^{116}Sn(^{10}B,3nγ),^{114}Sn(^{12}C,p2nγ) 1979Ga02,1978Yo03,2000Gi12

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Also includes ^{115}In(^{12}C,4nγ) from 1978Ti01 and 2000Gi12, and ^{112}Cd(^{14}N,3nγ) from 1979Ga02.

1979Ga02: ^{116}Sn(^{10}B,3nγ) E=44 MeV ^{10}B beam and 10.0 mg/cm^2 ^{116}Sn target; ^{112}Cd(^{14}N,3nγ) E=58 MeV ^{14}N beam and 3.0 mg/cm^2 ^{112}Cd target. Beams were produced from the Stony Brook FN tandem Van de Graaff accelerator. γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$, excitation functions. Deduced levels, J, π, band structures, γ-ray multipolarities. Level scheme is based on results from ^{116}Sn(^{10}B,3nγ) as indicated in Fig.4 of 1979Ga02.

1978Yo03: ^{114}Sn(^{12}C,p2nγ) E=55-63 MeV ^{12}C beams were produced from the Grenoble variable-energy cyclotron. Targets were about 2 mg/cm^2 metallic ^{114}Sn (66.5% enriched) on lead backings. γ rays were detected with two coaxial Ge(Li) detectors and charged particles were detected with a silicon detector. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$, particle-γ-coin, excitation functions. Deduced levels, J, π, band structures.

1978Ti01: ^{115}In(^{12}C,4nγ) E=72 MeV ^{12}C beam was produced from the University of Michigan cyclotron. Target was about 15 mg/cm^2 thick self-supporting natural indium (enriched 95.7% in ^{115}In). γ rays were detected with two coaxial Ge(Li) detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$. Deduced levels, band structure.

2000Gi12: ^{115}In(^{12}C,4nγ) E=57 MeV ^{12}C beam was produced from the Orsay MP-Tandem accelerator. Target was a thin self-supporting natural indium of 400 μg/cm^2 thickness. Recoiling ions were collected on a thin aluminum catcher placed 7 cm downstream from the target (corresponding to a time of flight of 27 ns). Prompt γ rays were detected with two Ge detectors close to the target and delayed γ rays were detected with a Ge detector placed near to the catcher, both started by a halo of six BaF_2 fast scintillators surrounding the target, which detected the burst of γ rays following each heavy-ion reaction. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t). Deduced halflife of a new isomer.

^{123}Cs Levels

$(7/2)^+$ bandhead of Band 1 and $(9/2^+)$ bandhead of Band 2: 1979Ga02 propose that the $(9/2^+)$ level (bandhead of Band 2) is at 296 keV and is de-excited by 201γ and 137γ (also proposed by 1992Hu02 in ^{118}Pd(^{19}F,4nγ). However, with the observations of both prompt and delayed transitions of 137γ and 201γ in their measurement of ^{115}In(^{12}C,4nγ), 2000Gi12 propose that the 137γ and 201γ de-excite a level at 231 keV with $J^\pi=7/2^+$, which is fed by an isomer at 231.7+x (x a few keV) with $T_{1/2}$=114 ns as the $(9/2^+)$ bandhead of Band 2. Later, 2004Si26 in ^{100}Mo(^{28}Si,4npγ) and 2004Si27 in ^{64}Ni(^{64}Ni,4npγ) propose the 328-keV level (proposed by 2000Gi12 as a separate level) to be the isomeric $(9/2^+)$ bandhead, based on the intensity balance of the feeding and de-exciting γ transitions (96.5γ and 233.5γ de-exciting the 328-keV level are seen in 2004Si26 with a thick target but not seen in 2004Si27 with a thin target due to ^{123}Cs nuclei recoiling into vacuum after reaction and decaying out of the detectors, supporting the 328-keV level being an isomer).

The level scheme here is based on that of 2000Gi12, 2004Si26 and 2004Si27, that is adopted in Adopted Levels, Gammas.

