ORNL new Pu-239 RR parameters impact on Keff

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ICSBEP Benchmarks

- A set of 21 ICSBEP Pu benchmarks
- TRIPOLI 4.6 Monte Carlo code with
  - JEFF-3.1 n-library
  - JEFF-3.1.1 n-library
  - JEFF-3.1.1 (–Pu239) + ORNL1
  - JEFF-3.1.1 (–Pu239) + ORNL1 + Maslov PNFS

ORNL1 = JEFF-3.1 + new ORNL MF-2

ORNL1m = JEFF-3.1 + new ORNL MF-2 + Maslov PNFS

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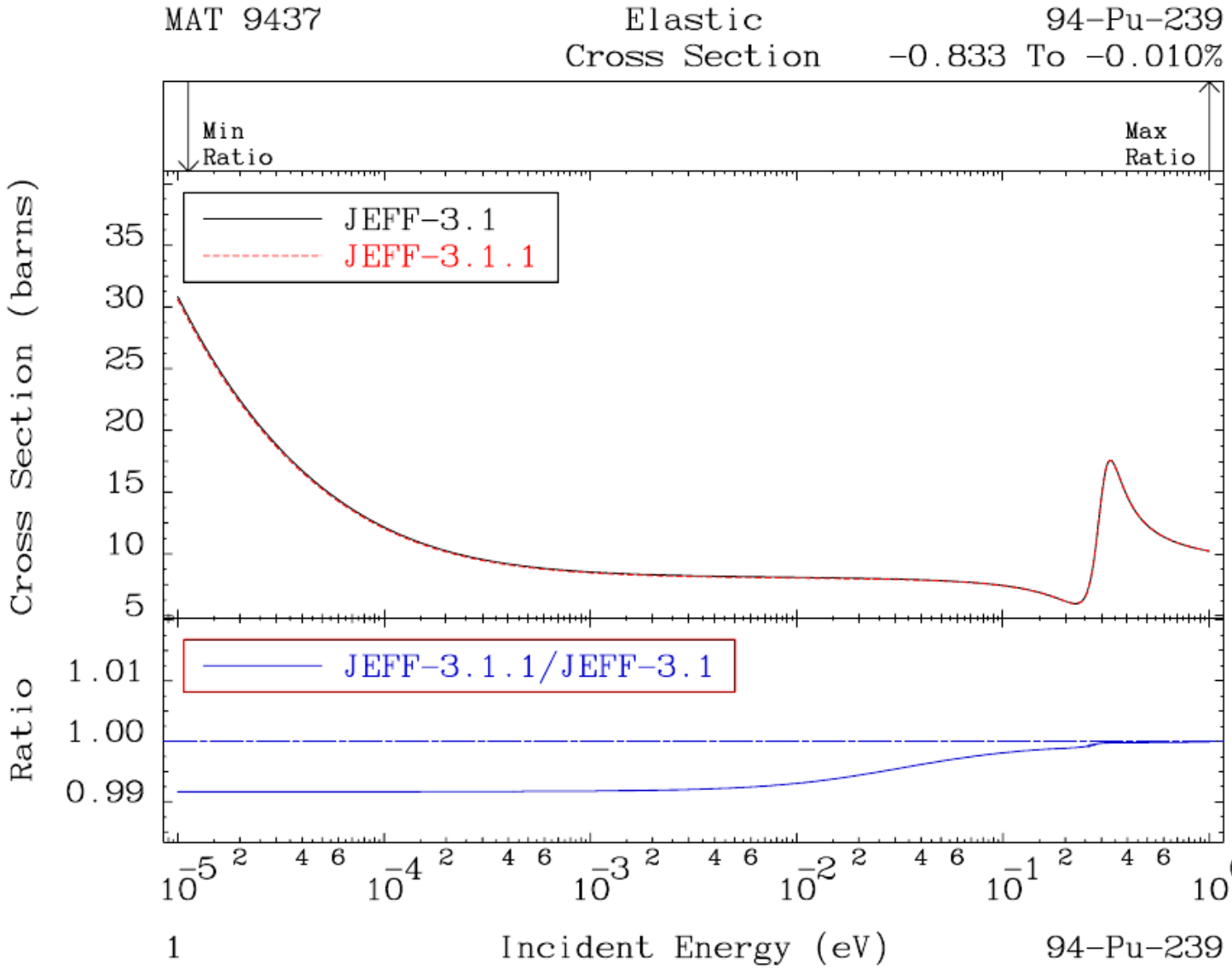

