

$^{160}\text{Gd}(^{19}\text{F},4\text{n}\gamma)$ 1996We07,1991Sh13

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia		NDS 102, 719 (2004)	1-Jun-2004

Target: Isotopically enriched metallic ^{160}Gd . Projectile: ^{19}F , E=87 MeV beam. Measured $\gamma\gamma$ -coin., I γ , DCO ratio, branching ratio; deduced high spin levels, J, π . Detector: 4 HPGe-BGO Compton-suppressed spectrometer.

Same first author in 1996We07 and 1991Sh13, other 12 out of 15 from 1996We07 are common.

 ^{175}Ta Levels

E(level) [†]	J π [‡]	Comments
0.0&	7/2 ⁺	
36.4@	5/2 ⁺	Additional information 1.
51.5#	5/2 ⁻	Additional information 2.
126.0# 10	9/2 ⁻	
129.9& 8	9/2 ⁺	
132.3 ^a 10	9/2 ⁻	
142.5@ 8	7/2 ⁺	
276.2@ 8	9/2 ⁺	
277.3 ^a 13	11/2 ⁻	
283.4& 8	11/2 ⁺	
298.1# 15	13/2 ⁻	
435.6@ 9	11/2 ⁺	
447.5 ^a 13	13/2 ⁻	
461.2& 9	13/2 ⁺	
572.1# 18	17/2 ⁻	
619.7@ 10	13/2 ⁺	
641.2 ^a 14	15/2 ⁻	
655.8& 10	15/2 ⁺	
825.7@ 11	15/2 ⁺	
858.0 ^a 15	17/2 ⁻	
872.4& 11	17/2 ⁺	
943.5# 20	21/2 ⁻	
1052.0@ 11	17/2 ⁺	
1094.7 ^a 15	19/2 ⁻	
1098.7& 11	19/2 ⁺	
1297.1@ 12	19/2 ⁺	
1340.9& 12	21/2 ⁺	
1351.5 ^a 16	21/2 ⁻	
1405.2# 23	25/2 ⁻	
1556.9@ 12	21/2 ⁺	
1589.5& 12	23/2 ⁺	
1623.2 ^a 17	23/2 ⁻	
1831.6@ 12	23/2 ⁺	
1850.0& 13	25/2 ⁺	
1911.5 ^a 17	25/2 ⁻	
1948.9# 25	29/2 ⁻	
2115.5@ 14	25/2 ⁺	
2116.1& 12	27/2 ⁺	

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$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ **1996We07,1991Sh13** (continued)

^{175}Ta Levels (continued)

E(level) [†]	J ^π [‡]	Comments
2209.0 ^a 18	27/2 ⁻	
2393.8 ^{&} 14	29/2 ⁺	
2405.5 [@] 13	27/2 ⁺	
2533.9 ^a	29/2 ⁻	Additional information 3. Not adopted: 623 γ placement uncertain for this level, and E γ differs from the 605.3 γ depopulating the 29/2 ⁻ state in $^{170}\text{Er}(^{10}\text{B},5n\gamma)$.
2566 [#] 3	33/2 ⁻	
2678.9 ^{&} 14	31/2 ⁺	
2870.6 ^a	31/2 ⁻	Additional information 4. Not adopted: 662 γ placement uncertain for this level, and E γ differs from the 619 γ depopulating the 31/2 ⁻ state in $^{170}\text{Er}(^{10}\text{B},5n\gamma)$.
2979.1 ^{&} 15	33/2 ⁺	
3248 [#] 3	37/2 ⁻	
3286.3 ^{&} 17	35/2 ⁺	
3610.1 ^{&} 18	37/2 ⁺	
3945.4 ^{&} 20	39/2 ⁺	
3990 [#] 3	41/2 ⁻	
4295.1 ^{&} 21	41/2 ⁺	
4661.5 [?] ^{&}	43/2 ⁺	Additional information 5.
4782 [#] 4	45/2 ⁻	
5027.1 [?] ^{&}	45/2 ⁺	Additional information 6.
5514 [#] 4	49/2 ⁻	
6265 [#] 4	53/2 ⁻	
7087 [#] 4	57/2 ⁻	
7998 [#] 4	61/2 ⁻	

[†] Deduced by evaluator from a least-squares fit to γ -ray energies, assuming $\Delta E=1$ keV for all γ -transitions.

