PAUL SCHERRER INSTITUT

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D. Rochman

EUROfusion PPPT task: status and achievements

EFFDOC-1402

JEFF Fusion WG meeting, 27 November 2019, OECD/NEA, Paris, France

Contents

- PPPT Task specifications 2019
- Status and achievement

PPPT Task specifications 2019

1. **Improvement of neutron induced activation cross-section data for 25 reactions** which have been identified to require specific improvements in the TENDL library. The improved cross-sections will be included in the new release TENDL-2019. A dedicated activation data library, based on the TENDL-2019 general purpose data library, will be produced in EAF- data format in collaboration with CCFE (WPPMI-7.4-T001).

2. **Investigations on the improvement of deuteron induced cross-sections** in TENDL as required for IFMIF-DONES transport and activation calculations.

3. **Advanced evaluation study of Fe-56 general purpose neutron cross-section data for TENDL**, based on model deficiencies. The method and tools developed by VR, University of Uppsala, within sub-task PMI-7.4-T008, will be applied to the TENDL methodology to assess the advantages and limits of such approach. This work is performed in close collaboration with the University of Uppsala (model defects), and JSI Ljubljana (benchmarking).

PPPT Task deliverables 2019

ID	Title	Start Date	End Date	RU	Del. Owner	AWP2019 PM 50%
PMI-7.4-T003 - D001	Report on updated neutron activation data library based on TENDL-2019	01-Jan-19	31-Dec-19	EPFL	Dimitri Rochman	3.000
PMI-7.4-T003 - D002	Report on advanced evaluation methodology for n + Fe-56 cross-section data	01-Jan-19	31-Dec-19	EPFL	Dimitri Rochman	3.000

- The TENDL update is presented in the following.
- For the work on Fe56 and the model defects, see the presentation from E. Alhassan.

Improvements in the TENDL-2019 library

- A total of 35 reactions were improved.
- For Resonance integrals and fng spectrum:

				C/E				
	Reaction	RI (b)	ΔRI (b)	EAF-2010	JEFF-3.3	ENDF/B-VIII	TENDL-2017	TENDL-2019
1	^{140}Ce(n,g)	0.54	0.05	0.49	0.55	0.55	0.55	0.91
2	^{164}Er(n,g)	105	10	1.35	1.58	1.60	1.42	1.15
3	^{76}Ge(n,g)	1.86	0.24	0.71	0.74	0.72	0.74	0.99
4	^{85}Kr(n,g)	1.8	1.0	-	2.7	1.6	2.3	1.20
5	^{154}Eu(n,g)	1320	130	-	1.6	1.6	2.3	1.52
6	^{119}Sn(n,g)	4.56	0.49	-	1.92	1.94	1.55	1.45
7	^{88}Sr(n,g)	0.024		-	0.63	0.51	0.62	1.29
8	^{130}Te(n,g)	0.42	0.02	-	0.64	0.65	0.65	1.18
	Reaction	Spectrum		EAF-2010	JEFF-3.3	ENDF/B-VIII	TENDL-2017	TENDL-2019
9	^{150}Nd(n,2n)	fng_5min		1.83	-	-	1.65	1.63
10	^{141}Pr(n,2n)	fng_5min		1.37	-	-	1.35	1.18

Improvements in the TENDL-2019 library

- For various other cross sections:

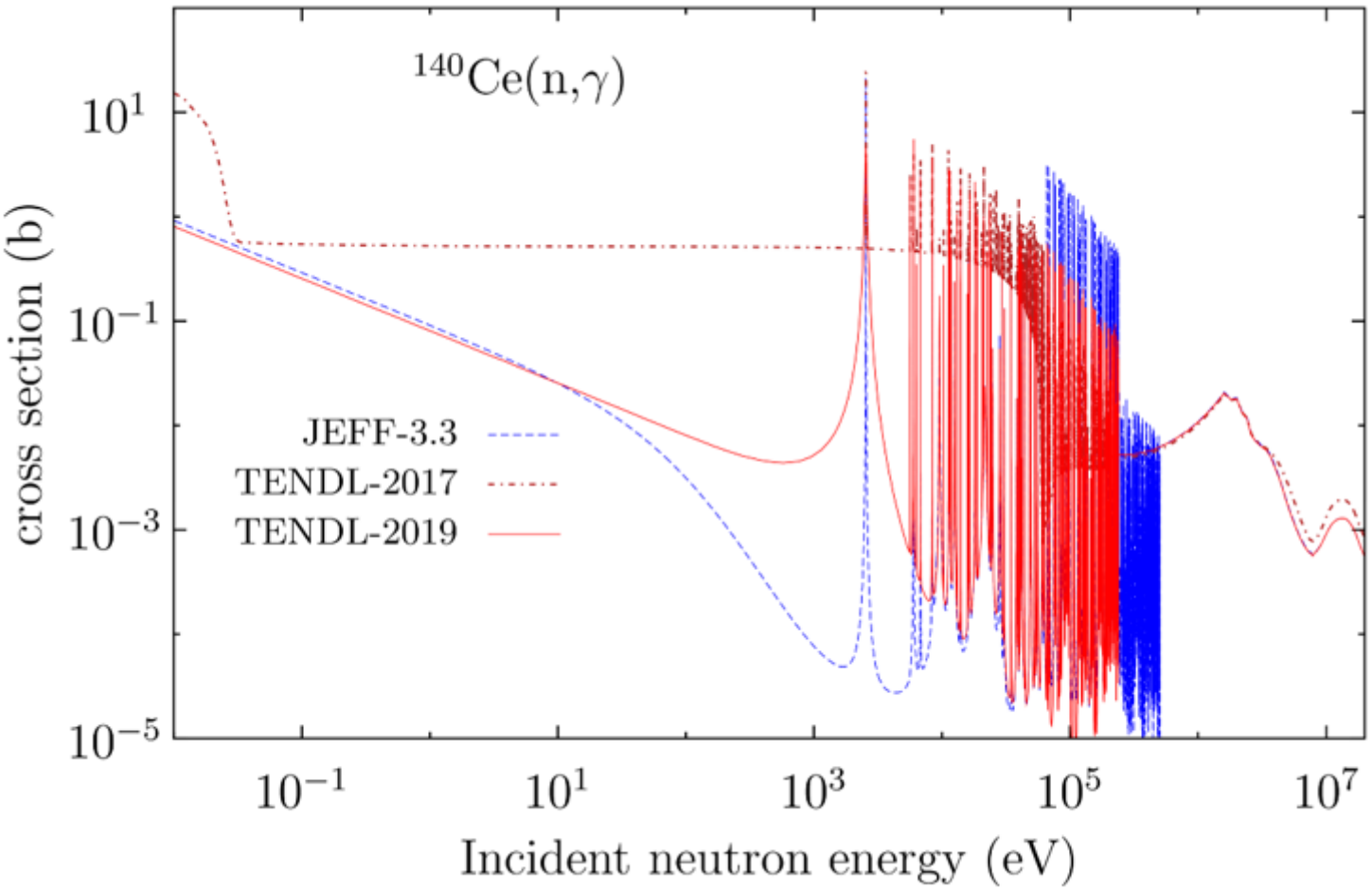
	Reaction	Remarks on TENDL-2017	Remarks on TENDL-2019
11	^{23}Na(n,2n)	XS probably too high between 19 and 30 MeV	Reaction corrected
12	^{24}Mg(n,p)	Energy grid not dense enough	Energy grid extended
13	^{27}Al(n,p)	Energy grid not dense enough	Energy grid extended
14	^{28}Si(n,p)	Energy grid not dense enough	Energy grid extended
15	^{31}P(n,p)	Energy grid not dense enough	Energy grid extended
16	^{45}Sc(n,g)	XS too low 100 - 200 keV Wrong shape above 14 MeV	Reaction corrected
17	^{52}Cr(n,2n)	XS too low above 18 MeV	Reaction corrected
18	^{54}Fe(n,2n)	XS too high above 18 MeV	Reaction corrected
19	^{56}Fe(n,p)	XS too high above 20 MeV	Reaction corrected
20	^{58}Ni(n,2n)	XS too low above 18 MeV	Reaction corrected
21	^{67}Zn(n,p)	Thermal 10^{18} too low	Reaction corrected
22	^{90}Zr(n,2n)	XS too low above 18 MeV	Reaction corrected
23	^{59}Co(n,2n)	XS too low above 18 MeV	Follows IRDFF-1.0
24	^{59}Co(n,p)	XS too low above 18 MeV	Follows IRDFF-1.0
25	^{65}Cu(n,2n)	XS too low above 18 MeV	Follows IRDFF-1.0
26	^{89}Y(n,2n)	XS too low above 18 MeV	Follows IRDFF-1.0
27	^{19}F(n,2n)	XS too low	Follows IRDFF-1.0

Improvements in the TENDL-2019 library

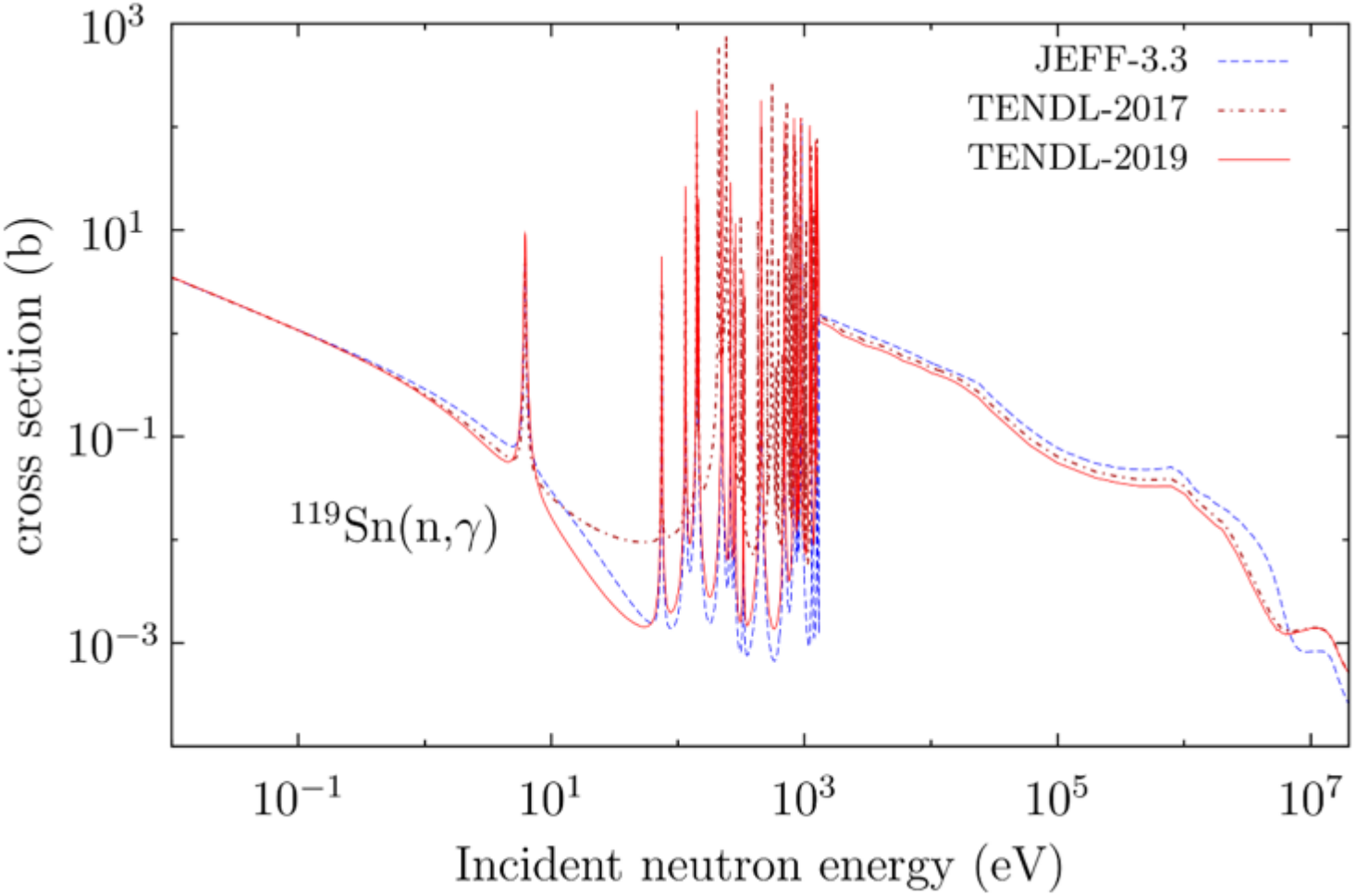
- For various other cross sections:

	Reaction	Remarks on TENDL-2017	Remarks on TENDL-2019
28	^{127}I(n,2n)	XS too low	Follows IRDFF-1.0
29	^{169}Tm(n,2n)	XS too low	Follows IRDFF-1.0
30	^{54}Fe(n,p)	XS too low	Follows IRDFF-1.0
31	^{54}Fe(n,a)	XS too low	Follows IRDFF-1.0
32	^{46}Ti(n,2n)	XS too low	Follows IRDFF-1.0
33	^{51}V(n,a)	XS too low	Follows IRDFF-1.0
34	^{141}Pr(n,2n)	XS too low	Follows IRDFF-1.0
35	^{32}S(n,p)	Energy grid not dense enough	Follows IRDFF-1.0

Improvements in the TENDL-2019 library



Improvements in the TENDL-2019 library



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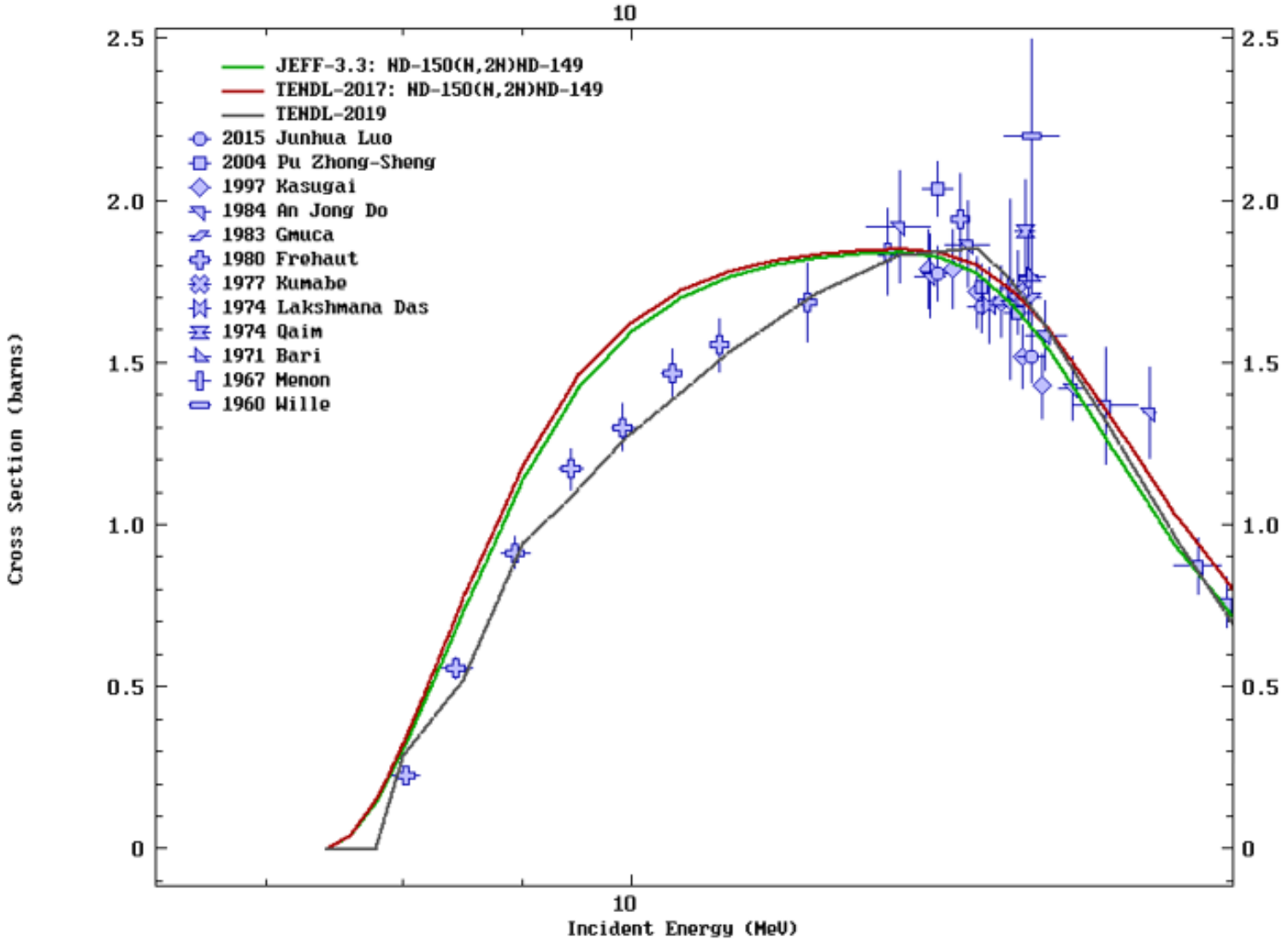

