IAEA Neutron Standards 2017

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+ IAEA Neutron Standard Data Development Project

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Neutron Standards evaluation (2017)

TABLE II. Neutron Cross Section Standards.

Reaction	Standards Energy Range
H(n,n)	1 keV to 20 MeV
^{3}He(n,p)	0.0253 eV to 50 keV
^{6}Li(n,t)	0.0253 eV to 1.4 MeV
^{10}B(n,α)	0.0253 eV to 1 MeV
^{10}B(n,$\alpha_1\gamma$)	0.0253 eV to 1 MeV
C(n,n)	10 eV to 1.8 MeV
Au(n,γ)	0.0253 eV, 0.2 to 2.5 MeV, 30 keV MACS
^{235}U(n,f)	0.0253 eV, 0.15 MeV to 200 MeV, 7.8-11 eV
^{238}U(n,f)	2 MeV to 200 MeV

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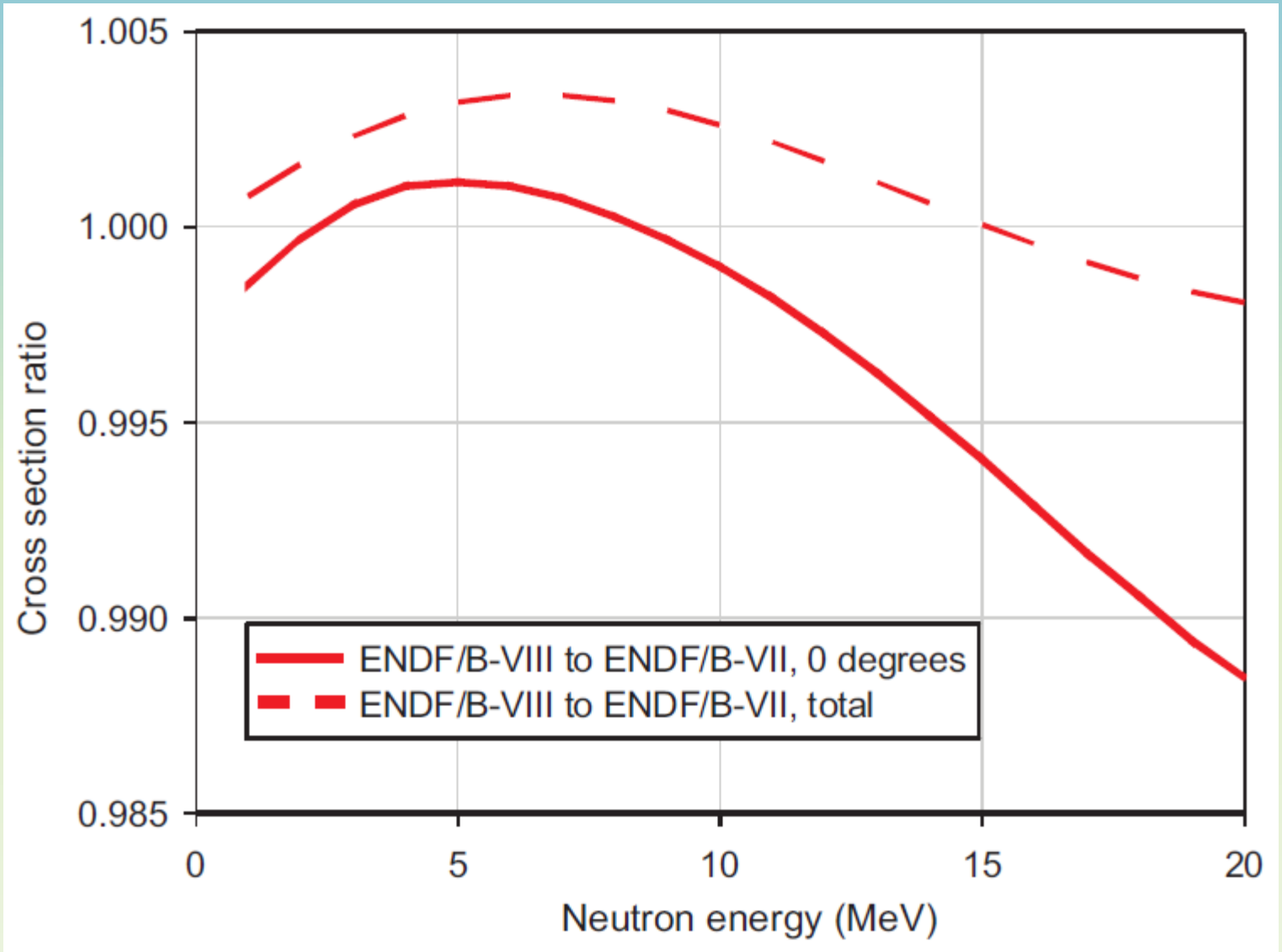
Neutron Standards XS: ^{1}H(n,n)



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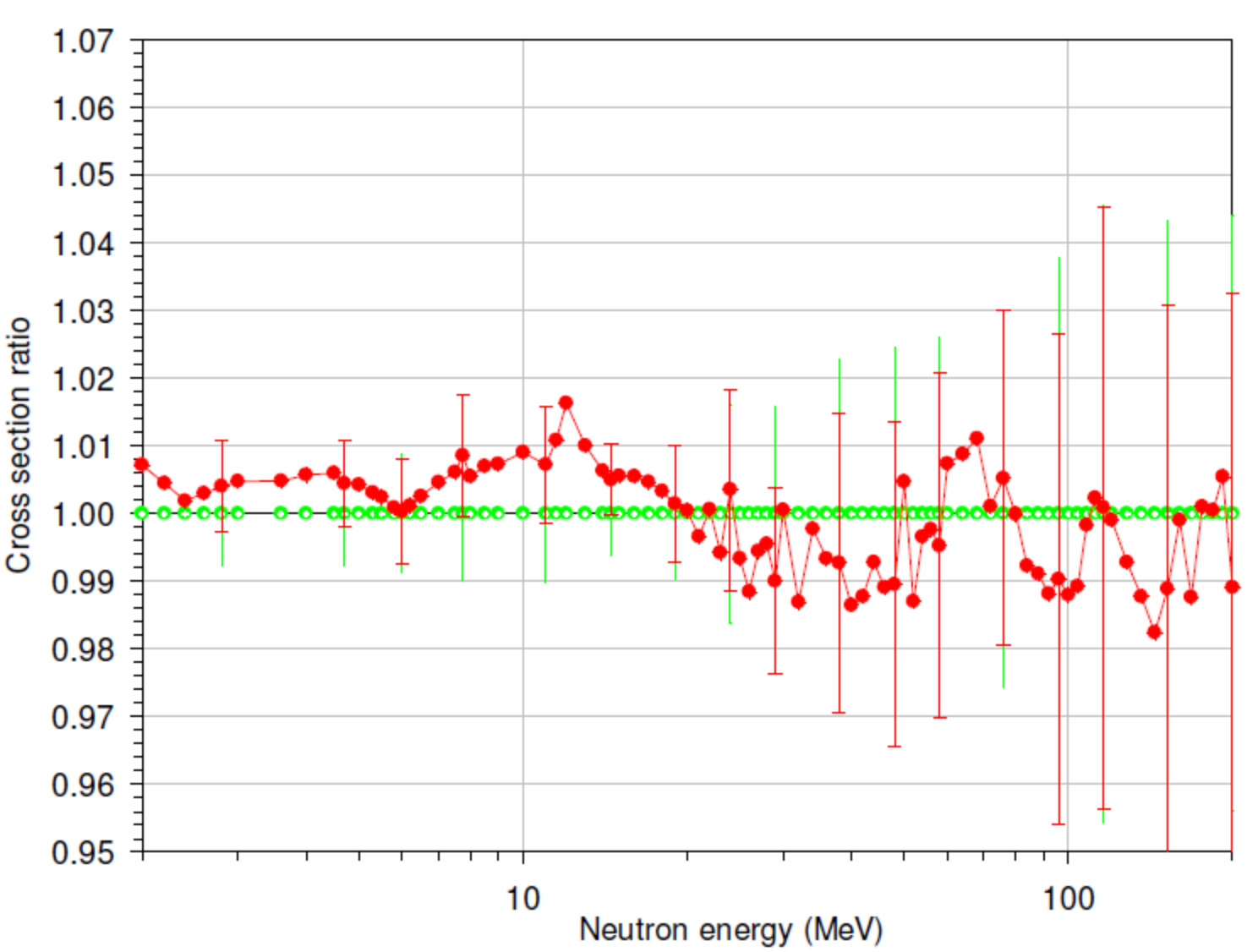
Neutron Standards XS: ^{238}U(n,f)



