

Table 16.10 from (1986AJ04): Energy Levels of  $^{16}\text{O}$  <sup>a</sup>

$E_x$ (MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_m$ (keV)	Decay	Reactions
0	$0^+; 0$		stable		2, 3, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 26, 28, 29, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74
$6.0494 \pm 1.0$	$0^+; 0$	$0^+$	$\tau_m = 96 \pm 7$ psec	$\pi$	2, 3, 7, 8, 9, 11, 13, 15, 17, 19, 26, 28, 29, 30, 34, 35, 39, 40, 43, 50, 51, 53, 61, 62, 65, 66, 68, 71, 73
$6.129893 \pm 0.04$	$3^-; 0$		$\tau_m = 26.6 \pm 0.7$ psec $g = +0.556 \pm 0.004$	$\gamma$	2, 3, 7, 8, 9, 11, 13, 14, 15, 17, 26, 27, 28, 29, 30, 33, 34, 35, 39, 40, 41, 42, 43, 45, 46, 47, 49, 50, 61, 62, 63, 65, 66, 68, 71, 73
$6.9171 \pm 0.6$	$2^+; 0$	$0^+$	$\tau_m = 6.78 \pm 0.19$ fsec	$\gamma$	2, 3, 7, 8, 9, 11, 13, 15, 26, 27, 28, 29, 30, 33, 34, 38, 39, 40, 41, 42, 43, 45, 46, 49, 50, 51, 62, 63, 65, 66, 68, 71, 73
$7.11685 \pm 0.14$	$1^-; 0$		$\tau_m = 12.0 \pm 0.7$ fsec	$\gamma$	2, 3, 7, 8, 9, 13, 15, 26, 27, 28, 29, 30, 33, 34, 35, 38, 39, 40, 42, 43, 46, 61, 62, 63, 65, 66, 68, 73
$8.8719 \pm 0.5$	$2^-; 0$		$\tau_m = 180 \pm 16$ fsec	$\gamma, \alpha$	2, 3, 7, 8, 12, 15, 26, 27, 29, 33, 34, 35, 39, 41, 42, 43, 45, 46, 62, 63, 68, 73
$9.585 \pm 11$	$1^-; 0$	$0^-$	$\Gamma = 420 \pm 20$	$\gamma, \alpha$	3, 5, 7, 8, 26, 34, 35, 41, 42, 43, 45, 46, 50, 51
$9.8445 \pm 0.5$	$2^+; 0$		$0.625 \pm 0.100$	$\gamma, \alpha$	2, 3, 5, 7, 8, 15, 26, 27, 29, 33, 34, 35, 39, 42, 43, 45, 46, 50, 51, 61, 63, 65, 68, 71, 73