[‡] Assigned in accordance with the angular momentum selection rule $I=\alpha_i \bmod 2$ and a systematic comparison with [1972Fo20](#).

[#] 1/2(541) band.

[@] 5/2(402) band.

[&] 7/2(404) band.

^a 9/2(514) band.

$\gamma(^{175}\text{Ta})$

E γ ^{†b}	I γ [@]	E _i (level)	J _i ^π	E _f	J _f ^π	Mult. ^a	DCO ratio
15.0 ^{#c}		51.5	5/2 ⁻	36.4	5/2 ⁺		
36.4 ^{#c}		36.4	5/2 ⁺	0.0	7/2 ⁺		
51.4 ^{#c}		51.5	5/2 ⁻	0.0	7/2 ⁺		
74.5 [‡]		126.0	9/2 ⁻	51.5	5/2 ⁻	[E2]	
106.0	17	142.5	7/2 ⁺	36.4	5/2 ⁺		
130.0	32	129.9	9/2 ⁺	0.0	7/2 ⁺		0.47 12
132.3	30	132.3	9/2 ⁻	0.0	7/2 ⁺		0.51 13
133.7	32	276.2	9/2 ⁺	142.5	7/2 ⁺		0.47 22
145.0	68	277.3	11/2 ⁻	132.3	9/2 ⁻		0.49 12
153.5	23	283.4	11/2 ⁺	129.9	9/2 ⁺		0.52 14

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$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ **1996We07,1991Sh13 (continued)** $\gamma(^{175}\text{Ta})$ (continued)