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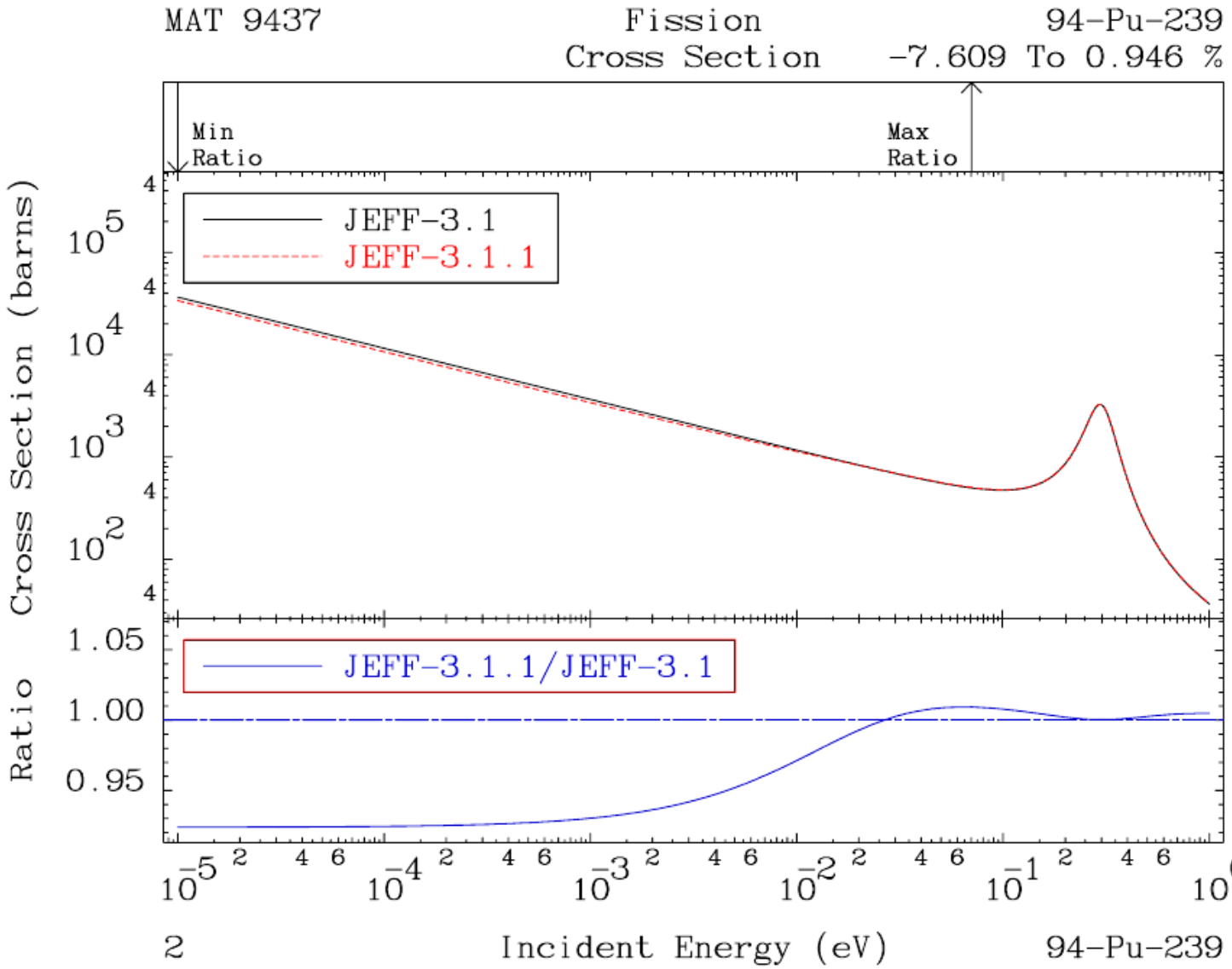