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(MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_{\text{m}}$ (keV)	Decay	Reactions
10.356 $\pm$ 3	4 <sup>+</sup> ; 0	0 <sup>+</sup>	26 $\pm$ 3	$\gamma, \alpha$	2, 3, 5, 7, 8, 9, 10, 12, 15, 17, 26, 27, 29, 34, 39, 42, 43, 45, 46, 50, 51, 57, 61, 63, 66, 68, 73
10.957 $\pm$ 1	0 <sup>-</sup> ; 0		$\tau_{\text{m}} = 8 \pm 5$ fsec		2, 26, 33, 34, 42, 43, 63, 68
11.080 $\pm$ 3	3 <sup>+</sup> ; 0		$\Gamma < 12$	$\gamma$	2, 26, 33, 34, 63, 68
11.0967 $\pm$ 1.6	4 <sup>+</sup> ; 0		0.28 $\pm$ 0.05	$\gamma, \alpha$	2, 3, 5, 7, 9, 10, 12, 15, 26, 27, 39, 42, 43, 45, 46, 50, 51, 68
(11.26) <sup>b</sup>	(0 <sup>+</sup> ; 0)		(2500)	( $\alpha$ )	5, 34
11.520 $\pm$ 4	2 <sup>+</sup> ; 0		71 $\pm$ 3	$\gamma, \alpha$	2, 3, 5, 15, 26, 39, 40, 42, 43, 45, 46, 50, 51, 57
11.60 $\pm$ 20	3 <sup>-</sup> ; 0	0 <sup>-</sup>	800 $\pm$ 100	$\alpha$	5, 10, 50, 51
12.049 $\pm$ 2	0 <sup>+</sup> ; 0		1.5 $\pm$ 0.5	$\gamma, \alpha$	5, 15, 19, 26, 39, 42, 43, 45, 46, 50, 51
12.440 $\pm$ 2	1 <sup>-</sup> ; 0		91 $\pm$ 6	$\gamma, \text{p}, \alpha$	3, 4, 5, 26, 30, 32, 33, 34, 39, 43, 46, 50, 51
12.530 $\pm$ 1	2 <sup>-</sup> ; 0		$(97 \pm 10) \times 10^{-3}$	$\gamma, \text{p}, \alpha$	2, 15, 26, 30, 32, 33, 34, 39, 42, 43, 46, 62
12.796 $\pm$ 4	0 <sup>-</sup> ; 1		40 $\pm$ 4	$\text{p}$	26, 32, 33, 34, 42
12.9686 $\pm$ 0.4	2 <sup>-</sup> ; 1		1.60 $\pm$ 0.14	$\gamma, \text{p}, \alpha$	15, 26, 30, 32, 33, 34, 39, 61, 62, 63
13.020 $\pm$ 10	2 <sup>+</sup> ; 0		150 $\pm$ 10	$\gamma, \text{p}, \alpha$	3, 5, 39, 42, 43, 45, 46, 50, 51, 57
13.090 $\pm$ 8	1 <sup>-</sup> ; 1		130 $\pm$ 5	$\gamma, \text{p}, \alpha$	3, 4, 5, 7, 26, 33, 34, 39, 63
13.129 $\pm$ 10	3 <sup>-</sup> ; 0		110 $\pm$ 30	$\gamma, \text{p}, \alpha$	2, 3, 4, 5, 26, 33
13.259 $\pm$ 2	3 <sup>-</sup> ; 0		21 $\pm$ 1	$\gamma, \text{p}, \alpha$	3, 4, 5, 26, 32, 33, 34, 39, 42, 61, 62, 63, 65, 67
13.664 $\pm$ 3	1 <sup>+</sup> ; 0		64 $\pm$ 3	$\gamma, \text{p}, \alpha$	26, 30, 32, 43
13.869 $\pm$ 20	4 <sup>+</sup> ; 0		89 $\pm$ 2	$\text{p}, \alpha$	2, 5, 26, 32, 39, 42, 45, 46, 50, 51
13.980 $\pm$ 2	2 <sup>-</sup>		20 $\pm$ 2	$\text{p}, \alpha$	2, 26, 27, 32
14.032 $\pm$ 15	0 <sup>+</sup>		185 $\pm$ 35	$\gamma, \alpha$	5, 39
14.1 $\pm$ 100	3 <sup>-</sup>		750 $\pm$ 200	$\alpha$	5
14.302 $\pm$ 3	4 <sup>(-)</sup>		34 $\pm$ 12		15, 26, 27