E_γ †b	I_γ @	E_i (level)	J_i^π	E_f	J_f^π	DCO ratio	Comments
159.6	24	435.6	11/2 ⁺	276.2	9/2 ⁺	0.4 3	
170.1	75	447.5	13/2 ⁻	277.3	11/2 ⁻	0.40 12	
172.1	91	298.1	13/2 ⁻	126.0	9/2 ⁻	1.04 12	
177.6	19	461.2	13/2 ⁺	283.4	11/2 ⁺	0.41 19	
184.4	29	619.7	13/2 ⁺	435.6	11/2 ⁺	0.50 25	
193.6	80	641.2	15/2 ⁻	447.5	13/2 ⁻	0.37 12	
194.5	16	655.8	15/2 ⁺	461.2	13/2 ⁺	0.37 19	
206.2	42	825.7	15/2 ⁺	619.7	13/2 ⁺	0.3 3	
216.1	6	872.4	17/2 ⁺	655.8	15/2 ⁺	0.57 21	
216.8	60	858.0	17/2 ⁻	641.2	15/2 ⁻	0.47 13	
226.0	6	1098.7	19/2 ⁺	872.4	17/2 ⁺	0.42 23	
226.1	22	1052.0	17/2 ⁺	825.7	15/2 ⁺	0.4 3	
236.7	45	1094.7	19/2 ⁻	858.0	17/2 ⁻	0.57 13	
240.0	7	276.2	9/2 ⁺	36.4	5/2 ⁺	0.89 19	$I_\gamma(133.7\gamma):I_\gamma(240.0\gamma)=1.00:0.18(4)$ from Branching ratio in 1996We07 .
242.3 ‡	7	1340.9	21/2 ⁺	1098.7	19/2 ⁺	0.40 20	
244.8	16	1297.1	19/2 ⁺	1052.0	17/2 ⁺	0.2 4	
248.5 ‡	6	1589.5	23/2 ⁺	1340.9	21/2 ⁺	0.38 19	
256.7	16	1351.5	21/2 ⁻	1094.7	19/2 ⁻	0.39 14	
260.0	4	1556.9	21/2 ⁺	1297.1	19/2 ⁺	0.2 4	
260.5 ‡	4	1850.0	25/2 ⁺	1589.5	23/2 ⁺	0.52 25	
266.1 ‡	2	2116.1	27/2 ⁺	1850.0	25/2 ⁺	0.4 3	E_γ : From Fig. 1, it is misprinted as 226.1 keV in Table 1 (1996We07).
271.6	6	1623.2	23/2 ⁻	1351.5	21/2 ⁻		
274.0	100	572.1	17/2 ⁻	298.1	13/2 ⁻		
274.7	<2&	1831.6	23/2 ⁺	1556.9	21/2 ⁺		
277.7 ‡	<1&	2393.8	29/2 ⁺	2116.1	27/2 ⁺		
283.2	24	283.4	11/2 ⁺	0.0	7/2 ⁺	1.03 14	$I_\gamma(153.5\gamma):I_\gamma(283.2\gamma)=1.00:1.03(14)$ from Branching ratio in 1996We07 .
283.7	<2&	2115.5	25/2 ⁺	1831.6	23/2 ⁺		
285.1 ‡	<1&	2678.9	31/2 ⁺	2393.8	29/2 ⁺		
288.1	5	1911.5	25/2 ⁻	1623.2	23/2 ⁻		
289.3	<1&	2405.5	27/2 ⁺	2116.1	27/2 ⁺		
293.0 ‡	18	435.6	11/2 ⁺	142.5	7/2 ⁺	0.92 16	$I_\gamma(159.6\gamma):I_\gamma(293.0\gamma)=1.00:0.75$. Branching ratio=1.00:0.35(7) for the same γ 's deduced from measured λ data in 1996We07 .
297.3	4	2209.0	27/2 ⁻	1911.5	25/2 ⁻		
300.2 ‡	<2&	2979.1	33/2 ⁺	2678.9	31/2 ⁺		
315.2	16	447.5	13/2 ⁻	132.3	9/2 ⁻	1.10 16	$I_\gamma(170.1\gamma):I_\gamma(315.2\gamma)=1.00:0.30(1)$ from Branching ratio in 1996We07 .
331.5	38	461.2	13/2 ⁺	129.9	9/2 ⁺	1.10 16	$I_\gamma(177.6\gamma):I_\gamma(331.5\gamma)=1.00:1.80(20)$ from Branching ratio in 1996We07 .
343.4	16	619.7	13/2 ⁺	276.2	9/2 ⁺	0.92 16	$I_\gamma(184.4\gamma):I_\gamma(343.4\gamma)=1.00:0.59(8)$ from Branching ratio in 1996We07 .
364.0	26	641.2	15/2 ⁻	277.3	11/2 ⁻	1.02 14	$I_\gamma(193.6\gamma):I_\gamma(364.0\gamma)=1.00:0.50(9)$ from Branching ratio in 1996We07 .
371.4	73	943.5	21/2 ⁻	572.1	17/2 ⁻	1.12 14	
372.4	37	655.8	15/2 ⁺	283.4	11/2 ⁺	1.12 21	$I_\gamma(194.5\gamma):I_\gamma(372.4\gamma)=1.00:2.31$. Branching ratio=1.00:2.90(32) for the same γ 's deduced from measured λ data in 1996We07 .
390.0	36	825.7	15/2 ⁺	435.6	11/2 ⁺	0.96 12	$I_\gamma(206.2\gamma):I_\gamma(390.0\gamma)=1.00:0.86(12)$ from Branching ratio in 1996We07 .
410.5	22	858.0	17/2 ⁻	447.5	13/2 ⁻	0.93 12	$I_\gamma(216.8\gamma):I_\gamma(410.5\gamma)=1.00:0.37$. Branching

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$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ **1996We07,1991Sh13 (continued)** $\gamma(^{175}\text{Ta})$ (continued)

