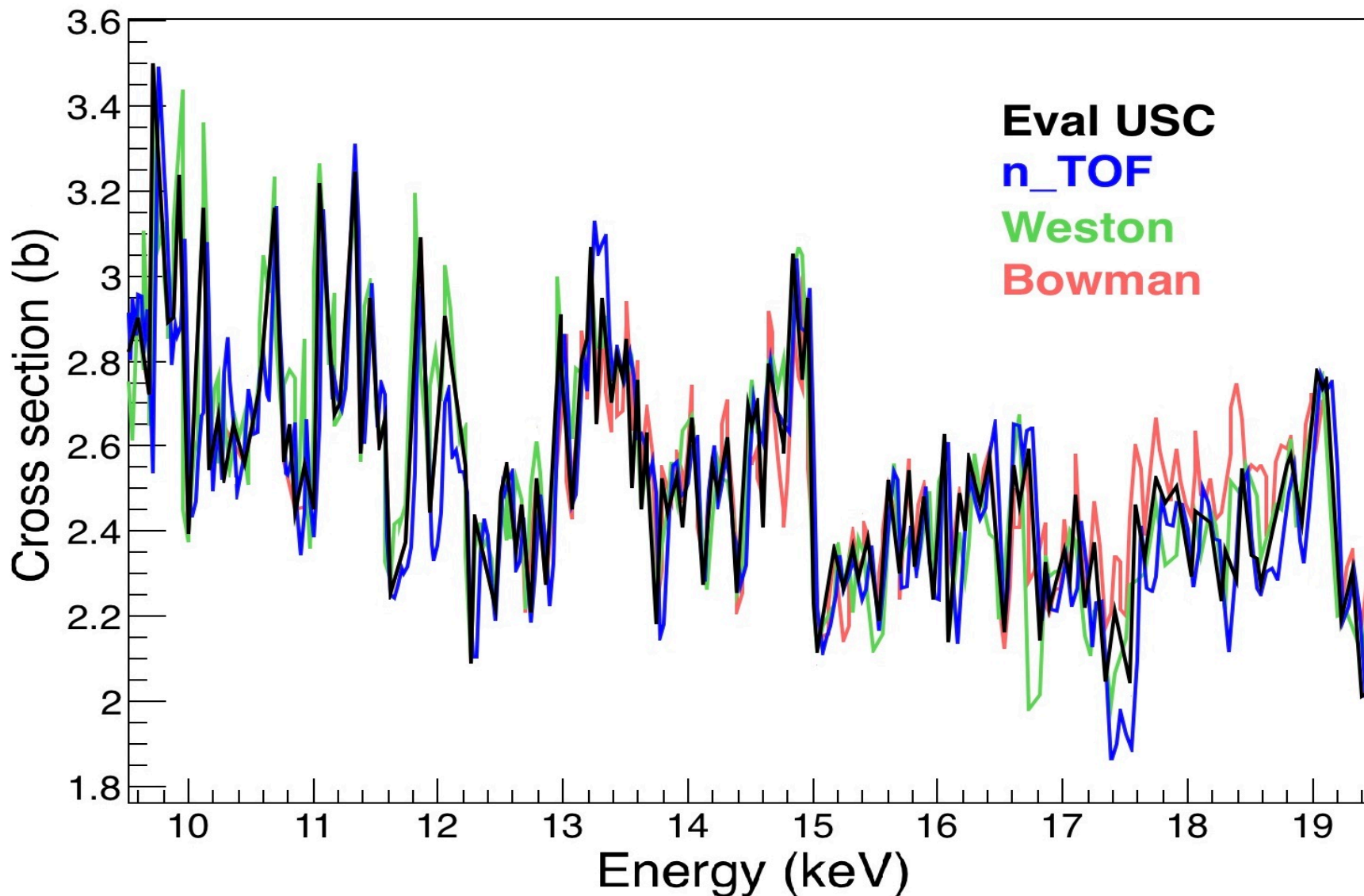


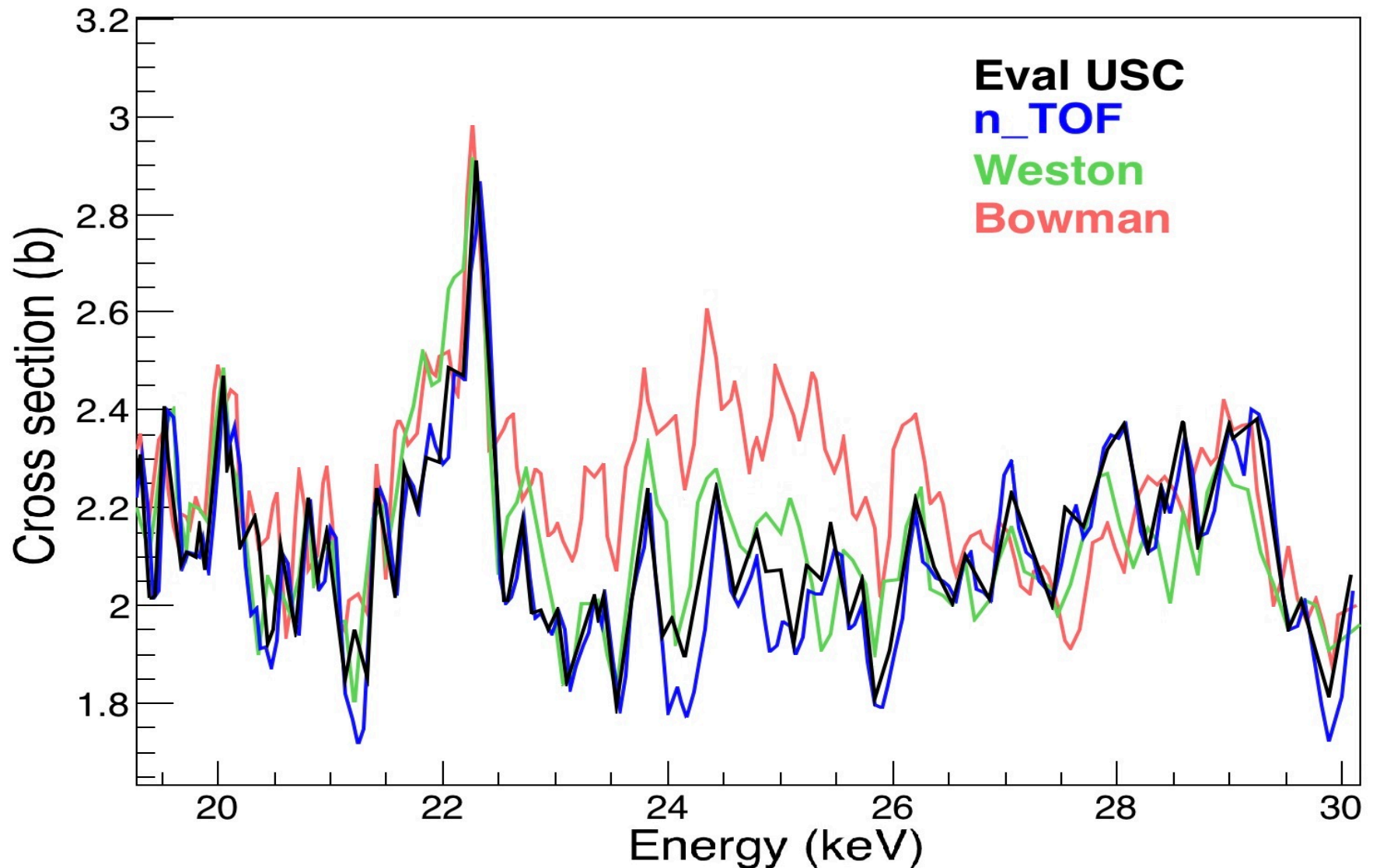
The IAEA Reference data (GMA based) can be used for normalisation.
These points are not Standards but after the CIELO project, major evaluated libraries become normalised.

