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^{16}O

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European Commission

The CIELO oxygen evaluation

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Status and achievements

- Understanding of the experimental database
- 4-5 new evaluations (Hale, Kunieda, Leal-high/low, Pigni).
- Contributed theoretical work (Svenne, Quaglioni)
- Benchmarking in context of
  - CIELO/ENDF-BVIII
  - JEFF-3.3
- Sensitivity and trend analyses
  - NDAST
  - KAPL (Trumbull, Romano, Lubitz)

Status and achievements

- Identified problems
  - Ambiguity experimental data (n,a) channel
    - Discrepant database
    - Possibly inconsistent with resonance analysis of total cross section
  - (n,tot) difference Cierjacks ‘68 and ‘81
  - (n,tot) Ohkubo, first resonance
- New experimental data
  - Danon et al. on (n,tot) discussion Cierjacks
  - Planned: Junghans et al., (n,tot) first resonance
  - Planned: new (n,a) n_TOF
  - Planned: new (n,a) LANL/WNR
  - Planned: new (n,a) GANIL-NFS/LPC Caen
  - Ongoing: new (n,tot) at Rez 22-35 MeV (Majerle)

Status of data

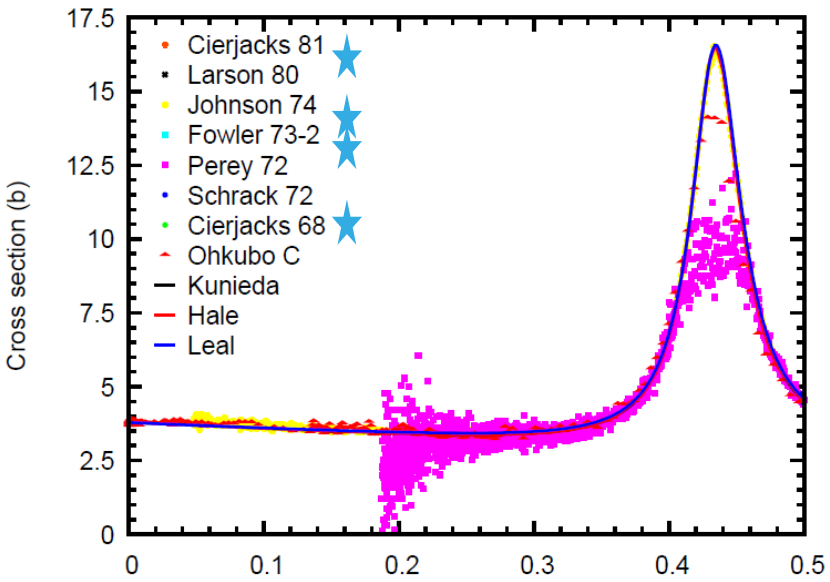
Verified level of documentation of data in the literature for the total cross section