E_γ † ^b	I_γ @	E_i (level)	J_i^π	E_f	J_f^π	DCO ratio	Comments
411.1	43	872.4	17/2 ⁺	461.2	13/2 ⁺	0.91 14	ratio=1.00:0.54(8) for the same γ 's deduced from measured λ data in 1996We07.
432.3	33	1052.0	17/2 ⁺	619.7	13/2 ⁺	1.03 13	$I_\gamma(216.1\gamma):I_\gamma(411.1\gamma)=1.0:7.2$. Branching ratio=1.0:3.5(3) for the same γ 's deduced from measured λ data in 1996We07.
443.3	32	1098.7	19/2 ⁺	655.8	15/2 ⁺	0.96 16	$I_\gamma(226.0\gamma):I_\gamma(443.3\gamma)=1.0:4.2$ (5) from Branching ratio in 1996We07.
453.4	23	1094.7	19/2 ⁻	641.2	15/2 ⁻	1.10 15	$I_\gamma(236.7\gamma):I_\gamma(453.4\gamma)=1.00:0.90$ (13) from Branching ratio in 1996We07.
461.7	61	1405.2	25/2 ⁻	943.5	21/2 ⁻	0.96 18	$I_\gamma(242.3\gamma):I_\gamma(468.4\gamma)=1.0:5.1$. Branching ratio=1.0:3.1(3) for the same γ 's deduced from measured λ data in 1996We07.
468.4	36	1340.9	21/2 ⁺	872.4	17/2 ⁺	0.89 17	
471.7	32	1297.1	19/2 ⁺	825.7	15/2 ⁺	0.98 12	$I_\gamma(244.8\gamma):I_\gamma(471.7\gamma)=1.0:1.5$ (3) from Branching ratio in 1996We07.
490.8	28	1589.5	23/2 ⁺	1098.7	19/2 ⁺	0.99 19	$I_\gamma(248.5\gamma):I_\gamma(490.8\gamma)=1.0:4.7$. Branching ratio=1.0:2.4(3) for the same γ 's deduced from measured λ data in 1996We07.
493.6	15	1351.5	21/2 ⁻	858.0	17/2 ⁻	1.03 16	$I_\gamma(256.7\gamma):I_\gamma(493.6\gamma)=1.00:1.20$ (19) from Branching ratio in 1996We07.
505.0	20	1556.9	21/2 ⁺	1052.0	17/2 ⁺	1.06 15	$I_\gamma(260.0\gamma):I_\gamma(505.0\gamma)=1.0:5.0$. Branching ratio=1.0:2.0(3) for the same γ 's deduced from measured λ data in 1996We07.
509.0	34	1850.0	25/2 ⁺	1340.9	21/2 ⁺	0.98 11	$I_\gamma(260.5\gamma):I_\gamma(509.0\gamma)=1.00:8.50$. Branching ratio=1.00:2.20(25) for the same γ 's deduced from measured λ data in 1996We07.
526.6	20	2116.1	27/2 ⁺	1589.5	23/2 ⁺	1.04 15	$I_\gamma(266.1\gamma):I_\gamma(526.6\gamma)=1.00:10.00$. Branching ratio=1.00:3.20(24) for the same γ 's deduced from measured λ data in 1996We07.
528.6	35	1623.2	23/2 ⁻	1094.7	19/2 ⁻	0.98 13	$I_\gamma(271.6\gamma):I_\gamma(528.6\gamma)=1.00:5.83$. Branching ratio=1.00:1.60(24) for the same γ 's deduced from measured λ data in 1996We07.
534.4	23	1831.6	23/2 ⁺	1297.1	19/2 ⁺	1.06 15	$I_\gamma(274.7\gamma):I_\gamma(534.4\gamma)=1.0:2.0$ (5) from Branching ratio in 1996We07.
543.7	50	1948.9	29/2 ⁻	1405.2	25/2 ⁻	1.06 12	$I_\gamma(277.7\gamma):I_\gamma(543.8\gamma)=1.0:14.0$. Branching ratio=1.0:3.1(3) for the same γ 's deduced from measured λ data in 1996We07.
543.8	14	2393.8	29/2 ⁺	1850.0	25/2 ⁺	1.19 14	
558.8	14	2115.5	25/2 ⁺	1556.9	21/2 ⁺	1.10 18	$I_\gamma(288.1\gamma):I_\gamma(560.0\gamma)=1.00:4.00$. Branching ratio=1.00:2.41(6) for the same γ 's deduced from measured λ data in 1996We07.
560.0	20	1911.5	25/2 ⁻	1351.5	21/2 ⁻	1.25 14	
562.8	10	2678.9	31/2 ⁺	2116.1	27/2 ⁺	1.08 19	$I_\gamma(297.3\gamma):I_\gamma(586.0\gamma)=1.0:5.0$. Branching ratio=1.0:2.0(4) for the same γ 's deduced from measured λ data in 1996We07.
574.0	16	2405.5	27/2 ⁺	1831.6	23/2 ⁺	1.09 19	
585.3	10	2979.1	33/2 ⁺	2393.8	29/2 ⁺	0.96 19	
586.0	20	2209.0	27/2 ⁻	1623.2	23/2 ⁻	0.96 14	
607.4	60	3286.3	35/2 ⁺	2678.9	31/2 ⁺	1.02 25	
617.0	37	2566	33/2 ⁻	1948.9	29/2 ⁻	1.08 18	
623.0 ‡ ^c	10	2533.9?	29/2 ⁻	1911.5	25/2 ⁻	0.89 20	
631.0	7	3610.1	37/2 ⁺	2979.1	33/2 ⁺	0.99 23	
659.1	4	3945.4	39/2 ⁺	3286.3	35/2 ⁺	0.9 3	
662.0 ‡ ^c	<13 &	2870.6?	31/2 ⁻	2209.0	27/2 ⁻	0.92 19	