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0	$1/2^{(+)}$		
30.4 *6*	$(3/2^+)$		E(level): Rounded value from Adopted Levels.
94.7 *3*	$5/2^{(+)}$		
156.4[a] *11*	$11/2^{(-)}$	1.7 s *2*	$T_{1/2}$: from Adopted Levels.
231.6[#] *5*	$(7/2^+)$		E(level): level proposed by 2000Gi12. This level is not reported in 1979Ga02 and other studies in this dataset. The de-exciting 137γ and 201γ are placed from a 296-keV level as the bandhead of the band based on $1g_{9/2}$ by 1979Ga02. see detailed comments above.
328.2[@] *8*	$(9/2^+)$	114 ns *5*	E(level): bandhead of the band based on $1g_{9/2}$. 1979Ga02 propose the $(9/2^+)$ bandhead at a 296 level (also 1992Hu02 in ^{108}Pd(^{19}F,4nγ)), de-excited by the 137γ and 201γ; 2000Gi12 proposed this bandhead at a 231.6+x level with an isomeric halflife; 2004Si26 and 2004Si27 propose the isomeric bandhead is the same level as the 328 level also seen in 2000Gi12. See detailed comments above. $T_{1/2}$: from 137γ(t) and 201γ(t) for the 231.6+x isomer in 2000Gi12.
476.9[a] *11*	$(15/2^-)$		
597.3[&] *9*	$(11/2^+)$		

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^{116}Sn(^{10}B,3nγ),^{114}Sn(^{12}C,p2nγ) 1979Ga02,1978Yo03,2000Gi12 (continued)

^{123}Cs Levels (continued)

E(level)†	Jπ‡	Comments
659.6# *6*	(11/2+)	
900.8@ *9*	(13/2+)	
999.1a *12*	(19/2−)	
1159.4 *12*	(17/2−)	
1237.7& *9*	(15/2+)	
1258.6# *12*	(15/2+)	
1593.4 *12*	(19/2−)	
1605.2@ *9*	(17/2+)	
1684.3a *12*	(23/2−)	
1729.3 *12*	(21/2−)	
1993.9& *10*	(19/2+)	
2298?		
2484.4a *12*	(27/2−)	
3352.4a *13*	(31/2−)	E(level): level from 1978Yo03, not reported in 1979Ga02.

† From a least-squares fit to γ-ray energies, unless otherwise noted.
‡ From Adopted Levels. Energies are rounded values.
# Band(A): Band 1 based on (7/2+). 1979Ga02 constructed this band based on a 296-keV level from which they claim the 137γ and 201γ are from. Now the bandhead is adopted to be the 232 level that is deexcited by the 137γ and 201γ. See detailed comments for the 232 and 328 levels.
@ Band(B): Band 2 based on (9/2+), α=+1/2. 1979Ga02 constructed this band based on a 296-keV level. Now the bandhead is adopted to be the 328 level.
& Band(b): Band 3 based on (9/2+), α=−1/2.
a Band(C): Band 4 based on 11/2(−).

γ(^{123}Cs)

Eγ†	Iγ†	Ei(level)	Jiπ	Ef	Jfπ	Mult.‡	δ‡	Comments
61.7		156.4	11/2(−)	94.7	5/2(+)	[E3]		Eγ: from Adopted Gammas. other: 64 from 1979Ga02.
94.7 *3*		94.7	5/2(+)	0.0	1/2(+)			Eγ: doublet in 1979Ga02; could include the 96.5γ from 328 level.
96.5@		328.2	(9/2+)	231.6	(7/2+)			
136.9# *3*	10	231.6	(7/2+)	94.7	5/2(+)			A2=−0.30 *5* (1979Ga02).
201.2# *3*	16	231.6	(7/2+)	30.4	(3/2+)			A2=+0.30 *15*, A4=+0.03 *18* (1979Ga02).
233.5@		328.2	(9/2+)	94.7	5/2(+)			
269.0 *3*	21	597.3	(11/2+)	328.2	(9/2+)	D+Q	≈+0.2	Eγ,Iγ: other: Eγ=269.1, Iγ=16 (1978Yo03). Mult.,δ: A2=+0.13 *4*, A4=+0.02 *5* (1979Ga02). A2=+0.19 *7* (1978Yo03).
303.3 *3*	16	900.8	(13/2+)	597.3	(11/2+)	D+Q	≈+0.2	Eγ,Iγ: other: Eγ=303.7, Iγ=9 (1978Yo03). Mult.,δ: A2=+0.08 *5*, A4=−0.08 *7* (1979Ga02). A2=+0.12 *6* (1978Yo03).
320.5 *3*	100	476.9	(15/2−)	156.4	11/2(−)			Eγ: weighted average of 320.6 *3* (1979Ga02) and 320.4 *4* (1978Ti01). Other: 320.6 (1978Yo03). Iγ: other: 100 (1978Yo03). A2=+0.34 *8*, A4=−0.04 *10* (1979Ga02). A2=+0.32 *4* (1978Yo03). A2=+0.50 *10*, A4=−0.22 *13* (1978Ti01).
337.0 *3*	12	1237.7	(15/2+)	900.8	(13/2+)	D+Q	≈+0.2	Eγ,Iγ: other: Eγ=337.0, Iγ=7 (1978Yo03).

