

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh		NDS 157, 1 (2019)	15-Apr-2019

$Q(\beta^-) = -7634.48$  7;  $S(n) = 13000.3$  22;  $S(p) = 9589.1$  9;  $Q(\alpha) = -8559.2$  5 [2017Wa10](#)

$S(2n) = 23583$  7,  $S(2p) = 16347.3$  4 ([2017Wa10](#)).

See [1994Wi05](#), [1993Wi21](#), [1990Ha13](#) and [1984KoZH](#) for  $Q(\epsilon)(^{50}\text{Mn})$  obtained for studies of super-allowed  $\beta$  decay. These values include atomic corrections.

Other reactions:

[1991Wi13](#):  $^{50}\text{Ti}(\pi^+, \pi^-)$ ,  $E = 450$  MeV, measured  $\sigma(\theta = 5^\circ)$  at LAMPF using Large Acceptance Spectrometer, deduced mass dependence for cross sections for the double-isobaric-analog state.

[1973De29](#):  $^{50}\text{Cr}(\gamma, n)$ ,  $E = 20.43\text{--}22.22$  MeV, measured  $\sigma$  by activation. Monochromatic  $\gamma$  rays from  $\text{H}(p, \gamma)$ ; FWHM = 122 keV.

Related results to the width of dipole state in  $^{50}\text{Cr}$ .

Theory references: consult the NSR database ([www.nndc.bnl.gov/nsr/](http://www.nndc.bnl.gov/nsr/)) for 142 primary references dealing with various aspects of nuclear structure.

Added in proofs: PRC accepted paper (April 9, 2019) by M.M. Giles et al used in the present evaluation, is now published as Phys. Rev. C 99, 044317 (2019).

 $^{50}\text{Cr}$  Levels

Isospin (T) From  $^{52}\text{Cr}(p, t)$ .

Cross Reference (XREF) Flags

<b>A</b>	$^{50}\text{V} \beta^-$ decay ( $2.65 \times 10^{17}$ y):?	<b>H</b>	$^{48}\text{Ti}(^{16}\text{O}, ^{14}\text{C})$	<b>O</b>	$^{50}\text{Cr}(d, d')$
<b>B</b>	$^{50}\text{Mn} \epsilon$ decay (283.19 ms)	<b>I</b>	$^{50}\text{V}(p, n\gamma)$	<b>P</b>	$^{50}\text{Cr}(^3\text{He}, ^3\text{He}')$
<b>C</b>	$^{50}\text{Mn} \epsilon$ decay (1.75 min)	<b>J</b>	$^{50}\text{Cr}(\gamma, \gamma'), (\text{pol } \gamma, \gamma')$	<b>Q</b>	$^{50}\text{Cr}(\alpha, \alpha')$
<b>D</b>	$^{24}\text{Mg}(^{32}\text{S}, \alpha 2p\gamma)$	<b>K</b>	$^{50}\text{Cr}(e, e')$	<b>R</b>	$^{50}\text{Cr}(\alpha, \alpha' \gamma)$
<b>E</b>	$^{28}\text{Si}(^{28}\text{Si}, \alpha 2p\gamma)$	<b>L</b>	$^{50}\text{Cr}(n, n' \gamma)$	<b>S</b>	$^{52}\text{Cr}(p, t)$
<b>F</b>	$^{40}\text{Ca}(^{16}\text{O}, \alpha 2p\gamma), (^{12}\text{C}, 2p\gamma)$	<b>M</b>	$^{50}\text{Cr}(p, p')$	<b>T</b>	$^{54}\text{Fe}(p, p\alpha)$
<b>G</b>	$^{48}\text{Ti}(^3\text{He}, n)$	<b>N</b>	$^{50}\text{Cr}(p, p' \gamma)$	<b>U</b>	Coulomb excitation

E(level) <sup>†</sup>	J <sup>π</sup> #	T <sub>1/2</sub> <sup>&amp;</sup>	XREF	Comments
0.0 <sup>b</sup>	0 <sup>+</sup>	$> 1.3 \times 10^{18}$ y	ABCDEFGHIJKLMNQRSTU	$\%2\epsilon = ?$ T=1 XREF: A(?). T <sub>1/2</sub> : from search for double beta decay by <a href="#">2003Bi05</a> and <a href="#">1985No03</a> who measured $\gamma^\pm$ (HPGe) and deduced a lower limit on T <sub>1/2</sub> for 0ν and 2ν modes: $> 1.8 \times 10^{17}$ y ( <a href="#">1985No03</a> ), $> 1.3 \times 10^{18}$ y ( <a href="#">2003Bi05</a> ). Other: <a href="#">1952Fr23</a> . Evaluated rms charge radius: $\langle r^2 \rangle^{1/2} = 3.6588$ fm 65 ( <a href="#">2013An02</a> ). Evaluated $\delta \langle r^2 \rangle (^{50}\text{Cr}, ^{52}\text{Cr}) = 0.099$ fm <sup>2</sup> 37 ( <a href="#">2013An02</a> ). $\mu = +1.24$ 6 ( <a href="#">2000Er06</a> , <a href="#">2014StZZ</a> ) $Q = -0.36$ 7 ( <a href="#">1975To06</a> , <a href="#">2016St14</a> ) XREF: A(?). J <sup>π</sup> : E2 783.3γ to 0 <sup>+</sup> . T <sub>1/2</sub> : weighted averaged mean lifetime = 13.1 ps 4 deduced from experimental values in different methods: mean lifetime $\tau = 13.3$ ps 6 (M.M. Giles et al., Phys. Rev. C, accepted April 9, 2019, RDDS in $^{40}\text{Ca}(^{12}\text{C}, 2p\gamma)$ ); $\tau = 13.0$ ps 4 ( <a href="#">2017Ar09</a> , RDDS in $^{27}\text{Al}(^{28}\text{Si}, \alpha p\gamma)$ ), see
783.31 <sup>b</sup> 10	2 <sup>+</sup>	9.08 ps 28	ABCDEFGHIJKLMNQRSTU	

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**Adopted Levels, Gammas (continued)** $^{50}\text{Cr}$  Levels (continued)

<u>E(level)<sup>†</sup></u>	<u>J<sup>π</sup>#</u>	<u>T<sub>1/2</sub>&amp;</u>	<u>S</u>	<u>XREF</u>	<u>Comments</u>
1881.42 <sup>b</sup> 19	4 <sup>+</sup>	2.20 ps 33		CDEF HI KLMNOPQRS U	<p>(<math>^{28}\text{Si}, \alpha 2p\gamma</math>) dataset); 13.2 ps 4 (2000Er01,2000Er06, DSAM in Coul. ex.); 12.6 ps 21 (1974Br04, RDDS in <math>^{40}\text{Ca}(^{16}\text{O}, 2p\alpha\gamma)</math>); 12.1 ps 12 (1973De09, RDDS in <math>^{40}\text{Ca}(^{12}\text{C}, 2p\gamma)</math>); 10 ps 2 (1972Ra14, DSAM in Coul. ex.); and the following mean lifetimes deduced by evaluators from B(E2)↑ measurements in Coulomb excitation: 13.5 ps 7 (B(E2)=0.102 5 in 1975To06); 12.1 ps 11 (B(E2)=0.115 10 in 1972Ra14); 15.2 ps 17 (B(E2)=0.092 14 in 1971DaZM); 12.1 ps 13 (B(E2)=0.115 12 in 1966Mc18,1961Mc18); 9.6 ps 19 (B(E2)=0.15 3 in 1960An09); and <math>\tau=14.9</math> ps 8 from B(E2)=0.093 5 in (e,e') (1983Li02). Omission of seemingly discrepant values of 9.6 ps 19 from 1960An09 and 15.2 ps 17 from 1971DaZM gives the same weighted average. Value is 9.11 ps +28–20 in 2016Pr01 evaluation.</p> <p><math>\mu</math>: from transient-magnetic fields (TF) in Coul. ex. (2000Er06). Others: +1.28 22 (1994Pa34, TF in <math>^{40}\text{Ca}, 2p\gamma</math>); +0.9 3 (1987Pa28, TF in Coul. ex.); +1.2 2 (ion implantation PAC, 1977Fa07).</p> <p>Q: reorientation method in Coul. ex. (1975To06).</p> <p><math>\mu=+3.1</math> 5 (2000Er06,2014StZZ)</p> <p>B(E4)↑=0.000451 (1983Li02)</p> <p>B(E4) from (e,e').</p> <p>J<sup>π</sup>: stretched E2 1098.1γ to 2<sup>+</sup>; L(p,t)=4.</p> <p>T<sub>1/2</sub>: unweighted average of 3.4 ps 5 (M.M. Giles et al., Phys. Rev. C, accepted April 9, 2019, RDDS in <math>^{40}\text{Ca}(^{12}\text{C}, 2p\gamma)</math>); 1.47 ps 16 (2004Br42, DSAM in <math>^{28}\text{Si}(^{28}\text{Si}, \alpha 2p)</math>); 1.7 ps 5 (1998Br34, DSAM in <math>^{28}\text{Si}(^{28}\text{Si}, \alpha 2p)</math>); 2.22 ps 49 (2000Er06,2000Er01, DSAM in Coulomb excitation); 2.22 ps 28 (1973De09, RDDS in <math>^{40}\text{Ca}(^{12}\text{C}, 2p\gamma)</math>). Other: &lt;2.8 ps (1974Br04, RDDS). Weighted average is 1.80 ps 26 with reduced <math>\chi^2=4.4</math> as compared to critical <math>\chi^2=2.4</math>.</p> <p><math>\mu</math>: from transient-magnetic fields (TF) in Coul. ex. (2000Er06). Other: +1.7 4 (1994Pa34, TF in <math>^{40}\text{Ca}, 2p\gamma</math>) is in disagreement.</p>
2924.6 4	2 <sup>+</sup>	9.4 fs 14		HI KLMNOPQ S	<p>J<sup>π</sup>: E2 2924γ to 0<sup>+</sup>; L(p,t)=2 from 0<sup>+</sup>.</p> <p>T<sub>1/2</sub>: from DSAM in (p,p'γ).</p>
3161.3 4	2 <sup>+</sup>	10.9 fs 16		k MNOPQ S	<p>XREF: k(3160)M(3156).</p> <p>T<sub>1/2</sub>: from DSAM in (p,p'γ).</p> <p>J<sup>π</sup>: L(α,α')=L(p,t)=2 from 0<sup>+</sup>.</p>
3164.06 <sup>b</sup> 25	6 <sup>+</sup>	0.80 ps 23		CDEF k N R	<p><math>\mu=+3.2</math> 10 (1994Pa34,2014StZZ)</p> <p>XREF: k(3160).</p> <p>J<sup>π</sup>: from γ(θ,pol) in (<math>^{16}\text{O}, \alpha 2p\gamma</math>); stretched E2 1282.5γ to 4<sup>+</sup>.</p> <p>T<sub>1/2</sub>: weighted average of 0.69 ps 14 from DSAM in <math>^{28}\text{Si}(^{28}\text{Si}, \alpha 2p\gamma)</math> (1998Br34) and 1.25 ps 28 from RDDS in (<math>^{12}\text{C}, 2p\gamma</math>) (1973De09).</p>
3324.56 22	4 <sup>+</sup>	97 fs 25	0.032	C EF K MNOPQ S	<p><math>\mu</math>: from g=0.54 16 (1994Pa34, TF in <math>^{40}\text{Ca}, 2p\gamma</math>).</p> <p>J<sup>π</sup>: L(α,α')=L(d,d')=4 from 0<sup>+</sup>.</p> <p>T<sub>1/2</sub>: from DSAM in (p,p'γ). Other: &lt;0.7 ps from RDM in (<math>^{12}\text{C}, 2p\gamma</math>).</p> <p>B(E4)=0.000192 (1983Li02) in (e,e').</p>