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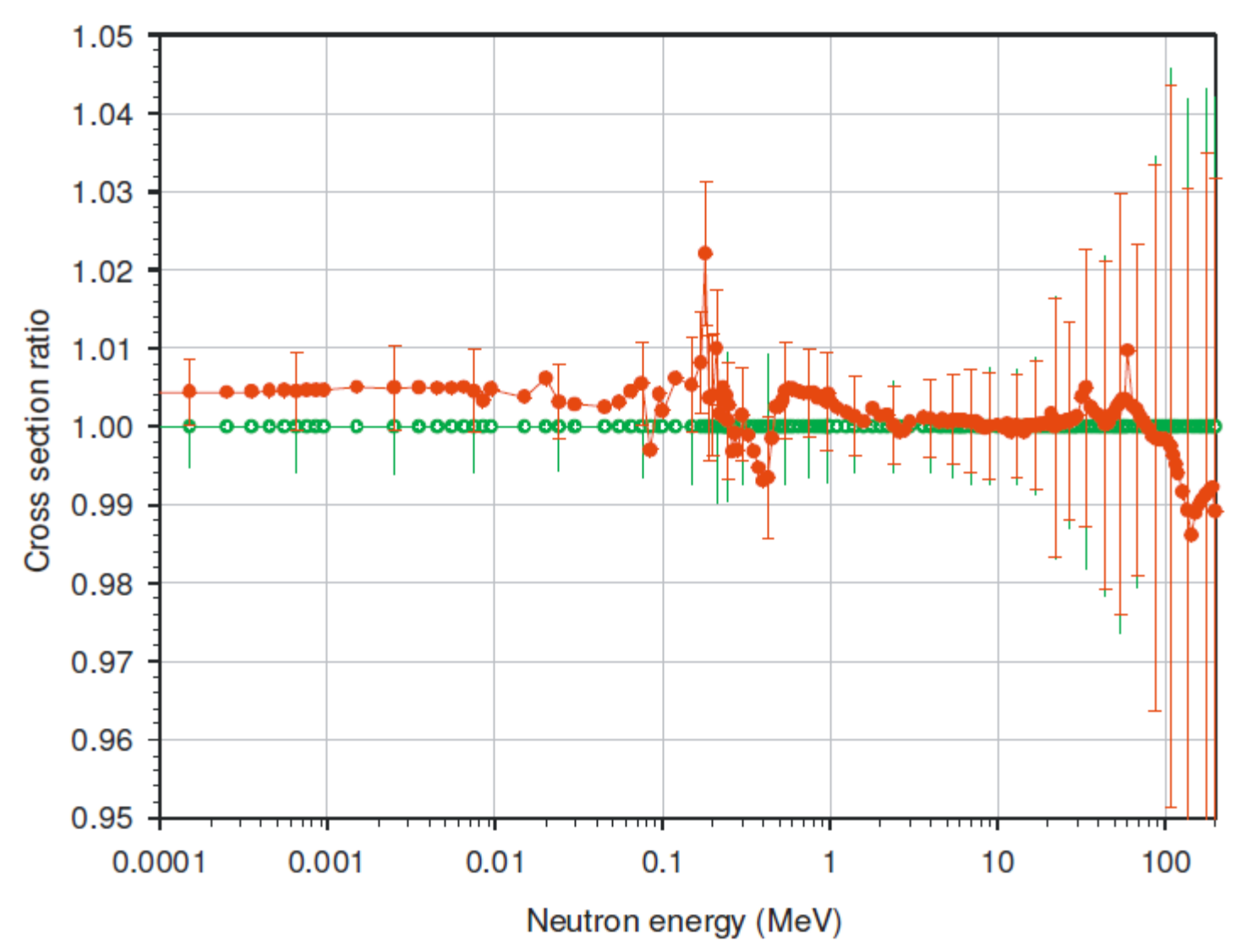
Neutron Standards XS: $^{235}U(n,f)$



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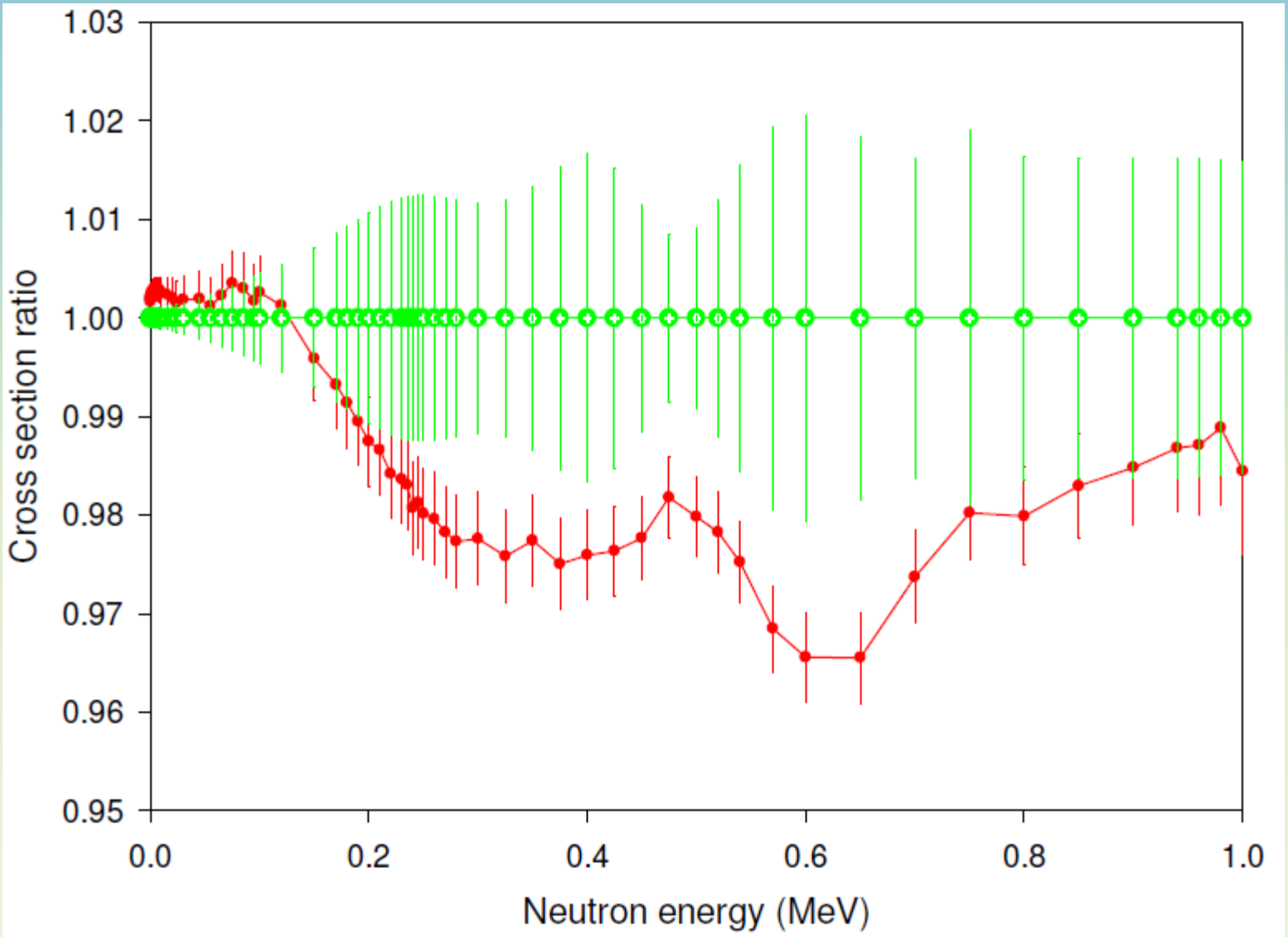
Neutron Standards XS: $^{10}B(n,a)$