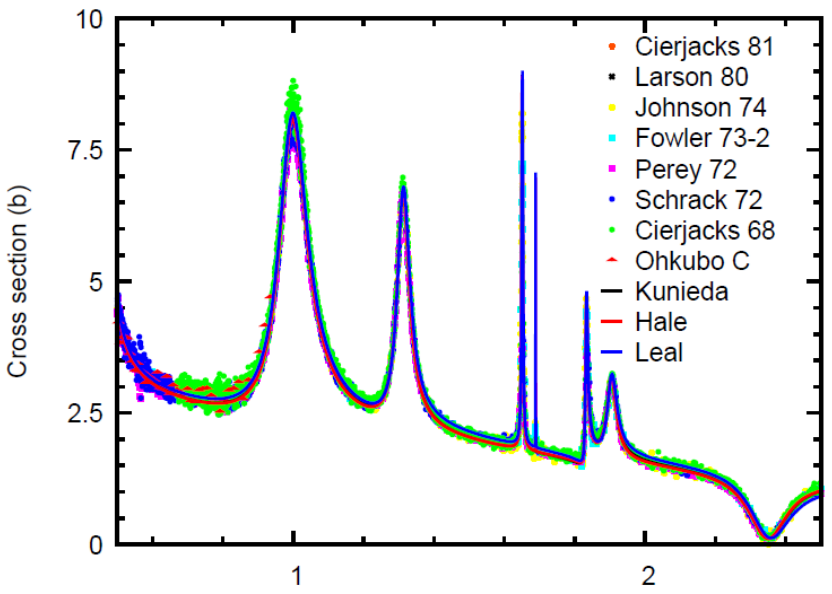
TABLE I. coherent scattering length

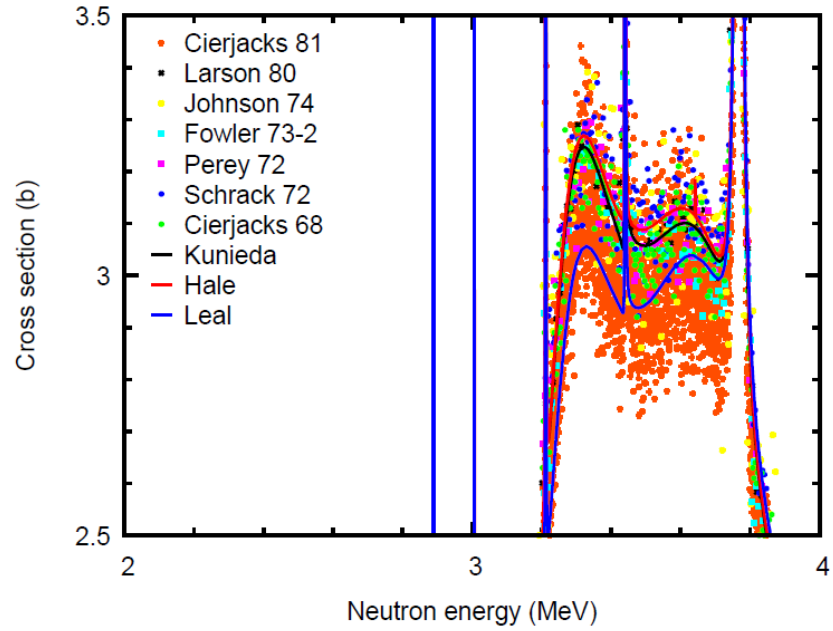
b_c [fm]	uncertainty [fm]	method	author	adjusted b_c[fm]
5.830	0.002	Prism deflection	Schneider [4]	5.830
5.801	0.006	gravity reflectometer	Nistler et al. [3]	5.804

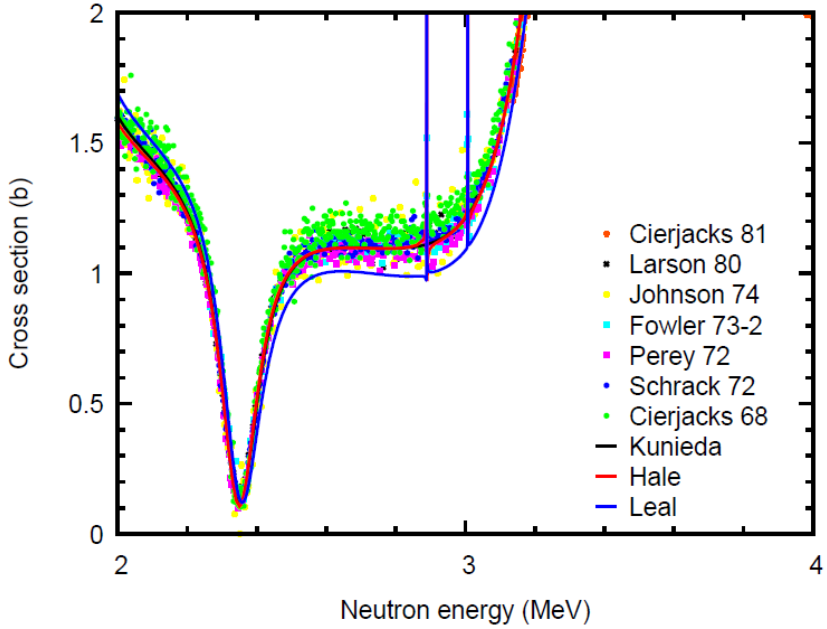
TABLE II. total cross section measurements below 300 keV