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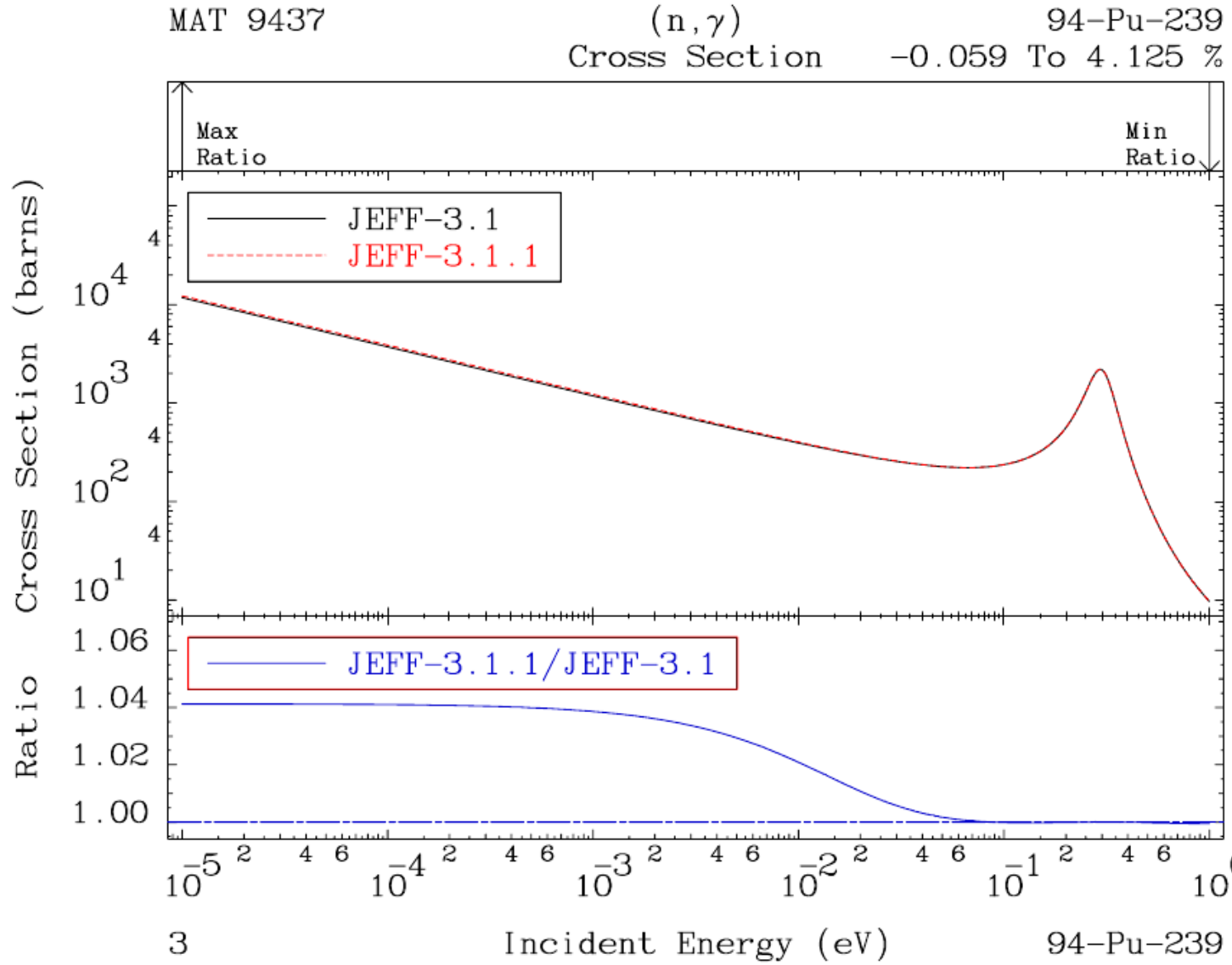
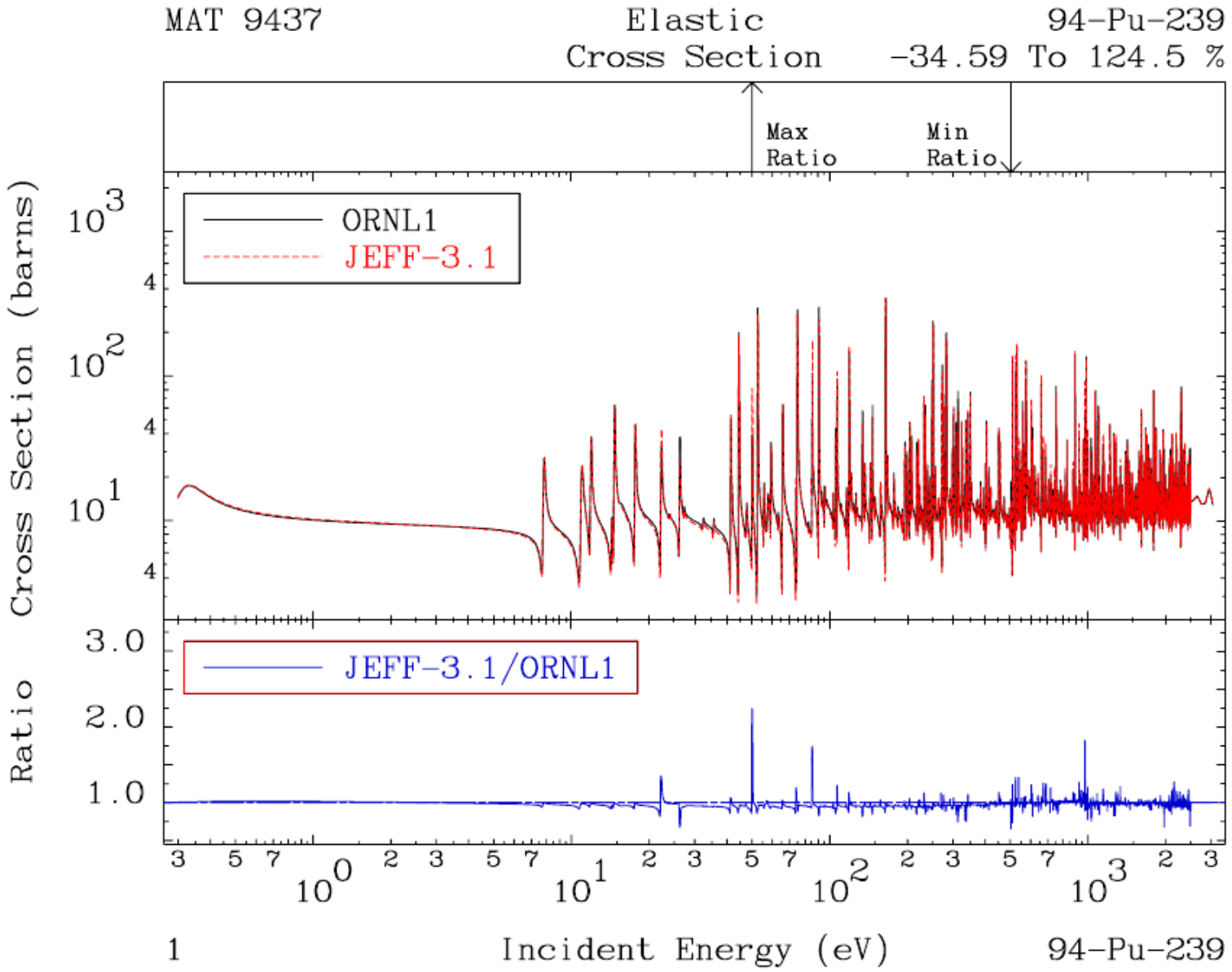

