ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Isotopi di interesse per il processo s

@ EAR1

@ EAR2

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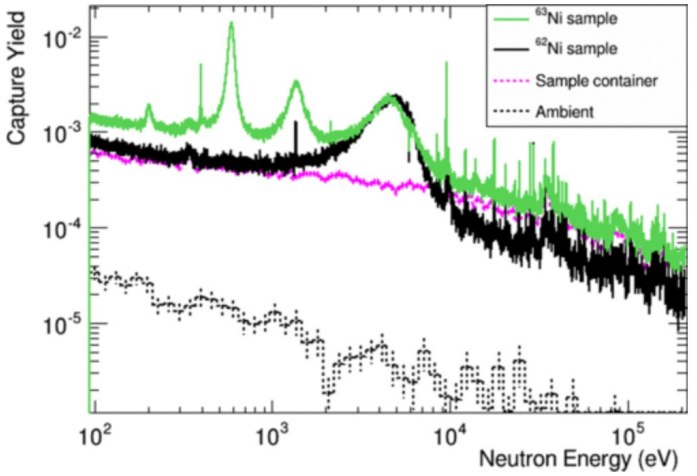
Department of Physics and Astronomy

$^{64}Ni_{36}(n,\gamma)$

Misurato @ n_TOF

^{60}Zn 2.38 m	^{61}Zn 1.48 m	^{62}Zn 9.19 h	^{63}Zn 38.47 m	^{64}Zn 48.63	^{65}Zn 243.63 d	^{66}Zn 27.9	^{67}Zn 4.1	^{68}Zn 18.75
^{59}Cu 1.36 m	^{60}Cu 23.70 m	^{61}Cu 3.33 h	^{62}Cu 9.67 m	^{63}Cu 69.17	^{64}Cu 12.70 h	^{65}Cu 30.83	^{66}Cu 5.12 m	^{67}Cu 2.58 d
^{58}Ni 68.077	^{59}Ni 75.99 ka	^{60}Ni 26.223	^{61}Ni 1.14	^{62}Ni 3.634	^{63}Ni 100.11 a	^{64}Ni 0.926	^{65}Ni 2.52 h	^{66}Ni 2.27 d
^{57}Co 271.76 d	^{58}Co 70.86 d	^{59}Co 100	^{60}Co 5.27 a	^{61}Co 1.65 h	^{62}Co 1.50 m	^{63}Co 27.40 s	^{64}Co 300.00 ms	^{65}Co 1.20 s
^{56}Fe 91.754	^{57}Fe 2.119	^{58}Fe 0.282	^{59}Fe 44.50 d	^{60}Fe 1.50 Ma	^{61}Fe 5.98 m	^{62}Fe 1.13 m	^{63}Fe 6.01 s	^{64}Fe 2.00 s



^{62,63}Ni Misurato @ n_TOF

MACS @ 30 keV → 22 mb

2 g
98 %

RRR ~ 200 keV

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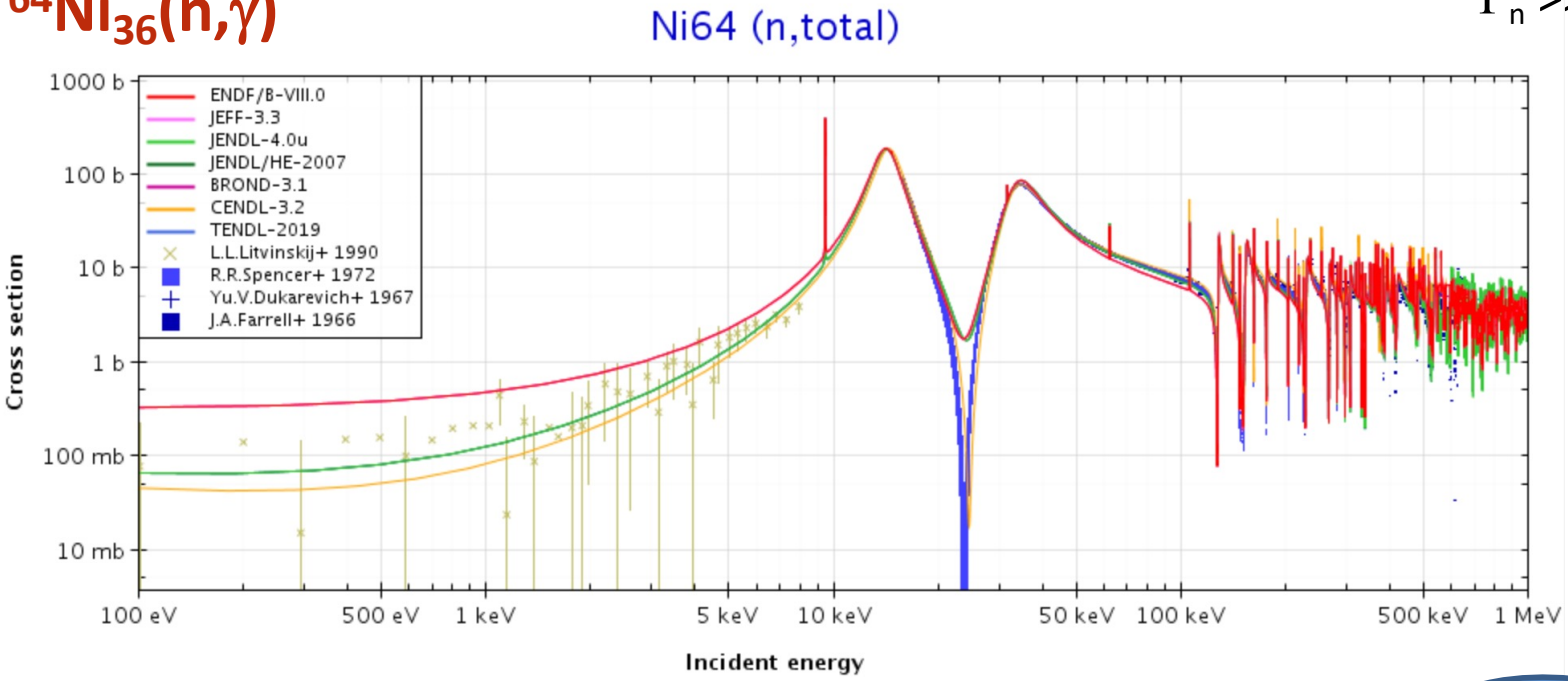
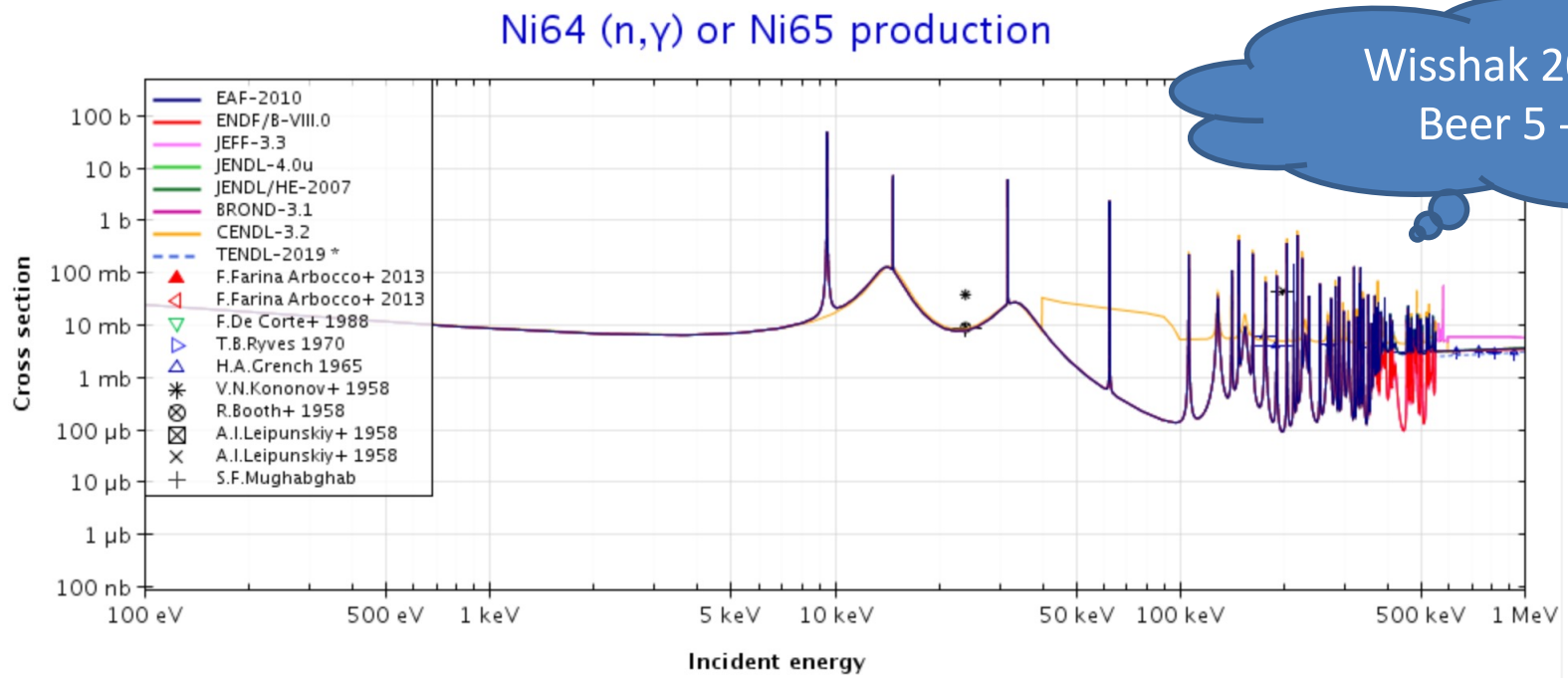
$^{64}Ni_{36}(n,\gamma)$