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(MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_m$ (keV)	Decay	Reactions
14.399 $\pm$ 2	5 <sup>+</sup>		27 $\pm$ 5		2, 8, 15, 26, 27
14.620 $\pm$ 20	(4 <sup>+</sup> )		490 $\pm$ 15	$\alpha$	5, 7
14.660 $\pm$ 20	5 <sup>-</sup>	0 <sup>-</sup>	670 $\pm$ 15	$\alpha$	5, 7, 8, 9, 10, 50, 51
14.8153 $\pm$ 1.6	6 <sup>+</sup> ; 0		70 $\pm$ 8	$\alpha$	2, 5, 7, 15, 26, 27, 45, 46, 50, 51
14.926 $\pm$ 2	2 <sup>+</sup>		54 $\pm$ 5	p, $\alpha$	2, 26, 32, 39
15.097 $\pm$ 5	0 <sup>+</sup>		166 $\pm$ 30	p, $\alpha$	4, 5, 26, 32
15.196 $\pm$ 3	2 <sup>-</sup> ; 0		63 $\pm$ 4	p, $\alpha$	26, 27, 32, 39, 42, 45, 61, 62, 63
15.26 $\pm$ 50	2 <sup>+</sup> ; (0)		300 $\pm$ 100	p, $\alpha$	32, 39, 42, 45
15.408 $\pm$ 2	3 <sup>-</sup> ; 0		132 $\pm$ 7	p, $\alpha$	4, 5, 26, 27, 32, 39, 42, 46, 50, 51, 57, 61, 62, 63
15.785 $\pm$ 5	3 <sup>+</sup>		40 $\pm$ 10		15, 26, 27
15.828 $\pm$ 30	3 <sup>-</sup>		700 $\pm$ 120	$\alpha$	5, 39
16.20 $\pm$ 90	1 <sup>-</sup> ; 0		580 $\pm$ 60	$\gamma$ , p, $\alpha$	3, 26, 32
16.209 $\pm$ 2	1 <sup>+</sup> ; 1		19 $\pm$ 3	$\gamma$ , n, p	26, 27, 30, 31, 32, 37, 39
16.275 $\pm$ 7	6 <sup>+</sup>		420 $\pm$ 20	$\alpha$	2, 5, 7, 8, 9, 10, 17, 27, 50, 51, 57
16.352 $\pm$ 8	2 <sup>+</sup>		61 $\pm$ 8	p, $\alpha$	4, 5, 26, 32, 42, 45, 46, 65
16.4423 $\pm$ 1.6	2 <sup>+</sup> ; 1		25 $\pm$ 2	$\gamma$ , n, p, $\alpha$	3, 4, 5, 26, 32, 39
16.817 $\pm$ 2	(2 <sup>-</sup> ; 0 + 1)		28 $\pm$ 3	$\gamma$ , p, $\alpha$	15, 26, 30, 32
16.844 $\pm$ 21	4 <sup>+</sup>		570 $\pm$ 60	$\alpha$	5
16.93 $\pm$ 50	2 <sup>+</sup>		$\approx$ 280	$\alpha$ , $^8\text{Be}$	5, 6
17.09 $\pm$ 40	1 <sup>-</sup> ; 1		380 $\pm$ 40	$\gamma$ , p	30, 32
17.129 $\pm$ 5	2 <sup>+</sup>		107 $\pm$ 14	n, p, $\alpha$	4, 5
17.140 $\pm$ 10	1 <sup>+</sup> ; 1		34 $\pm$ 3	$\gamma$ , n, p, $\alpha$	5, 30, 31, 32, 39
17.197 $\pm$ 17	2 <sup>+</sup>		160 $\pm$ 60	$\alpha$ , $^8\text{Be}$	2, 5, 6, 27, 34, 42, 45, 46
17.282 $\pm$ 11	1 <sup>-</sup> ; 1		78 $\pm$ 5	$\gamma$ , n, p, $\alpha$	4, 30, 31, 32, 37, 39
17.510 $\pm$ 26	1 <sup>-</sup>		180 $\pm$ 60	$\alpha$	5
17.555 $\pm$ 21	(6 <sup>+</sup> )		180 $\pm$ 70	n, $\alpha$	4, 5
17.609 $\pm$ 7	2 <sup>+</sup> ; (1)		114 $\pm$ 14	p, $\alpha$	4, 5, 32
17.72	(0 <sup>+</sup> , 2 <sup>+</sup> )		$\approx$ 75	p, $\alpha$ , $^8\text{Be}$	5, 6
17.775 $\pm$ 11	4 <sup>-</sup> ; 0		45 $\pm$ 7	p	15, 39, 40, 42, 45, 46, 62, 63