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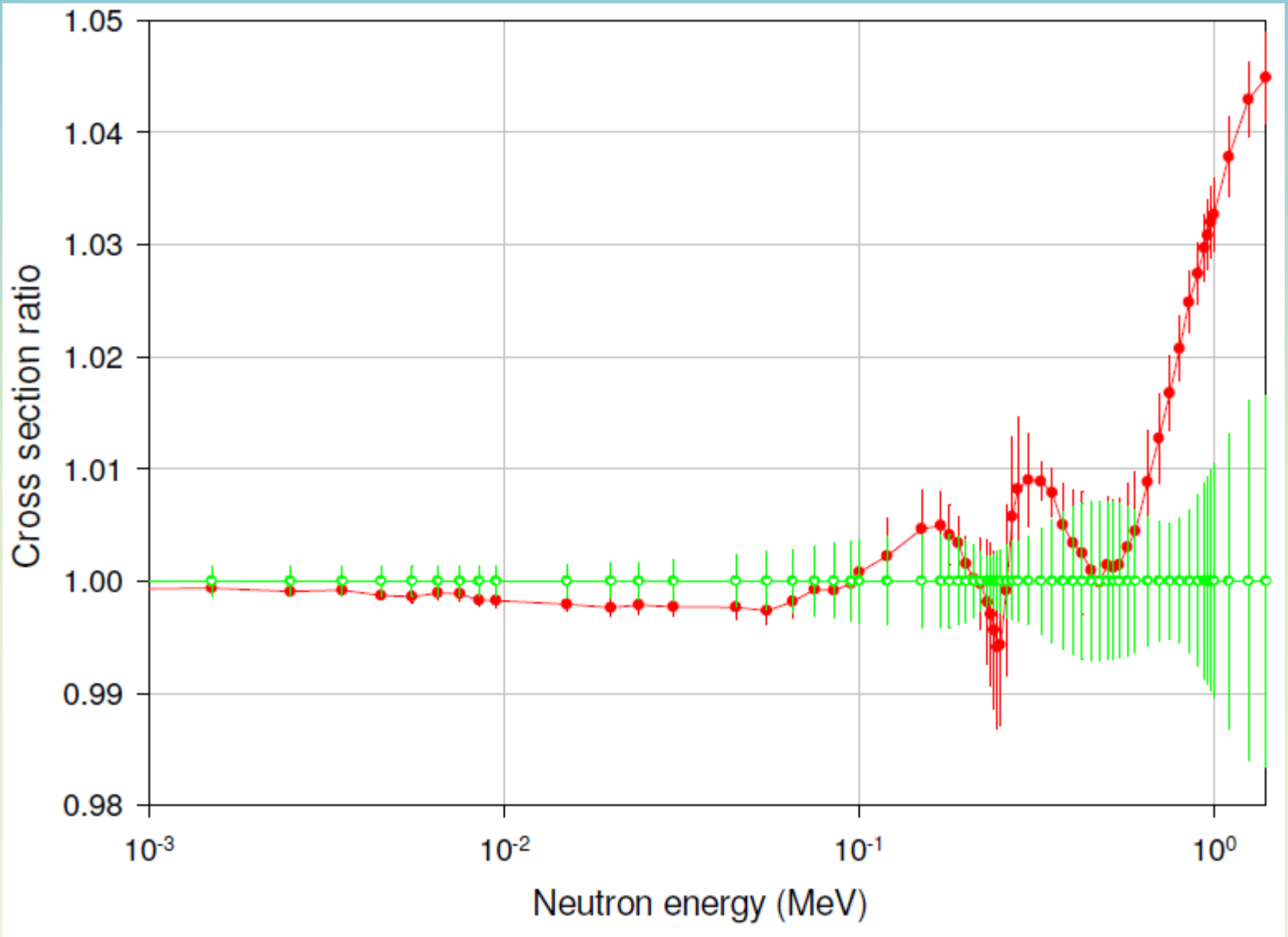
Neutron Standards XS: ^{6}Li(n,t)



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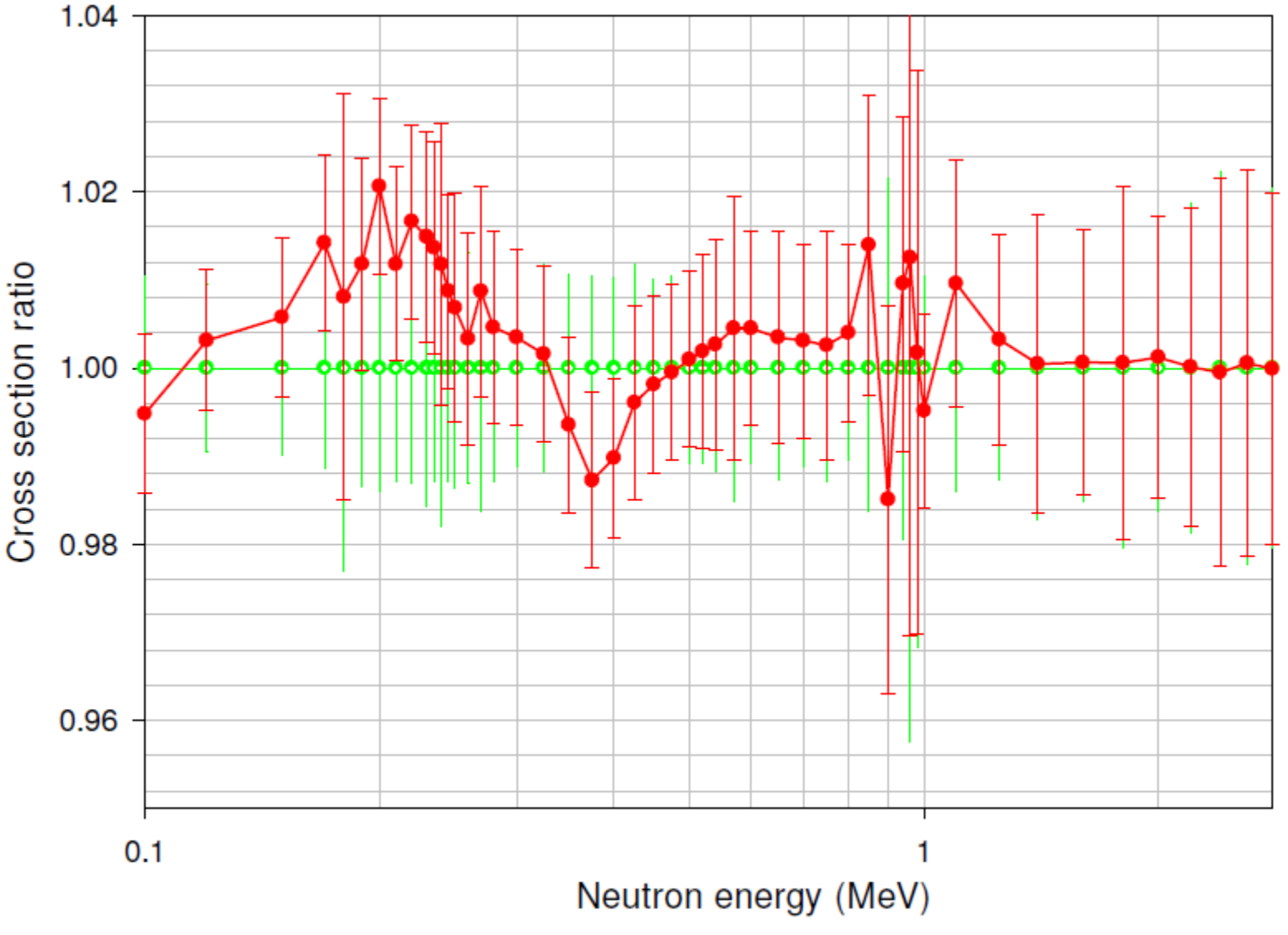
Neutron Standards XS: ^{197}Au(n,g)



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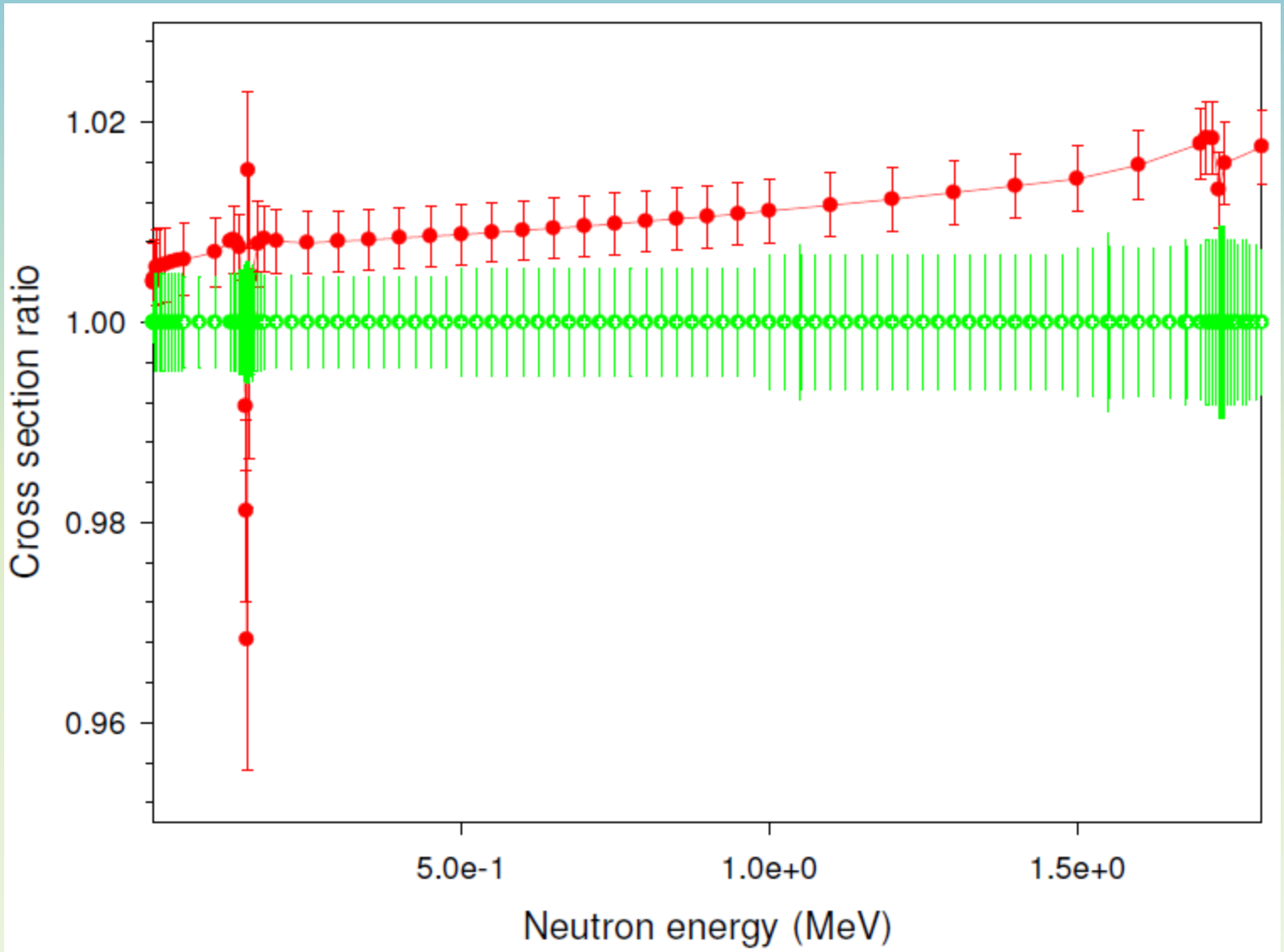
Neutron Standards XS: $^{nat}C(n,n)$