Neutron energy (eV)	Ref.	Measured	Extracted σ	Extracted b	Modified	Modified
130	Dilg	9.566(13)	3.761(7)	5.803 (6)	3.764(7)	5.805 (6)
1970	Koester	9.56 (5)	3.77(3)	5.815 (30)	3.750(30)	5.800 (30)
23500	Block		3.736(7)	5.820 (6)	n/a	n/a









(n,tot)

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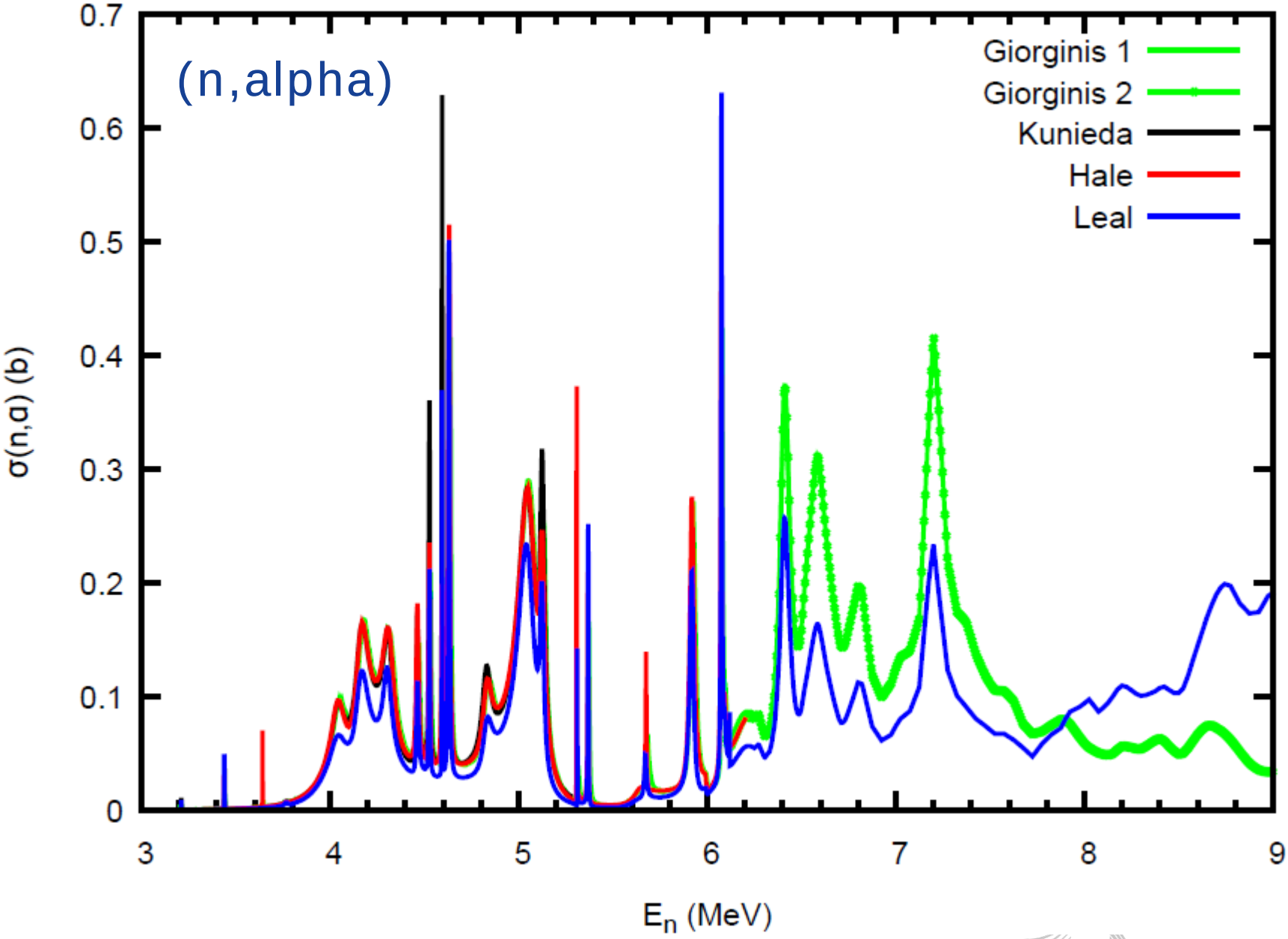