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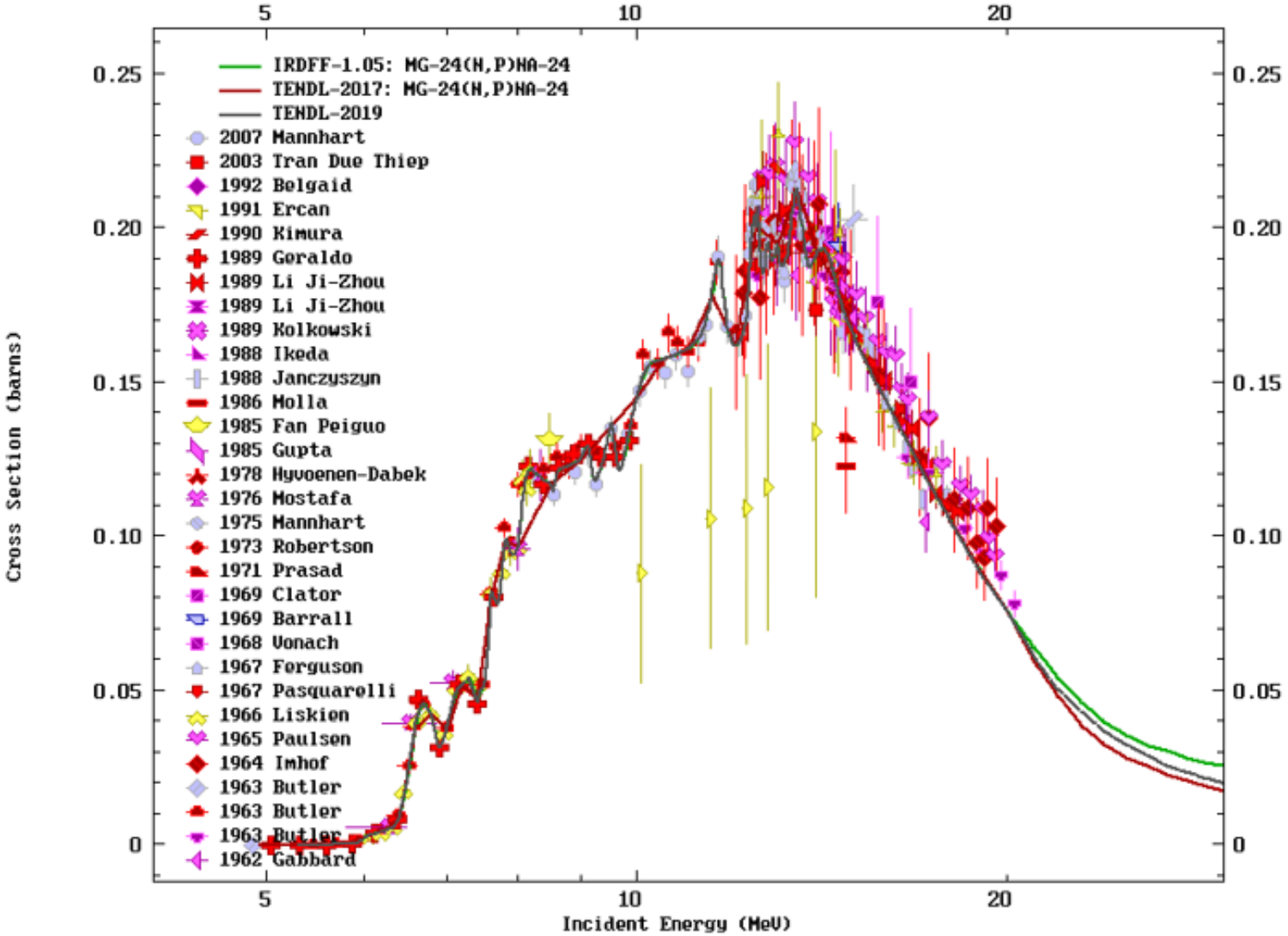

