Light Element Cross Sections

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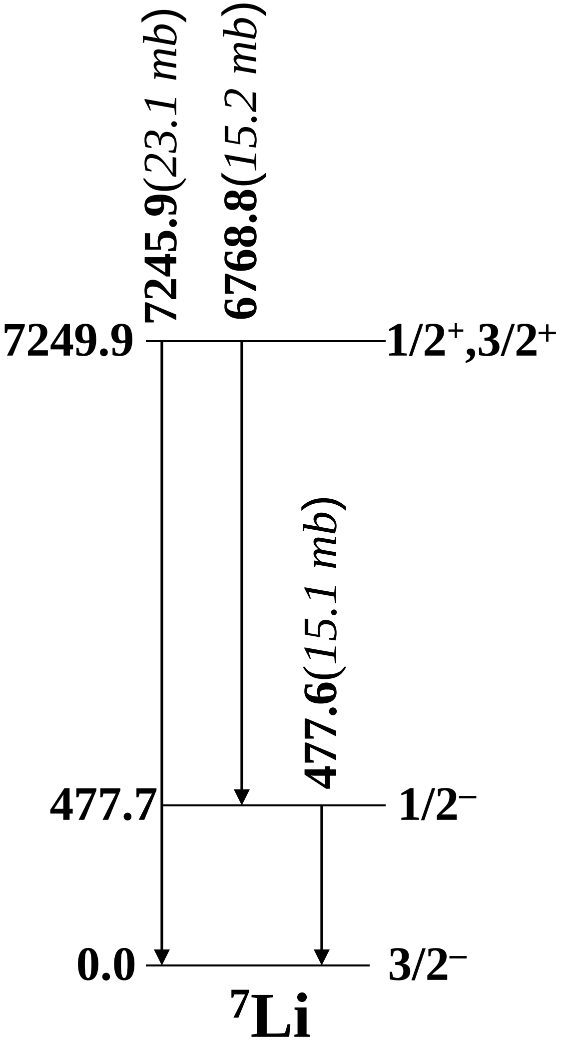
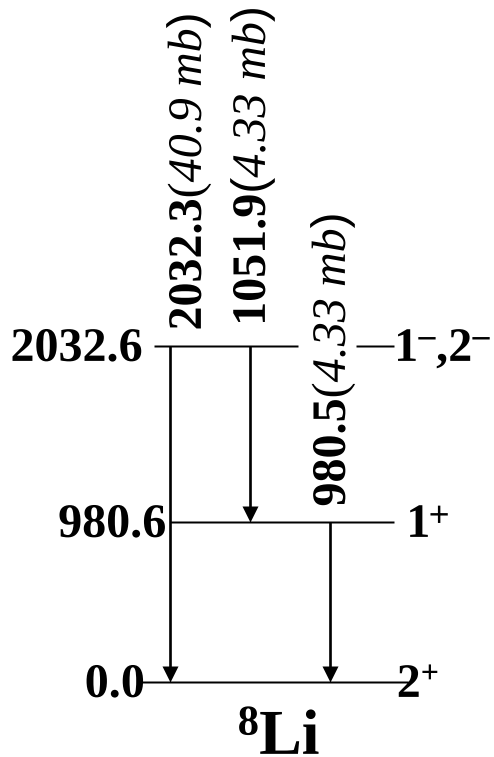
For all isotopes with Z≤19 the (n,γ) decay schemes are nearly completely determined experimentally. In these cases $\sigma_0=\Sigma\sigma_\gamma$(GS)$=\Sigma\sigma_\gamma$(primary).