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Thermal Neutron Constants (GMA fit)

		Standards 2006 (+Maxwellian)	ENDF/B-VII.1	Standards 2017 (2200 m/s)	ENDF/B-VIII.0.β4
$^{233}U(n_{th},f)$	σ_s	12.1±0.7	12.17	12.2±0.7	✓ 12.2
	σ_f	531.2±1.3	531.3	534.5±2.4	✓ 534.1
	σ_γ	45.6±0.7	45.3	41.9±1.7	✓ 42.3
	ν_t	2.4968±0.0035	2.4968	2.4852±0.0054	✓ 2.4852
$^{235}U(n_{th},f)$	σ_s	14.09±0.22	**15.11**	14.09±0.22	✓ 14.10
	σ_f	584.3±1.0	584.99	587.35±1.4	✓ 586.7
	σ_γ	99.4±0.7	98.69	99.3±2.0	✓ 99.4
	ν_t	2.4355(.0023)	2.4367(.0005)	2.4249(.0045)	✓ 2.4298
$^{239}Pu(n_{th},f)$	σ_s	7.8±1.0	7.99	7.8±1.0	✓ 8.1
	σ_f	750.0±1.8	**747.91**	752.4±2.2	**X 747.4**
	σ_γ	271.5±2.1	270.7	270.4±3.1	✓ 270.1
	ν_t	2.8836±0.0047	2.8807	2.877±0.006	✓ 2.8769
$^{241}Pu(n_{th},f)$	σ_s	12.1±2.6	11.2	11.9±2.6	✓ 11.2
	σ_f	1014±7	1012	1024±11	✓ 1012
	σ_γ	361.8±5.0	363.0	361.8±6.2	✓ 363.0
	ν_t	2.9479±0.0054	2.9453	2.9398±0.0064	✓ 2.9453
$^{252}Cf(sf)$	ν_t	3.7692±0.0047	3.7676	3.7635±0.0049	

Thermal constants (Neutron Standards)

		Standards 2006 (+Maxwellian)	Standards 2017 (2200 m/s)	Δ	Δ/σ
$^{235}U(n_{th},f)$	σ_s	14.09±0.22	14.09±0.22	0.00	0.00
	σ_f	584.3±1.0	587.2±1.4	2.9	+2.00
	σ_γ	99.4±0.7	99.3±2.0	-0.1	-0.05
	ν_t	2.4355±0.0023	2.4250±0.0045	-0.01	-2.30
derived	α	0.1701	0.1691		
$^{239}Pu(n_{th},f)$	σ_s	7.8±1.0	7.8±1.0	0.00	0.00
	σ_f	750.0±1.8	752.1±2.2	2.1	+0.95
	σ_γ	271.5±2.1	270.4±3.1	-1.1	0.35
	ν_t	2.8836±0.0047	2.8775±0.0060	-0.007	-1.20

Adamchuk 1988 (differential), ^{235}U α=0.1690±0.0035

Lounsbury 1970 (Beer 1975) (PIE), ^{235}U α=0.1697±0.0029

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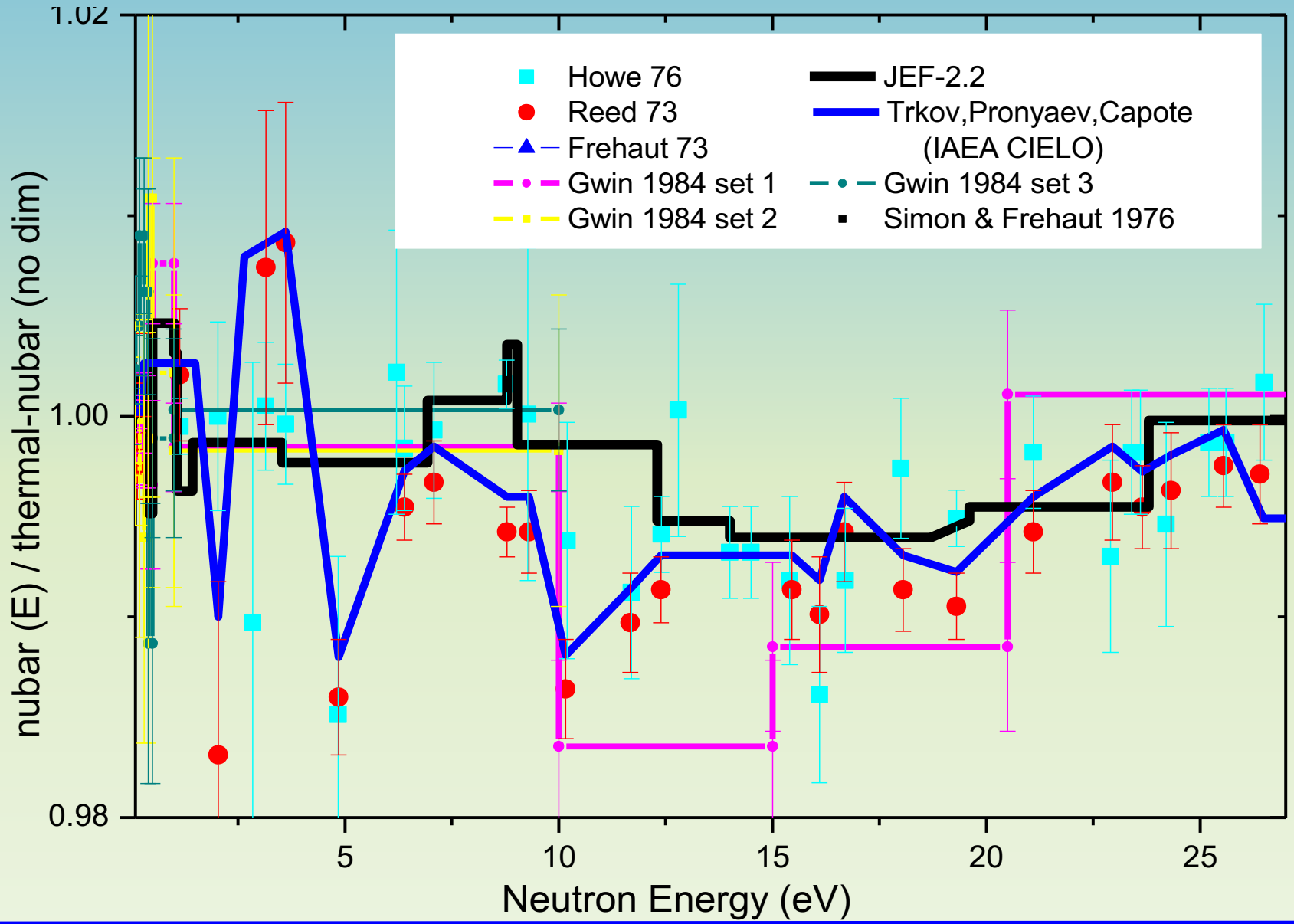
^{235}U nubar fluctuations