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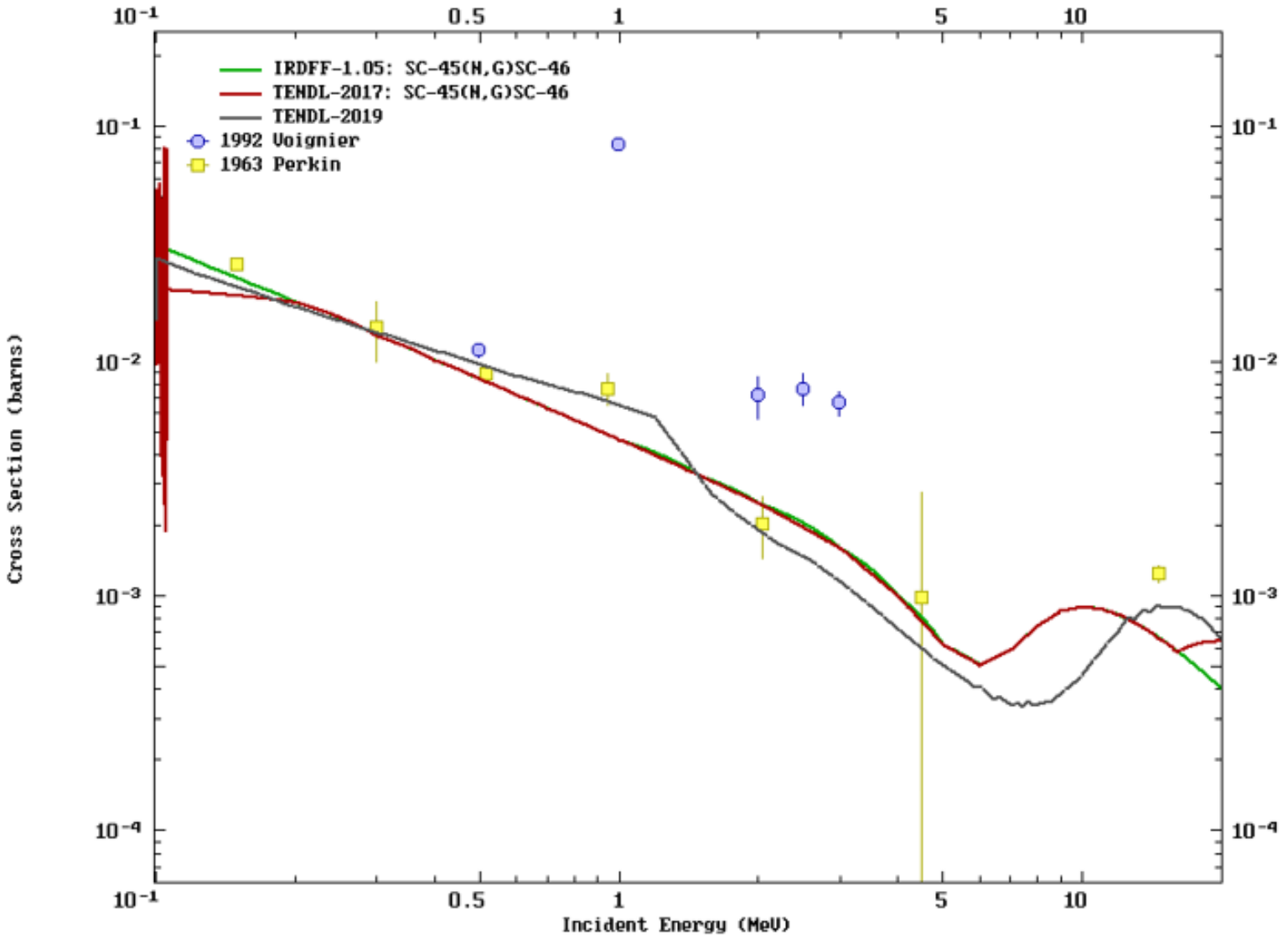

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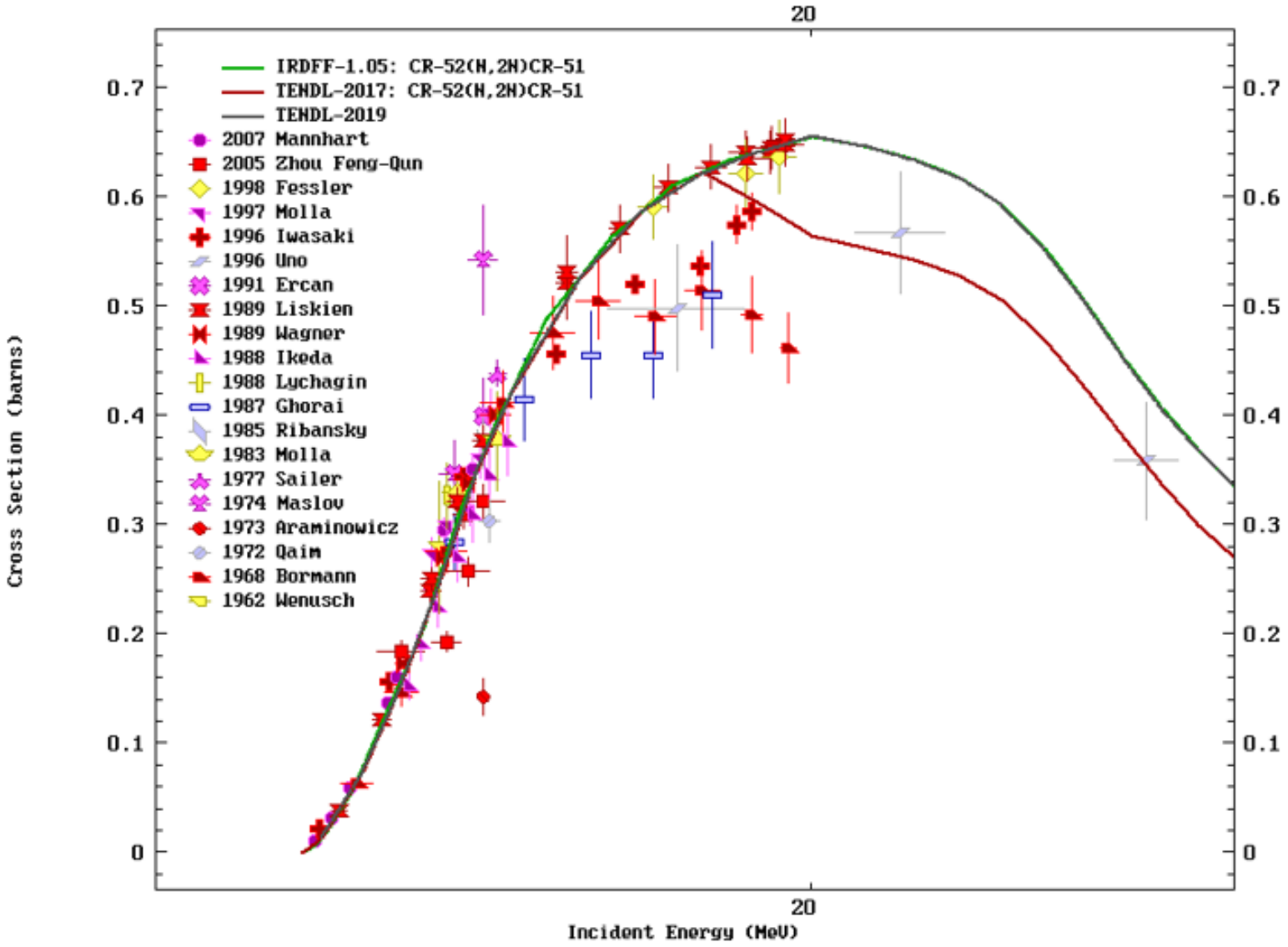