RRR 500 keV

$\Gamma_n >> \Gamma_{\gamma.}$ ~1000





Wisshak 20 - 40 keV
Beer 5 - 70 keV

$^{64}Ni_{36}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]
1.0	7.7 ± 0.3
0.3	8.0 ± 0.7
0.0	8.7 ± 0.9

Version	MACS @ 10 keV
1.0	24.8 (1.6)
0.3	13.6

List of all available values

original	renorm.	year	type	Comment	Ref
9.0 ± 0.3 kT= 25 keV	7.7 ± 0.3	2016	r	VdG, Act., Au:RaK88 corrected by 632/586= 1.0785; recalc. incl. energy dep. from tendl15	HKU08
6.56 ± 0.27 kT= 52 keV		2009	c	VdG, Act., Au:RaK88,Mac82e	DDF09
9.0 ± 0.3 kT= 25 keV	8.6	2008,2016	c	VdG, Act., Au:RaK88 corrected by 632/586= 1.0785;	HKU08
8.7 ± 0.9		1984	r	VdG, TOF, Au:B-V,Recalcul. including data of SpM82	WKM84
23.2 ± 5.0		1975	a	VdG, TOF, Au:596mb Kom69 Recalcul. including data of HBT69 at 9.52keV and data of SpM82 at 80.4 < E <163keV	BeS75
14.4		2015	e	TENDL-2015 using the TALYS code	tendl15
22.1 ± 8.4		2014	e	JEFF-3.2 incl. covariances	jeff32
20.1		2011	e	ENDF/B-VII.1	endfb71
20.1		2002	e	JENDL-4.0	jendl40