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REFERENCE CROSS SECTIONS

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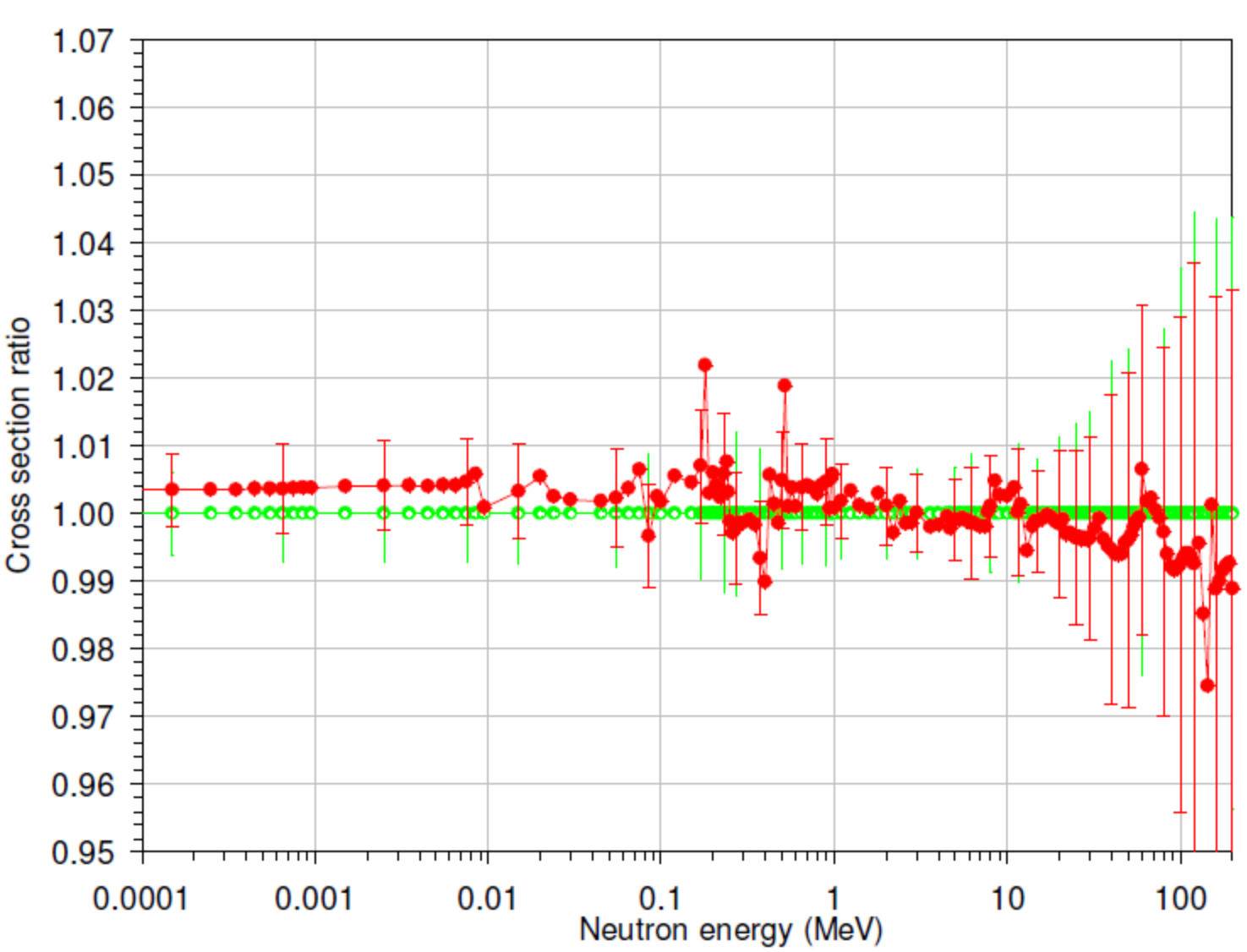

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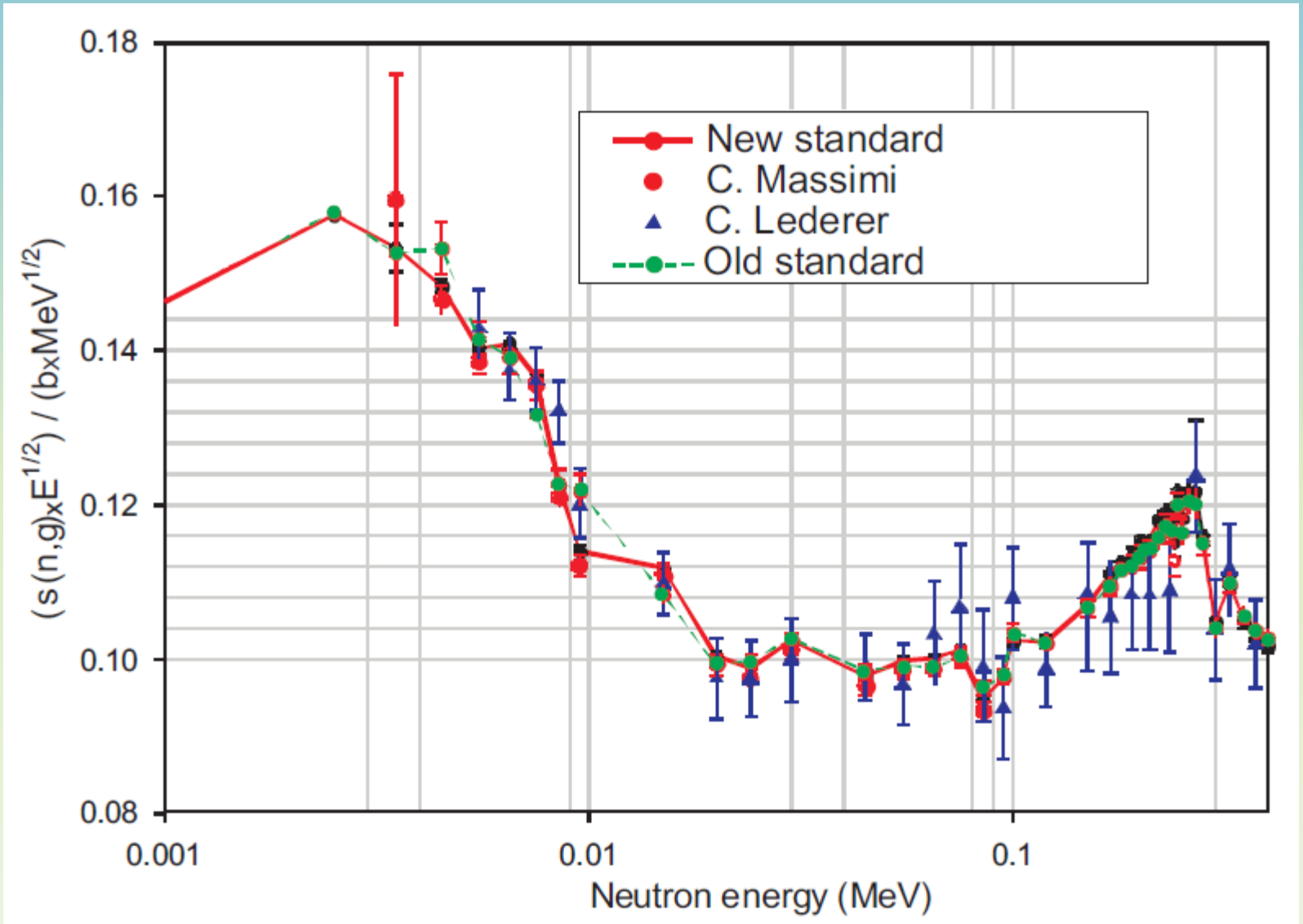

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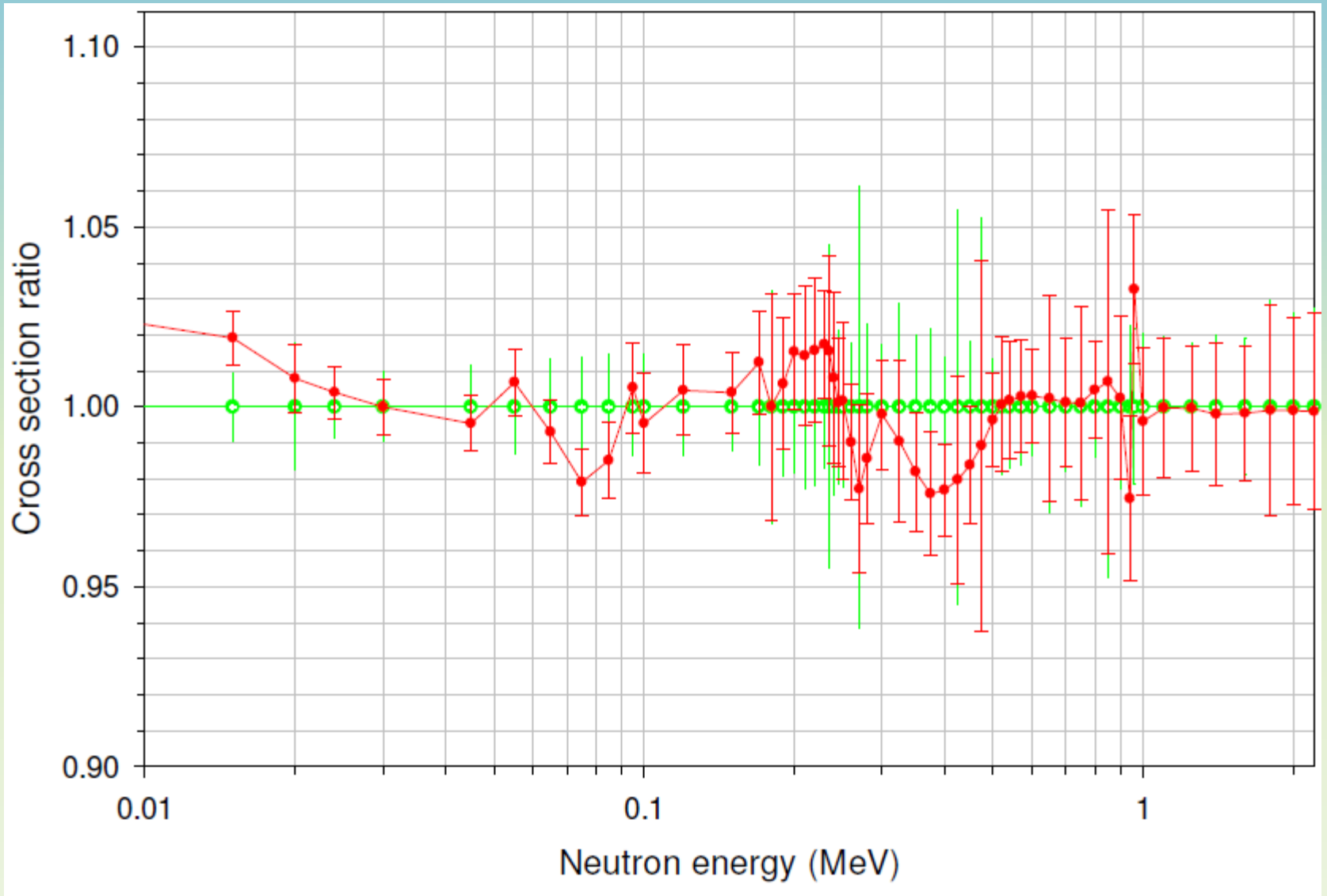

