

$^{46}\text{Ti}(^{58}\text{Ni},2\text{p}2\text{n}\gamma)$ 2000CI01,1994Go38,1992AI17

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen		NDS 172, 1 (2021)	31-Jan-2021

[2000CI01](#): E=215 MeV ^{58}Ni beam was produced from the ATLAS accelerator at ANL. Target was a foil of ≈ 1.0 mg/cm² 86% enriched ^{46}Ti on a ≈ 12 mg/cm² Au backing. γ rays were detected with the Gammasphere array of 88 Compton-suppressed Ge detectors, light-charged particles were detected with the Microball array of 4π CsI detectors, neutrons were detected with 20 liquid scintillators. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin, $\gamma\gamma\gamma$ -coin, $\text{n}\gamma\gamma$ -coin, $\gamma(\theta)$. Deduced levels, J, π , band structures. Comparisons with shell-model calculations.

[1994Go38](#) (also [1996Go15](#),[1995Gr10](#),[1995Sc34](#)), [1992AI17](#), [1987AI08](#): E=230 MeV ^{58}Ni beam was produced from the tandem-cyclotron combination of VICKSI. Target was 1.5 mg/cm² ^{46}Ti on 32 mg/cm² Nb backings. γ rays were detected with the OSIRIS array of 12 BGO-shielded HPGe detectors. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin, $\text{n}\gamma$ -coin, particle- γ -coin, $\gamma(\text{t})$. Deduced levels. A total of 13 γ rays reported by [1994Go38](#) and seven γ rays by [1992AI17](#) placed amongst nine excited states up to 4344 level.

[1987Da15](#): $^{46}\text{Ti}(^{58}\text{Ni},\alpha)$, deduced coalescence radius.

Other: [1988Hu07](#).

 ^{100}Cd Levels

E(level) [†]	J ^π [‡]	T _{1/2}	Comments
0.0 [#]	0 ⁺		
1004.11 [#] 20	2 ⁺		
1799.13 [#] 25	4 ⁺		
2046.30 25	4 ⁺		
2095.4 [#] 3	6 ⁺		
2457.7 3	6 ⁺		
2548.1 [#] 3	8 ⁺	58 ns 4	g=1.24 6 (1992AI17) T _{1/2} : from $\gamma(\text{t})$, weighted average of 60 ns 3 (1994Go38) and 52 ns 5 (1992AI17). Other: 40 ns +20-10 (1987AI08). g factor from DPAD method with correction for Knight shift and diamagnetic shift (1992AI17).
3656.7 [@] 4	(10 ⁺)		
4118.4 [@] 4	(11 ⁺)		
4344.2 [@] 4	(12 ⁺)		
4855.2 4	(12)		
5319.2 9	(12)		
5507.9 5	(14)		
6258.6 6	(14)		
6460.3 ^b 10	(13)		
6953.4 ^{&} 5	(14)		
6978.1 ^b 10	(14)		
7171.9 ^b 10	(15)		
7364.9 ^a 6	(14)		
7747.8 ^{&} 5	(15)		
7910.8 ^a 6	(16)		
8349.4 ^{&} 6	(17)		
8560.3 ^a 6	(17)		
8823.4 ^{&} 6	(18)		
8947.3 ^a 6	(18)		
9388.2 ^{&} 6	(20)		

[†] From least-squares fit to $E\gamma$ data.

[‡] As proposed by [2000CI01](#) based on $\gamma(\theta)$ data, the assignments in Adopted Levels are the same, except that most are placed in

$^{46}\text{Ti}(^{58}\text{Ni},2\text{p}2\text{n}\gamma)$ 2000CI01,1994Go38,1992AI17 (continued) ^{100}Cd Levels (continued)

parentheses there due to lack of strong supporting arguments.

Band(A): g.s. band.

@ Seq.(B): γ cascade based on (10⁺).

& Seq.(C): γ cascade based on (14).

^a Seq.(D): γ cascade based on (14).

^b Seq.(E): γ cascade based on (13).