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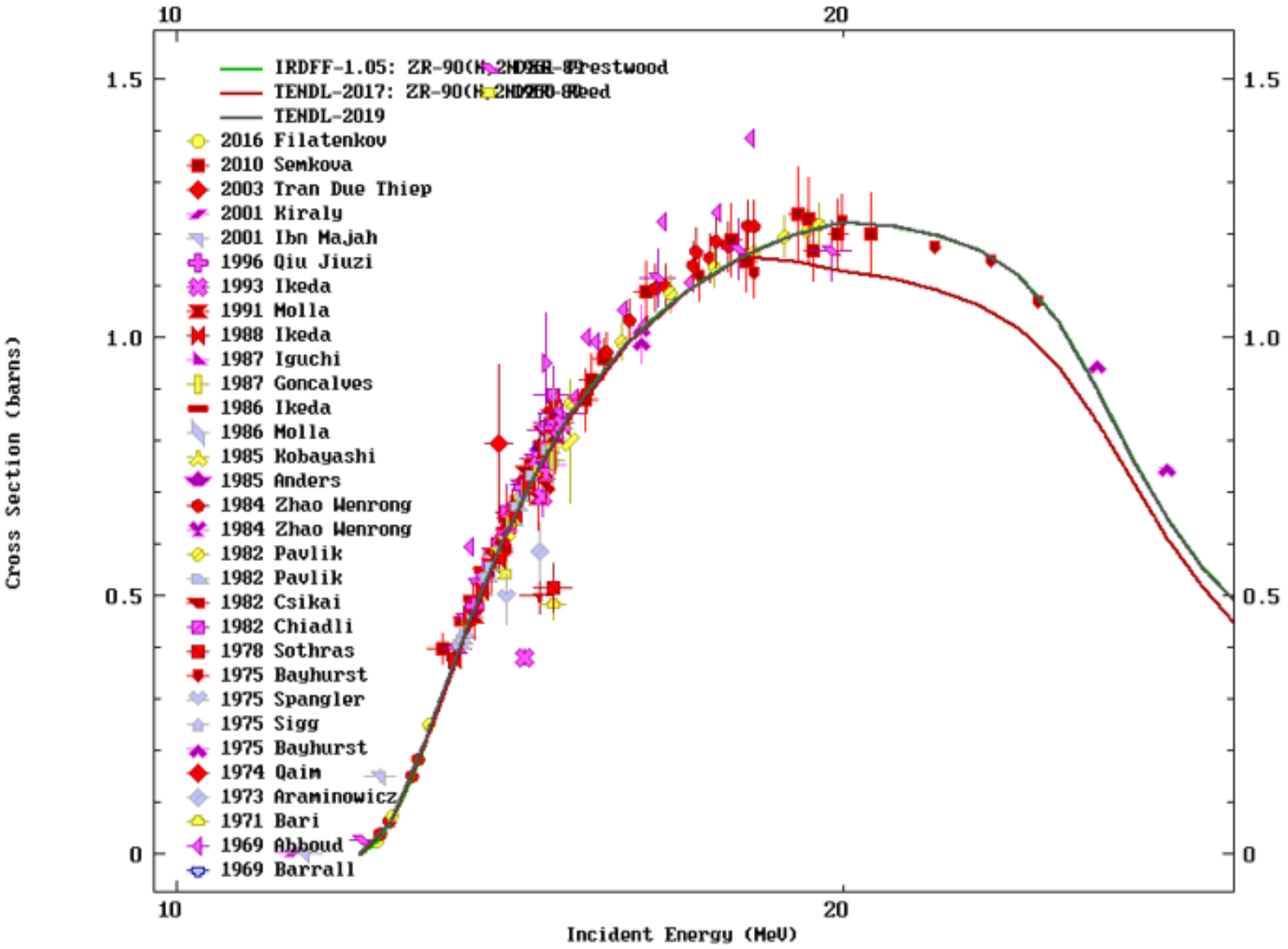