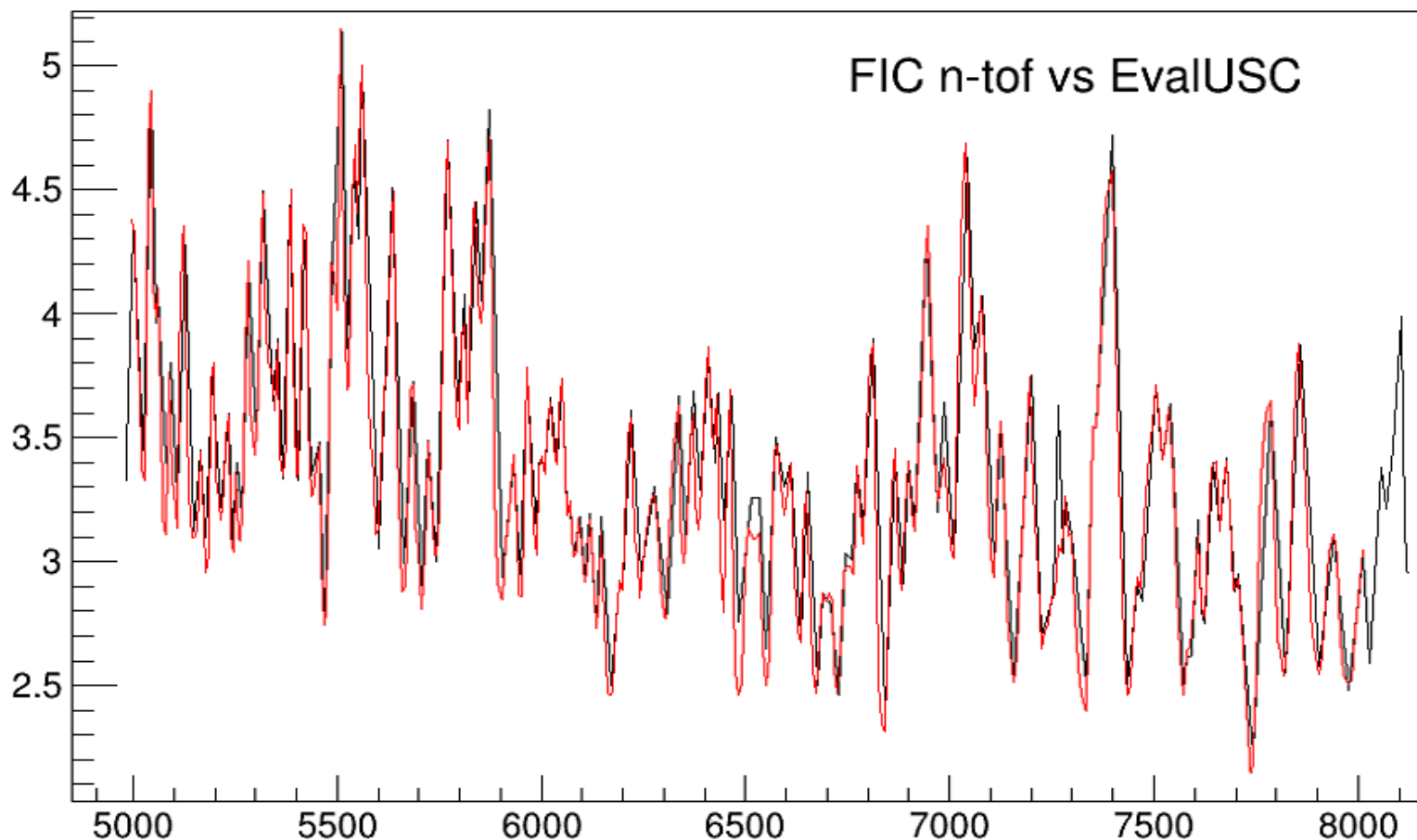
INTEGRAL MEAN-VALUES [b]

The nTOF (CP) data were normalised at 7.8 - 11 eV and its integral mean-values are in quasi-perfect agreement with the Reference points:

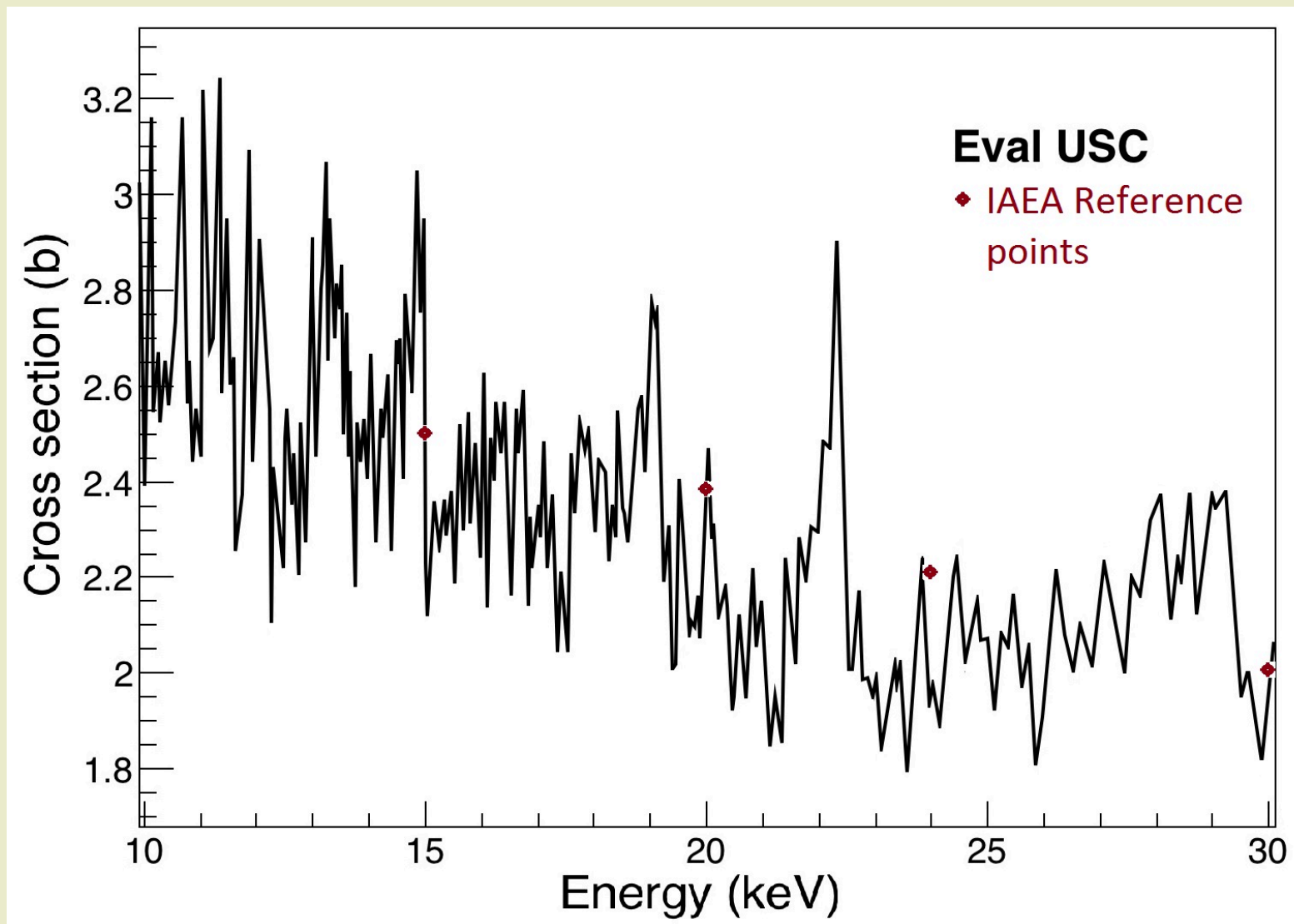
	En[keV]	IAEA-Std	EvalUSC	%	
.	3.51	4.808	4.802	- 0.1	
•	4.50	4.281	4.197	- 2,0	
•	5.49	3.857	3.891	+0.3	
•	6.49	3.307	3.308	0.0	
•	7.51	3.251	3.210	- 1,3	
•	8.48	3.019	2.934	- 2.9	
•	9.52	3.135	3.101	- 1.1	Both Weston and Bowman datasets have been re-normalised, just to compare with nTOF
•	12.5-17.5	2.504	2.500	- 0.2	
•	20-30	2.162	2.137	- 1.2	