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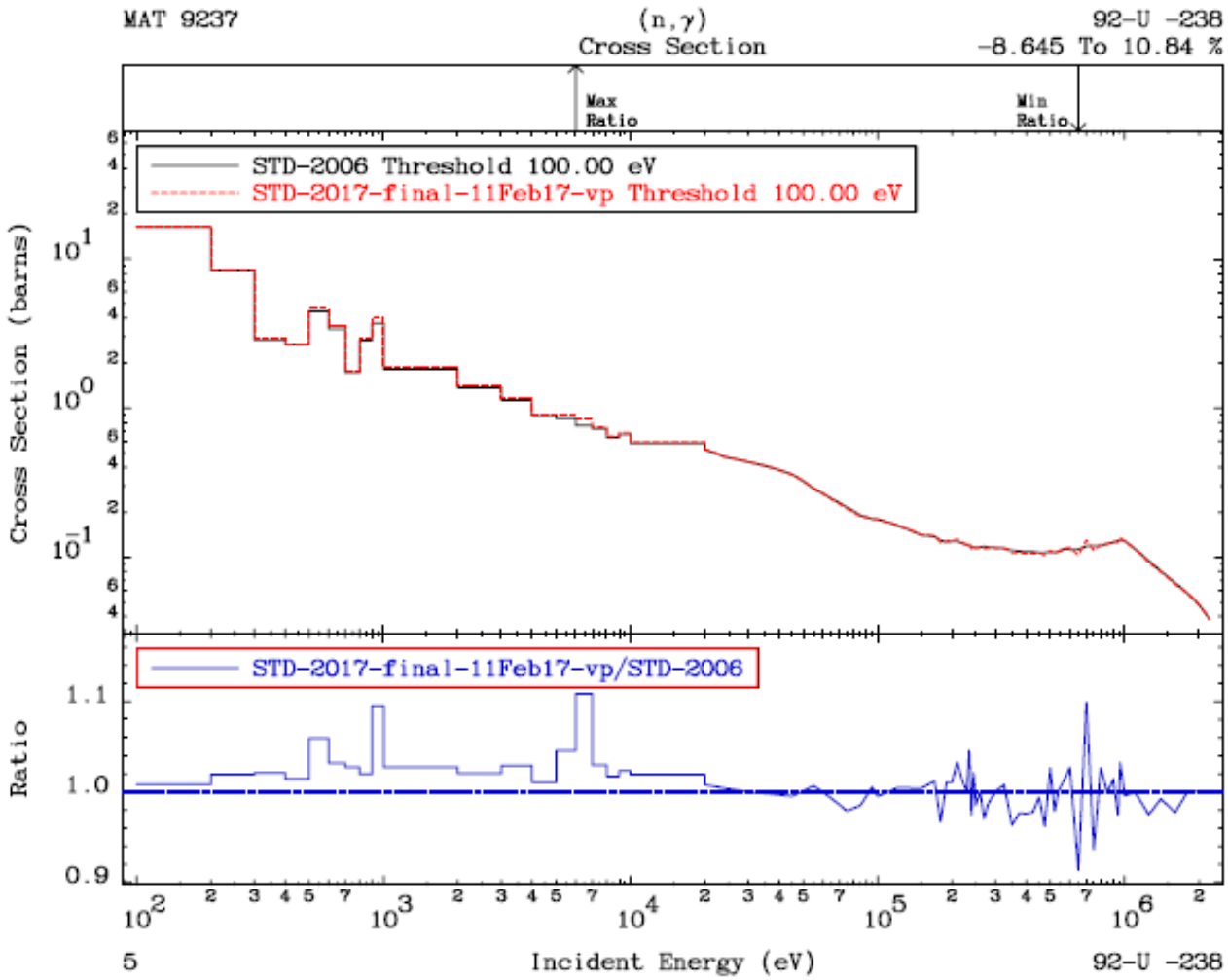

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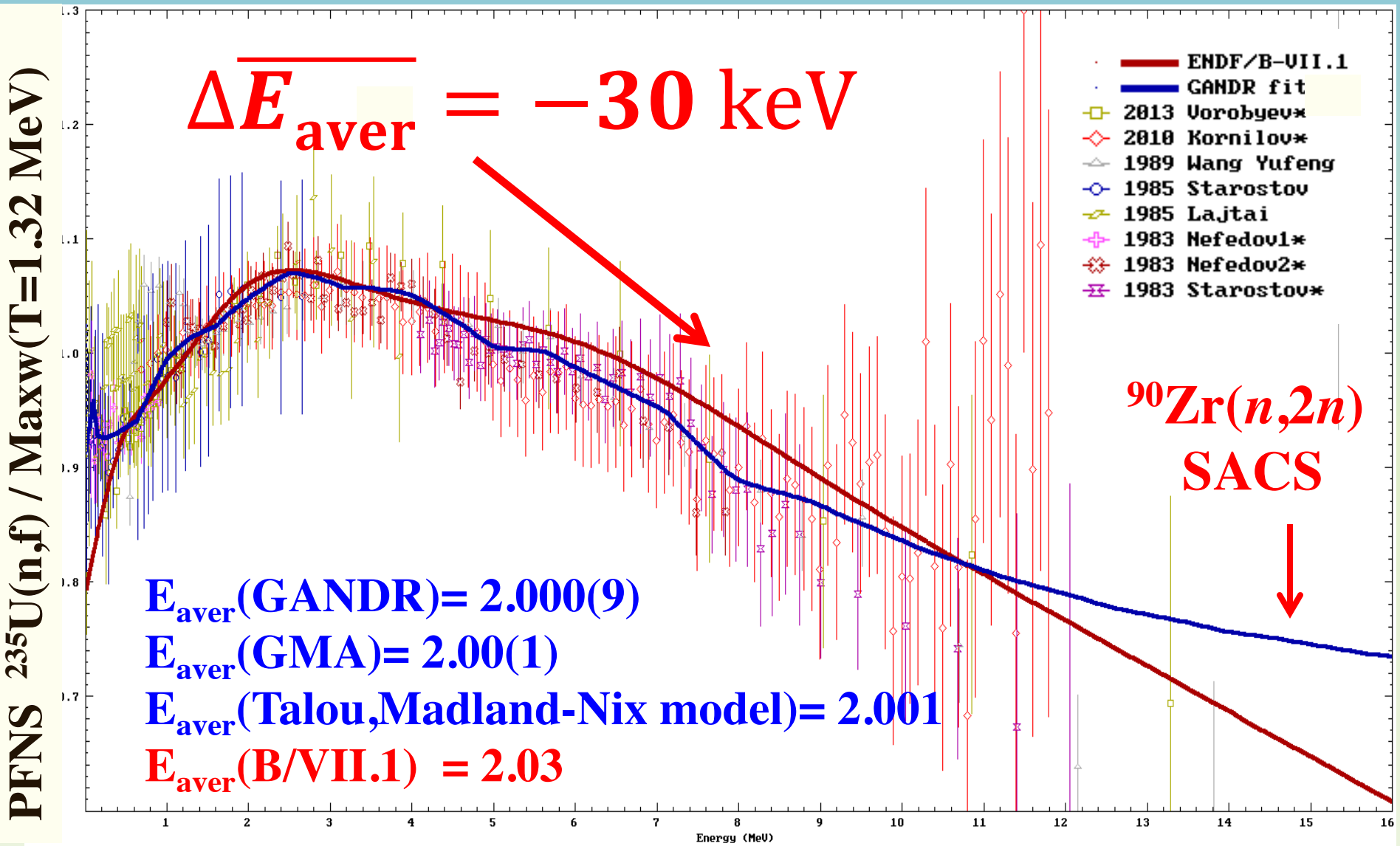
$^{235}U(n_{th},f)$ PFNS non-model evaluation