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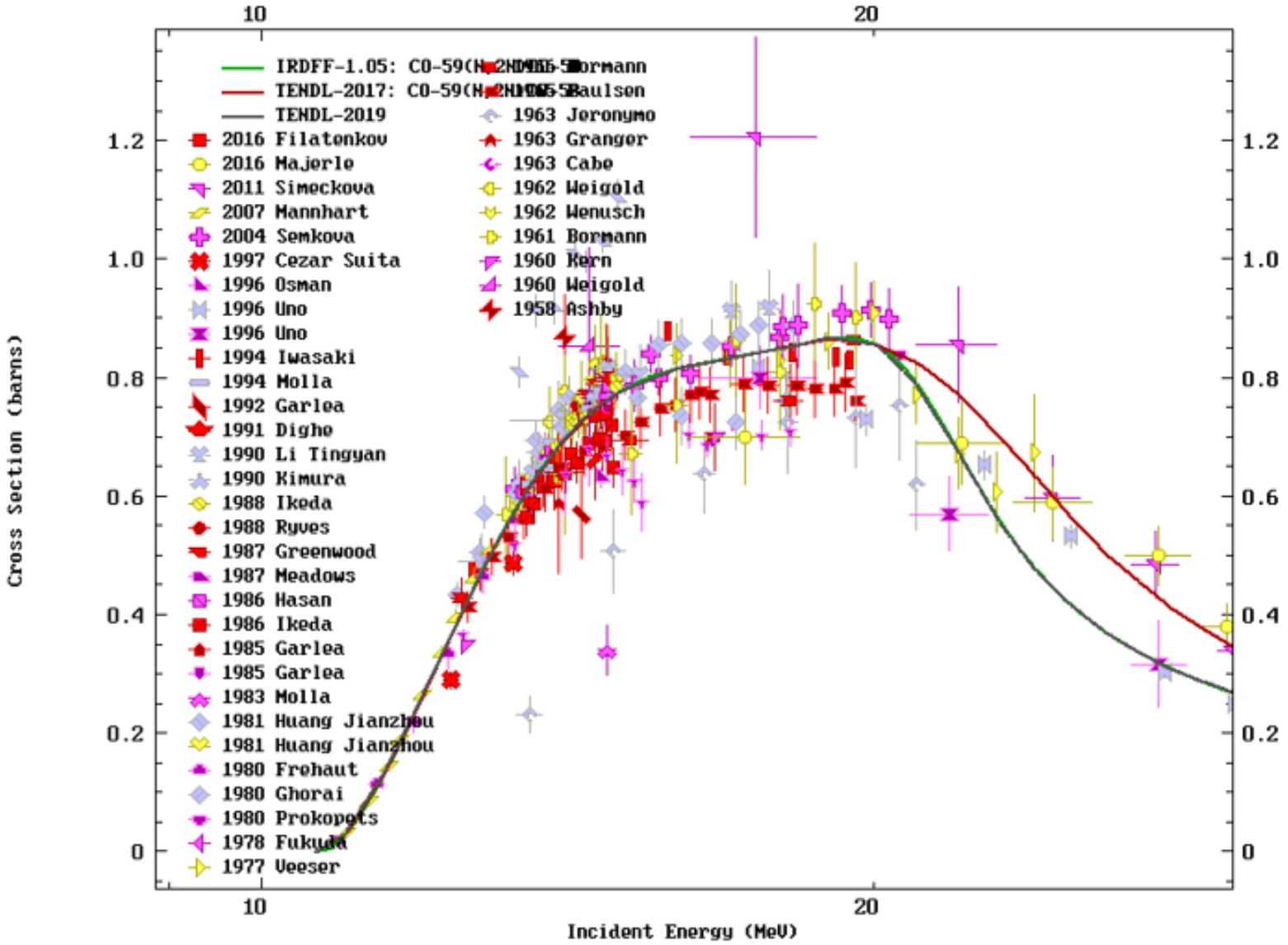

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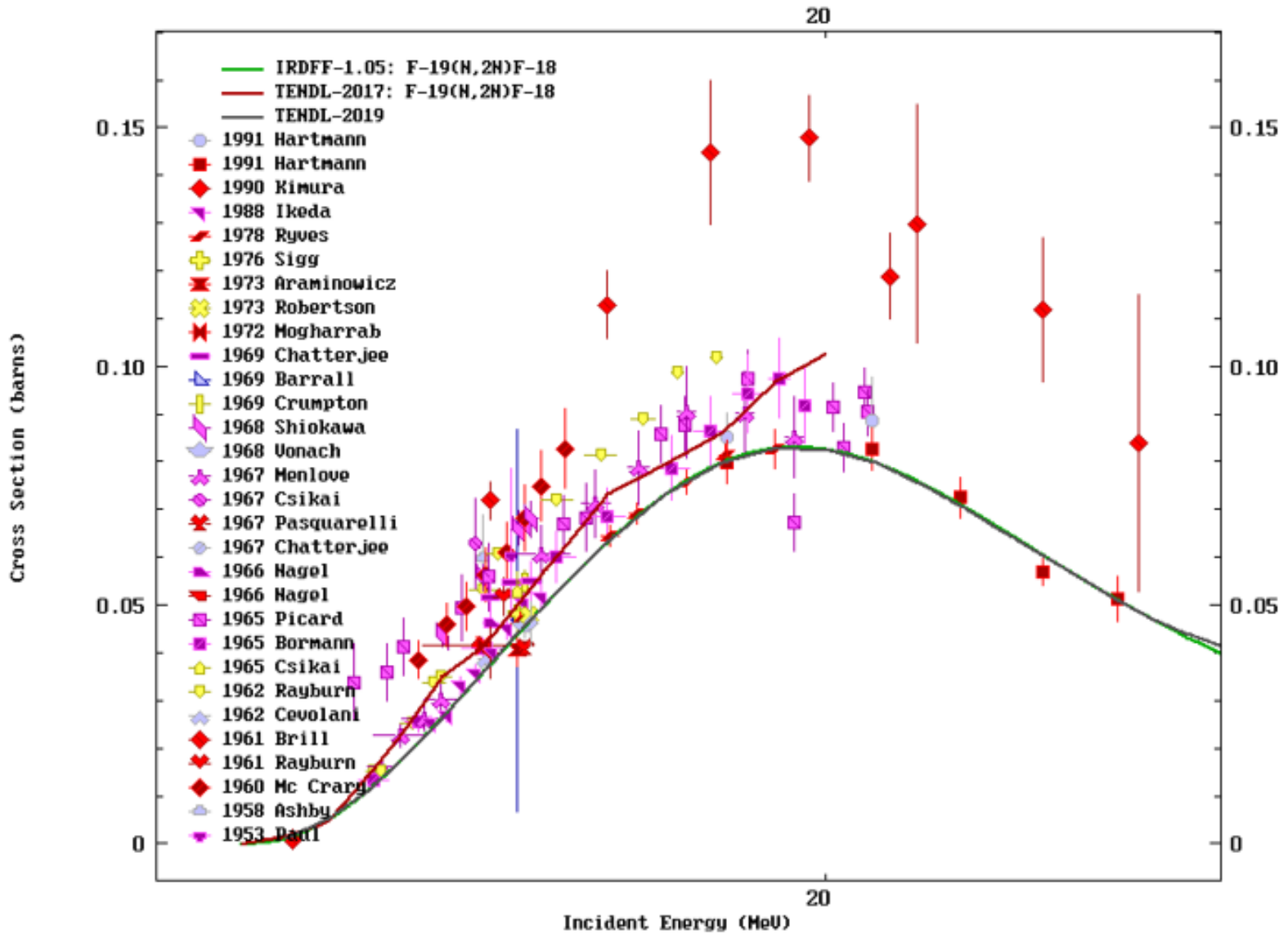