Wisshak 20 - 40 keV
Beer 5 - 70 keV

$^{184}W_{110}(n,\gamma)$

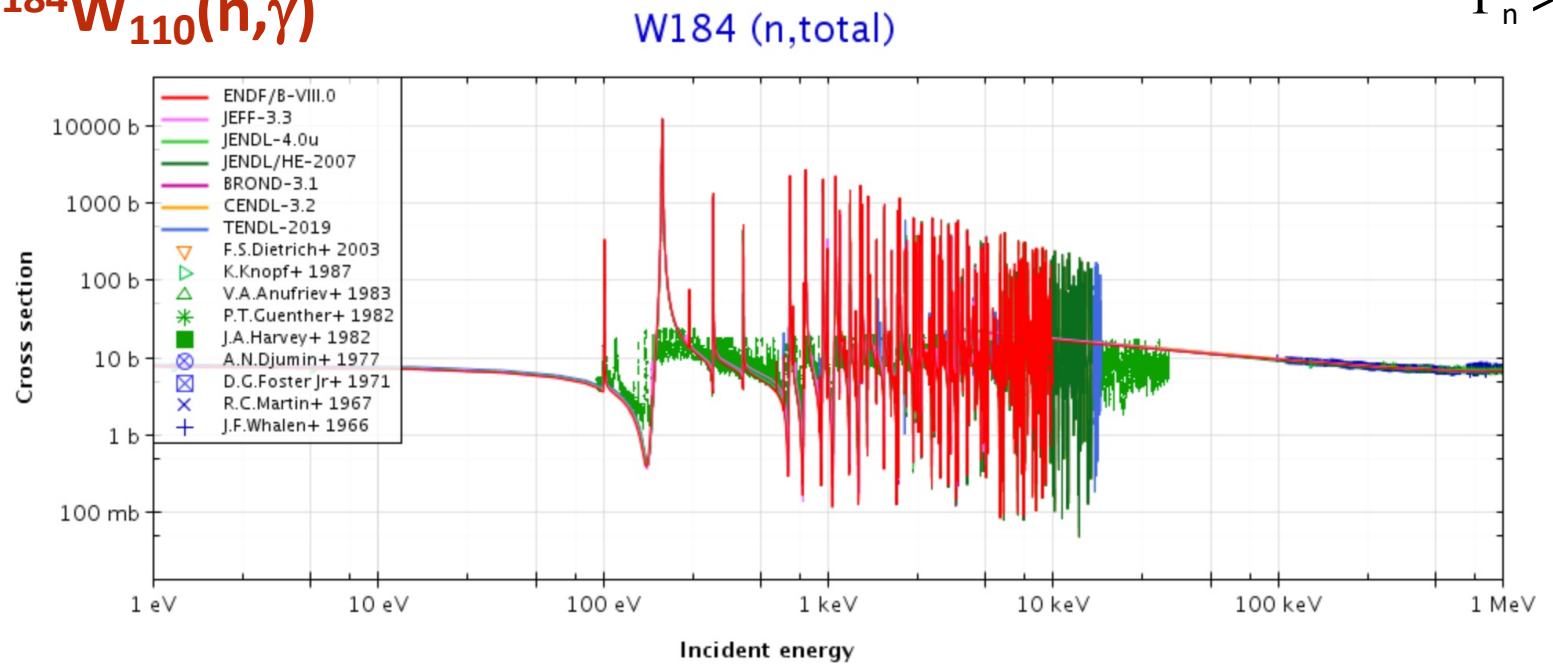
^{182}Os 22.10 h	^{183}Os 13.00 h	^{184}Os 0.02	^{185}Os 93.60 d	^{186}Os 1.59	^{187}Os 1.6	^{188}Os 13.29	^{189}Os 16.21	^{190}Os 26.36
^{181}Re 19.90 h	^{182}Re 2.67 d	^{183}Re 70.00 d	^{184}Re 38.00 d	^{185}Re 37.4	^{186}Re 3.72 d	^{187}Re 41.20×10^{9} y	^{188}Re 17.00 h	^{189}Re 1.01 d
^{180}W 0.12	^{181}W 121.20 d	^{182}W 26.5	^{183}W 14.31	^{184}W 30.64	^{185}W 75.10 d	^{186}W 28.43	^{187}W 23.72 h	^{188}W 69.78 d
^{179}Ta 1.82 a	^{180}Ta 8.15 h	^{181}Ta 99.988	^{182}Ta 114.43 d	^{183}Ta 5.10 d	^{184}Ta 8.70 h	^{185}Ta 49.40 m	^{186}Ta 10.50 m	^{187}Ta 2.00 m
^{178}Hf 27.28	^{179}Hf 13.62	^{180}Hf 35.08	^{181}Hf 42.39 d	^{182}Hf 8.90 Ma	^{183}Hf 1.07 h	^{184}Hf 4.12 h	^{185}Hf 3.50 m	^{186}Hf 2.60 m

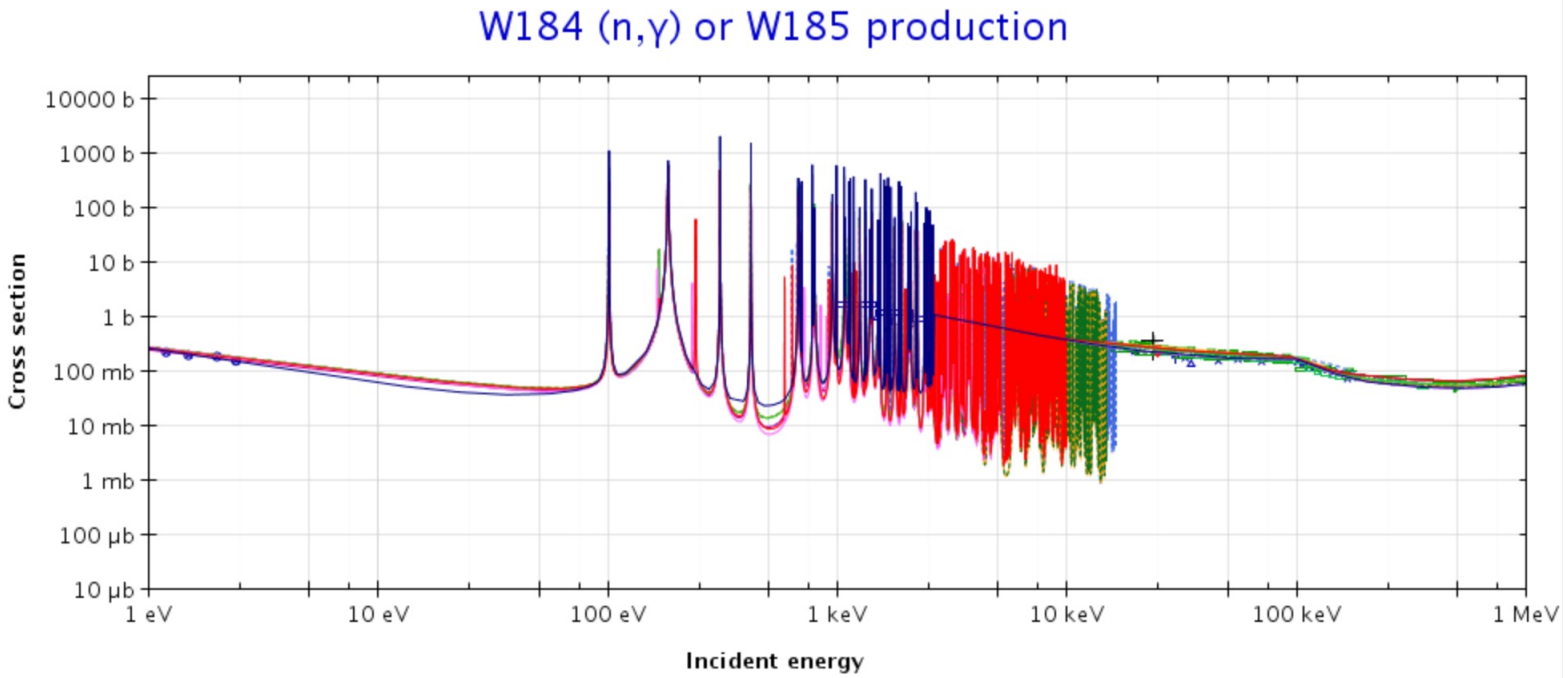
Misurato @ GELINA
solo su RRR

$^{184}W_{110}(n,\gamma)$

RRR 16 keV

$\Gamma_n >> \Gamma_{\gamma.} \sim 1000$





$^{184}W_{110}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]
1.0	225 ± 27
0.3	223 ± 5
0.0	224 ± 10