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^{116}Sn(^{10}B,3nγ),^{114}Sn(^{12}C,p2nγ) 1979Ga02,1978Yo03,2000Gi12 (continued)

γ(^{123}Cs) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
								Mult.,δ: A_2=+0.03 *4*, A_4=−0.02 *6* (1979Ga02). A_2=+0.15 *7* (1978Yo03).
367.4 *3*	5	1605.2	(17/2$^+$)	1237.7	(15/2$^+$)			E_γ,I_γ: other: Eγ=366.3, Iγ=5 (1978Yo03). A_2=+0.08 *5* (1979Ga02).
388.6 *3*	4	1993.9	(19/2$^+$)	1605.2	(17/2$^+$)			E_γ,I_γ: other: Eγ=388.8, Iγ=3 (1978Yo03). A_2=+0.04 *3* (1979Ga02).
428.0 *3*	10	659.6	(11/2$^+$)	231.6	(7/2$^+$)			E_γ: placed from a 724, (13/2$^+$) level in 1979Ga02. A_2=+0.30 *6*, A_4=+0.01 *8* (1979Ga02).
434.0 *3*	6	1593.4	(19/2$^-$)	1159.4	(17/2$^-$)			
522.2 *3*	69	999.1	(19/2$^-$)	476.9	(15/2$^-$)			E_γ: weighted average of 522.2 *3* (1979Ga02) and 522.3 *4* (1978Ti01). Other: 522.4 (1978Yo03). I_γ: other: 71 (1978Yo03). A_2=+0.35 *4*, A_4=−0.08 *5* (1979Ga02). A_2=+0.36 *4* (1979Ga02). A_2=+0.38 *3*, A_4=−0.10 *4* (1978Ti01).
572.8 *3*	9	900.8	(13/2$^+$)	328.2	(9/2$^+$)			E_γ,I_γ: other: Eγ=572.7, Iγ=9 (1978Yo03). A_2=+0.30 *3* (1979Ga02).
599		1258.6	(15/2$^+$)	659.6	(11/2$^+$)			E_γ: doublet in 1979Ga02; placed from a 1323 level in 1979Ga02.
640.3 *3*	9	1237.7	(15/2$^+$)	597.3	(11/2$^+$)			E_γ,I_γ: other: Eγ=640, Iγ=8 (1978Yo03). A_2=+0.15 *9* (1979Ga02).
682.5 *3*	20	1159.4	(17/2$^-$)	476.9	(15/2$^-$)			A_2=−0.29 *6*, A_4=−0.02 *8* (1979Ga02).
685.2 *3*	36	1684.3	(23/2$^-$)	999.1	(19/2$^-$)			E_γ: weighted average of 685.2 *3* (1979Ga02) and 685.3 *4* (1978Ti01). Other: 685.5 (1978Yo03). I_γ: other: 36 (1978Yo03). A_2=+0.30 *4*, A_4=−0.03 *5* (1979Ga02). A_2=+0.31 *1* (1978Yo03). A_2=+0.46 *5*, A_4=−0.10 *6* (1978Ti01).
701[&]		2298?		1593.4	(19/2$^-$)			
705		1605.2	(17/2$^+$)	900.8	(13/2$^+$)			E_γ: other: 703 (1978Yo03). I_γ: I(703γ)/I(367γ)=8/5 (1978Yo03).
730.2 *3*	15	1729.3	(21/2$^-$)	999.1	(19/2$^-$)	D+Q	≈−0.27	E_γ,I_γ: other: Eγ=730.7, Iγ=14 (1978Yo03). Mult.: A_2=−0.60 *5*, A_4=+0.17 *9* (1979Ga02). A_2=−0.51 *3* (1978Yo03).
757		1993.9	(19/2$^+$)	1237.7	(15/2$^+$)			E_γ: weak γ in 1979Ga02. Other: 755 (1978Yo03). I_γ: I(755γ)/I(388.8γ)=9/3 (1978Yo03).
800.1 *3*	14	2484.4	(27/2$^-$)	1684.3	(23/2$^-$)			E_γ: weighted average of 800.0 *3* (1979Ga02) and 800.3 *4* (1978Ti01). Other: 800.7 (1978Yo03). I_γ: other: 20 (1978Yo03). A_2=+0.23 *5*, A_4=−0.09 *7* (1979Ga02). A_2=+0.13 *20* (1978Yo03). A_2=+0.40 *7*, A_4=+0.22 *9* (1978Ti01) (A_4>0 inconsistent with ΔJ=2).
868.0 *4*		3352.4	(31/2$^-$)	2484.4	(27/2$^-$)			E_γ: from 1978Ti01. Other: 870 from 1978Yo03. I_γ: 7 (1978Yo03). A_2=+0.37 *18* (1978Yo03). A_2=+0.30 *16*, A_4=+0.21 *19* (1978Ti01) (A_4>0 inconsistent with ΔJ=2).