MAT 9437
(n,γ)
Cross Section
94-Pu-239
-0.059 To 4.125 %
Max Ratio
Min Ratio
JEFF-3.1
JEFF-3.1.1
JEFF-3.1.1/JEFF-3.1
Ratio Cross Section (barns)
Incident Energy (eV)
3
94-Pu-239



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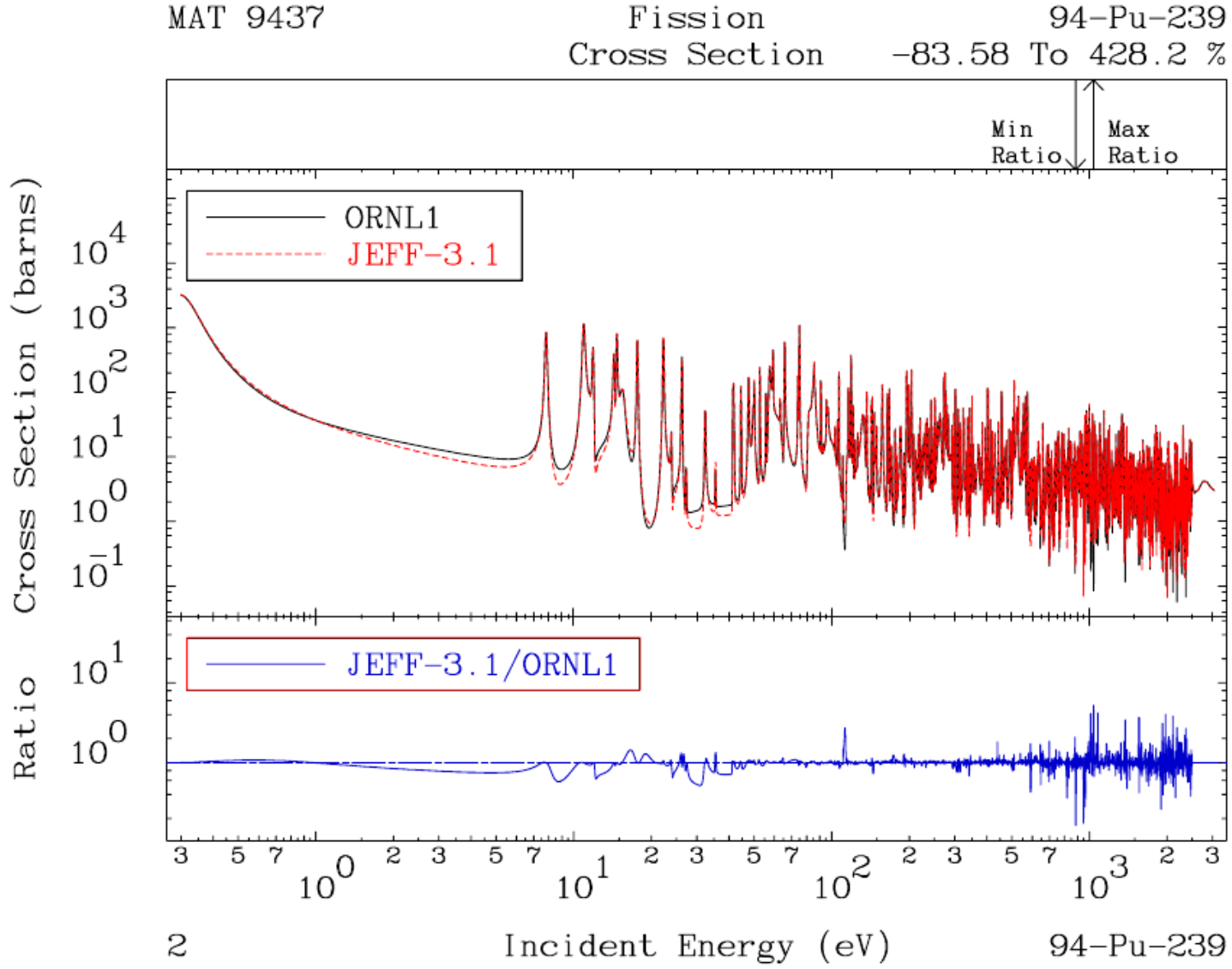