Version	MACS @ 10 keV
1.0	358 (19)
0.3	410

15%

List of all available values

original	renorm.	year	type	Comment	Ref
225 ± 27		2009,2013	r	VdG, Act., Au:RaK88; en. dep. from jeff31,endfb71,jendl40	MDD09b
222 ± 15		2009	c	VdG, Act., Au:RaK88	MDD09b
229 ± 11 E(n)= 31.5 (35) keV		1987	c	VdG, TOF, ^{7}Li(p,n); Au+Ag+Nd+Ta+W:Sat.	BKK87
217 ± 6		1983	b	Linac, TOF, ^{6}Li, Au:Sat.	MDA83
256 ± 10	238	1982	c	VdG, TOF, Au:B-IV	BKW82
252.2 ± 16.9		2011	e	ENDF/B-VII.1 incl. standard deviation	endfb71
244.2		2011	e	JENDL-4.0	jendl40
222.4		2006	e	ENDF/B-VII.0	endfb7

Gotha

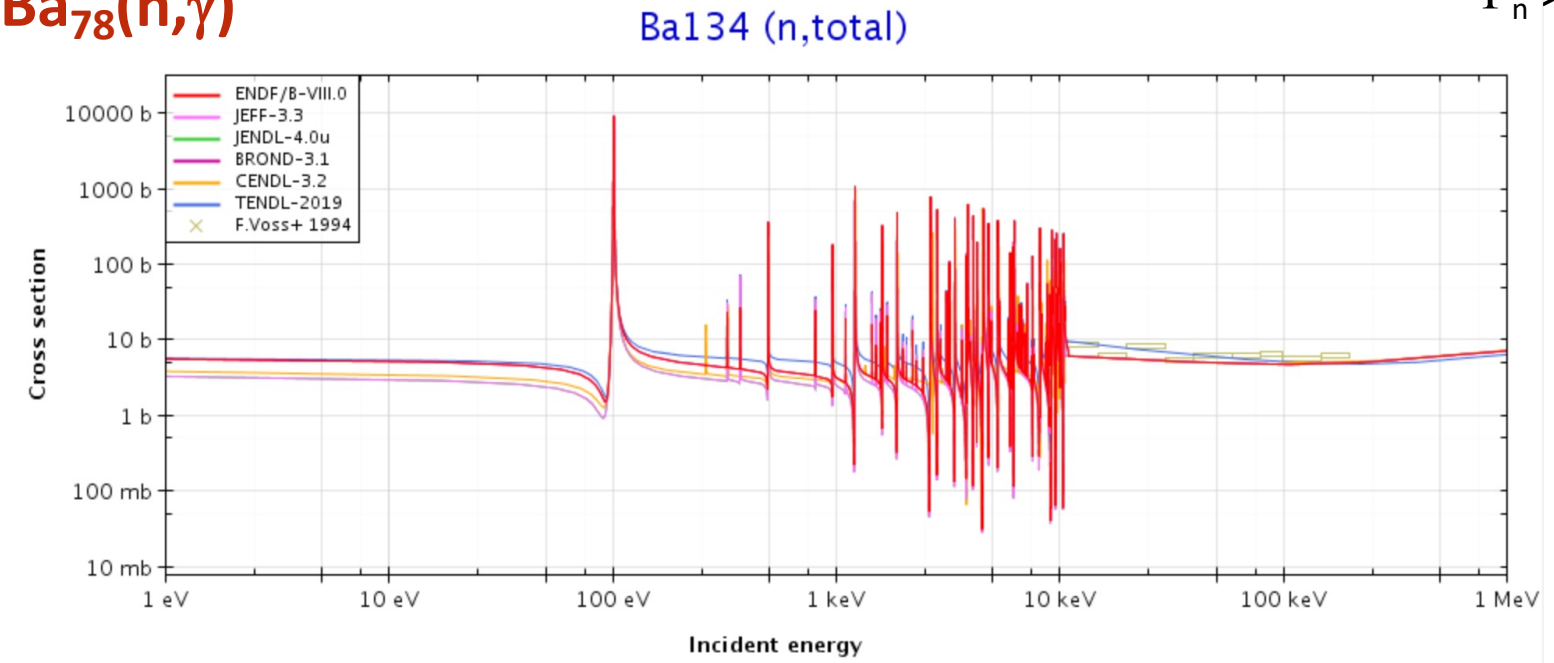
^{134,135,136,137}Ba(n,γ)