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$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ 1996We07,1991Sh13 (continued) $\gamma(^{175}\text{Ta})$ (continued)

E_γ ^{†b}	I_γ [@]	$E_i(\text{level})$	J_i^π	E_f	J_f^π	DCO ratio	Comments
682.2	25	3248	37/2 ⁻	2566	33/2 ⁻	1.09 19	
685.0	5	4295.1	41/2 ⁺	3610.1	37/2 ⁺	1.0 3	
716.0 ^{‡c}	<4 ^{&}	4661.5?	43/2 ⁺	3945.4	39/2 ⁺	1.1 3	716 γ weak transition placed at the top of 7/2[404] band.
732.0 ^{‡c}	<5 ^{&}	5027.1?	45/2 ⁺	4295.1	41/2 ⁺	1.1 4	732 γ Weak transition placed at the top of 7/2[404] band.
732.5	7	5514	49/2 ⁻	4782	45/2 ⁻	1.02 25	
741.6	14	3990	41/2 ⁻	3248	37/2 ⁻	1.00 22	
751.1	4	6265	53/2 ⁻	5514	49/2 ⁻	1.4 3	
792.0	10	4782	45/2 ⁻	3990	41/2 ⁻	0.90 23	
822.0	4	7087	57/2 ⁻	6265	53/2 ⁻	0.9 3	
911.0	2	7998	61/2 ⁻	7087	57/2 ⁻	1.2 4	

[†] Average from 1996We07 and 1991Sh13, except as noted. E_γ data for crossover transitions are identical in these studies but, for other transitions, E_γ data differ by as much as 2.2 keV.

[‡] From 1996We07.

[#] From 1991Sh13.

[@] In 1996We07. From a single spectrum, uncertainties between 5% and 50%.

[&] In 1996We07 given as '>', evaluator assigns '<'.

^a From 1996We07.

^b Uncertainties 0.5 keV, except for weak transitions and doublets whose uncertainty may be as high as 1 keV.