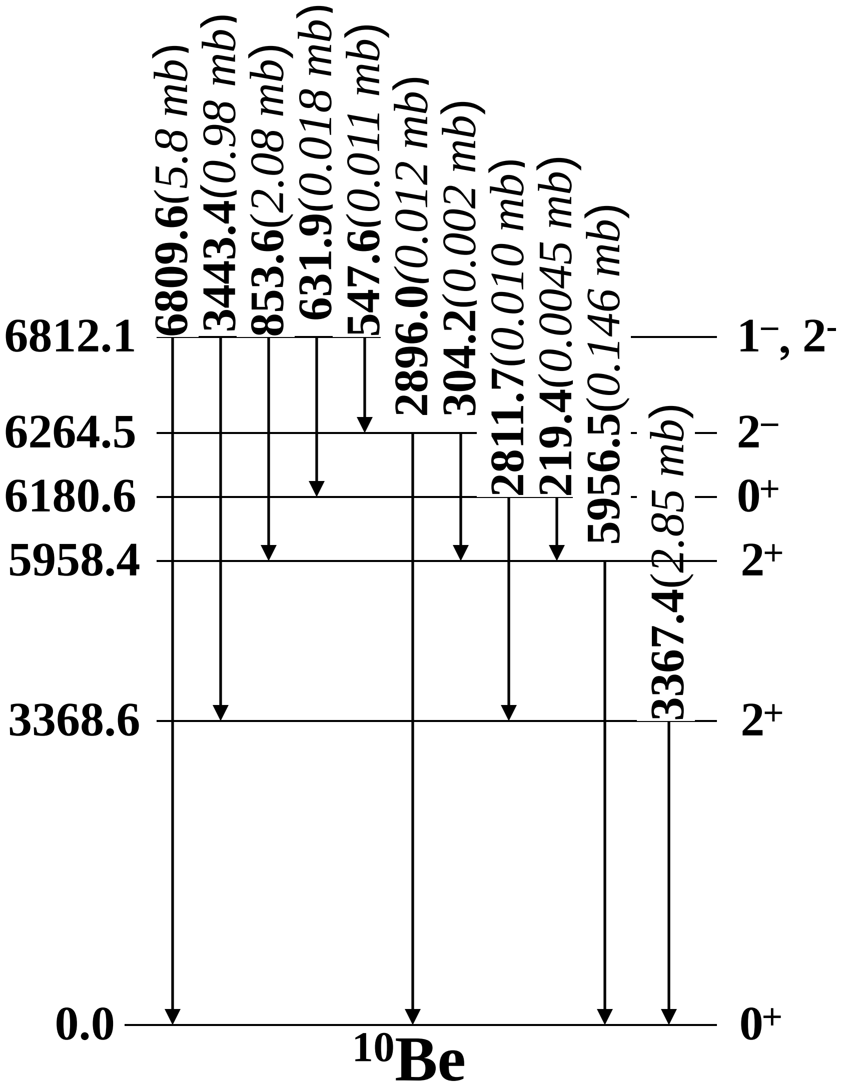
$^{6,7}Li(n,\gamma)$

$\sigma_0(^6Li)$=38.2(5) mb (EGAF)
=38.5(30) mb (Atlas)
$\sigma_0(^7Li)$=43.9(3) mb (EGAF)
=45.4(27) mb (Atlas)