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**Adopted Levels, Gammas (continued)** $^{50}\text{Cr}$  Levels (continued)

E(level) <sup>†</sup>	J <sup>π</sup> <sup>#</sup>	T <sub>1/2</sub> <sup>&amp;</sup>	XREF		Comments
3594.63 25	2 <sup>+</sup> ,3,4 <sup>+</sup>	30 fs 5	<b>h</b>	<b>MNOPQ</b>	XREF: h(3600)M(3587). J <sup>π</sup> : 1713.2γ to 4 <sup>+</sup> , 2811.2γ to 2 <sup>+</sup> can only have mult=D or E2 by RUL.
3611.4 4	4 <sup>+</sup>	6 fs 4	<b>E h</b>	<b>MNOPQ S</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ). XREF: h(3600)M(3602). J <sup>π</sup> : L(p,t)=4 from 0 <sup>+</sup> .
3628.9 5	1 <sup>+</sup>	0.305 eV 13	<b>B</b>	<b>J MN</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ). J <sup>π</sup> : dipole 3628.7γ to 0 <sup>+</sup> ; σ(θ) in (p,p') (1989Wi13); expected 1 <sup>+</sup> from shell-model predictions (see 1989Wi13).
3698.2 5	2 <sup>+</sup>	12.8 fs 18		<b>MNOPQ S</b>	T <sub>1/2</sub> : from Γ <sub>0</sub> =0.205 eV 9 in (γ,γ'). Other: 5 fs 3 in (p,p'γ). J <sup>π</sup> : L(p,t)=2; M1+E2 2914.8γ to 2 <sup>+</sup> . L(α,α')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=4 for a 3698 20 level inconsistent, if it is the same level as seen in other reactions.
3792.1 4	(5 <sup>+</sup> )	9.0 ps 14	<b>EF</b>	<b>MNO</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ). XREF: M(3786). J <sup>π</sup> : J <sup>π</sup> =5 <sup>+</sup> from pγ(θ) in (p,p'γ); L(p,p')=4; and absence of this level in (α,α'). However (4 <sup>-</sup> ) cannot be ruled out as proposed by 1998Br34 from γ(θ) in ( <sup>28</sup> Si,α2pγ).
3825.7 3	(6 <sup>+</sup> )	<0.7 ps	<b>C EF</b>	<b>MNOPqRs</b>	T <sub>1/2</sub> : from RDM in ( <sup>16</sup> O,α2pγ). Other: >73 fs from DSAM in (p,p'γ). XREF: q(3844)s(3832). J <sup>π</sup> : logft=5.0 from 5 <sup>+</sup> ; angular distribution of the 661.76 keV γ corresponds to ΔI=0 dipole or stretched quadrupole transition.
3844.4 4	2 <sup>+</sup> ,3,4 <sup>+</sup>	0.22 ps 6		<b>MNOPq s</b>	T <sub>1/2</sub> : inconsistent with 3.5 ps +35-14 (1973De09) from RDM in ( <sup>12</sup> C,2pγ). Other: <1.4 ps from RDDS in 1974Br04 in ( <sup>16</sup> O,α2pγ). XREF: q(3844)s(3832).
3850 20	0 <sup>+</sup>		<b>B G</b>		J <sup>π</sup> : 1962.9γ to 4 <sup>+</sup> and 683.4γ to 2 <sup>+</sup> can only have mult=D or E2 by RUL. T <sub>1/2</sub> : from DSAM in (p,p'γ). XREF: B(3827).
3875.4 3	(4 <sup>+</sup> ,5,6 <sup>+</sup> )	0.62 ps 21	<b>E</b>	<b>MNOPQ</b>	J <sup>π</sup> : L( <sup>3</sup> He,n)=0. XREF: M(3867).
3895.4 10	0 <sup>+</sup>	24 ps +14-10	<b>H</b>	<b>MNOPQ S</b>	J <sup>π</sup> : γs to 4 <sup>+</sup> and 6 <sup>+</sup> . J <sup>π</sup> : L(p,t)=0. L(α,α')=L(d,d')=L( <sup>3</sup> He, <sup>3</sup> He')=4 for 3898 20 is inconsistent if it is the same level as in other reactions.
3937.3 4	2 <sup>+</sup> ,3,4 <sup>+</sup>	2.2 fs 10		<b>MNOPQ S</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ). J <sup>π</sup> : 2055.5γ to 4 <sup>+</sup> and 3153.7γ to 2 <sup>+</sup> can only have mult=D or E2 by RUL.
4040	(0 <sup>+</sup> )			<b>N</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ).
4051.7 5	3 <sup>-</sup>	0.56 ps 11		<b>MNOPQ S</b>	J <sup>π</sup> : σ(θ) in (p,p') (1989Wi13). J <sup>π</sup> : L(α,α')=L(d,d')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=3 from 0 <sup>+</sup> . T <sub>1/2</sub> : from DSAM in (p,p'γ).
4068.2 22	0 <sup>+</sup>	6.5 fs 17		<b>MN S</b>	B(E3)(from g.s.)=0.0033 13 (2002Ki06 evaluation) deduced from β <sub>3</sub> in (α,α') (1990Ba23). E(level): 4068.8 5 from (p,t). J <sup>π</sup> : L(p,t)=0.
4129.9 5	(1,2 <sup>+</sup> )	0.18 ps 6	<b>H</b>	<b>MN</b>	T <sub>1/2</sub> : from DSAM in (p,p'γ). XREF: H(4150).

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**Adopted Levels, Gammas (continued)** $^{50}\text{Cr}$  Levels (continued)