$\gamma(^{100}\text{Cd})$								Comments
E_γ ‡	I_γ ‡	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. †	α @	
90.7 1	4.0# 17	2548.1	8 ⁺	2457.7	6 ⁺	[E2]	2.116 8	E_γ : weighted average of 90.7 1 (2000CI01) and 90.4 3 (1994Go38). I_γ : unweighted average of 5.6 8 (2000CI01) and 2.3 4 (1994Go38). R=1.21 10.
193.8 1	3.9 2	7171.9	(15)	6978.1	(14)	D		E_γ =226 (1994Go38). I_γ =55 6 (1992AI17). R=1.29 2.
225.8 1	37.2 5	4344.2	(12 ⁺)	4118.4	(11 ⁺)	D		
247.3 1	0.6# 3	2046.30	4 ⁺	1799.13	4 ⁺			E_γ : weighted average of 247.3 1 (2000CI01) and 247.1 3 (1994Go38). I_γ : weighted average of 1.0 3 (2000CI01) and 0.4 2 (1994Go38). $I_\gamma(247\gamma)/I_\gamma(1042\gamma)$ =0.4 2/1.9 11 (1994Go38).
296.1 1	92# 3	2095.4	6 ⁺	1799.13	4 ⁺			E_γ : weighted average of 296.1 1 (2000CI01) and 296.1 3 (1994Go38). I_γ : weighted average of 88 3 (2000CI01), 95 3 (1994Go38) and 102 10 (1992AI17).
362.4 1	9.5# 9	2457.7	6 ⁺	2095.4	6 ⁺			E_γ : weighted average of 362.4 1 (2000CI01) and 362.2 3 (1994Go38). I_γ : weighted average of 8.6 9 (2000CI01) and 10.3 8 (1994Go38). R=1.32 7.
386.9 1	5.3 2	8947.3	(18)	8560.3	(17)	D		E_γ : weighted average of 411.5 1 (2000CI01) and 411.5 3 (1994Go38). I_γ : weighted average of 3.1 4 (2000CI01) and 2.4 8 (1994Go38). R=0.91 5.
411.5 1	3.0# 4	2457.7	6 ⁺	2046.30	4 ⁺			
440.8 2	5.4 2	9388.2	(20)	8947.3	(18)	Q		
452.5 1	86.4# 25	2548.1	8 ⁺	2095.4	6 ⁺			E_γ : weighted average of 452.5 1 (2000CI01) and 452.5 3 (1994Go38). I_γ : unweighted average of 85 3 (2000CI01) and 87.4 25 (1994Go38). Other: 111 11 (1992AI17).
461.7 1	100.0 10	4118.4	(11 ⁺)	3656.7	(10 ⁺)	D		Ordering of 1108.6-461.7 is reversed in earlier (1994Go38) studies. E_γ =463 (1994Go38). I_γ =86 9 (1992AI17). R=1.30 2.
474.0 1	6.8 3	8823.4	(18)	8349.4	(17)	D		R=1.26 6.
517.8 1	5.1 2	6978.1	(14)	6460.3	(13)	D		R=1.52 8.
545.8 2	3.7 2	7910.8	(16)	7364.9	(14)	Q		R=1.07 8.
564.9 2	4.1 2	9388.2	(20)	8823.4	(18)	Q		R=0.89 6.
596.9 6	1.8 5	8947.3	(18)	8349.4	(17)	(D)		R=1.16 18.
601.6 2	9.1 4	8349.4	(17)	7747.8	(15)	Q		R=1.02 5.
649.5 2	4.9 3	8560.3	(17)	7910.8	(16)	D		R=1.31 17.
658.5 2	4.1# 5	2457.7	6 ⁺	1799.13	4 ⁺			E_γ : weighted average of 658.5 2 (2000CI01) and 658.5 3 (1994Go38).