$^{9}Be(n,\gamma)$

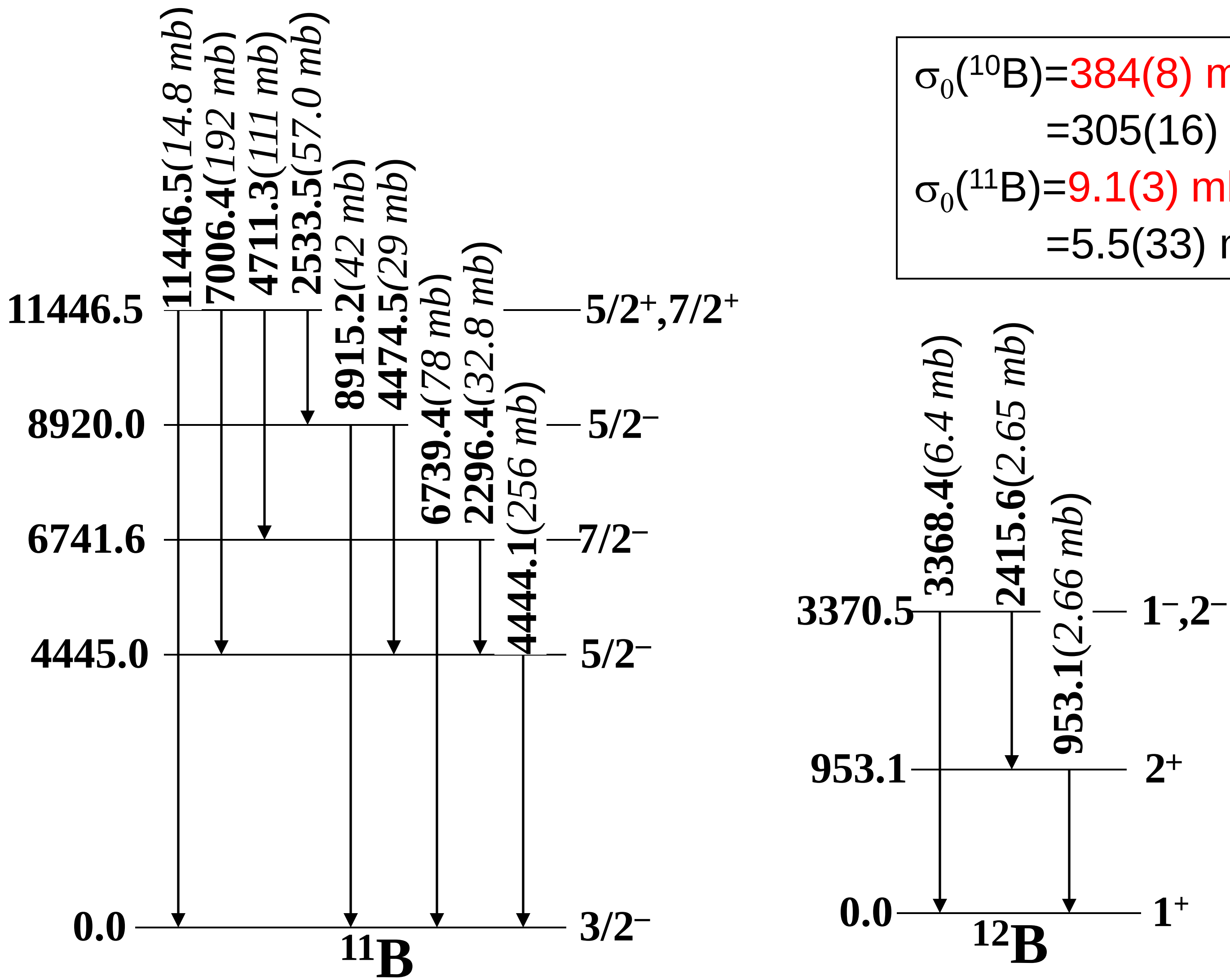


$\sigma_0(^{9}Be)$=9.1(7) mb (EGAF)

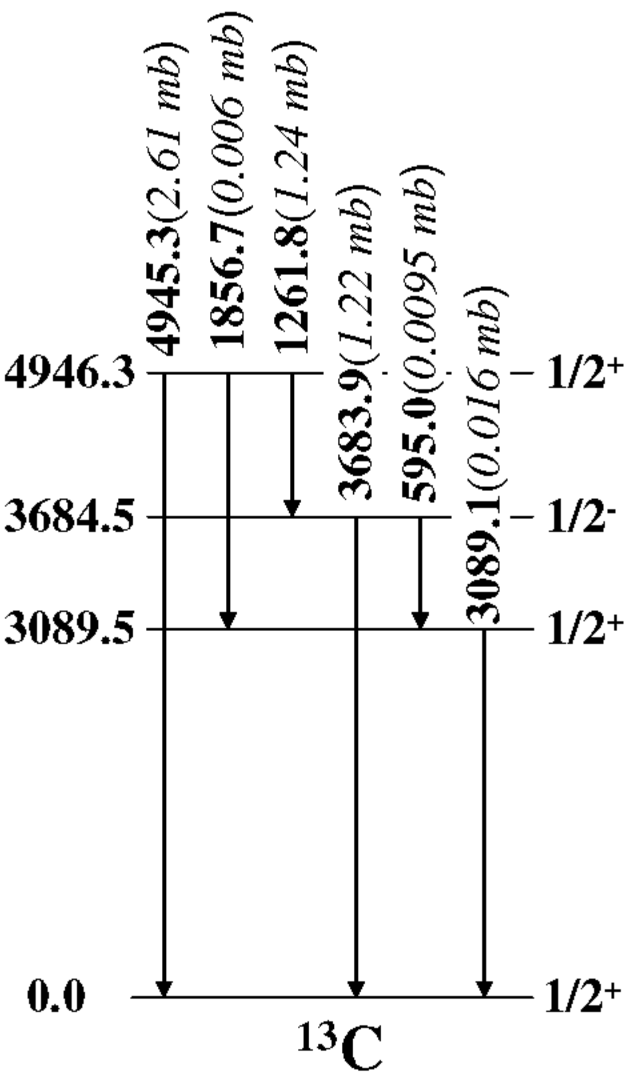
=8.49(34) mb (Atlas)