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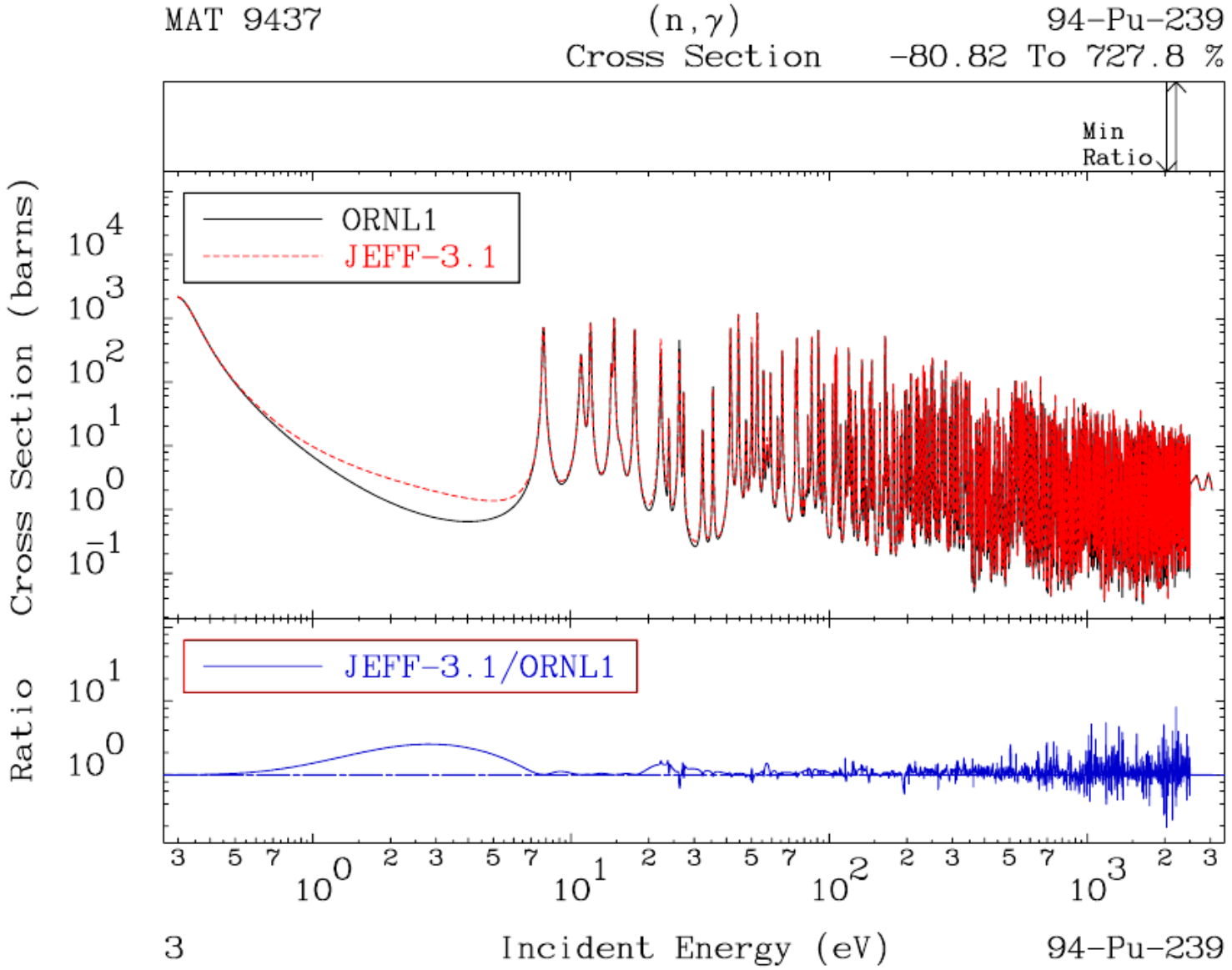

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Code				Tripoli-4.6		Tripoli-4.6		Tripoli-4.6		
Library				JEFF-3.1		JEFF-3.1.1		ORNL1		
	Experiment			Calc.		Calc.	Δ	Calc.	Δ	Δ
		Keff	Unc.	Kcalc	S.D.	Kcalc	Δ (C-C)	Kcalc	(C-C)	(C-C)
ICSBEP	Name			Theraml range Pu			3.1		3.1	3.1.1
PST-009	48" sphere, Al vessel, bare									
9.54 gPu/l	c-2A	1.0003	330	1.01893	11	1.01105		1.01578		
9.46 gPu/l	c-3A	1.0003	330	1.01927	11	1.01466		1.01928		
Average				1.01910		1.01285		1.01753		
Δ (C-E)				1880		1255	-625	1723	-157	468
MCT-004	Mox 3.01 wt% PuO2-UO2 fuel rods,									
2.4 w/f ratio	c-1	1.0000	460	0.99683	13	0.99601		0.99840		
2.9 w/f ratio	c-4	1.0000	390	0.99707	13	0.99605		0.99870		
4.2 w/f ratio	c-7	1.0000	400	0.99779	13	0.99654		0.99855		
5.5 w/f ratio	c-10	1.0000	510	0.99783	13	0.99631		0.99862		
Average				0.99738		0.99622		0.99857		
Δ (C-E)				-262		-378	-116	-143	119	234
PST-001	11.5" sphere, water reflected									
73.0 gPu/l	c-1	1.0000	500	1.00186	12	1.00218		1.00646		
96.0 gPu/l	c-2	1.0000	500	1.00356	12	1.00403		1.00822		
119.0 gPu/l	c-3	1.0000	500	1.00665	12	1.00713		1.01136		
132.0 gPu/l	c-4	1.0000	500	1.00104	12	1.00144		1.00575		
140.0 gPu/l	c-5	1.0000	500	1.00505	12	1.00552		1.00994		
268.7 gPu/l	c-6	1.0000	500	1.00681	12	1.00732		1.01243		
Average				1.00416		1.00460		1.00903		
Δ (C-E)				416		460	44	903	487	443
PST-011	16&18" sphere, bare									
34.9 gPu/l	16-1	1.0000	520	1.00669	13	1.00736		1.01160		
43.4 gPu/l	16-5	1.0000	520	1.00337	13	1.00370		1.00802		
Average				1.00503		1.00553		1.00981		
Δ (C-E)				503		553	50	981	478	428
22.3 gPu/l	18-1	1.0000	520	0.99134	13	0.99160		0.99602		
27.5 gPu/l	18-6	1.0000	520	0.99708	13	0.99761		1.00198		
Average				0.99421		0.99460		0.99900		
Δ (C-E)				-579		-540	39	-100	479	440