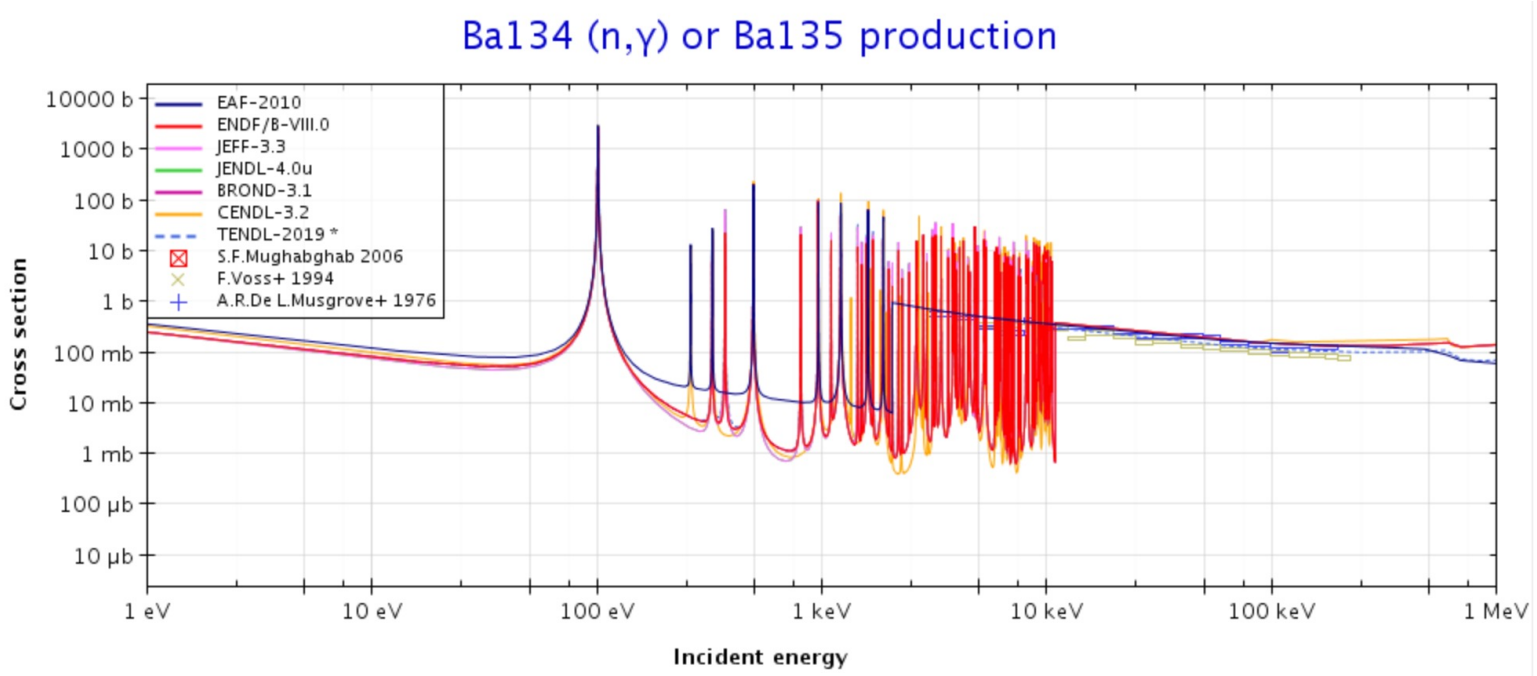
^{132}Ce 3.51 h	^{133}Ce 1.62 h	^{134}Ce 3.16 d	^{135}Ce 17.70 h	^{136}Ce 0.185	^{137}Ce 9.00 h	^{138}Ce 0.251	^{139}Ce 137.62 d	^{140}Ce 88.45
^{131}La 59.00 m	^{132}La 4.80 h	^{133}La 3.91 h	^{134}La 6.45 m	^{135}La 19.50 h	^{136}La 9.87 m	^{137}La 59.99 ka	^{138}La 102.01×10^{9} y	^{139}La 99.91
^{130}Ba 0.106	^{131}Ba 11.50 d	^{132}Ba 0.101	^{133}Ba 10.52 a	^{134}Ba 2.417	^{135}Ba 6.592	^{136}Ba 7.854	^{137}Ba 11.232	^{138}Ba 71.698
^{129}Cs 1.34 d	^{130}Cs 29.21 m	^{131}Cs 9.69 d	^{132}Cs 6.48 d	^{133}Cs 100	^{134}Cs 2.07 a	^{135}Cs 2.30 Ma	^{136}Cs 13.04 d	^{137}Cs 30.03 a
^{128}Xe 1.91	^{129}Xe 26.4	^{130}Xe 4.071	^{131}Xe 21.232	^{132}Xe 26.909	^{133}Xe 5.24 d	^{134}Xe 10.436	^{135}Xe 9.14 h	^{136}Xe 8.857

$^{134}Ba_{78}(n,\gamma)$

RRR 10 keV

$\Gamma_n > \Gamma_{\gamma.} \sim 100$





$^{134}Ba_{78}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]	Partia
1.0	185.8 ± 0.6	
0.0	176.0 ± 5.6	

(Version 0.0 corresponds to Bao et al.)

Version	MACS @ 10 keV
1.0	312 (12)
0.3	283

10%

List of all available values

original	renorm.	year	type	Comment	Ref
173.6 ± 5.6		1999	c	VWG94 and KSW96 below 5 keV	Kae99
179.0 ± 5.7		1996	c	Linac, TOF, ^{6}Li, Au:Sat.	KSW96
176.3 ± 5.6		1994	c	VdG, TOF, Au:RaK88,Mac82e	VWG94
221 ± 35		1978	c,2	Linac, TOF, ^{6}Li, Au:Sat., k=0.9833	MAM78a
225 ± 35		1976	c	Linac, TOF, ^{6}Li+^{235}U, Au:Sat.	MAB76a
227.5		2011	e	ENDF/B-VII.1	endfb71
230.1		2011	e	JENDL-4.0	jendl40