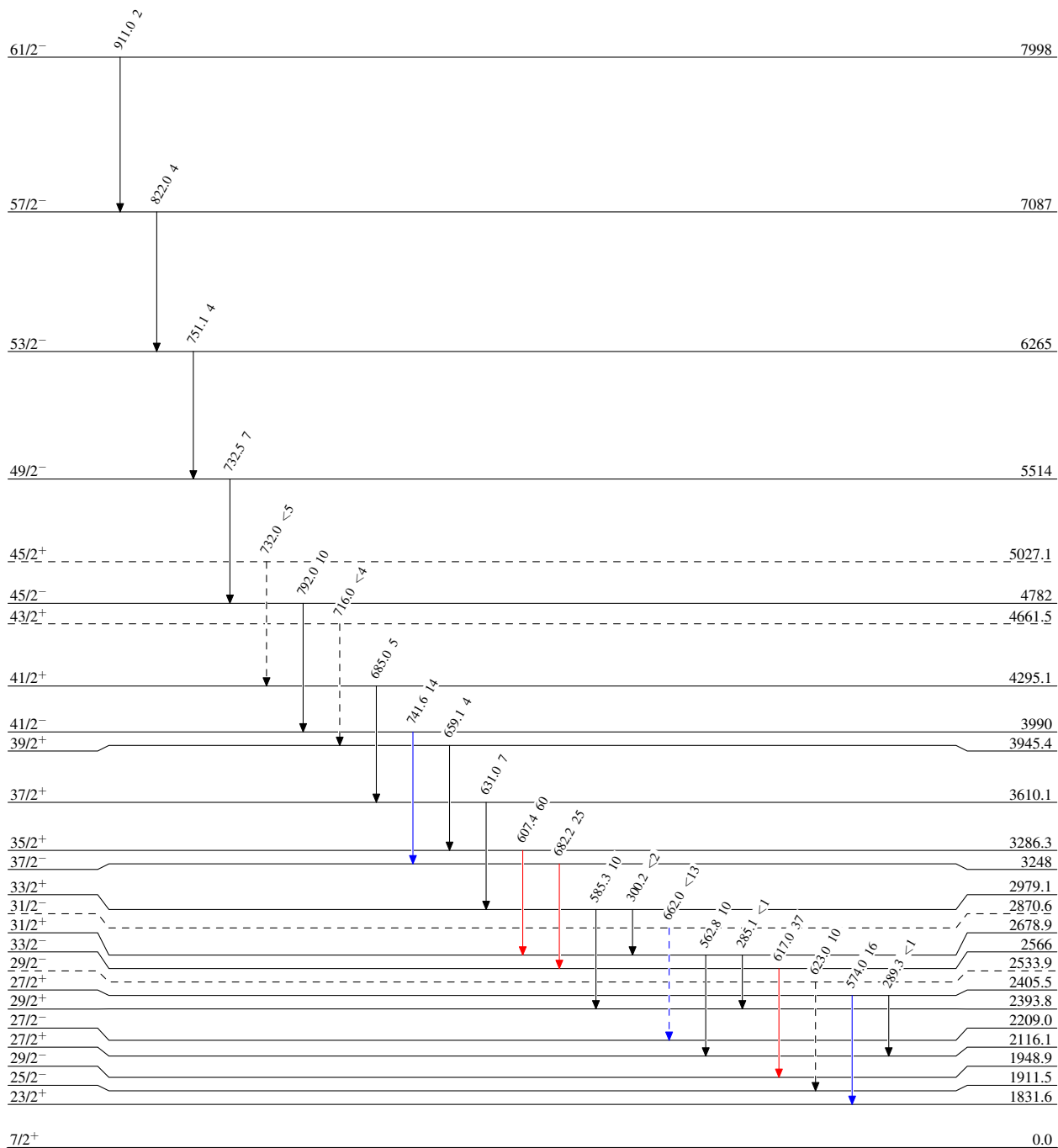
^c Placement of transition in the level scheme is uncertain.