Data used in evaluations

TABLE IV. cross section data used in ORNL evalaution

Authors	energy range	Experimental data
Johson et al	0.2-6.3	Total Cross Section
Cierjacks (1980)	3.14-6.3 MeV	Total Cross Section
Larson (ORELA)	2.0-6.3 MeV	Total Cross Section
Fowler (ORNL Van de Graff)	0.6 -6.3 MeV	Total Cross Section
Ohkubo	0.79e-03 -0.935 MeV	Total Cross Section
Johnson et al	2.24-2.49 MeV	Total Cross Section
Bair and Haas	3.2-6.3 MeV	(n,α) extracted from (α,n)
Drottlett	2.87 -3.458 MeV	(n,α) extracted from (α,n)
Firestone	thermal	Capture Cross Section

TABLE V. cross section data used in IRSN evalaution

Authors	energy range	Experimentl data
Firestone	thermal	Capture Cross Section
Sears	n/a	coherent scattering length
Larson (ORELA)	2.0-6.3 MeV	Total Cross Section
Danon (RPI)	2.0-6.3 MeV	Total Cross Section
Fowler (ORNL Van de Graff)	0.6 -4.3 MeV	Total Cross Section
Cierjacks (1980)	3.14-6.3 MeV	Total Cross Section
Bair and Haas	3.2-6.3 MeV	(n,α) extracted from (α,n)
Harissopulos	3.0 -6.3 -3.458 MeV	(n,α) extracted from (α,n)

TABLE VI. cross section data used in JAEA evalaution

Authors	energy range	Experimental data
Schrack	0.5-6.2 MeV	Total Cross Section
Perey	0.5-6.2 MeV	Total Cross Section
Ohkubo	0.79e-03 -0.935 MeV	Total Cross Section
Harissopulos	3.0-6.3 MeV	((α,n)

TABLE III. cross section data used (LANL evalaution

Authors	energy range	energy shift	Normalization
total cross section			
Schneider	0.0253 eV	0	1.0(fixed)
Dilg, Koester,BLock	0.13 - 23.5 keV	0	1.0 (fixed)
Ohkubo (corr.)	0.8-935 keV	0	0.9989
Johnsoin & Fowler	49-3139 keV	0	0.9799
Cierjacks et al. (1980)	3.143-7.0 MeV	0	1.0378
(cross section α,n)			
Drotleff et al.	346-1389 keV	0	1.0 (fixed)
Heil et al.	416-899 keV	0	1.0 (fixed)
Kellogg	445-1045 keV	0	1.506
Bair and Haas	997-5402 keV	-4 keV	0.9410

Benchmarking

1. Due to changes in total and angular distribution.
2. $^{16}O(n,a)$ has changed since B-VII.1.
3. New insights in role of O-16 in benchmarks from many comparisons and new NDAST tool NEA.
4. Primarily responsible for a downshift in reactivity of solution benchmarks and a trend with leakage.
5. The downshift cannot be accommodated by the present JEFF evaluation, but seems to have been dealt with by ENDF/B-VIII.

Publications

Leal et al., Eur.Phys.J. N 2 (2016) 43
Kunieda et al., Nucl. Data Sheets 123 (2015) 159
Pigni et al. (in prep)
Danon et al. (AccApp'15 proceedings)
Hale et al. (?)

Plompen(Kopecky) et al. NDS (in prep).

Status versus new evaluations

ENDF/B-VIII.b4 adopted Hale evaluation

JEFF/3.3T3 tested O-16 Leal-high with Barioche TSL
- rejected for 3.3 on account of LST, HST, PST
- going low (compensation with actinides for JEFF-4)

JENDL4 updated
- Kanda-Murata 1983
- Last changes tot+sc July 2008
- Last changes (n,a) April 2009
- No CIELO related changes

CENDL-3
- Zhang and Duan (Liu) (1993 – 2008-06)
- No CIELO related changes