Continued on next page (footnotes at end of table)

$^{46}\text{Ti}(^{58}\text{Ni}, 2\text{p}2\text{n}\gamma)$ **2000CI01, 1994Go38, 1992AI17** (continued) $\gamma(^{100}\text{Cd})$ (continued)

E_γ [‡]	I_γ [‡]	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. [†]	Comments
							I_γ : weighted average of 4.2 5 (2000CI01) and 3.8 9 (1994Go38).
736.8 2	10.8 3	4855.2	(12)	4118.4	(11 ⁺)	D	R=1.30 6.
750.7 3	5.5 3	6258.6	(14)	5507.9	(14)	D	Mult.: $\Delta J=0$ transition.
794.5 2	17.6 4	7747.8	(15)	6953.4	(14)	D	R=1.03 21.
795.1 2	96 [#] 3	1799.13	4 ⁺	1004.11	2 ⁺		R=1.45 3.
							E_γ : weighted average of 795.0 2 (2000CI01) and 795.2 3 (1994Go38).
							I_γ : weighted average of 94 3 (2000CI01) and 98 3 (1994Go38).
812.6 3	7.2 3	8560.3	(17)	7747.8	(15)	Q	R=0.93 7.
1004.2 2	100 [#] 3	1004.11	2 ⁺	0.0	0 ⁺		E_γ : weighted average of 1004.1 2 (2000CI01) and 1004.5 3 (1994Go38).
							I_γ : from 1994Go38. Other: 100 4 (2000CI01).
1042.3 2	2.4 [#] 6	2046.30	4 ⁺	1004.11	2 ⁺		E_γ : weighted average of 1042.2 2 (2000CI01) and 1042.5 3 (1994Go38).
							I_γ : weighted average of 2.6 6 (2000CI01) and 1.9 11 (1994Go38).
1108.6 2	36 10	3656.7	(10 ⁺)	2548.1	8 ⁺	Q	I_γ : from 1992AI17.
							Ordering of 1108.6-461.7 is reversed in earlier (1994Go38) studies.
							Additional information 1.
							R=0.85 2.
1141.1 9	1.3 2	6460.3	(13)	5319.2	(12)	D	R=1.28 14.
1163.7 3	11.5 4	5507.9	(14)	4344.2	(12 ⁺)	Q	R=1.03 5.
1200.7 10	2.3 3	5319.2	(12)	4118.4	(11 ⁺)		
1445.8 10	1.5 3	6953.4	(14)	5507.9	(14)		
1652.2 11	2.5 3	7910.8	(16)	6258.6	(14)		
1914.4 12	1.2 2	6258.6	(14)	4344.2	(12 ⁺)		
2098.7 7	4.9 6	6953.4	(14)	4855.2	(12)	Q	R=1.02 12.
2116.3 12	3.9 6	6460.3	(13)	4344.2	(12 ⁺)	D	R=1.36 29.
2508.4 9	2.9 3	7364.9	(14)	4855.2	(12)	Q	R=1.06 15.
2609.1 4	17.1 4	6953.4	(14)	4344.2	(12 ⁺)	Q	$A_2=+0.24$ 3; $A_4=-0.05$ 3
							R=0.75 3.
							Mult.: E3 multipolarity is ruled out for which expected $A_2=+0.55$.

[†] From 2000CI01 based on $R=I_\gamma(90^\circ)/I_\gamma(150^\circ)$, where $R=0.94$ 5 indicates $\Delta J=2$, quadrupole transition and $R=1.27$ 5 indicates $\Delta J=1$, dipole transition. The mult=Q refers to $\Delta J=2$, stretched quadrupole (most likely E2), mult=D refers to $\Delta J=1$ (in one case $\Delta J=0$), dipole with possible quadrupole admixture (most likely M1+E2).

[‡] From 2000CI01, unless otherwise noted. Prompt intensities are normalized to 100 for 461.7 γ from 4118 level. Delayed intensities are normalized to 100 for 1004.1 γ from 1004 level.

[#] From delayed- γ spectrum and normalized separately to 100 for 1004.1 γ (2000CI01, 1994Go38).