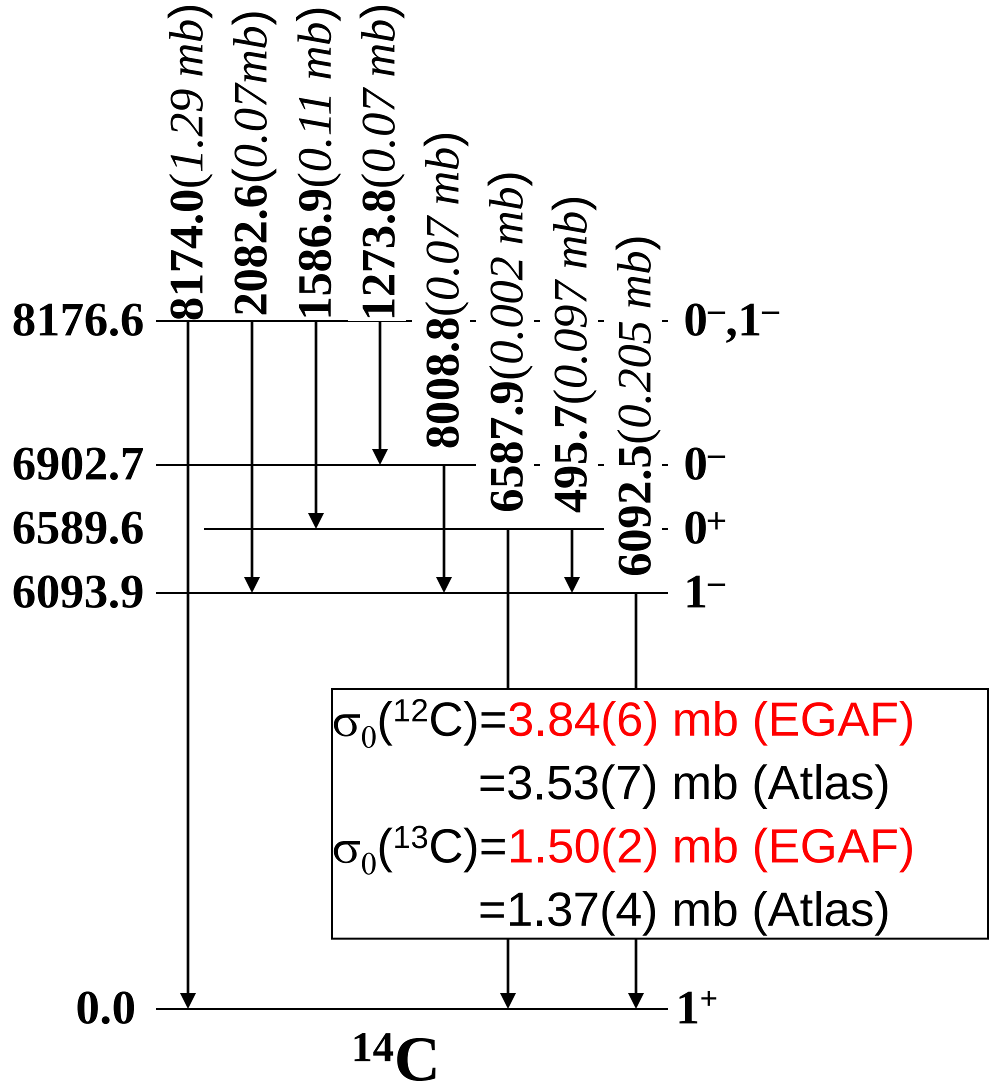
^{10,11}B(n,γ)

$\sigma_0(^{10}B)$=384(8) mb (EGAF)
=305(16) mb (Atlas)
$\sigma_0(^{11}B)$=9.1(3) mb (EGAF)
=5.5(33) mb (Atlas)