Thermal Pu239

/JEFF-3.1
up to +480 pcm
nearly as much as JEFF-3.1.1 but
not on the same
set of benchmarks

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Thermal - Pu239 up to + 450 pcm
Fast - Pu239 no change (as expected)

Code				Tripoli-4.6		Tripoli-4.6		Tripoli-4.6		
Library				JEFF-3.1		JEFF-3.1.1		ORNL1		
	Experiment			Calc.		Calc.	Δ	Calc.	Δ	Δ
		Keff	Unc.	Kcalc	S.D.	Kcalc	Δ (C-C)	Kcalc	(C-C)	(C-C)
PST-013	**256-mm cyl, in air**						**3.1**		**3.1**	**3.1.1**
115 gPu/l	c-1	0.9980	400	1.00169	12	1.00203		1.00658		
115 gPu/l	c-2	0.9980	400	1.00157	12	1.00200		0.99875		
Average				**1.00163**		**1.00202**		**1.00266**		
Δ (C-E)				**363**		**402**	**38**	**466**	**103**	**65**
115 gPu/l	c-4	0.9965	520	0.99419	12	0.99460		0.99875		
Δ (C-E)				**-231**		**-190**	**41**	**225**	**456**	**415**
PMF-001	**Bare Sphere of Pu-239 Metal**									
Jezebel	c-1	1.0000	200	1.00025	15	0.99999		1.00019		
Δ (C-E)				**25**		**-1**	**-26**	**19**	**-5**	**20**
PMF-002	**Bare Sphere of Pu-239 Metal**									
Jez. 240	c-1	1.0000	200	1.00430	15	1.00426		1.00416		
Δ (C-E)				**430**		**426**	**-4**	**416**	**-14**	**-9**

Notice the impact difference on an Identical serie

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Résumé

- ORNL1 new RR is has efficient/potent as the JEFF-3.1.1 on some benchmarks
- It also is base on a more “physical” base approach as opposed to an engineered solution
- A full RR parameters set is given allowing for better self-shielding and temperature dependant evolution

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Code				Tripoli-4.6		Tripoli-4.6		Tripoli-4.6		
Library				JEFF-3.1		JEFF-3.1.1		ORNL1m		
	Experiment			Calc.		Calc.	Δ	Calc.	Δ	Δ
		Keff	Unc.	Kcalc	S.D.	Kcalc	Δ (C-C)	Kcalc	(C-C)	(C-C)
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268.7 gPu/l	c-6	1.0000	500	1.00681	12	1.00732		1.01244		
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Average				0.99421		0.99460		0.99900		
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Thermal Pu239

not a great deal of difference compared with ORNL1

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No more impact difference on an Identical series

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Résumé

- on top of the new ORNL1 resonance parameters Malsov spectra are having even more subtle effects

  - It level, iron out the delta with JEF-3.1 and JEFF-3.1.1 on the solutions benchmarks
  - Those benchmarks have been found to be very sensitive to those new spectra

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Conclusions

- From this specific studies it has been demonstrated that:
  - Those modifications induces some subtle changes
  - ICSBEP series “Keff trend” are been seriously challenged by such step by step impact benchmarking studies
  - Better physics may lead to Keff comparison deterioration, there nothing wrong with that, we know that compensation exists

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