[@] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

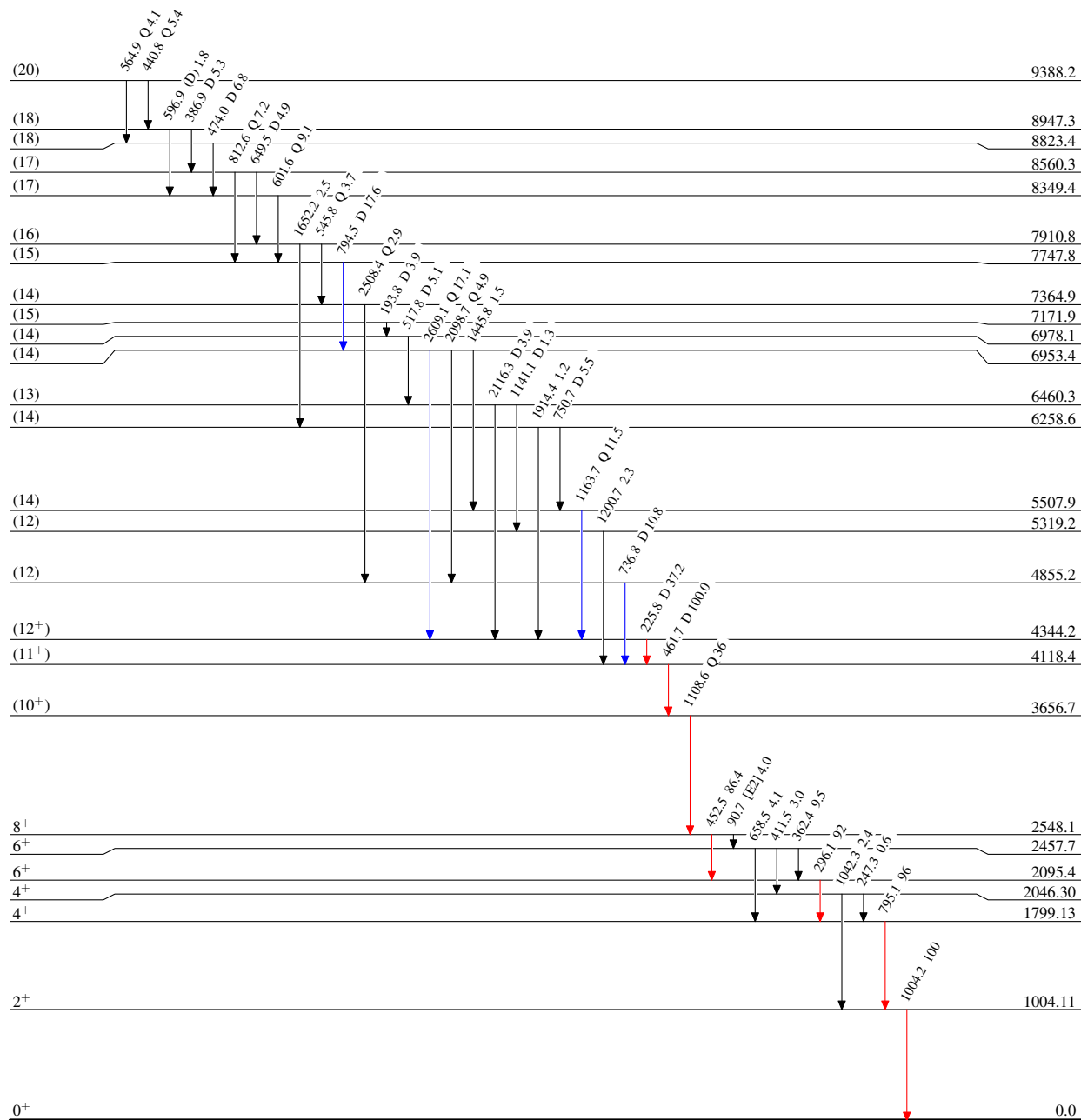
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Level Scheme

Intensities: Relative I_γ

Legend

- $\longrightarrow$ $I_\gamma < 2\% \times I_\gamma^{\text{max}}$
 $\longrightarrow$ $I_\gamma < 10\% \times I_\gamma^{\text{max}}$
 $\longrightarrow$ $I_\gamma > 10\% \times I_\gamma^{\text{max}}$



58 ns 4

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