E(level) <sup>†</sup>	J <sup>π</sup> #	T <sub>1/2</sub> &	XREF		Comments
4193.0 8	2 <sup>+</sup>			MNOPQ s	J <sup>π</sup> : 1205.3γ to 2 <sup>+</sup> ; possible 4130γ to 0 <sup>+</sup> . T <sub>1/2</sub> : from DSAM in (p,p'γ). XREF: s(4200).
4207 7				M s	J <sup>π</sup> : L(α,α')=L(d,d')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=2 from 0 <sup>+</sup> . XREF: s(4200).
4282 7				M	
4367.2 <sup>c</sup> 4	5 <sup>-</sup>	1.39 ps 35	EF	M OPQ S	J <sup>π</sup> : L(p,t)=L(α,α')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=5 from 0 <sup>+</sup> .
4523.8 15	(4 <sup>+</sup> )			MN	J <sup>π</sup> : 1363γ to 6 <sup>+</sup> and 3740.5γ to 2 <sup>+</sup> .
4546.3 12	3 <sup>-</sup>			MNOPQ S	XREF: O(4570)P(4570)Q(4570)S(4540).
4653.3 15				MN	J <sup>π</sup> : L(p,t)=L(α,α')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=3 from 0 <sup>+</sup> .
4676 7	2 <sup>+</sup>			M OPQ	XREF: O(4680)P(4680)Q(4680).
4700	(1 <sup>+</sup> )			M	E(level): from (p,p').
4731 5	0 <sup>+</sup>		G	M S	J <sup>π</sup> : L(α,α')=L(d,d')=2. J <sup>π</sup> : from σ(θ) in (p,p') (1989Wi13). XREF: G(4740).
4744.9 <sup>b</sup> 4	8 <sup>+</sup>	0.28 ps 7	DEF	R	E(level): weighted average of 4728 7 from (p,p') and 4733 5 from (p,t). J <sup>π</sup> : L(p,t)=L( <sup>3</sup> He,n)=0.
4755 7				M	μ=+4.3 7 (1994Pa34,2014StZZ)
4766 5	2 <sup>+</sup>			M OPQ S	J <sup>π</sup> : ΔJ=2, E2 γ to 6 <sup>+</sup> ; spin=2 from γ(θ) in ( <sup>16</sup> O,α2pγ). μ: g=+0.54 9 from TF in ( <sup>40</sup> Ca,2pγ) (1994Pa34).
4807 5				M S	E(level): weighted average of 4772 7 from (p,p') and 4763 5 from (p,t).
4906 7				M	J <sup>π</sup> : L(p,t)=L(α,α')=2.
4924 7	(4 <sup>+</sup> )			M opq	E(level): weighted average of 4801 7 from (p,p') and 4810 5 from (p,t).
4961 7	(4 <sup>+</sup> )			M opq	XREF: o(4940)p(4940)q(4940).
4997.1 4	1 <sup>(+)</sup>	0.140 eV 14	B	J M	J <sup>π</sup> : L(α,α')=L( <sup>3</sup> He, <sup>3</sup> He')=4 for a level at 4940 20. XREF: o(4940)p(4940)q(4940).
5015 10				M	J <sup>π</sup> : L(α,α')=L( <sup>3</sup> He, <sup>3</sup> He')=4 for a level at 4940 20.
5039 10				M s	J <sup>π</sup> : log ft=5.9 from 0 <sup>+</sup> ; spin=1 from γ(θ) in (γ,γ').
5053 10				M s	T <sub>1/2</sub> : from Γ <sub>0</sub> =0.070 eV 7 in (γ,γ').
5078 10				M	
5093 10				M	XREF: s(5040).
5198 10				M	XREF: s(5040).
5207 10				M	
5213.4 <sup>c</sup> 4	(6 <sup>-</sup> )	0.42 ps 7	E	M OPQ	J <sup>π</sup> : 846.2γ to 5 <sup>-</sup> and 1421.1γ to 5 <sup>+</sup> ; band assignment.
5233 10	4 <sup>+</sup>			M OPQ	L: L(α,α')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=4 for a level at 5230 20.
5250 10				M	
5272 10				M	
5297 10				M	
5336 10				M	
5376 10				M	
5429 10				M	
5445 10				M opq	XREF: o(5450)p(5450)q(5450).
5455 10				M opq	XREF: o(5450)p(5450)q(5450).
5548 10				M	
5597 10				M	
5611 10				M	
5623 10				M	

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**Adopted Levels, Gammas (continued)**

$^{50}\text{Cr}$ Levels (continued)					
E(level) <sup>†</sup>	J <sup>π</sup> #	T <sub>1/2</sub> <sup>&amp;</sup>	XREF		Comments
5684 10				M	
5731 10			g	M	XREF: g(5710).
					J <sup>π</sup> : L( <sup>3</sup> He,n)=0 for a level at 5710 gives 0 <sup>+</sup> for one of the levels at 5731 or 5741.
5741 10			g	M opq	XREF: g(5710)o(5760)p(5760)q(5760).
5780 10				M opq	XREF: o(5760)p(5760)q(5760).
5813 10				M	
5835 10				M	
5859 10				M	
5903 10				M	
5931.2 5	1 <sup>+</sup> <sup>a</sup>	0.073 eV 6	J	M	
5944 10				M	
5957 10				M	
5983 10	3 <sup>-</sup>			M OPQ	XREF: O(5990)P(5990)Q(5990).
					J <sup>π</sup> : L(α,α')=L(d,d')=L( <sup>3</sup> He, <sup>3</sup> He')=3.
5998.0 <sup>c</sup> 5	(7 <sup>-</sup> )	<0.35 ps	E		J <sup>π</sup> : 784.6γ to (6 <sup>-</sup> ), 1630.9γ to 5 <sup>-</sup> ; band assignment. T <sub>1/2</sub> : effective half-life=0.28 ps 7 from DSAM in ( <sup>28</sup> Si,α2pγ).
6003 10				M	
6027 <sup>‡</sup> 10				M	
6032 10				M	
6071 10				M	
6083 10				M	
6116 <sup>‡</sup> 10				M	
6123 10				M	
6138 10				M opq	XREF: o(6150)p(6150)q(6150).
6175 10				M	
6202 10				M	
6226 <sup>‡</sup> 10				M	
6230 10				M	
6243 10				M	
6272 10				M	
6305 10				M	
6330 10				M	
6340.6 <sup>b</sup> 5	10 <sup>+</sup>	0.76 ps 14	DEF	R	J <sup>π</sup> : ΔJ=2, E2 1595.7γ to 8 <sup>+</sup> ; spin=10 from γ(θ) in ( <sup>16</sup> O,α2pγ); band assignment.
6342 10				M	
6376 10				M	
6450 20	3 <sup>-</sup>			M OPQ	J <sup>π</sup> : L(α,α')=L(p,p')=L( <sup>3</sup> He, <sup>3</sup> He')=L(d,d')=3.
6650 20	3 <sup>-</sup>			M OPQ	J <sup>π</sup> : L(α,α')=L(d,d')=L( <sup>3</sup> He, <sup>3</sup> He')=3.
6754.5 5	10 <sup>+</sup>	0.111 ps 21	DE		J <sup>π</sup> : ΔJ=2, E2 2009.6γ to 8 <sup>+</sup> ; 414.1γ to 10 <sup>+</sup> ; band assignment.
6790 20	3 <sup>-</sup>			M OPQ	J <sup>π</sup> : L(α,α')=L(d,d')=L( <sup>3</sup> He, <sup>3</sup> He')=L(p,p')=3.
6950.6 <sup>d</sup> 5	11 <sup>+</sup>	0.49 ps 4	DEF		J <sup>π</sup> : ΔJ=1, M1 610.2γ to 10 <sup>+</sup> ; spin=11 from γ(θ) in ( <sup>16</sup> O,α2pγ); band assignment.
7340	(1 <sup>+</sup> ) <sup>@</sup>			M	
7360 20	3 <sup>-</sup>			M OPQ	J <sup>π</sup> : L(α,α')=L(d,d')=3.
7600.8 5	1 <sup>+</sup> <sup>@a</sup>	0.334 eV 37	J	M	XREF: M(7610).
7613.1 <sup>d</sup> 5	12 <sup>+</sup>	0.111 ps 10	DEF		J <sup>π</sup> : ΔJ=1, M1 662.2γ to 11 <sup>+</sup> ; spin=12 from γ(θ) in ( <sup>16</sup> O,α2pγ); band assignment.
7645.7 5	1 <sup>+</sup> <sup>a</sup>	0.118 eV 14	J		
7.78×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
7860 20	3 <sup>-</sup>			M OPQ	J <sup>π</sup> : L(α,α')=L(d,d')=L( <sup>3</sup> He, <sup>3</sup> He')=3.
7948.2 4	1 <sup>+</sup> <sup>a</sup>	1.76 eV 10	J		

Continued on next page (footnotes at end of table)