$^{12,13}C(n,\gamma)$



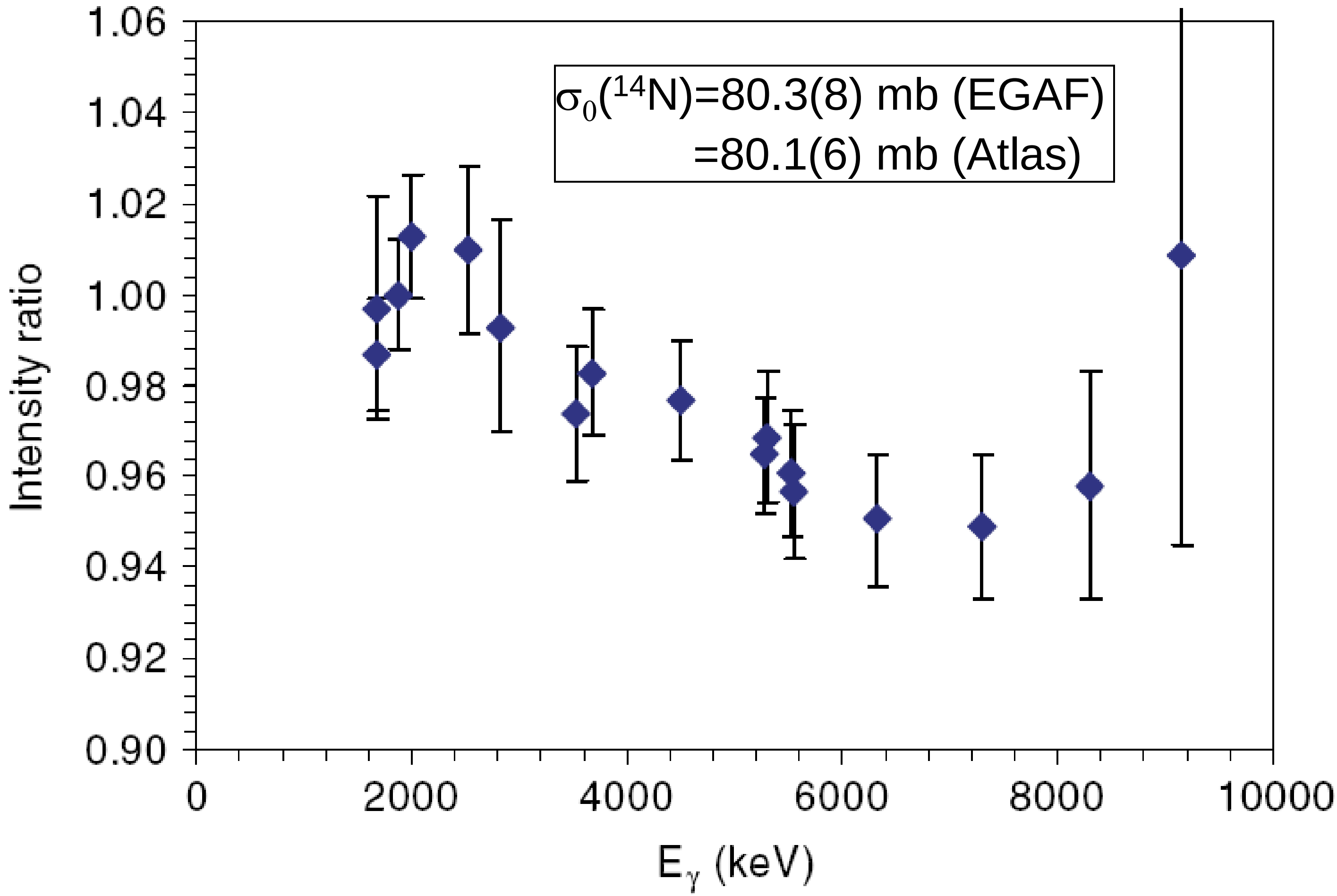


^{12}C, ^{2}H Cross Section Discrepancy

^{12}C Author (Year)	σ_0	$\Delta\sigma$ (mb)	^{2}H Author (Year)	σ_0	$\Delta\sigma$ (mb)
Prestwich (1981)	3.50	0.16	Trail (1964)	0.36	0.03
Jurney (1982)	3.53	0.07	Alfimenkov (1980)	0.476	0.020
Nichols (1960)	3.57	0.03	Jurney (1982)	0.508	0.015
Sagot (1963)	3.72	0.15	Merritt (1968)	0.521	0.009
Jurney (1963)	3.8	0.4	Silk (1969)	0.523	0.029
Starr (1962)	3.83	0.06	Ishikawa (1973)	0.55	0.01
Hennig (1967)	3.85	0.15	Kaplan (1952)	0.57	0.01
Matsue (2004)	3.81	0.11	Jurney (1963)	0.60	0.05
EGAF (2007)	3.84	0.06	Sargent (1947)	0.92	0.22
Atlas	3.53	0.07	Atlas	0.508	0.015
Suggested value	**3.84**	**0.06**	**Suggested value**	**0.549**	**0.010**