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(MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_{\text{m}}$ (keV)	Decay	Reactions
17.784 $\pm$ 15	4 <sup>+</sup>		400 $\pm$ 40	n, $\alpha$ , $^8\text{Be}$	4, 5, 6, 39, 50, 51
17.877 $\pm$ 6	(1, 2) <sup>-</sup> ; 1		24 $\pm$ 3	$\gamma$ , p, ( $\alpha$ )	30, 32, 37
18.016 $\pm$ 1	4 <sup>+</sup> ; (0)		14 $\pm$ 2	n, p, $\alpha$ , $^8\text{Be}$	4, 5, 6, 15
18.029 $\pm$ 5	3 <sup>(-)</sup> ; 1		26 $\pm$ 4	$\gamma$ , n, p, $\alpha$	15, 30, 31, 32, 39, 62
18.089 $\pm$ 25	(0 <sup>+</sup> )		288 $\pm$ 44	( $\gamma$ ), n, p, $\alpha$	3, 4, 5, 31, 42, 46
18.202 $\pm$ 8	2 <sup>+</sup>		220 $\pm$ 50	$\gamma$ , p	32, 39, 42, 46
18.29			$\approx$ 380	$\gamma$ , p, $\alpha$	3, 4, 5
18.404 $\pm$ 12	5 <sup>-</sup>		550 $\pm$ 40	$\alpha$	5
18.430 $\pm$ 15	2 <sup>+</sup> ; 0		90 $\pm$ 40	p	32, 42, 45, 46
18.484 $\pm$ 6	1 <sup>-</sup>		35 $\pm$ 6	p	32
18.6	(1 <sup>-</sup> , 5 <sup>-</sup> )		$\approx$ 150	$\alpha$	5
18.6	(4 <sup>+</sup> )		$\approx$ 300	$\alpha$ , $^8\text{Be}$	5, 6
18.640 $\pm$ 15	(5 <sup>+</sup> )		22 $\pm$ 7	(n, p)	2, 15, 39
18.773 $\pm$ 22	1 <sup>-</sup>		215 $\pm$ 45	p, $\alpha$	4, 5
18.785 $\pm$ 6	4 <sup>+</sup>		260 $\pm$ 20	n, p, $\alpha$ , $^8\text{Be}$	4, 5, 6
18.79 $\pm$ 10	1 <sup>+</sup> ; 1		120 $\pm$ 20	$\gamma$ , p	30, 32, 39
18.977 $\pm$ 6	4 <sup>-</sup> ; 1		8.2 $\pm$ 3.8	$\gamma$ , p, $\alpha$	15, 30, 32, 39, 40, 42, 45, 62, 63
19.001 $\pm$ 24	2 <sup>-</sup> ; 1		420 $\pm$ 50	$\gamma$ , p	30, 32, 39
19.08 $\pm$ 30	2 <sup>+</sup> ; (1)		$\approx$ 120	$\gamma$ , (n), p, $\alpha$	4, 5, 10, 30, 32
19.206 $\pm$ 12	3 <sup>-</sup> ; 1		68 $\pm$ 10		39, 62, 63
19.253 $\pm$ 30	(5 <sup>-</sup> )		50 $\pm$ 45	n, $\alpha$	4, 5
19.257 $\pm$ 9	2 <sup>+</sup> ; (1)		155 $\pm$ 25	$\gamma$ , p, $\alpha$	4, 5, 30, 32
19.319 $\pm$ 14	(6 <sup>+</sup> )		65 $\pm$ 35	p, $\alpha$ , $^8\text{Be}$	4, 5, 6
19.375 $\pm$ 2	4 <sup>+</sup>		23 $\pm$ 4	p, $\alpha$	4, 5
19.47 $\pm$ 30	1 <sup>-</sup> ; 1		200 $\pm$ 70	$\gamma$ , p	30, 32, 39
19.539 $\pm$ 19	2 <sup>+</sup> ; 0		255 $\pm$ 75	n, $\alpha$	2, 4, 5, 42, 46
19.754 $\pm$ 16	2 <sup>+</sup>		290 $\pm$ 50	p, $\alpha$	4, 5
19.808 $\pm$ 11	4 <sup>-</sup> ; 0		32 $\pm$ 4		15, 40, 42, 62, 63
19.895 $\pm$ 7	3; 1		42 $\pm$ 9	$\gamma$ , p, $\alpha$	2, 30, 32
20.055 $\pm$ 13	2 <sup>+</sup> ; 0		400 $\pm$ 32	$\gamma$ , n, p, $\alpha$	3, 4, 5, 45, 46
20.412 $\pm$ 17	2 <sup>-</sup> ; 1		190 $\pm$ 20	$\gamma$ , n, p	30, 31, 32, 39, 62, 63
20.541 $\pm$ 2	5 <sup>-</sup>		11 $\pm$ 2	p, $\alpha$	2, 4, 5
20.560 $\pm$ 2	even $\pi$		< 5	p, $\alpha$	4, 5
20.615 $\pm$ 3	even $\pi$		< 10	$\alpha$	5
(20.8)			( $\approx$ 60)	n, p, $\alpha$	4
20.857 $\pm$ 14	7 <sup>-</sup>	0 <sup>-</sup>	900 $\pm$ 60	$\alpha$	5, 7, 8, 9, 10