**Adopted Levels, Gammas (continued)**

$^{50}\text{Cr}$ Levels (continued)					
E(level) <sup>†</sup>	J <sup>π</sup> #	T <sub>1/2</sub> <sup>&amp;</sup>	XREF		Comments
7.98×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
8045.8 5	1 <sup>+</sup> <sup>a</sup>	0.238 eV 26		J	
8121.5 5	1 <sup>+</sup> <sup>a</sup>	0.094 eV 11		J	
8.27×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
8360 50			G		
8425 7	6 <sup>+</sup>			S	T=2
					J <sup>π</sup> : isobaric analog state from $^{52}\text{Cr}(\text{p},\text{t})$ .
8527.6 4	1 <sup>+</sup> <sup>a</sup>	0.85 eV 11		J	
8638?	(1 <sup>+</sup> ) <sup>@</sup>			M S	XREF: M(8650).
8680 20	3 <sup>-</sup>		G	M OPQ	J <sup>π</sup> : L( $\alpha,\alpha'$ )=L(d,d')=L( $^3\text{He},^3\text{He}'$ )=3.
8748 6	4 <sup>+</sup>			S	T=2
					J <sup>π</sup> : isobaric analog state from $^{52}\text{Cr}(\text{p},\text{t})$ .
8813 6	2 <sup>+</sup>			S	T=2
					J <sup>π</sup> : isobaric analog state from $^{52}\text{Cr}(\text{p},\text{t})$ .
8885.6 5	1 <sup>+</sup> <sup>a</sup>	0.53 eV 5		J	
9007.9 5	1 <sup>+</sup> <sup>@a</sup>	0.286 eV 34		J M	XREF: M(9010).
9208.3 5	1 <sup>+</sup> <sup>@a</sup>	0.37 eV 9		J M	XREF: M(9190).
9327.1 <sup>b</sup> 5	(12 <sup>+</sup> )		DE		J <sup>π</sup> : $\Delta J=(2)$ , (Q) 2572.6 $\gamma$ to 10 <sup>+</sup> and 1713.8 $\gamma$ to 12 <sup>+</sup> ; band assignment.
9409.5 5	1 <sup>+</sup> <sup>@a</sup>	0.81 eV 13		J M	XREF: M(9400).
9579.1 5	1 <sup>+</sup> <sup>@a</sup>	0.30 eV 6		J M	XREF: M(9570).
9642.2 <sup>d</sup> 6	13 <sup>+</sup>	0.05 ps 2	DE		J <sup>π</sup> : $\Delta J=2$ , E2 2692.0 $\gamma$ to 11 <sup>+</sup> ; $\Delta J=1$ , D 2028.9 $\gamma$ to 12 <sup>+</sup> .
9719.1 5	1 <sup>+</sup> <sup>@a</sup>	1.42 eV 17		J M	XREF: M(9710).
9900 50	2 <sup>+</sup>		G	M	J <sup>π</sup> : L( $^3\text{He},\text{n}$ )=2, but 1 <sup>+</sup> in (p,p').
9914.8 <sup>d</sup> 6	14 <sup>+</sup>	0.22 ps 4	DE		J <sup>π</sup> : $\Delta J=2$ , E2 $\gamma$ to 12 <sup>+</sup> ; $\Delta J=1$ , D $\gamma$ to 13 <sup>+</sup> .
10.11×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
10.24×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
10.38×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
10500 50	(1 <sup>+</sup> ) <sup>@</sup>		G	M	XREF: M(10520).
					E(level): from $^{48}\text{Ti}(^3\text{He},\text{n})$ .
10750 30	2 <sup>+</sup>		G		J <sup>π</sup> : L( $^3\text{He},\text{n}$ )=2.
10797.5 6	13 <sup>(+)</sup>	<0.62 ps	DE		J <sup>π</sup> : $\Delta J=1$ , D $\gamma$ to 12 <sup>+</sup> .
10.82×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
11013.9 6	13 <sup>+</sup>	0.06 ps 1	DE		J <sup>π</sup> : $\Delta J=1$ , D 3400.5 $\gamma$ to 12 <sup>+</sup> ; $\Delta J=2$ , E2 2204.2 from 15 <sup>+</sup> .
11060 50	(1 <sup>+</sup> ) <sup>@</sup>		G	M	XREF: M(11020).
11.18×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
11.4×10 <sup>3</sup> 1			G		
11530 50	0 <sup>+</sup>		G		J <sup>π</sup> : L( $^3\text{He},\text{n}$ )=0.
11660	(1 <sup>+</sup> ) <sup>@</sup>			M	
11680 20	0 <sup>+</sup>		G		E(level): IAS of 3230,(0) <sup>+</sup> level in $^{50}\text{V}$ from 1975Bo14 in ( $^3\text{He},\text{n}$ ).
					J <sup>π</sup> : L( $^3\text{He},\text{n}$ )=0.
11.82×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	
11870 20	0 <sup>+</sup>		G		J <sup>π</sup> : L( $^3\text{He},\text{n}$ )=0.
					E(level): IAS of 3462,(0) <sup>+</sup> level in $^{50}\text{V}$ from 1975Bo14 in ( $^3\text{He},\text{n}$ ).
12.30×10 <sup>3</sup>	(1 <sup>+</sup> ) <sup>@</sup>			M	E(level): multiplet.
12391.5 6	15 <sup>(+)</sup>		DE		J <sup>π</sup> : $\Delta J=1$ , D 2476.9 $\gamma$ to 14 <sup>+</sup> .
12542.0 7	(14 <sup>+</sup> )		DE		J <sup>π</sup> : 4927.9 $\gamma$ to 12 <sup>+</sup> ; 2492.1 $\gamma$ from 16 <sup>+</sup> .

Continued on next page (footnotes at end of table)

**Adopted Levels, Gammas (continued)** $^{50}\text{Cr}$  Levels (continued)

E(level) <sup>†</sup>	J <sup>π</sup> <sup>#</sup>	T <sub>1/2</sub> <sup>&amp;</sup>	XREF	Comments
12680 50			G	
12790 50			G	
12950 50			G	
13218.4 <sup>d</sup> 6	15 <sup>+</sup>	0.021 ps +7-4	DE	J <sup>π</sup> : ΔJ=2, E2 3578.7γ to 13 <sup>+</sup> ; ΔJ=1, D 3304.8γ to 14 <sup>+</sup> . T=3
13222 6	0 <sup>+</sup>		G	XREF: S(13220). E(level): from $^{52}\text{Cr}(p,t)$ ; IAS of 4815,(0) <sup>+</sup> level in $^{50}\text{V}$ from 1975Bo14 in ( $^3\text{He},n$ ). J <sup>π</sup> : L( $^3\text{He},n$ )=0.
13495.3 21			E	
13641.0 6	14 <sup>(+)</sup>		D	J <sup>π</sup> : ΔJ=1, D 2627.1γ to 13 <sup>(+)</sup> .
13900 20	0 <sup>+</sup>		G	J <sup>π</sup> : L( $^3\text{He},n$ )=0.
13920.8 12	15 <sup>(+)</sup>	<0.076 ps	DE	J <sup>π</sup> : ΔJ=1, D 4005.8γ to 14 <sup>+</sup> .
14500 30			G	
14570 30			G	
14900 20	0 <sup>+</sup>		G	J <sup>π</sup> : L( $^3\text{He},n$ )=0.
15034.2 <sup>d</sup> 7	16 <sup>+</sup>	<0.021 ps	DE	J <sup>π</sup> : ΔJ=2, E2 5121γ to 14 <sup>+</sup> .
15809.0 6	16 <sup>+</sup>	<0.05 ps	DE	J <sup>π</sup> : ΔJ=2, E2 2168.1γ to 14 <sup>+</sup> .
16049.4 7	17 <sup>(+)</sup>		D	J <sup>π</sup> : ΔJ=2, Q 2830.9γ to 15 <sup>+</sup> .
17669.2 16	(16,17)		D	J <sup>π</sup> : 3748.2γ to 15 <sup>(+)</sup> .
17790.0 12	(16,17)		D	J <sup>π</sup> : 5398.2γ to 15 <sup>(+)</sup> .
17956.6 <sup>d</sup> 10	18 <sup>+</sup>	<0.07 ps	DE	J <sup>π</sup> : ΔJ=2, E2 2922.3γ to 16 <sup>+</sup> .

<sup>†</sup> From a least-squares fit to γ-ray energies for levels connected by γ transitions, unless otherwise noted.

<sup>‡</sup> Unresolved doublet; spacing <5 keV.

<sup>#</sup> From  $^{24}\text{Mg}(^{32}\text{S},\alpha 2p\gamma)$ , except as noted, based on  $\gamma(\theta)$  and  $\gamma\gamma(\theta)$  measurements together with band associations from  $\gamma\gamma$  coincidence data.

<sup>@</sup> 1<sup>+</sup> from (p,p') E=201 MeV (1989Wi13), interpreted as spin-flip transition from forward angle cross sections.

<sup>&</sup> T<sub>1/2</sub> from DSAM, as given in  $^{28}\text{Si}(^{28}\text{Si},\alpha 2p\gamma)$  dataset, width from (γ,γ'), except as noted.

<sup>a</sup> From  $\gamma(\theta,\text{pol})$  in (γ,γ') (2016Pa04).

<sup>b</sup> Band(A): g.s. band.

<sup>c</sup> Seq.(B): γ cascade based on 5<sup>-</sup>.

<sup>d</sup> Seq.(C): γ cascade based on 11<sup>+</sup>.

**Adopted Levels, Gammas (continued)**

$\gamma(^{50}\text{Cr})$

See (p,p' $\gamma$ ) and <sup>50m</sup>Mn  $\beta^+$  decay for possible but unobserved transitions.

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	$\delta^\dagger$	$\alpha^\&$	Comments
783.31	2 <sup>+</sup>	783.3 1	100	0.0	0 <sup>+</sup>	E2			B(E2)(W.u.)=19.3 6 E <sub>γ</sub> : weighted average of 783.3 1 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min), 783.6 3 from ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), 783.3 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), 783.3 5 from ( $\gamma,\gamma'$ ), 783.4 2 from (p,p' $\gamma$ ), and 783.3 2 from ( $\alpha,\alpha'\gamma$ ). Others: 778 2 from (p,n $\gamma$ ) and 783 1 from (n,n' $\gamma$ ). Mult.: from $\gamma(\theta,\text{pol})$ in ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), $\gamma\gamma$ (DCO) in ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), and RUL.
1881.42	4 <sup>+</sup>	1098.1 2	100	783.31	2 <sup>+</sup>	E2			B(E2)(W.u.)=14.7 +26-19 E <sub>γ</sub> : weighted average of 1098.0 2 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min), 1097.9 3 from ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), 1098.2 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), 1097.9 5 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), 1098.2 3 from (p,p' $\gamma$ ), and 1098.1 2 from ( $\alpha,\alpha'\gamma$ ). Other: 1107 3 from (p,n $\gamma$ ). Mult.: from $\gamma(\theta,\text{pol})$ in ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), $\gamma\gamma$ (DCO) in ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), and RUL.
2924.6	2 <sup>+</sup>	2141.5 4	100 5	783.31	2 <sup>+</sup>	(M1(+E2))	-0.03 6		B(M1)(W.u.)=0.22 +5-4 E <sub>γ</sub> : others: 2138 1 from (n,n' $\gamma$ ), 2140 5 from (p,n $\gamma$ ). Mult.: D(+Q) from $\gamma(\theta)$ in (p,p' $\gamma$ ); $\Delta\pi$ =no from level scheme.
		2924 2	9.0 24	0.0	0 <sup>+</sup>	E2			B(E2)(W.u.)=2.1 +11-8 Mult.: Q from $\gamma(\theta)$ in (p,p' $\gamma$ ) and M2 ruled out by RUL.
3161.3	2 <sup>+</sup>	2378.3 5	100	783.31	2 <sup>+</sup>	M1+E2	+0.24 9		B(E2)(W.u.)=3.4 +38-22; B(M1)(W.u.)=0.142 +30-24 Mult., $\delta$ : D+Q from p $\gamma(\theta)$ in (p,p' $\gamma$ ); M2 ruled out by RUL.
3164.06	6 <sup>+</sup>	1282.5 2	100	1881.42	4 <sup>+</sup>	E2			B(E2)(W.u.)=19 +8-4 E <sub>γ</sub> : weighted average of 1282.4 3 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min), 1282.3 3 from ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), 1282.1 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), 1282.6 5 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), 1282.7 7 from (p,p' $\gamma$ ), and 1282.7 2 from ( $\alpha,\alpha'\gamma$ ). Mult.: from $\gamma(\theta,\text{pol})$ in ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), $\gamma\gamma$ (DCO) in ( <sup>32</sup> S, $\alpha$ 2p $\gamma$ ), and RUL.
3324.56	4 <sup>+</sup>	161 <sup>b</sup>	≤3	3164.06	6 <sup>+</sup>	[E2]		0.0674	$\alpha(K)$ =0.0596; $\alpha(L)$ =0.00583 E <sub>γ</sub> ,I <sub>γ</sub> : possible $\gamma$ from 1.75-min <sup>50</sup> Mn decay only. B(M1)(W.u.)=0.073 28
		1443.3 2	100 7	1881.42	4 <sup>+</sup>	(M1(+E2))	-0.02 +16-52		E <sub>γ</sub> : weighted average of 1443.3 2 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min), 1443.3 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), 1443.1 5 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), and 1442.7 7 from (p,p' $\gamma$ ). Mult.: D(+Q) from $\gamma(\theta)$ in (p,p' $\gamma$ ); $\Delta\pi$ =no from level scheme.
		2541.0 3	0.8	783.31	2 <sup>+</sup>	[E2]			B(E2)(W.u.)=0.039 +30-16 E <sub>γ</sub> ,I <sub>γ</sub> : from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ).
3594.63	2 <sup>+</sup> ,3,4 <sup>+</sup>	1713.2 3	70 10	1881.42	4 <sup>+</sup>				