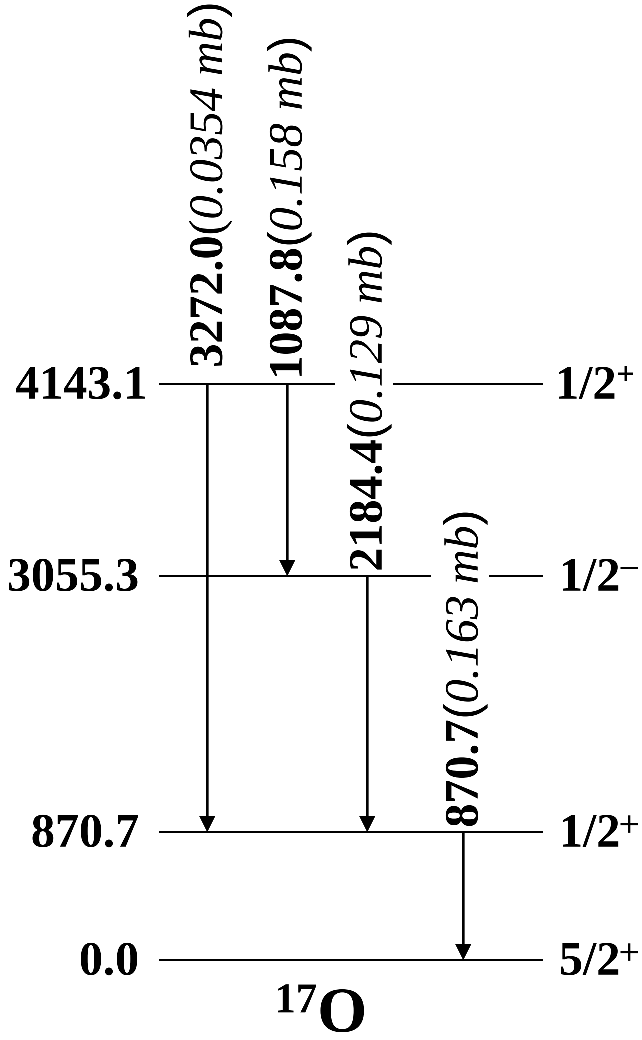
The $\sigma_0(^{12}C)$ measurement by Jurney is low by ≈10%. This suggests that the $\sigma_0(^{2}H)$ measurement by Jurney with the same ^{12}C cross section standard in the same experiment is also low by 10%.

$^{14}N(n,\gamma)$ efficiency calibration



Ratio of $^{14}N(n,\gamma)$ γ-ray intensities measured by Jurney (PRC 56, 118, 1997) to those determined from a least-squares fit to the ^{15}N level scheme by Belgya (PRC 74, 024603, 2006). Jurney's values are efficiency standards for high-energy γ-rays.