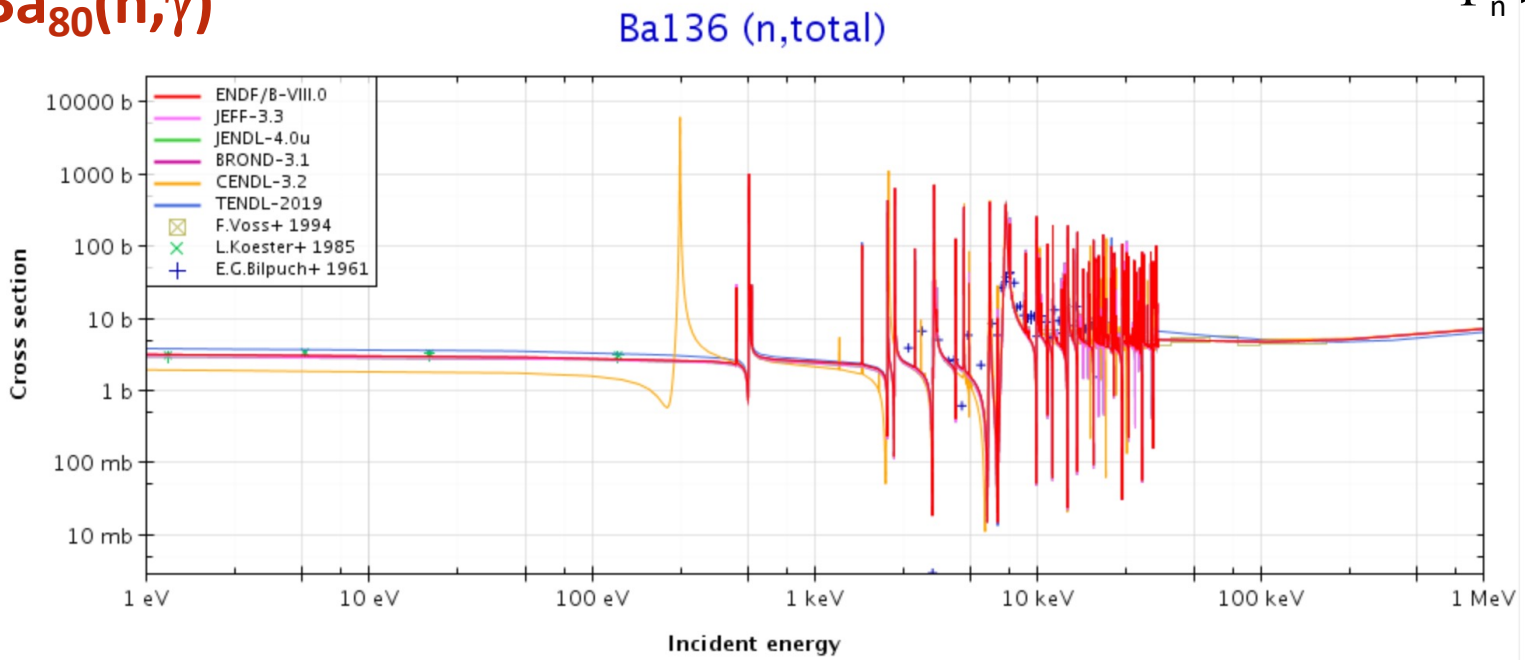
Kaeppeler
Koehler
Musgrove

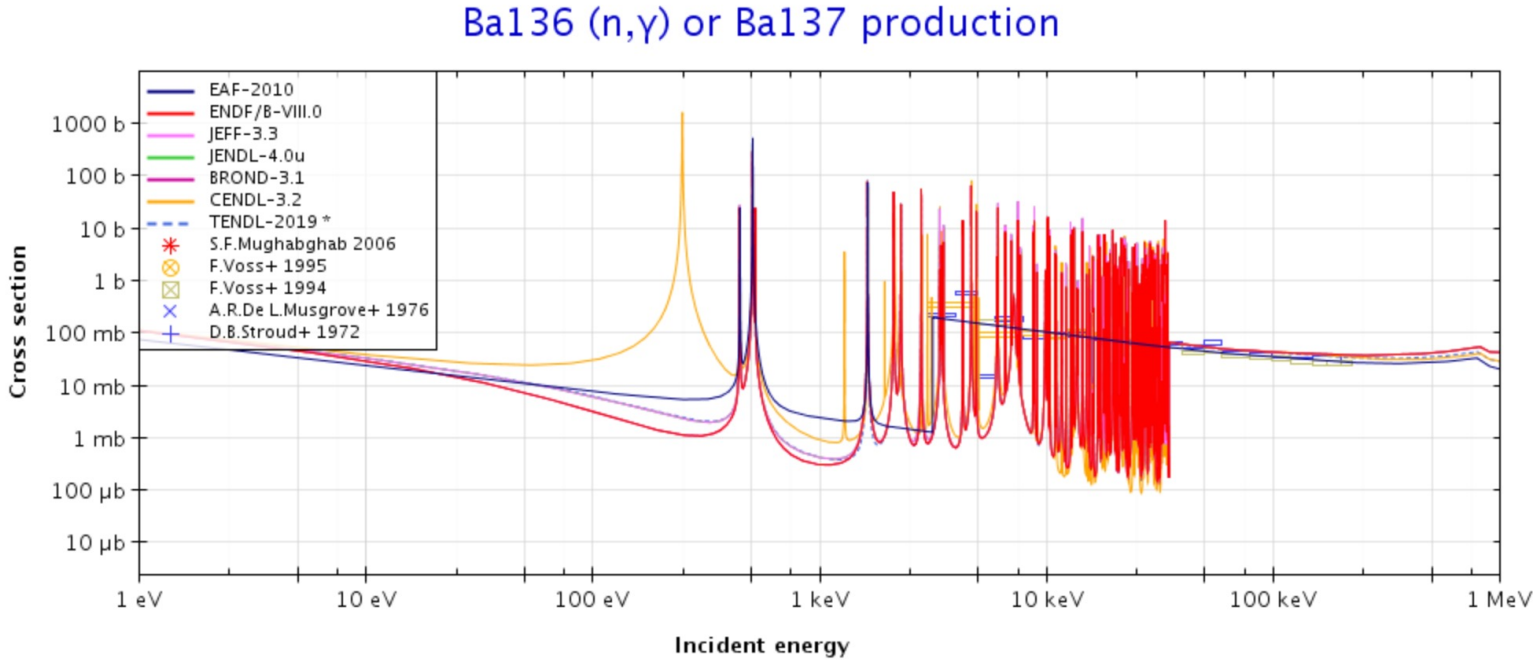
Cattuta @ ORELA con C_6D_6
Trasmissione @ ORELA
20 eV < E_n < 500 keV

$^{136}Ba_{80}(n,\gamma)$

RRR 34 keV

$\Gamma_n > \Gamma_{\gamma.} \sim 100$





$^{136}Ba_{80}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]	P
1.0	67.5 ± 2..2	
0.0	61.1 ± 2.0	

(Version 0.0 corresponds to Bao et al.)

Version	MACS @ 10 keV
1.0	132 (5)
0.3	115

15%

List of all available values

original	renorm.	year	type	Comment	Ref
173.6 ± 5.6		1999	c	VWG94 and KSW96 below 5 keV	Kae99
179.0 ± 5.7		1996	c	Linac, TOF, ^{6}Li, Au:Sat.	KSW96
176.3 ± 5.6		1994	c	VdG, TOF, Au:RaK88,Mac82e	VWG94
221 ± 35		1978	c,2	Linac, TOF, ^{6}Li, Au:Sat., k=0.9833	MAM78a
225 ± 35		1976	c	Linac, TOF, ^{6}Li+^{235}U, Au:Sat.	MAB76a
227.5		2011	e	ENDF/B-VII.1	endfb71
230.1		2011	e	JENDL-4.0	jendl40