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(MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_{\text{m}}$ (keV)	Decay	Reactions
20.945 $\pm$ 20	1 <sup>-</sup> ; 1		300 $\pm$ 10	$\gamma$ , n, p	30, 31, 32, 39
21.05 $\pm$ 50	(2 <sup>+</sup> ; 0)		298 $\pm$ 43		42, 46
21.052 $\pm$ 6	6 <sup>+</sup>		205 $\pm$ 15	$\alpha$	5
21.175 $\pm$ 15					2
21.50	(1 $\rightarrow$ 4)		120	p	32
21.623 $\pm$ 11	7 <sup>-</sup>		60 $\pm$ 30	n, p, $\alpha$	4, 5
21.648 $\pm$ 3	6 <sup>+</sup>		115 $\pm$ 8	n, $\alpha$	4, 5, 7
21.776 $\pm$ 9	3 <sup>-</sup>		43 $\pm$ 20	n, p, $\alpha$	2, 4, 5
22.04	0 <sup>+</sup>		60	n, d, $\alpha$	4, 21
22.150 $\pm$ 10	1 <sup>-</sup> ; 1		680 $\pm$ 10	$\gamma$ , n, p, d, $\alpha$	10, 20, 22, 25, 30, 31, 32, 36, 37, 38
22.35	2 <sup>+</sup>		175	n, d, $\alpha$	21, 25
22.5 $\pm$ 100	3 <sup>-</sup>		400 $\pm$ 50	p, d, $\alpha$	22, 25, 46
22.65 $\pm$ 30			60	n, $\alpha$ , $^8\text{Be}$	2, 4, 6
22.721 $\pm$ 3	0 <sup>+</sup> ; 2		12.5 $\pm$ 2.5	n, p, d, $\alpha$	4, 5, 19, 22, 25, 65
22.89 $\pm$ 10	1 <sup>-</sup> ; 1		300 $\pm$ 10	$\gamma$ , p, d	20, 22, 30, 32
23.0 $\pm$ 100	6 <sup>+</sup>		$\lesssim$ 500	(d), $\alpha$ , $^8\text{Be}$	6, 7, 25
23.1			$\approx$ 20	(n), d, $\alpha$ , $^8\text{Be}$	5, 6, 21, 25
23.235 $\pm$ 62	(1 <sup>-</sup> ; 1)		560 $\pm$ 150	n, p, d	21, 22, 23, 31, 42
23.51 $\pm$ 30	(5 <sup>-</sup> )		300	p, d, $\alpha$	2, 5, 10, 22, 23, 25, 45, 46
23.879 $\pm$ 6	6 <sup>+</sup>		26 $\pm$ 4	p, $\alpha$ , $^8\text{Be}$	4, 5, 6, 7
24.07 $\pm$ 30	1 <sup>-</sup> ; 1		550 $\pm$ 40	$\gamma$ , p, $^3\text{He}$	13, 30, 32, 42
24.36 $\pm$ 70	(2 <sup>+</sup> , 3 <sup>-</sup> ); 0		424 $\pm$ 45	n, p	31, 46
24.522 $\pm$ 11	2 <sup>+</sup> ; 2		< 50		19, 65
24.76 $\pm$ 50	(2, 4) <sup>+</sup> ; 1		340 $\pm$ 60	$\gamma$ , n, p	30, 31, 32
25.12 $\pm$ 50	1 <sup>-</sup> ; 1		3000 $\pm$ 300	$\gamma$ , p, $^3\text{He}$ , $\alpha$	13, 30, 32, 38, 45
25.50 $\pm$ 150	1 <sup>-</sup> ; 1		1300 $\pm$ 300	$\gamma$	39, 42
25.6	(3 <sup>-</sup> ); 1		450	$^3\text{He}$ , $\alpha$	5, 13
26.0 $\pm$ 100	1 <sup>-</sup> ; (1)		500 – 1000	$\gamma$ , $^3\text{He}$ , $\alpha$	13
26.363 $\pm$ 62	(2, 4) <sup>+</sup> ; 1		550 $\pm$ 70	$\gamma$ , n, p, $\alpha$	5, 30, 31, 32
27.35 $\pm$ 100	(2, 4) <sup>+</sup> ; 1		830 $\pm$ 110	$\gamma$ , p, $^3\text{He}$ , $\alpha$ , $^8\text{Be}$	13, 30, 32
27.5	(3 <sup>-</sup> ; 0)		$\approx$ 2500	$\gamma$ , $^3\text{He}$	13
28.2	7 <sup>-</sup>		1000	$\alpha$	5, 7
28.6 $\pm$ 200				$\gamma$ , $^3\text{He}$	13
29.0	7 <sup>-</sup>		1000	p, $\alpha$	5, 7
29.8 $\pm$ 100	9 <sup>-</sup> + 8 <sup>+</sup>		500 – 1000	$^3\text{He}$ , $\alpha$	10, 13

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(MeV $\pm$ keV)	$J^\pi; T$	$K^\pi$	$\Gamma_{\text{c.m.}}$ or $\tau_{\text{m}}$ (keV)	Decay	Reactions
31.8 $\pm$ 600	10 <sup>+</sup> (9 <sup>-</sup> )		2300	$\gamma, \alpha$	7, 38
34				$\alpha$	5, 7
35				$\alpha$	7

<sup>a</sup> See also Tables 16.11 and 16.22.

<sup>b</sup> I am indebted to Professor H.T. Richards concerning his comments on the existence of this level.