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Results for samples realized in LR-0

	E 50%	^{235}U SACS	C/E-1 of reaction rates with IRDFF XS	
			ENDF/B-VII	CIELO
^{75}As(n,2n)	12.67	0.323	-4.6%	-1.2%
^{89}Y(n,2n)	13.70	0.172	-9.1%	0.5%
^{90}Zr(n,2n)	14.22	0.107	-12.2%	-0.4%
^{23}Na(n,2n)	15.23	0.004	-12.5%	6.7%

Courtesy: M. Kostal, Rez, Cech Rep., @IRDFF 3rd RCM, IAEA CRP, March 2017

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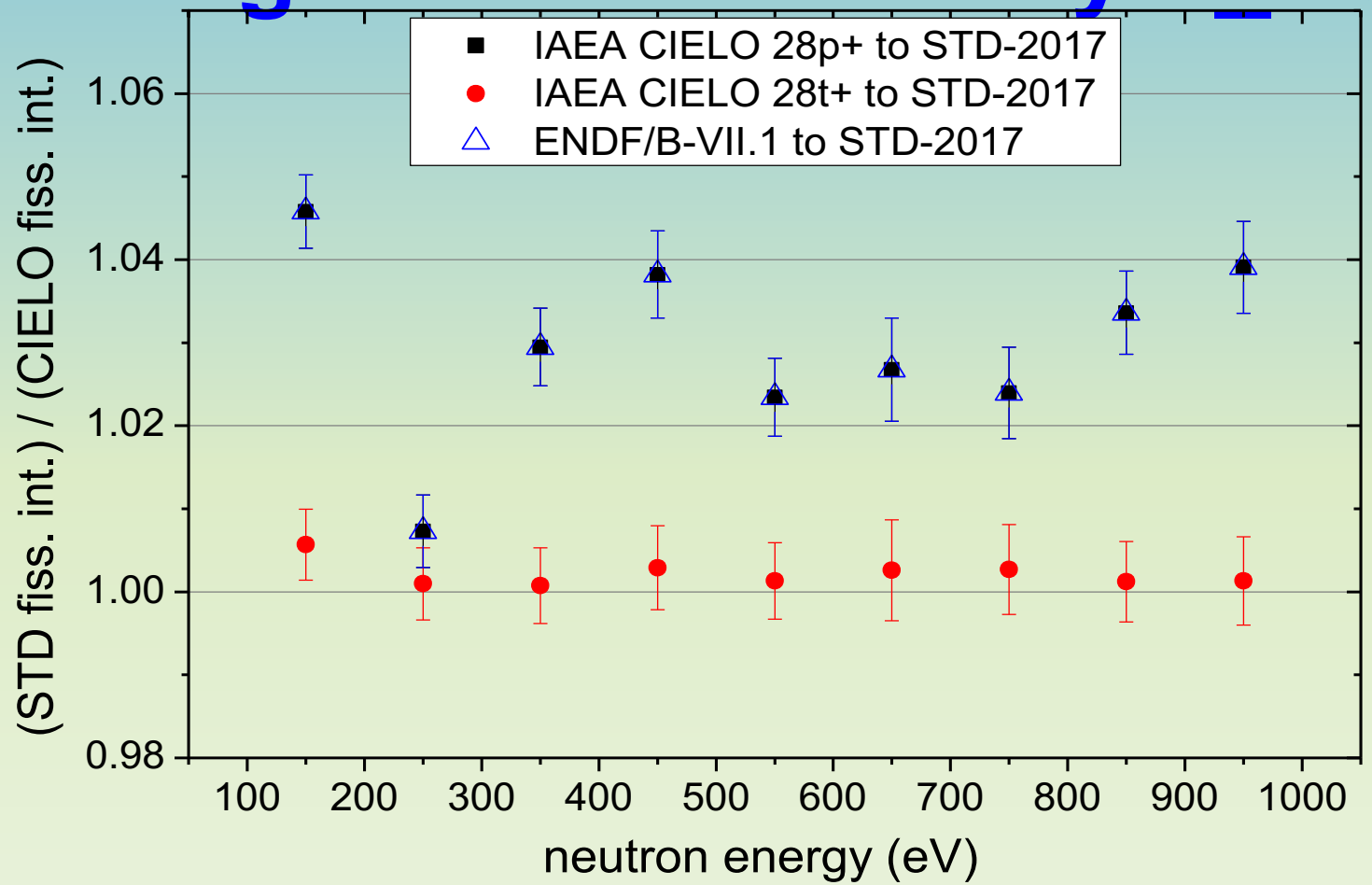
Recommended ^{235}U(n,f) resonance integrals confirmed by n_TOF



Following Duran et al, WONDER 2015

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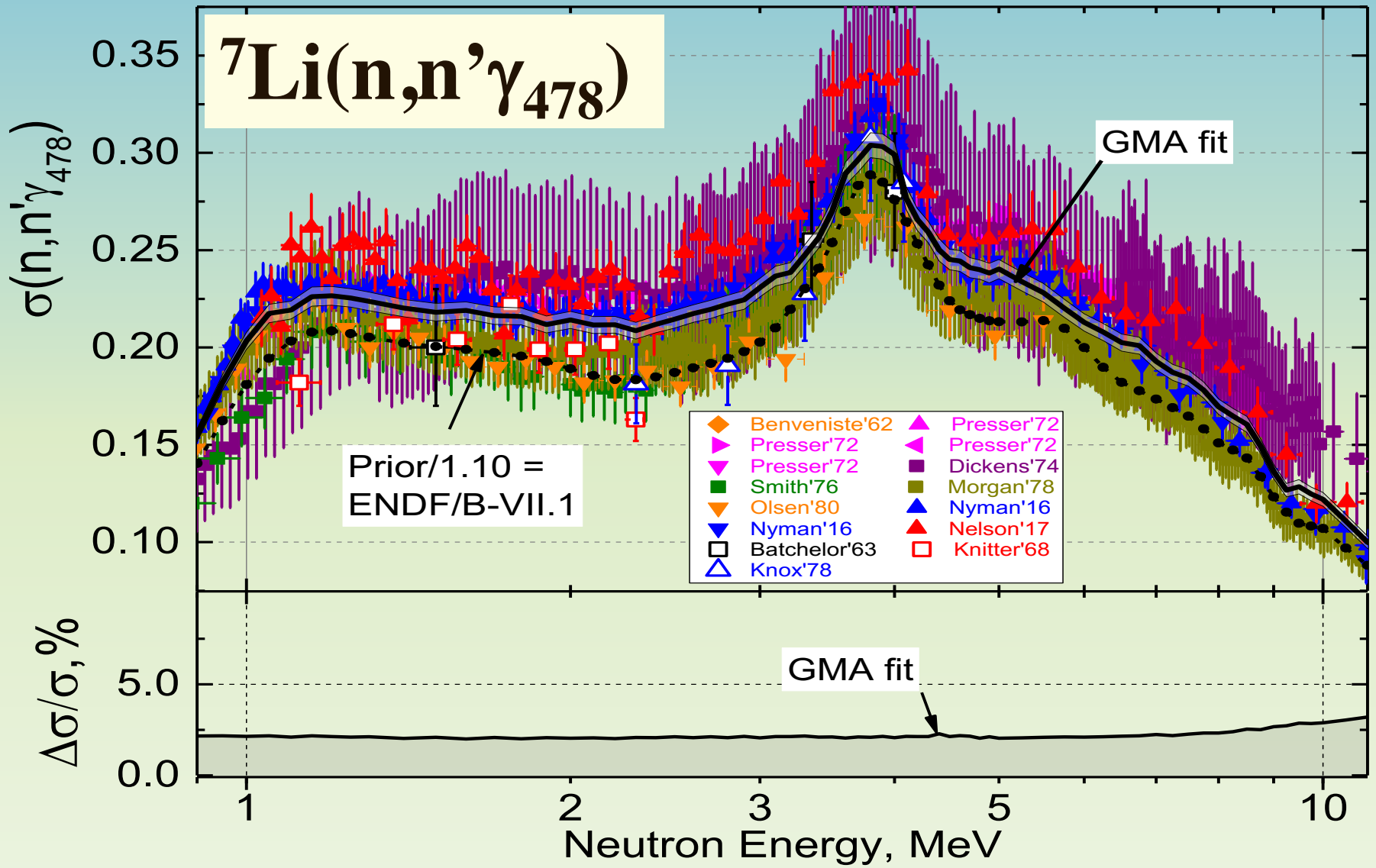
Reference cross section for γ-prod (GMA)