[†] From 1979Ga02, unless otherwise noted.
[‡] From $\gamma(\theta)$ in 1979Ga02, unless otherwise noted.
[#] This γ is placed from a 296-keV level by 1979Ga02 and the placement here is from 2000Gi12.
[@] Rounded values from Adopted Gammas; not reported by 1979Ga02 and 2000Gi12.
[&] Placement of transition in the level scheme is uncertain.

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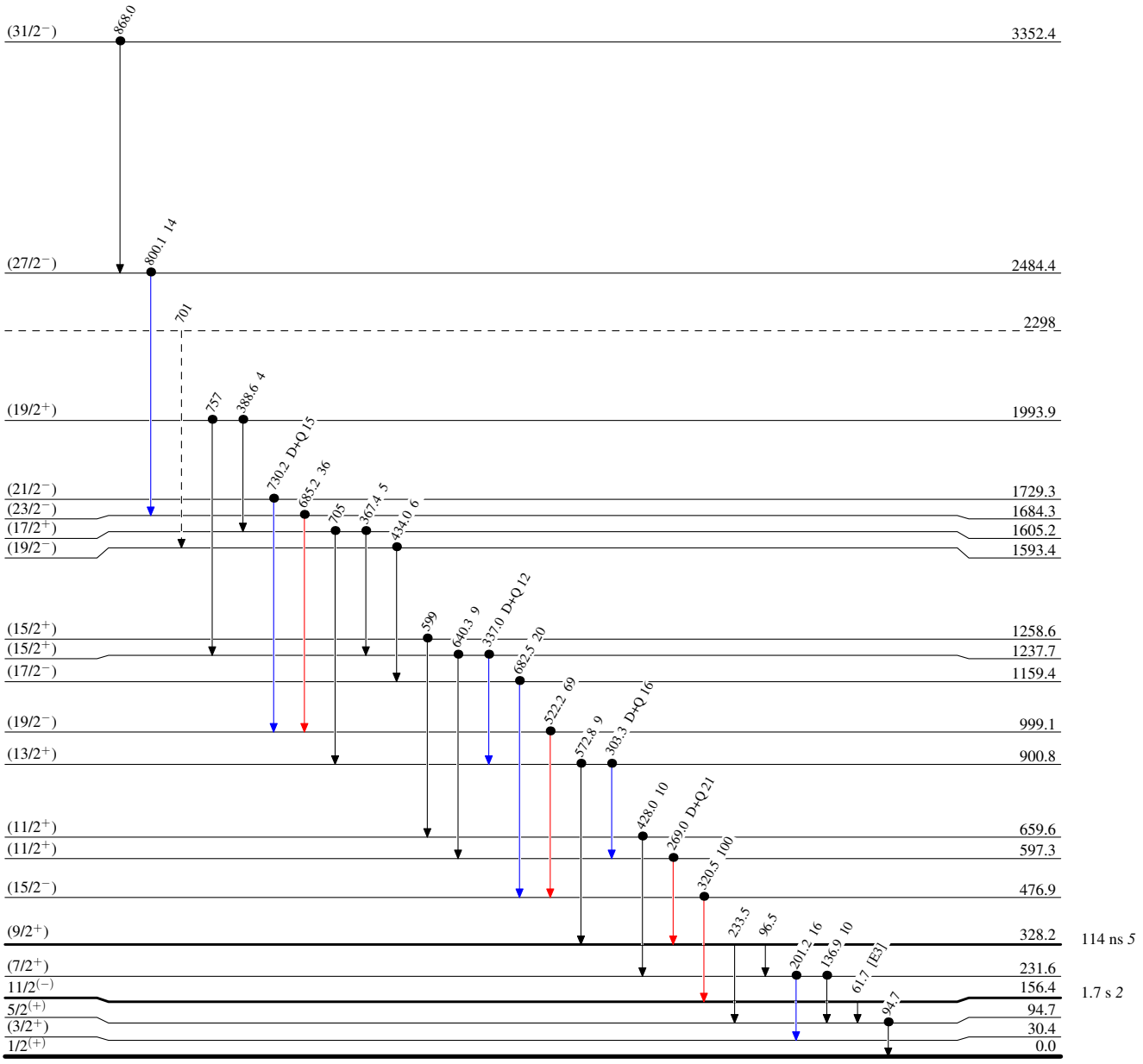
Level Scheme