$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ 1996We07,1991Sh13

Legend

Level Scheme
 Intensities: Relative I_γ

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




 $^{175}_{73}\text{Ta}_{102}$

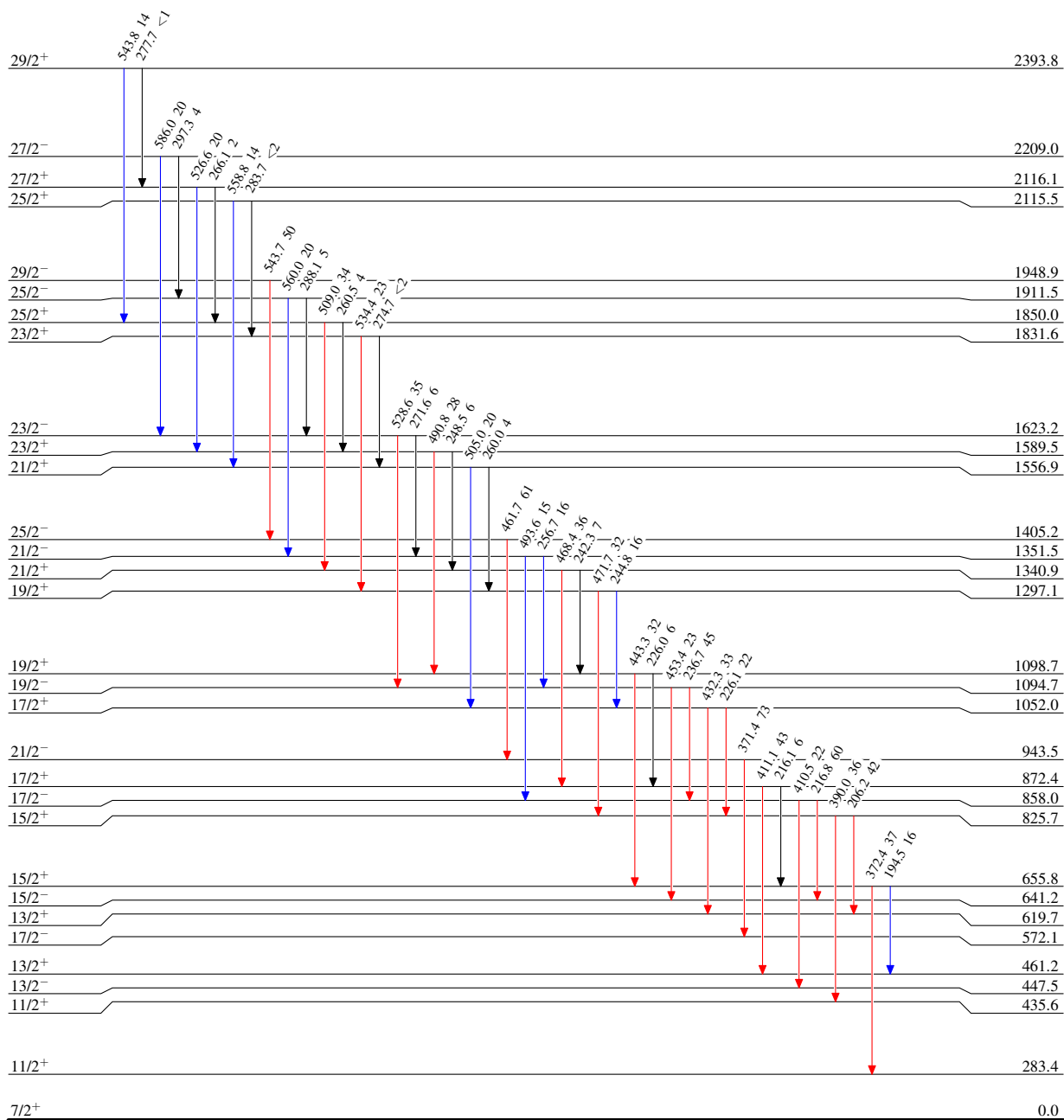
$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ 1996We07,1991Sh13

Level Scheme (continued)

Intensities: Relative I_γ

Legend

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

 $^{175}_{73}\text{Ta}_{102}$

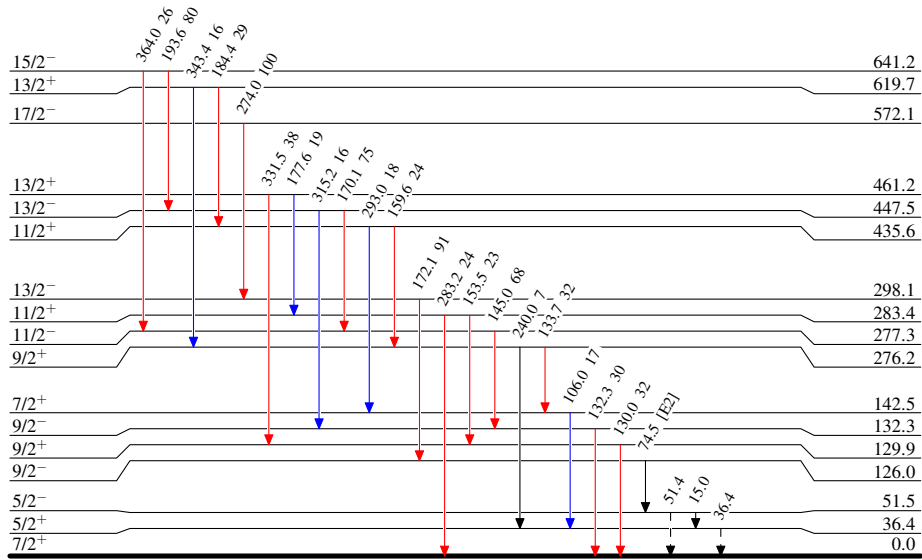
$^{160}\text{Gd}(^{19}\text{F},4n\gamma)$ 1996We07,1991Sh13

Legend

Level Scheme (continued)

Intensities: Relative I_γ

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



$^{175}_{73}\text{Ta}_{102}$