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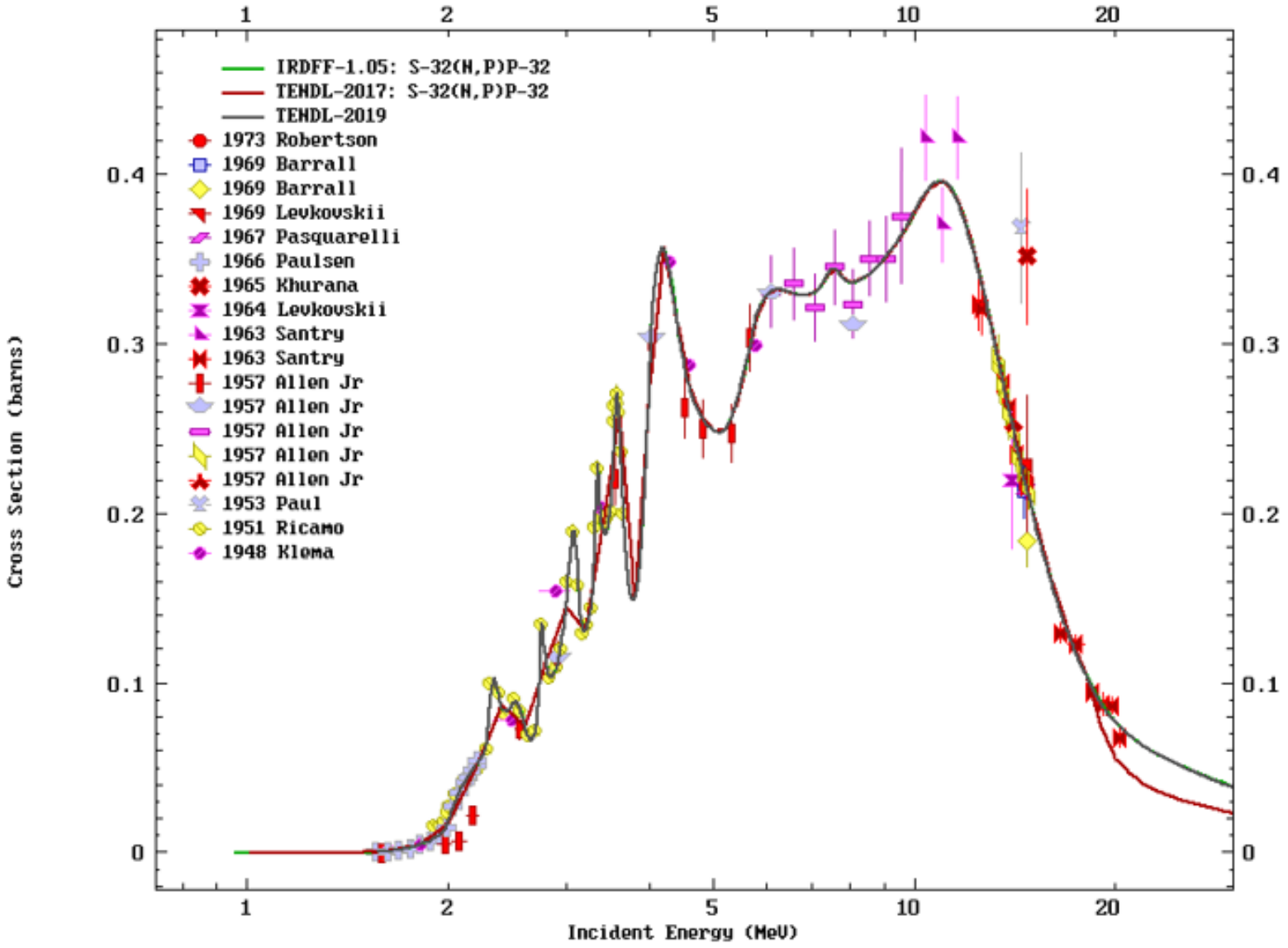

Conclusion

- Task 1:
  - In this activity, a number of cross sections from the TENDL-2019 library have been improved. 35 reactions were identified and corrected.
  - These cross sections are of importance for the activation calculations and in the selected cases, TENDL-2019 is similar to the IRDFF library.
  - TENDL-2019 will be available by December 2019 at

    https://tendl.web.psi.ch/tendl_2019/tendl2019.html

- Tasks 2:
  - See Erwin's presentation

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