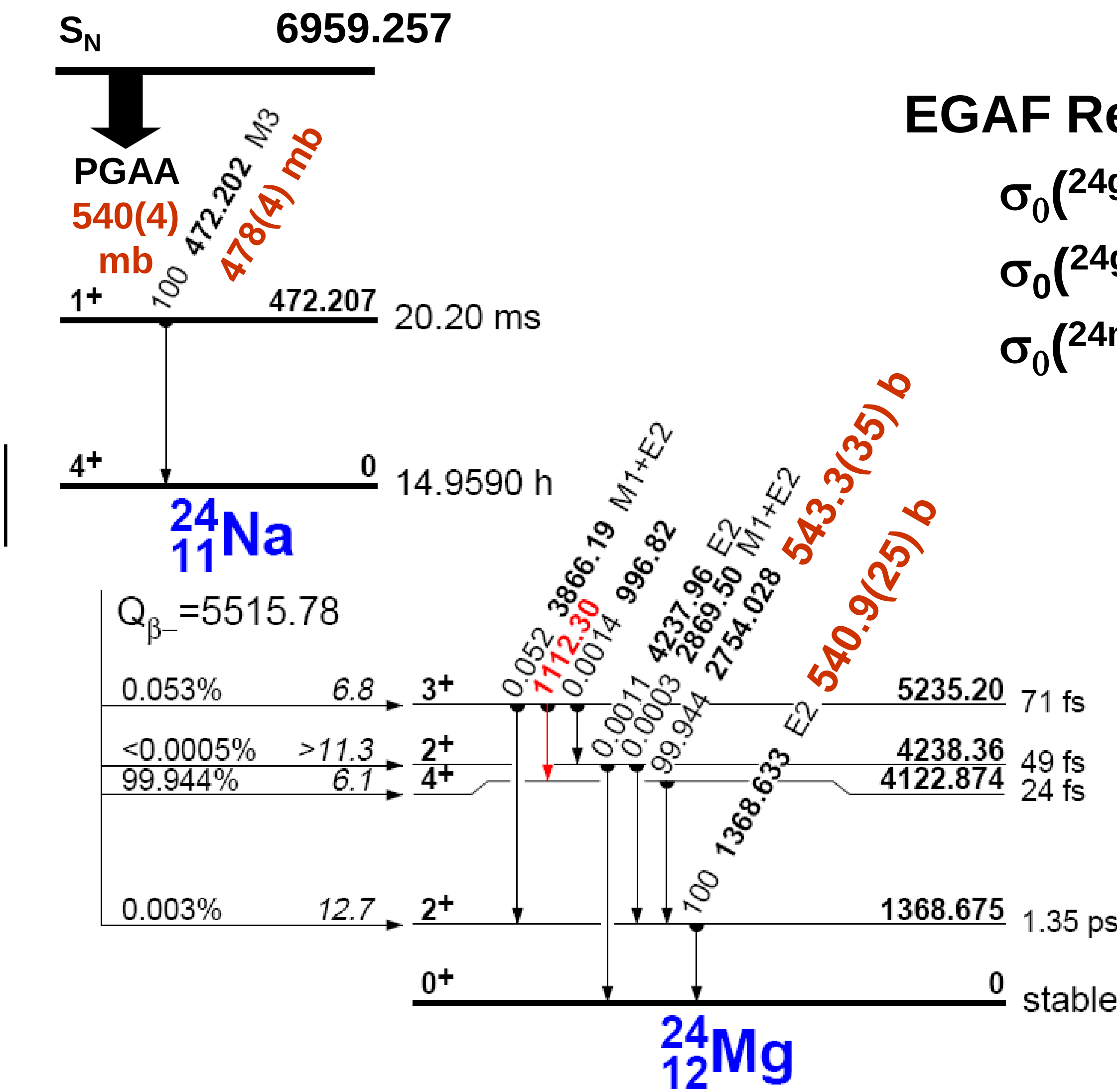
$^{16}O(n,\gamma)$



$\sigma_0(^{16}O)$=0.163(3) mb (EGAF)

=0.190(19) mb (Atlas)

$^{23}Na(n,\gamma)$ prompt and decay γ-rays



EGAF Results

$\sigma_0(^{24g}Na)_{NAA}$ = 542(3) mb

$\sigma_0(^{24g}Na)_{PGAA}$ = 540(4) mb

$\sigma_0(^{24m}Na^m)$ = 478(4) mb

$^{23}Na(n,\gamma)$ discrepancy?

^{23}Na	Author (year)	σ_0 $\Delta\sigma$ (mb)
	Coltman (1946)	0.47 0.04
	Pomerance (1951)	0.470 0.024
	Meadows (1961)	0.47 0.06
	Brooksbank (1955)	0.50 0.05
	Koehler (1963)	0.50 0.02
	Yamamuro (1970)	0.50 0.03
	Harris (1953)	0.503 0.005
	Grimeland (1955)	0.51 0.03
	De Corte (2003)	0.513 0.006
	Kennedy (2003)	0.515 0.021
	Heft (1978)	0.523 0.005
	Ryves (1970)	0.527 0.005
	Szentmiklosi (2006)	0.527 0.008
	Bartholomew (1953)	0.530 0.032
	Wolf (1960)	0.531 0.008