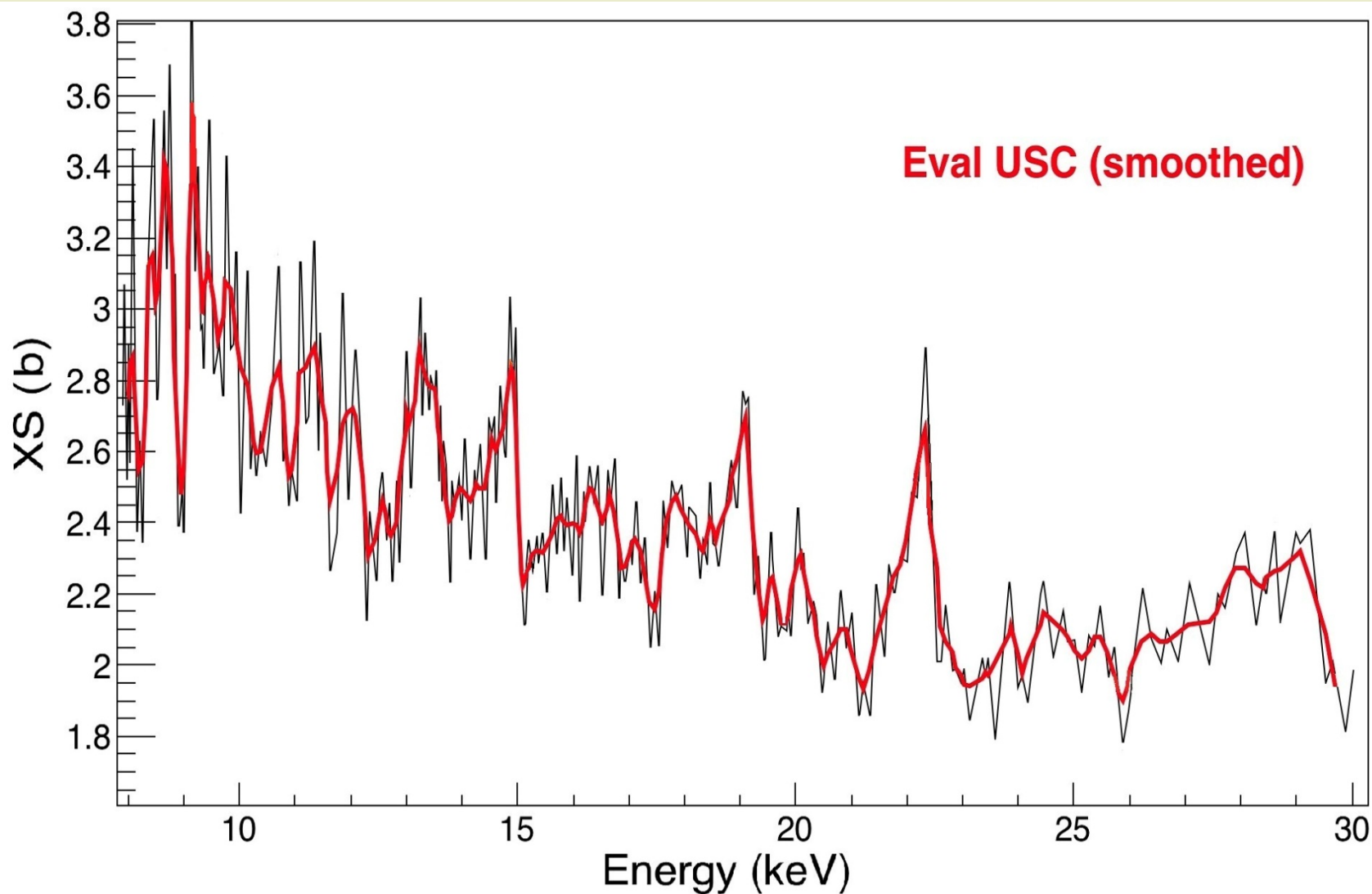


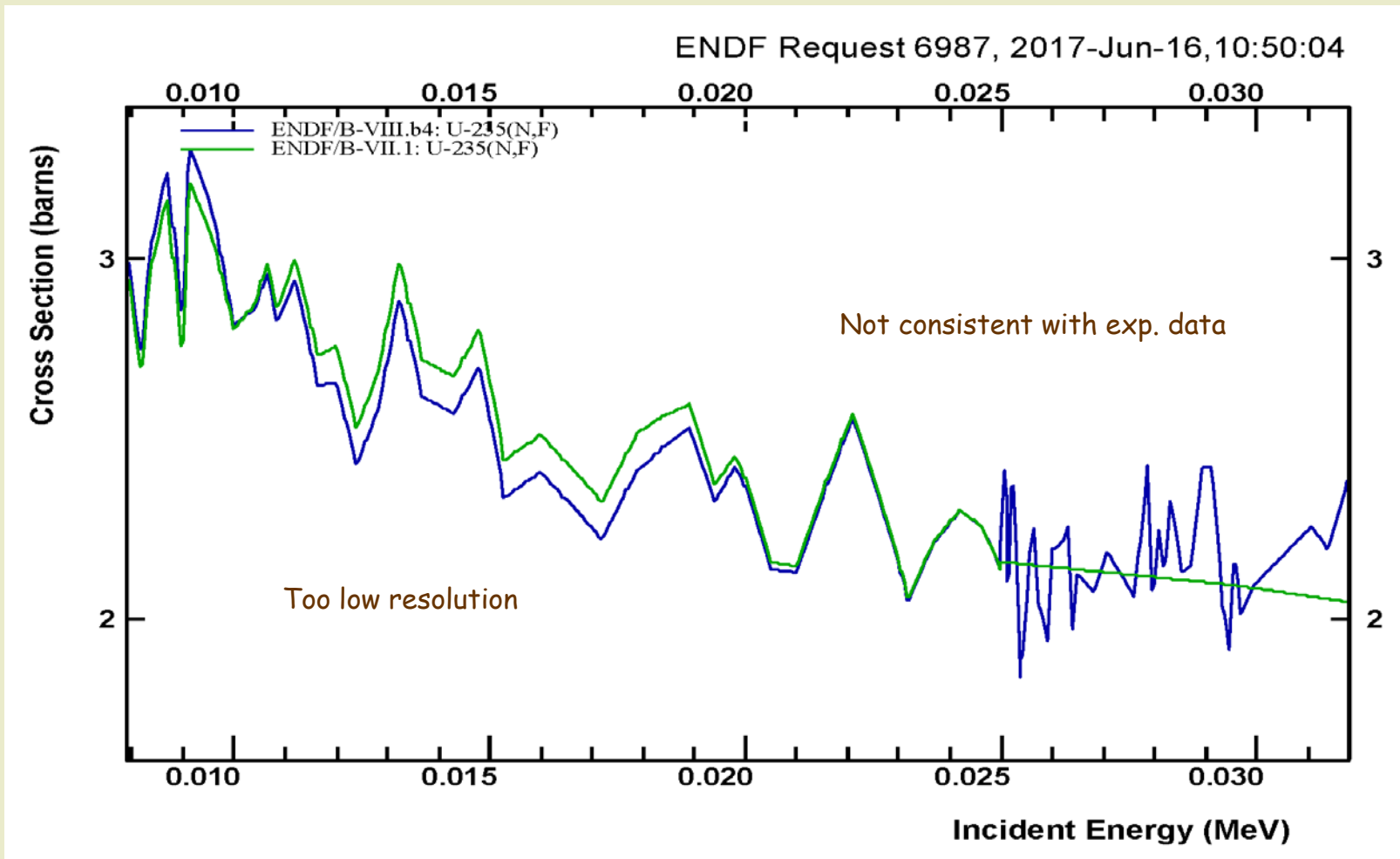




**The FIC dataset shows both better statistics and better resolution.
Analysis not yet completed. Big thanks to Walter Furman and co.!!**