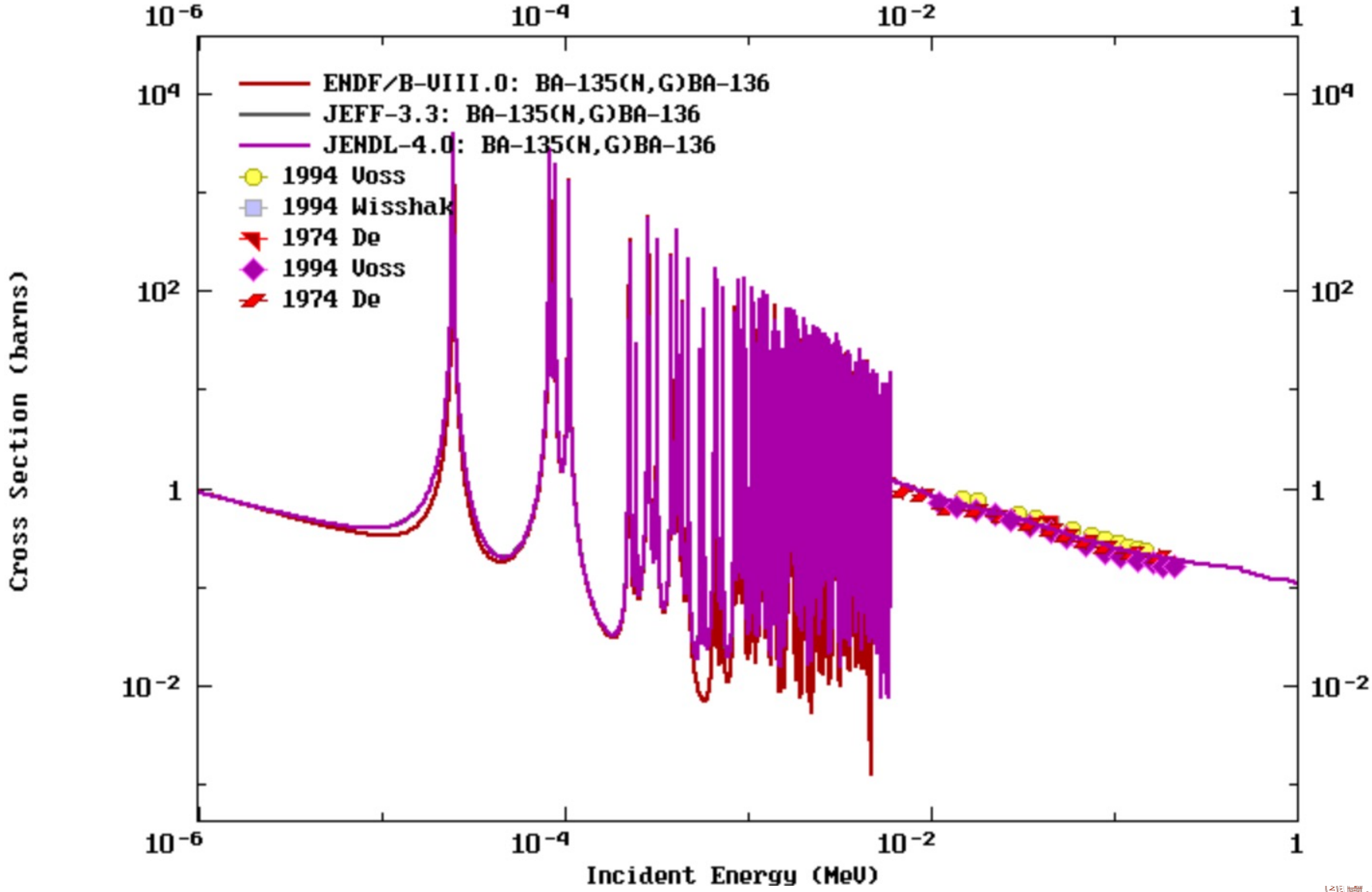
Kaeppeler
Koehler
Musgrove

Cattuta @ ORELA con C_6D_6
Trasmissione @ ORELA
20 eV < E_n < 500 keV

$^{135}Ba_{79}(n,\gamma)$

RRR 45 keV

$\Gamma_n \sim \Gamma_\gamma$



$^{135}Ba_{79}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]
1.0	489 ± 15
0.0	455 ± 15

(Version 0.0 corresponds to Bao et al.)

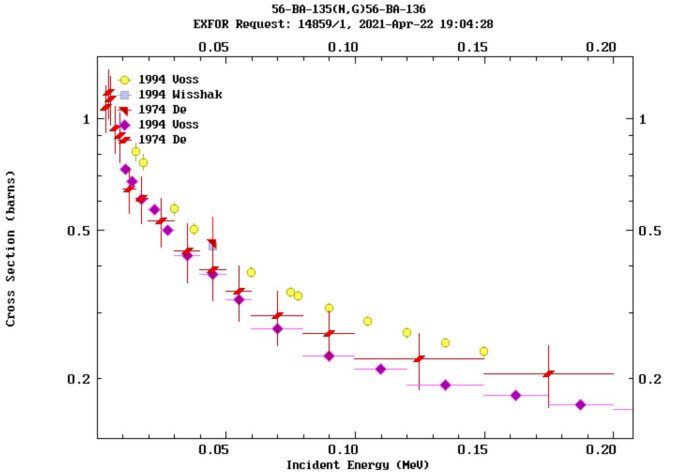
Version	MACS @ 10 keV
1.0	912 (34)
0.3	846

8%

List of all available values

original	renorm.	year	type	Comment	Ref
455 ± 15		1994	c	VdG, TOF, Au:RaK88,Mac82e	VWG94
457 ± 80		1978	c,2	Linac, TOF, ^{6}Li, Au:Sat., k=0.9833	MAM78a
300 ± 60		1976	c	Linac, TOF, ^{6}Li+^{235}U, Au:Sat.	MAB76b
485.1		2011	e	ENDF/B-VII.1	endfb71
499.1		2011	e	JENDL-4.0	jendl40

