

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$ 

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
$1.3174 \pm 2.2$	$(2.8 \pm 0.3) \times 10^{-2}{}^b$	$\alpha_0$			$5.7877 \pm 2.6$	$1^-$
$2.522 \pm 2.5{}^c$	$19.0 \pm 0.9$	$\alpha_0$		22	$6.751 \pm 3$	$0^+$
$3.0382 \pm 2.0{}^{a,c}$	$8.1 \pm 0.3{}^b$	$\alpha_0$		36	7.164	$3^-$
$3.082 \pm 3.1{}^c$	$3.4 \pm 0.2{}^c$	$\alpha_0$		1.1	$7.199 \pm 3$	$0^+$
$3.372 \pm 3.4{}^c$	$15.1 \pm 0.7{}^c$	$\alpha_0$		4.7	$7.431 \pm 3$	$2^+$
$3.885 \pm 10$	2	$\alpha_0$		0.6	$7.841 \pm 8$	$2^+$
$4.653 \pm 5$	$0.013 \pm 0.004$	$\alpha_0$		0.07	$8.455 \pm 5$	$5^-$
$\approx 4.9$	$> 800$	$\alpha_0$		$\approx 70$	$\approx 8.7$	$0^+$
5.002	2.5	$\alpha_0$		0.23	8.734	$1^-$
$5.058 \pm 3$	$0.11 \pm 0.02$	$\alpha_0$		$8.5 \pm 1.5$	$8.779 \pm 3$	$6^+$
$\approx 5.1$	$> 800$	$\alpha_0$		$\approx 95$	$\approx 8.8$	$2^+$
5.11	$< 1$	$\alpha_0$			8.82	$(5^-)$
$5.152 \pm 5$	19	$\alpha_0$		1.1	$8.854 \pm 5$	$1^-$
$5.395 \pm 5$	3	$\alpha_0$		3.9	$9.049 \pm 5$	$4^+$
$5.486 \pm 5$	3.2	$\alpha_0$		0.49	$9.121 \pm 5$	$3^-$
$5.955 \pm 10$	24	$\alpha_0$		1.4	$9.496 \pm 8$	$2^+$
$6.569 \pm 10$	97	$\alpha_0$		17	$9.987 \pm 8$	$4^+$
$6.912 \pm 5$	141	$\alpha_0$		66	$10.262 \pm 5$	$5^-$
$6.92 \pm 10$	$\leq 0.3$	$\alpha_0$		$\leq 1.3 \times 10^{-3}$	$10.27 \pm 10$	$(2^+)$
$7.092 \pm 5$	81	$\alpha_0$		4.8	$10.406 \pm 5$	$3^-$
$7.276 \pm 5$	16	$\alpha_0$		1.8	$10.553 \pm 5$	$4^+$
$7.314 \pm 10$	24	$\alpha_0$		0.85	$10.583 \pm 8$	$2^+$
$7.580 \pm 100$	349	$\alpha_0$		33	$10.80 \pm 75$	$4^+$