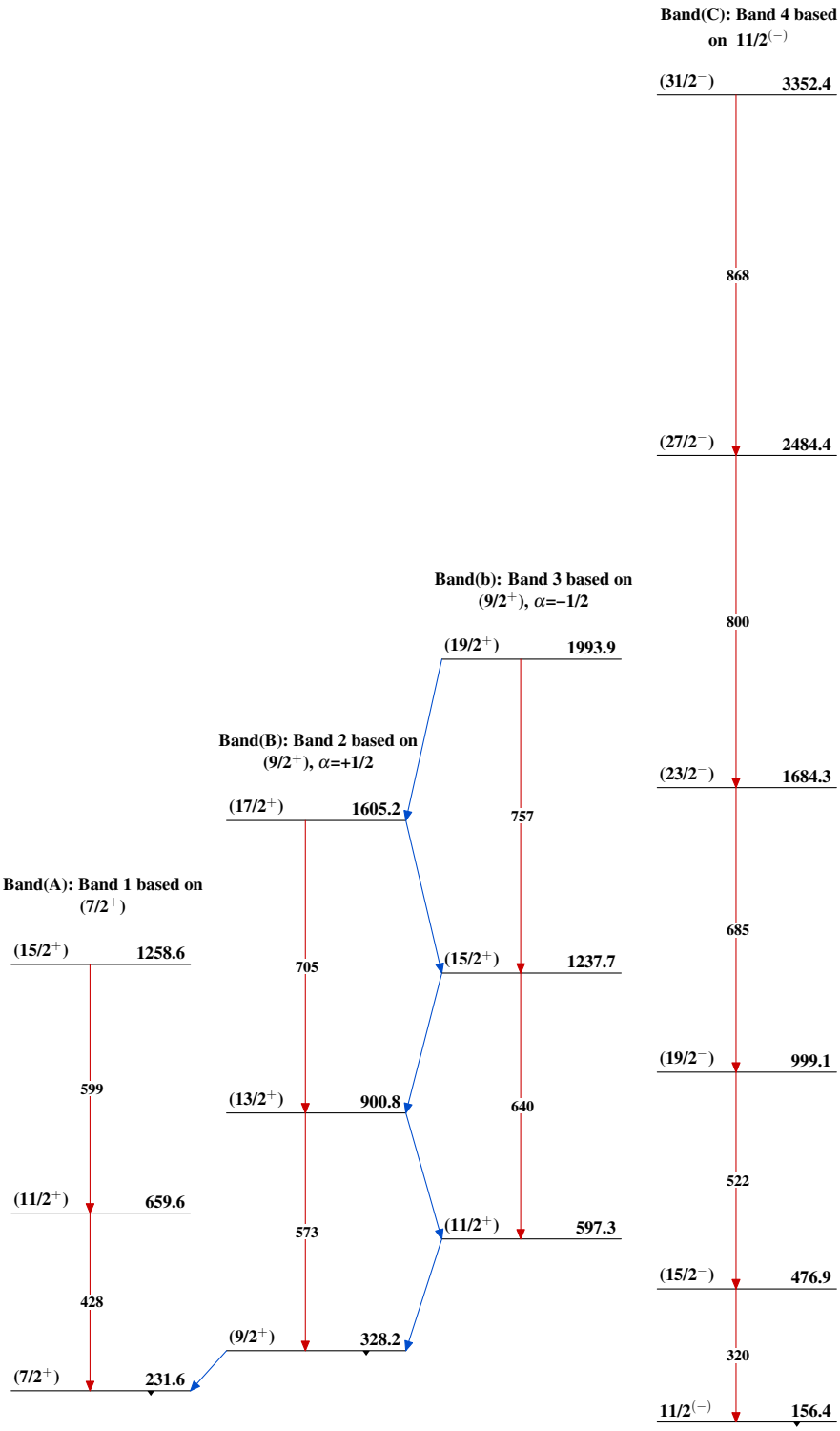
Intensities: Relative I_γ

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence



$^{123}_{55}Cs_{68}$

^{116}Sn(^{10}B,3nγ),^{114}Sn(^{12}C,p2nγ) 1979Ga02,1978Yo03,2000Gi12



$^{123}_{55}Cs_{68}$