^{23}Na	Author (year)	σ_0 $\Delta\sigma$ (mb)
	Cocking (1958)	0.536 0.006
	Jowitt (1959)	0.536 0.008
	Rose (1959)	0.539 0.008
	Gleason (1975)	0.54 0.02
	Kaminishi (1963)	0.577 0.008
	Seren (1947)	0.63 0.13
	EGAF-PGAA	**0.540 0.004**
	EGAF-NAA	**0.542 0.003**
	Atlas	**0.517 0.004**

^{23m}Na	Author (year)	σ_0 $\Delta\sigma$ (mb)
	Alexander (1963)	0.40 0.03
	Groshev (1955)	0.39 0.06
	Matsue (2004)	0.476 0.011
	EGAF	**0.478 0.004**
	Atlas	**0.40 0.03**

New measurements are planned to recheck data normalization

$^{40,41}K(n,\gamma)$

^{40}K	Author (Year)	σ_0	$\Delta\sigma$ (mb)
	Asghar (1978)	30	
	Beckstrand (1971)	30	8
	Pomerance (1952)	66	20
	Gillette (1966)	70	
	Atlas	30	8
	EGAF*	**94**	**7**
^{39}K			
	Pomerance(1952)	2.1	0.2
	Gillette (1966)	1.4	
	Hanson (1949)	3.0	1.5
	Atlas	2.1	0.2
	EGAF	**2.24**	**0.04**

^{41}K	Author (Year)	σ_0	$\Delta\sigma$ (mb)
	Seren (1947)	1.0	0.2
	Pomerance (1952)	1.19	0.10
	Koehler (1967)	1.2	0.1
	Gryntakis (1976)	1.28	0.06
	Gleason (1975)	1.43	0.03
	Heft (1978)	1.43	0.03
	Ryves (1970)	1.46	0.03
	Kappe (1966)	1.49	0.03
	Kaminishi (1982)	1.57	0.17
	Krusche(1985)-EGAF*	1.523	0.022
	Atlas	1.46	0.03
	EGAF	**1.523**	**0.022**

Discrepancy between ^{41}K EGAF data and previous measurements based on NAA may be resolved if $P_\gamma(1524.7)=0.1808(9)$ (ENSDF) were replaced with $P_\gamma(1524.7)=0.173(3)$ inferred by EGAF.

New normalization and activation measurements are planned.

* Extensive $^{40}K(n,\gamma)$ data of Krusche *et al,* (NPA 417, 1984) were renormalized to EGAF σ_γ data.

Light element cross section summary

Isotope or ratio	σ0 (This work) mb except where noted		σ0 Atlas (2006)		Isotope	σ0 (This work) mb except where noted		σ0 Atlas (2006)	
2H*	0.549	0.010	0.508	0.015	27Al	232.2	1.7	231	3
6Li	38.2	0.5	38.5	3.0	28Si	187	3	177	4
7Li	43.9	0.3	45.4	2.7	29Si	128	4	119	3
9Be	9.1	0.7	8.49	0.34	30Si	116.3	2.3	107	2
10B	384	8	305	16	31P	169	5	165	3
11B	9.1	0.3	5.5	3.3	32S	542	7	518	14
12C	3.84	0.06	3.50	0.07	33S	449	17	454	25
13C	1.50	0.02	1.37	0.04	34S	284	8	256	9
14N	80.3	0.4	80.1	0.6	35Cl	44.22	0.18 b	43.6	0.4 b
15N	0.0378	0.0011	0.024	0.008	37Cl	407	12	433	6
16O	0.163	0.003	0.190	0.019	36Ar/40Ar	9.6	1.3	9.5	1.2
19F	9.51	0.11	9.51	0.09	39K	2250	40	2100	200
20Ne/22Ne	1.04	0.04	1.12	0.21	40K	94	7 b	30	8 b
23Na	541	3	517	4	41K	1530	30	1460	30
24Mg	53.9	0.2	53.8	1.3					
25Mg	196	8	199	3					
26Mg	38.8	1.4	38.4	0.6					

Publication of the Z≤19 σ_0 data is planned for 2011.

* Expected value based on new ^{12}C standard cross section. A new measurement is planned at Munich Reactor.