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Adopted Levels, Gammas (continued)

$\gamma(^{50}\text{Cr})$  (continued)

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	$\delta^\dagger$	Comments
3594.63	2 <sup>+</sup> ,3,4 <sup>+</sup>	2811.2 3	100 10	783.31	2 <sup>+</sup>			
3611.4	4 <sup>+</sup>	449 <sup>ab</sup> 2	$\approx 8^a$	3164.06	6 <sup>+</sup>	[E2]		
		449 <sup>ab</sup> 2	$\approx 8^a$	3161.3	2 <sup>+</sup>	[E2]		
		1729.9 <sup>a</sup> 3	100 <sup>a</sup> 11	1881.42	4 <sup>+</sup>			
3628.9	1 <sup>+</sup>	2845.5 <sup>@</sup> 6	49 <sup>@</sup> 1	783.31	2 <sup>+</sup>	[M1] <sup>@</sup>		$E_\gamma$ : weighted average of 2845.0 5 from $(\gamma,\gamma')$ and 2846.1 6 from $(p,p'\gamma)$ . $I_\gamma$ : from $(\gamma,\gamma')$ . Others: 50 5 from <sup>50</sup> Mn $\varepsilon$ decay, 50 22 from $(p,p'\gamma)$ . $E_\gamma$ : weighted average of 3628.0 5 from $(\gamma,\gamma')$ and 3629.3 5 from $(p,p'\gamma)$ . Mult.: from $\gamma(\theta)$ and polarization asymmetry in $(\gamma,\gamma')$ . B(E2)(W.u.)=6.4 +41-33; B(M1)(W.u.)=0.046 +20-14 Mult., $\delta$ : D+Q from $p\gamma(\theta)$ in $(p,p'\gamma)$ ; M2 ruled out by RUL.
		3628.7 7	100	0.0	0 <sup>+</sup>	M1		
3698.2	2 <sup>+</sup>	2914.8 5	100	783.31	2 <sup>+</sup>	M1+E2	+0.71 23	
3792.1	(5 <sup>+</sup> )	467.8 5	100 9	3324.56	4 <sup>+</sup>	D+Q		$E_\gamma$ : weighted average of 467.9 5 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ) and 467.7 8 from $(p,p'\gamma)$ . $I_\gamma$ : from $(p,p'\gamma)$ (1968Mo07). Others: 100 16 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), 100 11 from 1972Ra14 in $(p,p'\gamma)$ . Mult.: from $\gamma(\theta)$ in $(p,p'\gamma)$ .
		1910.8 8	100 12	1881.42	4 <sup>+</sup>	(M1+E2)	-0.47 16	$E_\gamma$ : weighted average of 1910.9 9 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ) and 1910.7 8 from $(p,p'\gamma)$ . $I_\gamma$ : weighted average of 79 9 from $(p,p'\gamma)$ (1968Mo07) and 79 16 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ). Other: 133 23 from 1972Ra14 in $(p,p'\gamma)$ is in disagreement. Mult., $\delta$ : D+Q from $p\gamma(\theta)$ in $(p,p'\gamma)$ ; RUL forbids M2. But $\gamma(\theta)$ data in ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), suggesting pure dipole, is in disagreement with results from $(p,p'\gamma)$ .
3825.7	(6 <sup>+</sup> )	661.6 3	100 4	3164.06	6 <sup>+</sup>			$E_\gamma$ : weighted average of 661.5 3 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min), 661.5 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ), 661.7 5 from ( <sup>16</sup> O, $\alpha$ 2p $\gamma$ ), and 661.9 6 from $(\alpha,\alpha'\gamma)$ . Other: 662 2 from $(p,p'\gamma)$ . $I_\gamma$ : from <sup>50</sup> Mn $\beta^+$ decay (1.75 min). $E_\gamma$ : weighted average of 1944.5 5 from <sup>50</sup> Mn $\varepsilon$ decay (1.75 min) and 1944.4 3 from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ). $I_\gamma$ : from <sup>50</sup> Mn $\beta^+$ decay (1.75 min).
		1944.4 3	15.2 20	1881.42	4 <sup>+</sup>			
3844.4	2 <sup>+</sup> ,3,4 <sup>+</sup>	683.4 10	22 6	3161.3	2 <sup>+</sup>			
		1962.9 4	100 11	1881.42	4 <sup>+</sup>			
		3060.9 6	50 11	783.31	2 <sup>+</sup>			
3875.4	(4 <sup>+</sup> ,5,6 <sup>+</sup> )	551.0 3	$\approx 33$	3324.56	4 <sup>+</sup>			$E_\gamma$ : from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ). Other: 550 2 from $(p,p'\gamma)$ .
		711.1 3	67 17	3164.06	6 <sup>+</sup>			$E_\gamma$ : from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ). Other: 711.1 6 from $(p,p'\gamma)$ .
		1993.8 37	100 33	1881.42	4 <sup>+</sup>			$E_\gamma$ : from ( <sup>28</sup> Si, $\alpha$ 2p $\gamma$ ). Other: 1993.8 6 from $(p,p'\gamma)$ .
3895.4	0 <sup>+</sup>	732 <sup>ab</sup> 2	$\approx 5^a$	3161.3	2 <sup>+</sup>	[E2]		B(E2)(W.u.)=0.5 +15-4 B(E2)(W.u.)=0.007 +6-3
		3112.0 10	100 40	783.31	2 <sup>+</sup>	[E2]		Mult., $\delta$ : $\delta(J=1)=-0.09$ 29, $\delta(J=2)=+0.34$ 13 from $p\gamma(\theta)$ in $(p,p'\gamma)$ which suggests D(+Q), but $\Delta J^\pi$ requires E2 if the parent level is the same one as the 0 <sup>+</sup> ,3895 level in (p,t).
3937.3	2 <sup>+</sup> ,3,4 <sup>+</sup>	1014.3 9	$\approx 17$	2924.6	2 <sup>+</sup>			
		2055.5 4	100 17	1881.42	4 <sup>+</sup>			
		3153.7 20	$\approx 83$	783.31	2 <sup>+</sup>			

Adopted Levels, Gammas (continued)