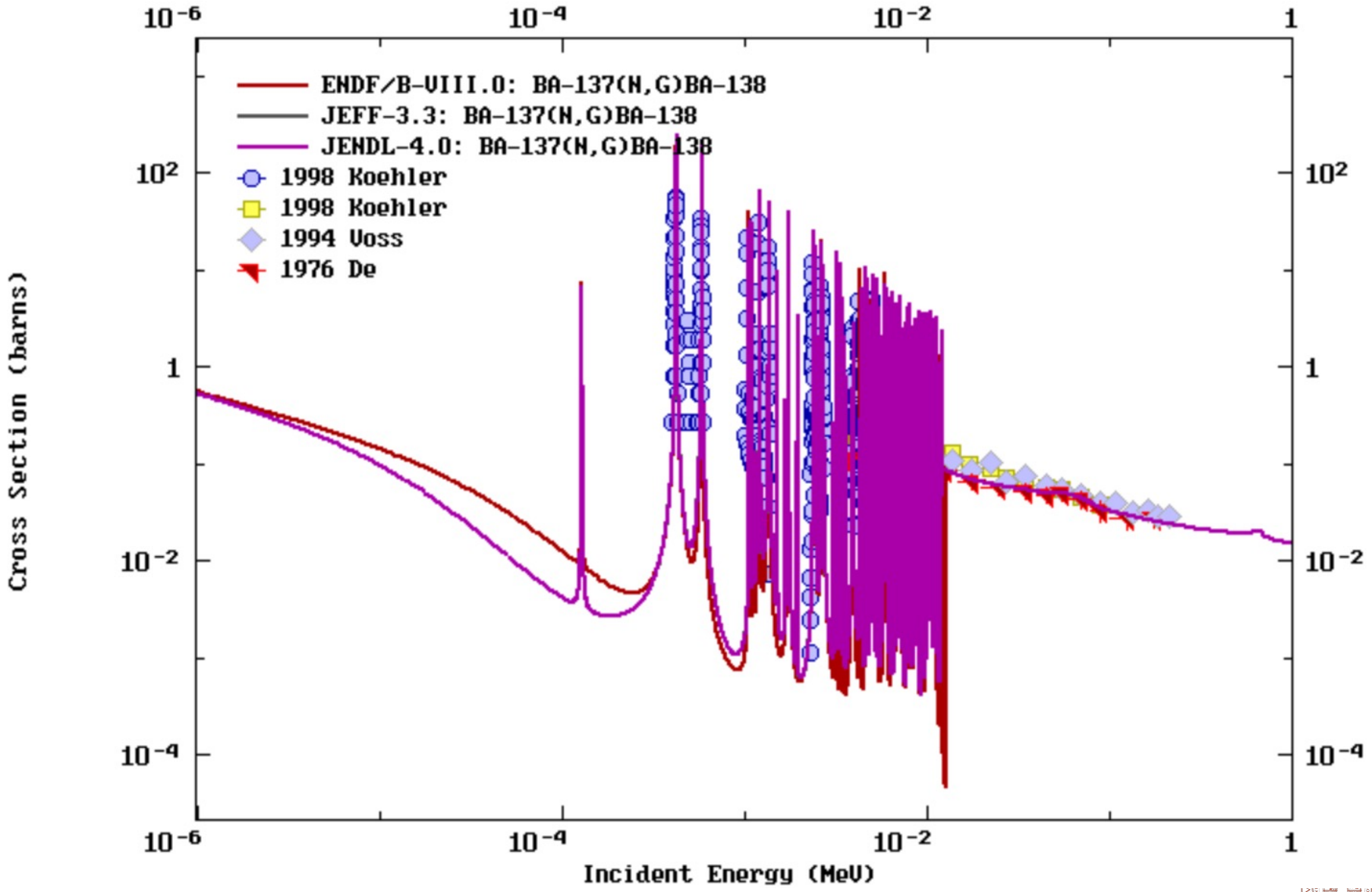
Musgrove
ORELA @ 40m
F_6C_6



$^{137}Ba_{81}(n,\gamma)$

RRR 11 keV

$\Gamma_n > \Gamma_{\gamma.} \sim 10$



$^{137}Ba_{81}(n,\gamma)$

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars

History

Version	Total MACS [mb]
1.0	90.2 ± 3..4
0.0	76.2 ± 2.5

(Version 0.0 corresponds to Bao et al.

Version	MACS @ 10 keV
1.0	203 (13)
0.3	140

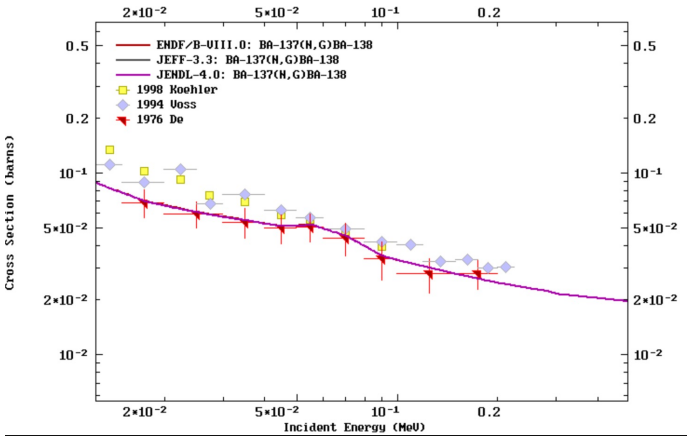
45%

List of all available values

original	renorm.	year	type	Comment	Ref
75.7 ± 2.4		1998	c	Linac, TOF, ^{6}Li, Au:Sat.	KSG98
76.9 ± 2.9		1994	c	VdG, TOF, Au:RaK88,Mac82e	VWG94
57 ± 10		1978	c,2	Linac, TOF, ^{6}Li, Au:Sat., k=0.9833	MAM78a
53 ± 10		1976	c	Linac, TOF, ^{6}Li+^{235}U, Au:Sat.	MAB76b
58.8		2011	e	ENDF/B-VII.1	endfb71
63.7		2011	e	JENDL-4.0	jendl40

Musgrove
Koehler

Cattuta @ ORELA con C_6D_6
Trasmissione @ ORELA



(mie) conclusioni

^{64}Ni(n,γ)

- **Ampio** margine di **miglioramento**
- Completa lo studio su nichel
- **Costo** del campione non trascurabile

Più promettente

^{184}W(n,γ)

- **Minimo** margine di **miglioramento**
- **Difficile** passare **INTC** (misura recente GELINA)

Usare MACS da ENDF/B-VIII

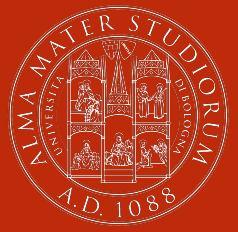
^{134,136}Ba(n,γ)

- **Minimo** margine di **miglioramento**
- **Difficile** passare **INTC** (misura recente ORELA)

Usare MACS da ENDF/B-VIII

^{135,137}Ba(n,γ)

- Margine di miglioramento (principalmente su 135)
- **URR** regione da migliorare



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