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)$  <sup>a</sup> (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
7.635 $\pm$ 5	13	$\alpha_0$		0.42	10.840 $\pm$ 5	2 <sup>+</sup>
7.636	45	$\alpha_0$		2.1	10.841	3 <sup>-</sup>
(7.75)	80	$\alpha_0$			(10.93)	
7.80 $\pm$ 150	576	$\alpha_0$		14	10.97 $\pm$ 113	0 <sup>+</sup>
7.860 $\pm$ 10	24	$\alpha_0$		2.0	11.020 $\pm$ 8	4 <sup>+</sup>
7.93 $\pm$ 10	$\leq 0.5$	$\alpha_0$		$\leq 0.05$	11.08 $\pm$ 10	(4 <sup>+</sup> )
8.132 $\pm$ 30	172	$\alpha_0$		4.2	11.24 $\pm$ 23	1 <sup>-</sup>
8.16 $\pm$ 10	$\leq 0.3$	$\alpha_0$		$\leq 0.009$	11.26 $\pm$ 10	(1 <sup>-</sup> )
8.24 $\pm$ 10	40 $\pm$ 10	$\alpha_0$		1.4	11.32 $\pm$ 10	2 <sup>+</sup>
8.528 $\pm$ 10	1.0 $\pm$ 0.5	$\alpha_0$		0.03	11.551 $\pm$ 8	0 <sup>+</sup> <sup>i</sup>
( $\approx$ 8.6)	$\approx$ 500	$\alpha_0$			( $\approx$ 11.6)	(2 <sup>+</sup> )
8.930 $\pm$ 20	46	$\alpha_0$		1.1	11.875 $\pm$ 15	2 <sup>+</sup>
8.997 $\pm$ 5	0.44 $\pm$ 0.15	$\alpha_0, \gamma_{6.13}$		0.04 $\pm$ 0.01	11.929 $\pm$ 5	4 <sup>+</sup>
9.026 $\pm$ 5	(35 $\pm$ 10) $\times 10^{-3}$	$\alpha_0$		1.0 $\pm$ 0.3	11.952 $\pm$ 5	8 <sup>+</sup>
9.043 $\pm$ 10	30 $\pm$ 5	$\alpha_0$		0.72	11.966 $\pm$ 8	1 <sup>-</sup>
9.25 <sup>d</sup>		$\alpha_0, \gamma_{6.13}$		<sup>e</sup>	12.137 $\pm$ 5	6 <sup>+</sup>
9.403 $\pm$ 9	155 $\pm$ 15	$\alpha_0$	0.89 $\pm$ 0.05	6.8	12.253 $\pm$ 10	4 <sup>+</sup>
9.406 $\pm$ 4 <sup>f</sup>	< 1	$\gamma_{6.13}$		<sup>e</sup>	12.256 $\pm$ 4	3 <sup>-</sup> ; 1
9.495 $\pm$ 13	390 $\pm$ 50	$\alpha_0$	0.92 $\pm$ 0.04	8	12.327 $\pm$ 10	2 <sup>+</sup>
9.587 $\pm$ 2	37.3 $\pm$ 0.9	$\alpha_0, \gamma_{6.13}$	1.00 $\pm$ 0.04	1.2	12.401 $\pm$ 5	3 <sup>-</sup>
9.628 $\pm$ 5	24.4 $\pm$ 0.5	$\alpha_0, \alpha_1$	0.62 $\pm$ 0.15	0.3	12.433 $\pm$ 5	0 <sup>+</sup>
9.677 $\pm$ 8	124 $\pm$ 6	$\alpha_0$	0.88 $\pm$ 0.05	2.4	12.472 $\pm$ 10	(2 <sup>+</sup> )
9.818 $\pm$ 6	72 $\pm$ 9	$\alpha_0$	0.68 $\pm$ 0.05	14	12.585 $\pm$ 5	6 <sup>+</sup>