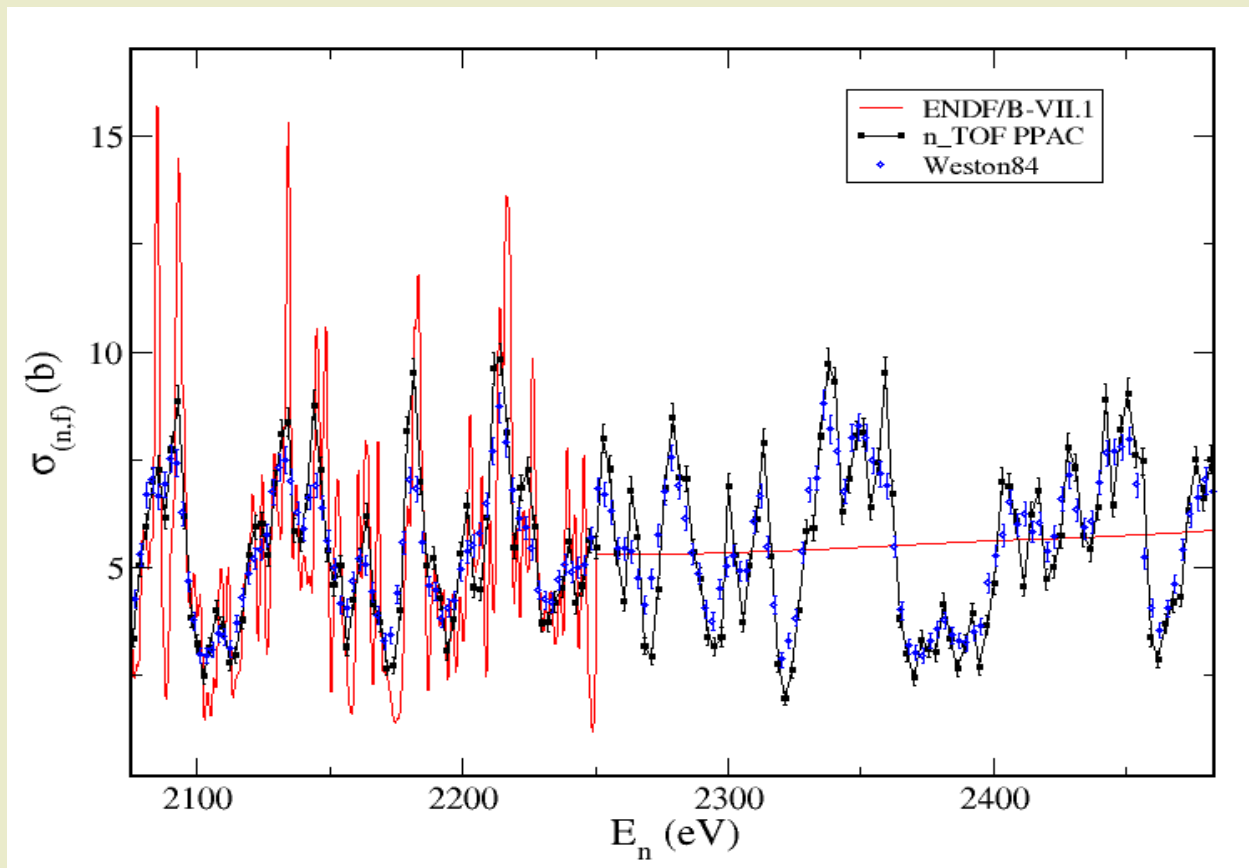






**CIELO-1 (ENDF/B-VIII) evaluation,
can it be improved?**

- * Different experimental high-resolution measurements has been evaluated, looking for consistent fluctuations in the $U5(n,f)$ XS.
- * Accurate energy calibration is achieved in the nTOF datasets by the 5.903(8) keV $Al(n,tot)$ narrow peak.
- * Accurate normalisation is done by comparing with the IAEA Standard at the 9.4 eV peak (around 1%).
- * A reliable XS spectrum shape has been obtained, showing some well defined structures (worth of a theoretical analysis).
- * The IAEA Reference file (wide energy slots) is found very useful.
- * The ENDF/B-VIII (CIELO) evaluation is worth of criticism



Once fitted the 7.8 - 11 eV resonance, the nTOF original energy calibration was hold. Above 2 keV we still followed accurately Weston84, when keeping its same binning.

Note how the ENDF/B-VII energy calibration starts to shift.

ENDF stops giving the shape at 2.25 keV (RRR → URR)