$\gamma(^{50}\text{Cr})$ (continued)							Comments
$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	
4051.7	$3^-$	441 <sup>ab</sup> 2	$\approx 5^a$	3611.4	$4^+$	[E1]	$B(E1)(\text{W.u.})=2.7\times 10^{-4} \ +34-17$
		458 <sup>b</sup> 2	$\approx 2$	3594.63	$2^+, 3, 4^+$		
		890.6 5	41 7	3161.3	$2^+$	[E1]	
		1126.9 5	100 9	2924.6	$2^+$	[E1]	
		3267.4 14	45 16	783.31	$2^+$	[E1]	
4068.2	$0^+$	441 <sup>ab</sup> 2	$\approx 7^a$	3628.9	$1^+$		$B(E1)(\text{W.u.})=5.9\times 10^{-6} \ +43-28$
		3284.8 22	100 25	783.31	$2^+$	[E2]	
4129.9	$(1, 2^+)$	500 2	$\approx 2$	3628.9	$1^+$		
		1205.3 4	38 6	2924.6	$2^+$		
		4130 <sup>b</sup> 3	$\approx 100$	0.0	$0^+$		
4193.0	$2^+$	494 <sup>ab</sup> 2	$\approx 10^a$	3698.2	$2^+$		
		1268.3 8	35 5	2924.6	$2^+$		
		3410.1 20	40 10	783.31	$2^+$		
		4193 <sup>b</sup> 3	$\approx 100$	0.0	$0^+$		
		542 <sup>#</sup>	61 <sup>#</sup>	3825.7	$(6)^+$		
4367.2	$5^-$	575.3 <sup>#</sup> 3	100 <sup>#</sup>	3792.1	$(5^+)$		
		755 <sup>#</sup>		3611.4	$4^+$		
		1042 <sup>#</sup>	34 <sup>#</sup>	3324.56	$4^+$		
		1203 <sup>#</sup> 1	37 <sup>#</sup>	3164.06	$6^+$		
		2485 <sup>#</sup>	32 <sup>#</sup>	1881.42	$4^+$		
		732 <sup>ab</sup> 2	$\approx 15^a$	3792.1	$(5^+)$		
		1363 <sup>ab</sup> 2	$\approx 38^a$	3164.06	$6^+$		
4523.8	$(4^+)$	1363 <sup>ab</sup> 2	$\approx 38^a$	3161.3	$2^+$		
		1599 2	$\approx 15$	2924.6	$2^+$		
		3740.5 20	100 23	783.31	$2^+$		
		494 <sup>ab</sup> 2	$\approx 33^a$	4051.7	$3^-$		
		1384.8 15	$\approx 100$	3161.3	$2^+$		
4546.3	$3^-$	1622 2	$\approx 67$	2924.6	$2^+$		
		2665 <sup>b</sup>	$\leq 80$	1881.42	$4^+$		
		3763 3	83 33	783.31	$2^+$		
		955 2	$\approx 33$	3698.2	$2^+$		
		1493 <sup>b</sup> 2	$\approx 10$	3161.3	$2^+$		
4653.3		1730.0 <sup>ab</sup> 3	323 <sup>a</sup> 36	2924.6	$2^+$		
		3870 2	100 29	783.31	$2^+$		
		1580.8 3	100	3164.06	$6^+$		
4744.9	$8^+$					E2	$B(E2)(\text{W.u.})=19 \ +6-4$ $E_\gamma$ : weighted average of 1580.5 3 from ( $^{32}\text{S}, \alpha 2p\gamma$ ), 1580.9 3 from ( $^{28}\text{Si}, \alpha 2p\gamma$ ), 1581.1 5 from ( $^{16}\text{O}, \alpha 2p\gamma$ ), and 1581.2 5 from ( $\alpha, \alpha'\gamma$ ). Mult.: from $\gamma(\theta, \text{pol})$ in ( $^{16}\text{O}, \alpha 2p\gamma$ ), $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in ( $^{32}\text{S}, \alpha 2p\gamma$ ).

Adopted Levels, Gammas (continued)

$\gamma(^{50}\text{Cr})$  (continued)

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	Comments
4997.1	1 <sup>(+)</sup>	4213.8@ 5	100@ 10	783.31	2 <sup>+</sup>	[M1]@	
		4996.7@ 5	100@	0.0	0 <sup>+</sup>	(M1)@	Mult.: from $\gamma(\theta)$ and polarization asymmetry in $(\gamma, \gamma')$ .
5213.4	(6 <sup>-</sup> )	846.2# 3	100# 10	4367.2	5 <sup>-</sup>		
		1388#		3825.7	(6) <sup>+</sup>		
		1421.1# 3	80# 7	3792.1	(5) <sup>+</sup>		
5931.2	1 <sup>+</sup>	5930.8@ 5	100	0.0	0 <sup>+</sup>	M1@	Mult.: from $\gamma(\theta)$ and polarization asymmetry in $(\gamma, \gamma')$ .
5998.0	(7 <sup>-</sup> )	784.6# 3	68# 18	5213.4	(6 <sup>-</sup> )		
		1630.9# 3	100# 18	4367.2	5 <sup>-</sup>		
6340.6	10 <sup>+</sup>	1595.7 2	100	4744.9	8 <sup>+</sup>	E2	B(E2)(W.u.)=6.6 +15-10 E <sub>γ</sub> : weighted average of 1595.2 3 from ( <sup>32</sup> S,α2pγ), 1595.9 3 from ( <sup>28</sup> Si,α2pγ), 1595.7 5 from ( <sup>16</sup> O,α2pγ), and 1596.5 5 from (α,α'γ). Mult.: from $\gamma(\theta, \text{pol})$ in ( <sup>16</sup> O,α2pγ), $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in ( <sup>32</sup> S,α2pγ). E <sub>γ</sub> : unweighted average of 414.5 3 from ( <sup>32</sup> S,α2pγ) and 413.6 3 from ( <sup>28</sup> Si,α2pγ). I <sub>γ</sub> : weighted average of 18 6 from ( <sup>32</sup> S,α2pγ) and 15.2 14 from ( <sup>28</sup> Si,α2pγ). E <sub>γ</sub> : weighted average of 2009.3 3 from ( <sup>32</sup> S,α2pγ) and 2009.8 3 from ( <sup>28</sup> Si,α2pγ). I <sub>γ</sub> : from ( <sup>28</sup> Si,α2pγ). Other: 100 12 from ( <sup>32</sup> S,α2pγ). Mult.: Q from $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in ( <sup>32</sup> S,α2pγ), $\gamma\gamma(\text{ADO})$ in ( <sup>28</sup> Si,α2pγ); M2 ruled out by RUL.
6754.5	10 <sup>+</sup>	414.1 5	15.3 14	6340.6	10 <sup>+</sup>		
		2009.6 3	100 10	4744.9	8 <sup>+</sup>	E2	
6950.6	11 <sup>+</sup>	196.0 4	3.0 3	6754.5	10 <sup>+</sup>	(M1)	B(M1)(W.u.)=0.174 22 E <sub>γ</sub> : weighted average of 196.3 3 from ( <sup>32</sup> S,α2pγ) and 195.6 3 from ( <sup>28</sup> Si,α2pγ). I <sub>γ</sub> : weighted average of 3.4 11 from ( <sup>32</sup> S,α2pγ) and 3.0 3 from ( <sup>28</sup> Si,α2pγ). Mult.: D from $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in ( <sup>32</sup> S,α2pγ); Δπ=no from level scheme.
		610.2 3	100.0 15	6340.6	10 <sup>+</sup>	M1	B(M1)(W.u.)=0.192 16 E <sub>γ</sub> : weighted average of 610.3 3 from ( <sup>32</sup> S,α2pγ), 610.1 3 from ( <sup>28</sup> Si,α2pγ), and 609.9 5 from ( <sup>16</sup> O,α2pγ). I <sub>γ</sub> : from ( <sup>28</sup> Si,α2pγ). Others: 100 11 from ( <sup>16</sup> O,α2pγ), 100 10 from ( <sup>32</sup> S,α2pγ). Mult.: from $\gamma(\theta, \text{pol})$ in ( <sup>16</sup> O,α2pγ), $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in ( <sup>32</sup> S,α2pγ).
7600.8	1 <sup>+</sup>	7600.2@ 5	100	0.0	0 <sup>+</sup>	M1@	
7613.1	12 <sup>+</sup>	662.2 3	100.0 15	6950.6	11 <sup>+</sup>	M1	B(M1)(W.u.)=0.66 6 E <sub>γ</sub> : weighted average of 662.4 3 from ( <sup>32</sup> S,α2pγ), 662.2 3 from ( <sup>28</sup> Si,α2pγ), and 661.8 5 from ( <sup>16</sup> O,α2pγ). I <sub>γ</sub> : other: 100 10 from ( <sup>32</sup> S,α2pγ) and ( <sup>16</sup> O,α2pγ). Mult.: from $\gamma(\theta, \text{pol})$ in ( <sup>16</sup> O,α2pγ), $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ from ( <sup>32</sup> S,α2pγ). B(E2)(W.u.)=4.0 8 E <sub>γ</sub> : weighted average of 1272 1 from ( <sup>32</sup> S,α2pγ) and 1272.2 3 from ( <sup>28</sup> Si,α2pγ). I <sub>γ</sub> : weighted average of 4.3 15 from ( <sup>32</sup> S,α2pγ) and 2.8 3 from ( <sup>28</sup> Si,α2pγ). Other: <4.9 from ( <sup>16</sup> O,α2pγ).
		1272.2 3	2.9 3	6340.6	10 <sup>+</sup>	[E2]	
7645.7	1 <sup>+</sup>	7645.1@ 5	100	0.0	0 <sup>+</sup>	M1@	
7948.2	1 <sup>+</sup>	7164.5@ 5	27@ 2	783.31	2 <sup>+</sup>	[M1]	

**Adopted Levels, Gammas (continued)**

$\gamma(^{50}\text{Cr})$  (continued)