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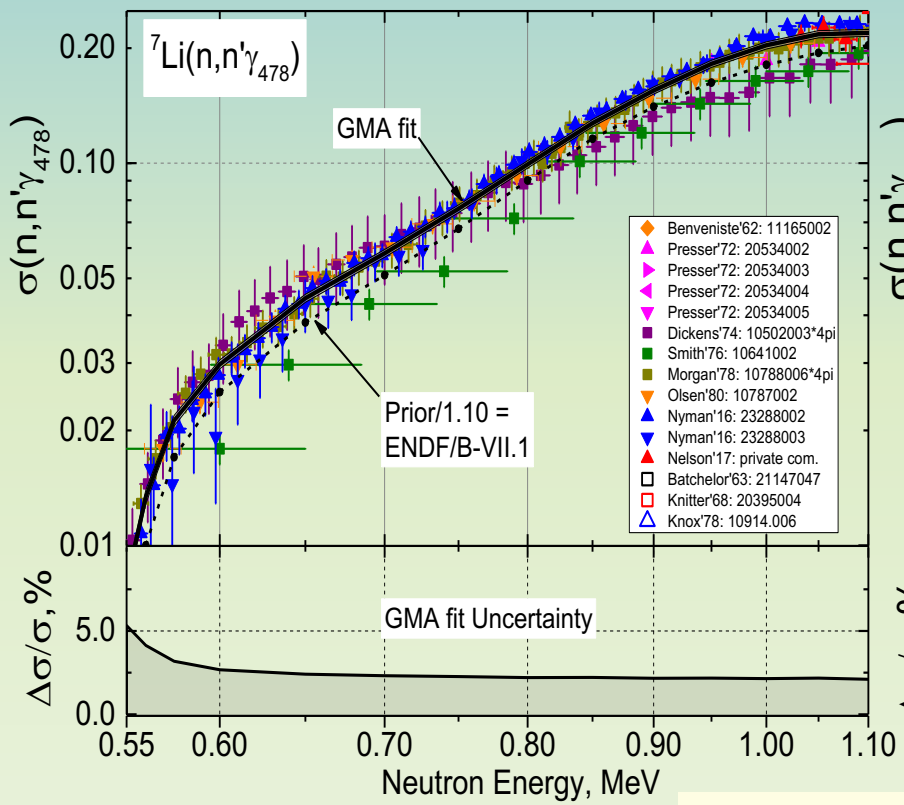
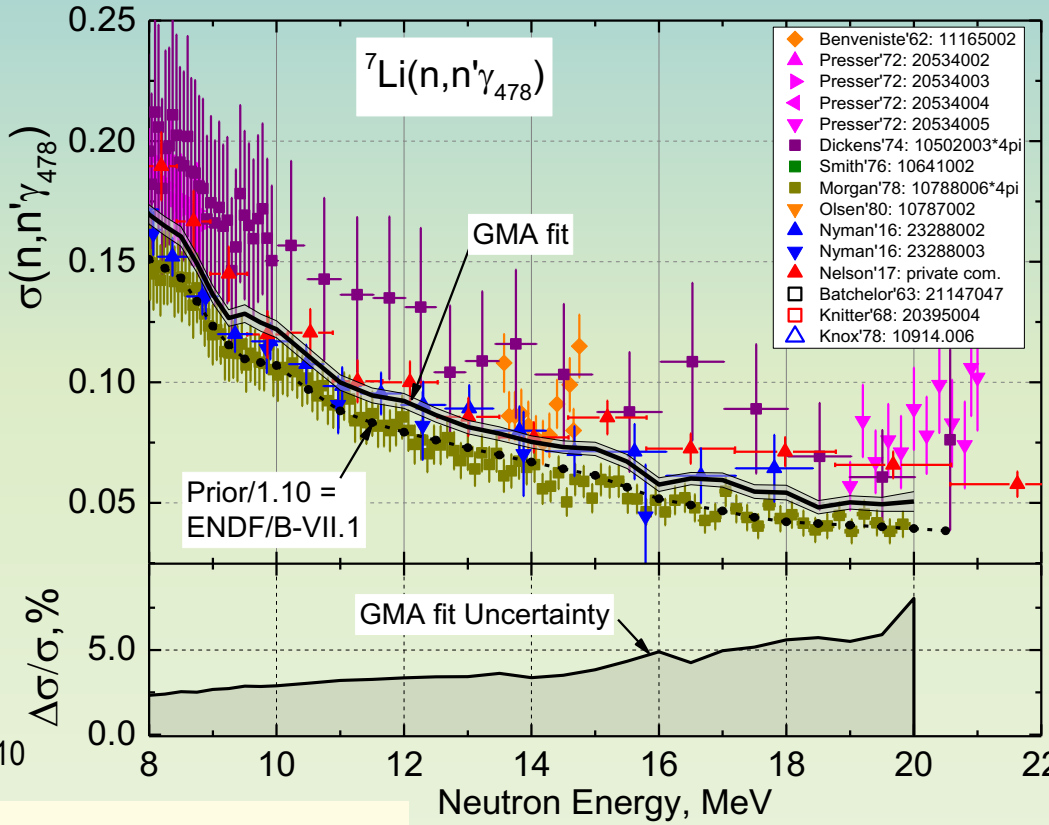
E_n<1.1 MeV



E_n>8 MeV



^{7}Li(n,n'γ$_{478}$)

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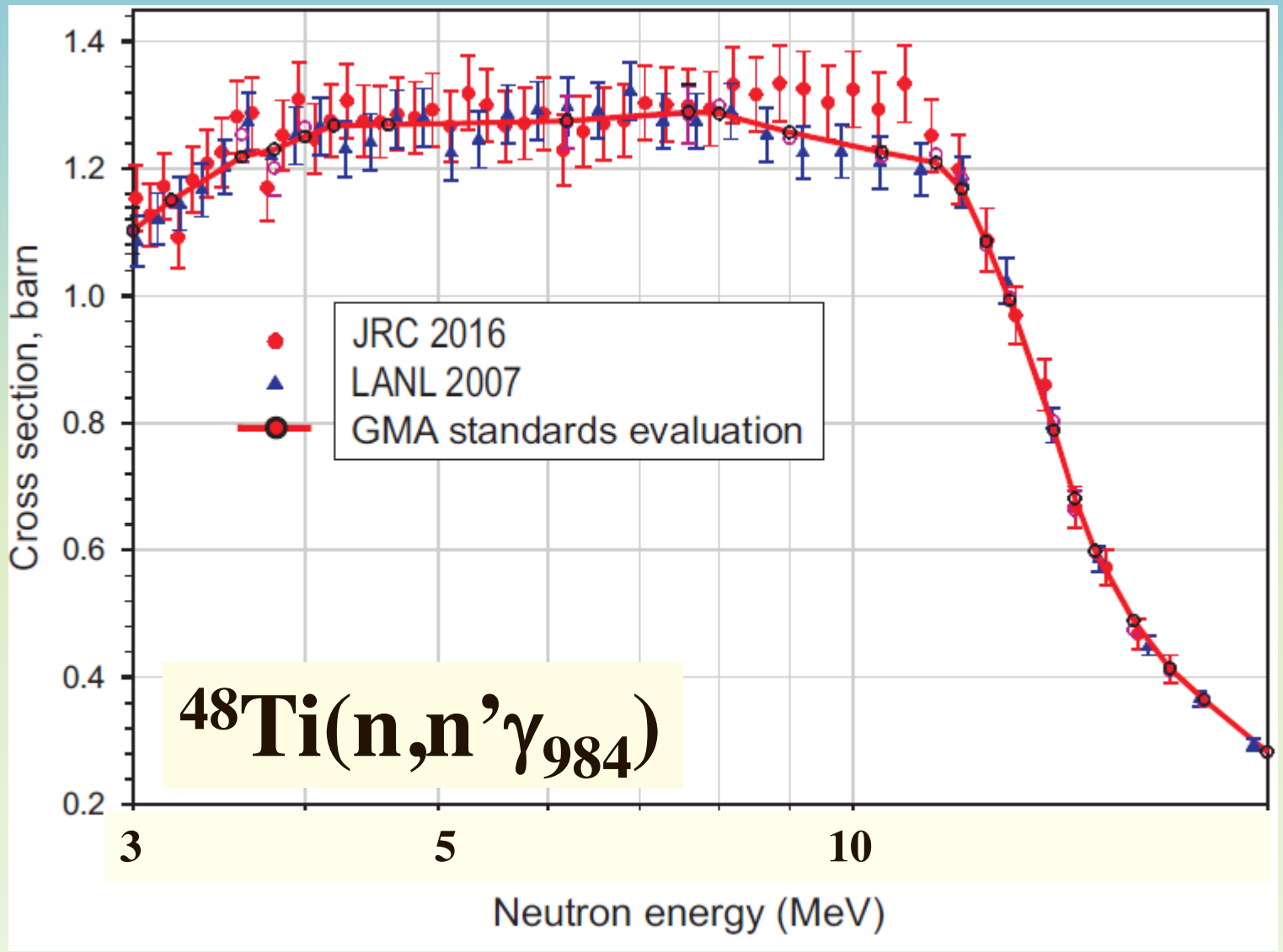

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