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	Comments
7948.2	1 <sup>+</sup>	7947.4 @ 5	100 @	0.0	0 <sup>+</sup>	M1 @	
8045.8	1 <sup>+</sup>	8045.1 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
8121.5	1 <sup>+</sup>	8120.8 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
8527.6	1 <sup>+</sup>	7743.1 @ 5	39 @ 6	783.31	2 <sup>+</sup>	[M1]	
		8527.4 @ 5	100 @	0.0	0 <sup>+</sup>	M1 @	
8885.6	1 <sup>+</sup>	8884.8 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9007.9	1 <sup>+</sup>	9007.0 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9208.3	1 <sup>+</sup>	9207.4 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9327.1	(12 <sup>+</sup> )	1713.8 ‡ 3	85 ‡ 25	7613.1	12 <sup>+</sup>		
		2572.6 ‡ 3	100 ‡ 35	6754.5	10 <sup>+</sup>	(Q)	
		2987 ‡ 1	<50 ‡	6340.6	10 <sup>+</sup>		
9409.5	1 <sup>+</sup>	9408.5 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9579.1	1 <sup>+</sup>	9578.1 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9642.2	13 <sup>+</sup>	2028.9 8	100 # 10	7613.1	12 <sup>+</sup>	D	$E_\gamma$ : unweighted average of 2028.1 3 from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and 2029.7 3 from ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ). Mult.: from $\gamma\gamma$ (DCO) and $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ).
		2692.0 # 3	4.8 # 10	6950.6	11 <sup>+</sup>	E2	B(E2)(W.u.)=0.34 +40-16 Mult.: Q from $\gamma$ (ADO) in ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ); M2 ruled out by RUL.
9719.1	1 <sup>+</sup>	9718.1 @ 5	100	0.0	0 <sup>+</sup>	M1 @	
9914.8	14 <sup>+</sup>	273.1 3	15 # 2	9642.2	13 <sup>+</sup>	D	$E_\gamma$ : weighted average of 273.3 3 from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and 272.9 3 from ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ). $I_\gamma$ : other: 44 4 from <sup>24</sup> Mg( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) is in disagreement.
		2302.0 12	100 # 10	7613.1	12 <sup>+</sup>	E2	$E_\gamma$ : unweighted average of 2300.9 3 from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and 2303.2 3 from ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ). $I_\gamma$ : also from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ).
10797.5	13 <sup>(+)</sup>	3183.9 ‡ 3	100	7613.1	12 <sup>+</sup>	D	Mult.: from $\gamma\gamma$ (DCO) and $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ).
11013.9	13 <sup>+</sup>	3400.5 ‡ 3	100 ‡	7613.1	12 <sup>+</sup>	D	Mult.: from $\gamma\gamma$ (DCO) and $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ), and $\gamma\gamma$ (ADO) in ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ).
12391.5	15 <sup>(+)</sup>	1593.6 ‡ 3	100 ‡ 14	10797.5	13 <sup>(+)</sup>		
		2476.9 ‡ 3	40 ‡ 9	9914.8	14 <sup>+</sup>	D	Mult.: from $\gamma\gamma$ (DCO) and $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ).
12542.0	(14 <sup>+</sup> )	4927.9 ‡ 10	100	7613.1	12 <sup>+</sup>		
13218.4	15 <sup>+</sup>	2204.2 ‡ 3	100 ‡ 10	11013.9	13 <sup>+</sup>	E2	Mult.: Q from $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and $\gamma\gamma$ (DCO) in ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ); M2 ruled out by RUL.
		3304.8 15	54 5	9914.8	14 <sup>+</sup>	D	$E_\gamma$ : unweighted average of 3303.3 3 from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and 3306.3 3 from ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ). $I_\gamma$ : from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ). Mult.: from $\gamma$ (DCO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ).
		3578.7 16	54 9	9642.2	13 <sup>+</sup>	E2	$E_\gamma$ : unweighted average of 3577.1 10 from ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ) and 3580.3 10 from ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ). Mult.: Q from $\gamma\gamma$ (ADO) in ( <sup>28</sup> Si, $\alpha$ 2 $\gamma$ ); M2 ruled out by RUL.
13495.3		3853 # 2		9642.2	13 <sup>+</sup>		
13641.0	14 <sup>(+)</sup>	2627.1 ‡ 3	100	11013.9	13 <sup>+</sup>	D	Mult.: from $\gamma\gamma$ (ADO) in ( <sup>32</sup> S, $\alpha$ 2 $\gamma$ ).

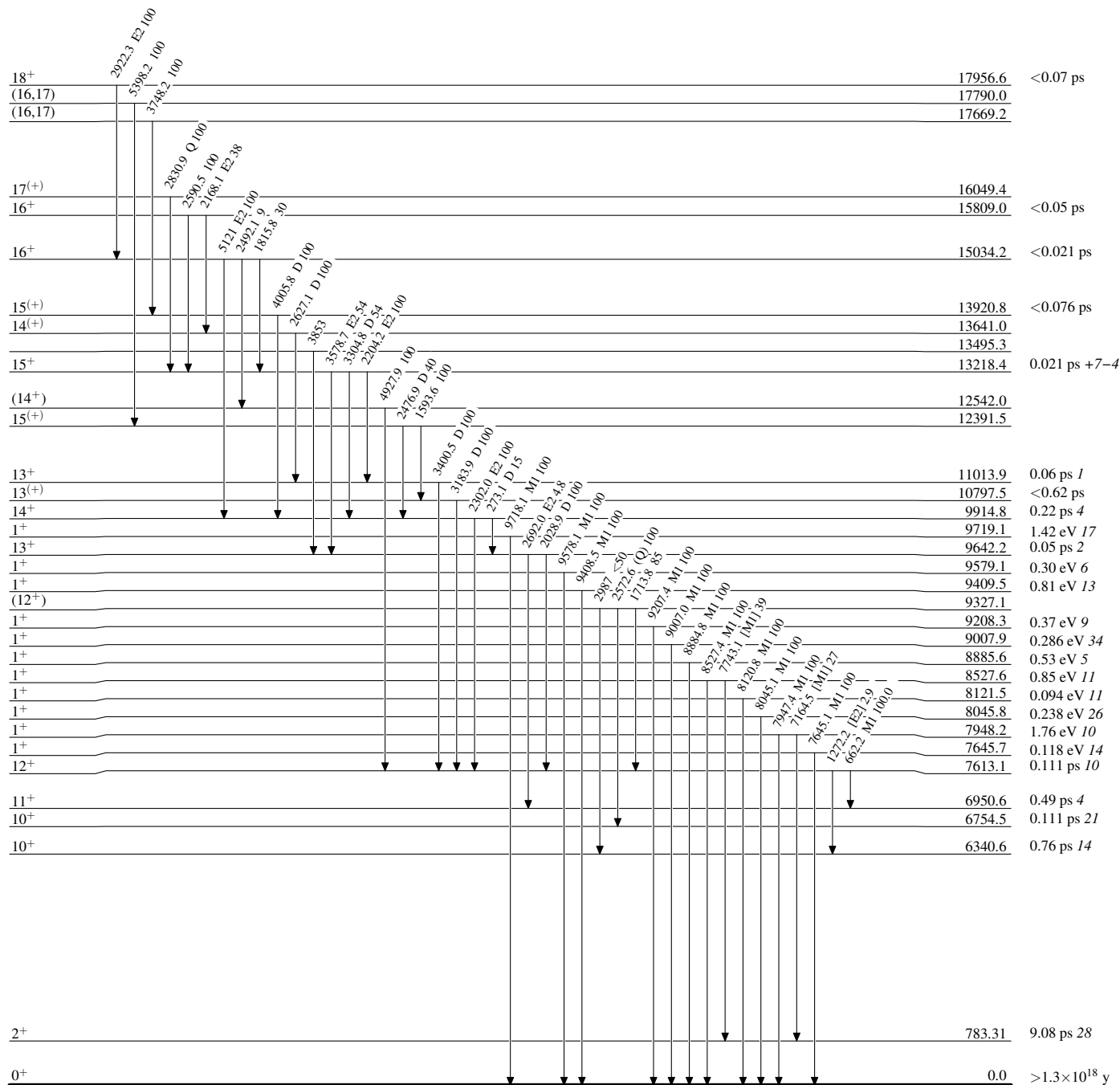
**Adopted Levels, Gammas (continued)** $\gamma(^{50}\text{Cr})$  (continued)

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Mult.	Comments
13920.8	15 <sup>(+)</sup>	4005.8 $^\ddagger$ 10	100	9914.8	14 <sup>+</sup>	D	Mult.: from $\gamma\gamma(\text{DCO})$ and $\gamma\gamma(\text{ADO})$ in $(^{32}\text{S},\alpha 2p\gamma)$ and $(^{28}\text{Si},\alpha 2p\gamma)$ .
15034.2	16 <sup>+</sup>	1815.8 4	30 5	13218.4	15 <sup>+</sup>		$E_\gamma$ : weighted average of 1815.5 3 from $(^{32}\text{S},\alpha 2p\gamma)$ and 1816.2 3 from $(^{28}\text{Si},\alpha 2p\gamma)$ . $I_\gamma$ : weighted average of 29 5 from $(^{32}\text{S},\alpha 2p\gamma)$ and 33 7 from $(^{28}\text{Si},\alpha 2p\gamma)$ .
		2492.1 $^\ddagger$ 3	9 $^\ddagger$ 5	12542.0	(14 <sup>+</sup> )		
		5121 2	100 $^\#$ 22	9914.8	14 <sup>+</sup>	E2	$E_\gamma$ : unweighted average of 5119.1 10 from $(^{32}\text{S},\alpha 2p\gamma)$ and 5123.4 10 from $(^{28}\text{Si},\alpha 2p\gamma)$ . Mult.: Q from $\gamma\gamma(\text{ADO})$ in $(^{32}\text{S},\alpha 2p\gamma)$ and M2 ruled out by RUL.
15809.0	16 <sup>+</sup>	2168.1 $^\ddagger$ 3	38 $^\ddagger$ 11	13641.0	14 <sup>(+)</sup>	E2	Mult.: Q from $\gamma\gamma(\text{ADO})$ in $(^{32}\text{S},\alpha 2p\gamma)$ and M2 ruled out by RUL.
		2590.5 $^\ddagger$ 3	100 $^\ddagger$ 22	13218.4	15 <sup>+</sup>		
16049.4	17 <sup>(+)</sup>	2830.9 $^\ddagger$ 3	100	13218.4	15 <sup>+</sup>	Q	Mult.: Q from $\gamma\gamma(\text{ADO})$ in $(^{32}\text{S},\alpha 2p\gamma)$ .
17669.2	(16,17)	3748.2 10	100	13920.8	15 <sup>(+)</sup>		
17790.0	(16,17)	5398.2 10	100	12391.5	15 <sup>(+)</sup>		
17956.6	18 <sup>+</sup>	2922.3 7	100	15034.2	16 <sup>+</sup>	E2	$E_\gamma$ : unweighted average of 2921.6 3 from $(^{32}\text{S},\alpha 2p\gamma)$ and 2923.0 3 from $(^{28}\text{Si},\alpha 2p\gamma)$ .

<sup>†</sup> From  $^{50}\text{Cr}(\text{p},\text{p}'\gamma)$ , except as noted.<sup>‡</sup> From  $^{24}\text{Mg}(^{32}\text{S},\alpha 2p\gamma)$ .<sup>#</sup> From  $^{28}\text{Si}(^{28}\text{Si},\alpha 2p\gamma)$ .<sup>@</sup> From  $(\gamma,\gamma'),(\text{pol } \gamma,\gamma')$ . Mult. are based on  $\gamma(\theta,\text{pol})$  data (2016Pa04).<sup>&</sup> Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on  $\gamma$ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.<sup>a</sup> Multiply placed with undivided intensity.<sup>b</sup> Placement of transition in the level scheme is uncertain.

**Adopted Levels, Gammas****Level Scheme**

Intensities: Relative photon branching from each level

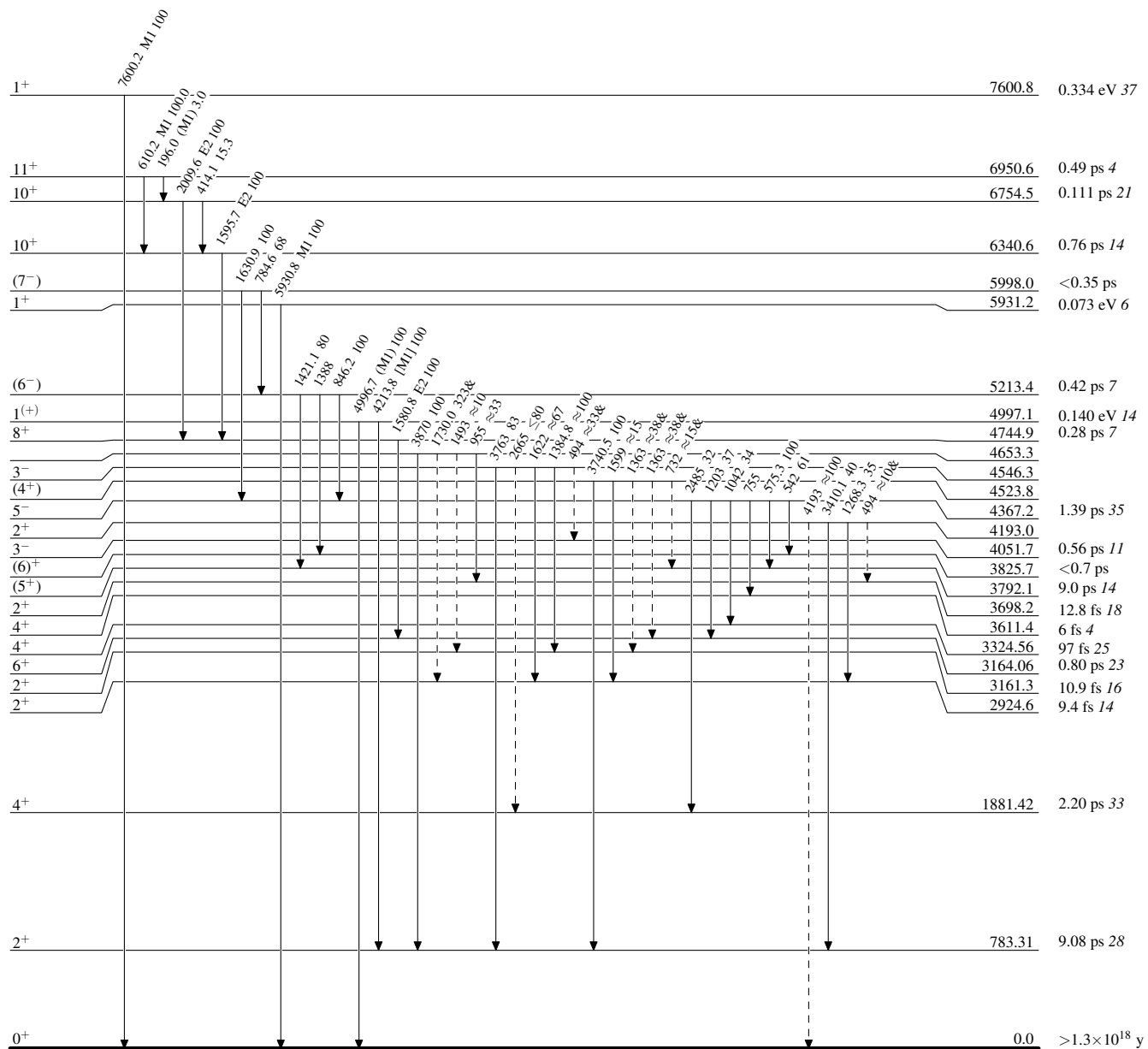
 $^{50}_{24}\text{Cr}_{26}$

**Adopted Levels, Gammas**

Legend

**Level Scheme (continued)**

Intensities: Relative photon branching from each level  
& Multiply placed: undivided intensity given

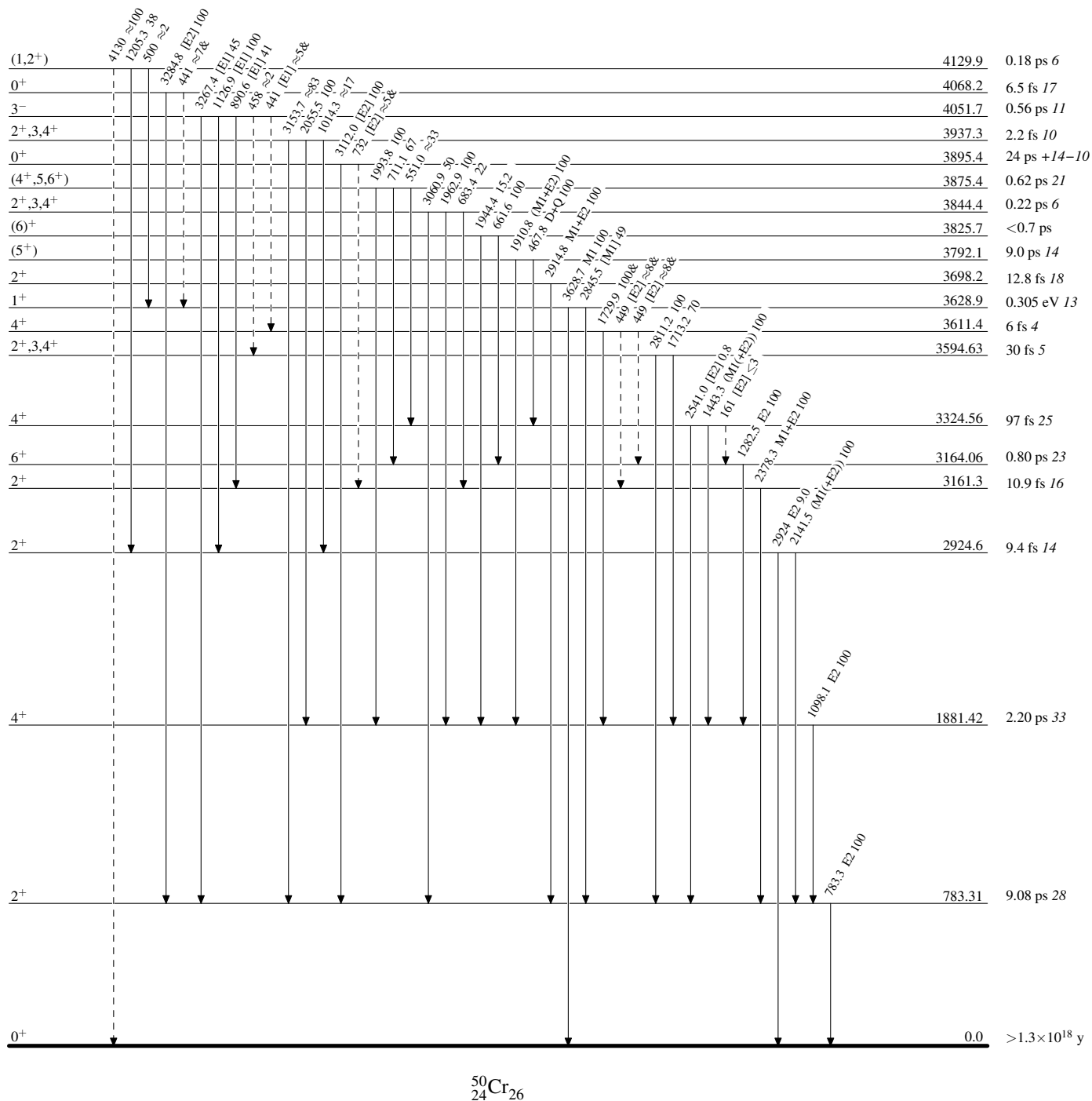
-----►  $\gamma$  Decay (Uncertain) $^{50}_{24}\text{Cr}_{26}$

**Adopted Levels, Gammas**

Legend

**Level Scheme (continued)**

Intensities: Relative photon branching from each level  
& Multiply placed: undivided intensity given

-----►  $\gamma$  Decay (Uncertain)



Adopted Levels, Gammas