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
9.827 $\pm$ 14	145 $\pm$ 25	$\alpha_0$	0.78 $\pm$ 0.09	2.5	12.592 $\pm$ 15	(2 <sup>+</sup> )
9.978 $\pm$ 6	84 $\pm$ 8	$\alpha_0$	1.00 $\pm$ 0.05	7.3	12.713 $\pm$ 5	5 <sup>-</sup>
10.015 $\pm$ 7	61 $\pm$ 12	$\alpha_0$	0.72 $\pm$ 0.09	0.9	12.743 $\pm$ 10	(2 <sup>+</sup> )
10.132 $\pm$ 2	30 $\pm$ 5	$\alpha_0, \gamma_{6.13}$	0.83 $\pm$ 0.09	0.45	12.836 $\pm$ 5	1 <sup>-</sup>
(10.27)	(580)	( $\alpha_0$ )	(0.92)	(21)	(12.95)	(4 <sup>+</sup> )
10.283 $\pm$ 2	38 $\pm$ 4	$\alpha_0, \gamma_{6.13}$	1.00 $\pm$ 0.08	0.8	12.957 $\pm$ 5	2 <sup>+</sup>
10.397 $\pm$ 1	18 $\pm$ 3	$\alpha_0, \gamma_{6.13}$	0.55 $\pm$ 0.05	0.4	13.048 $\pm$ 5	4 <sup>+</sup>
(10.419 $\pm$ 15)	(305 $\pm$ 55)	( $\alpha_0$ )	(0.42 $\pm$ 0.03)	(3.2)	(13.066 $\pm$ 15)	(3 <sup>-</sup> , 5 <sup>-</sup> )
10.461 $\pm$ 12	53 $\pm$ 24	$\alpha_0$	0.22 $\pm$ 0.07	0.5	13.099 $\pm$ 10	(0 <sup>+</sup> )
10.468 $\pm$ 5	102 $\pm$ 5	$\alpha_0$	0.52 $\pm$ 0.04	11	13.105 $\pm$ 5	6 <sup>+</sup>
10.508 $\pm$ 2	48 $\pm$ 4	$\alpha_0$	1.00 $\pm$ 0.05	1.2	13.137 $\pm$ 5	3 <sup>-</sup>
10.614 $\pm$ 7	40 $\pm$ 13	$\alpha_0$	0.55 $\pm$ 0.13	0.4	13.222 $\pm$ 10	0 <sup>+</sup>
10.617 $\pm$ 19	$\approx$ 80	$\alpha_0$	0.22 $\pm$ 0.07	0.3	13.224 $\pm$ 15	1 <sup>-</sup>
10.620 $\pm$ 2	53 $\pm$ 4	$\alpha_0$	1.00 $\pm$ 0.04	1.3	13.226 $\pm$ 5	3 <sup>-</sup>
10.759 $\pm$ 6 <sup>f</sup>	(8 $\pm$ 3) $\times$ 10 <sup>-2</sup>	$\alpha_0$		0.08 $\pm$ 0.03	13.338 $\pm$ 5	7 <sup>-</sup>
10.763 $\pm$ 1	26 $\pm$ 3	$\alpha_0, \gamma_{6.13}$	0.70 $\pm$ 0.05	0.6	13.341 $\pm$ 5	4 <sup>+</sup>
10.854 $\pm$ 3	34 $\pm$ 5	$\alpha_0, \gamma_{6.13}$	0.46 $\pm$ 0.05	0.4	13.414 $\pm$ 5	3 <sup>-</sup>
10.857 $\pm$ 4	$\approx$ 16	$\alpha_0$	0.16 $\pm$ 0.06	0.06	13.416 $\pm$ 5	(3 <sup>-</sup> )
10.870 $\pm$ 4	49 $\pm$ 7	$\alpha_0$	0.38 $\pm$ 0.04		13.426 $\pm$ 5	(5 <sup>-</sup> )
10.913 $\pm$ 8	195 $\pm$ 25	$\alpha_0$	0.99 $\pm$ 0.05	3.2	13.461 $\pm$ 10	1 <sup>-</sup>
10.971 $\pm$ 4	24 $\pm$ 8	$\alpha_0$	0.36 $\pm$ 0.07	0.15	13.507 $\pm$ 5	1 <sup>-</sup>
10.999 $\pm$ 4	61 $\pm$ 8	$\alpha_0$	0.72 $\pm$ 0.05	0.8	13.529 $\pm$ 5	2 <sup>+</sup>
11.000 $\pm$ 15	76 $\pm$ 32	$\alpha_0$	0.52 $\pm$ 0.13	0.6	13.530 $\pm$ 15	(0 <sup>+</sup> )

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
11.054 $\pm$ 3	12 $\pm$ 5	$\alpha_0$	0.19 $\pm$ 0.06	0.04	13.573 $\pm$ 5	2 <sup>+</sup>
11.183 $\pm$ 1	11 $\pm$ 2	$\alpha_0$	0.33 $\pm$ 0.05	0.2	13.677 $\pm$ 5	5 <sup>-</sup>
11.202 $\pm$ 12	310 $\pm$ 30	$\alpha_0, \gamma_{6.13}$	0.51 $\pm$ 0.03	84	13.692 $\pm$ 10	7 <sup>-</sup>
11.267 $\pm$ 26	$\approx$ 80	$\alpha_0$	0.33 $\pm$ 0.12	0.4	13.744 $\pm$ 20	0 <sup>+</sup>
11.371 $\pm$ 9	136 $\pm$ 15	$\alpha_0$	0.73 $\pm$ 0.04	2.1	13.827 $\pm$ 10	3 <sup>-</sup>
11.420 $\pm$ 34	$\approx$ 175	$\alpha_0$	0.21 $\pm$ 0.06	0.6	13.866 $\pm$ 30	1 <sup>-</sup>
11.473 $\pm$ 5	74 $\pm$ 10	$\alpha_0$	0.75 $\pm$ 0.06	1.0	13.908 $\pm$ 5	2 <sup>+</sup>
11.498 $\pm$ 5	65 $\pm$ 3	$\alpha_0$	0.86 $\pm$ 0.04	6.9	13.928 $\pm$ 5	6 <sup>+</sup>
11.522 $\pm$ 7	79 $\pm$ 15	$\alpha_0$	1.0 $\pm$ 0.1	1.3	13.948 $\pm$ 10	0 <sup>+</sup>
11.544 $\pm$ 2	8.1 $\pm$ 1	$\alpha_0$	0.46 $\pm$ 0.05	0.11	13.965 $\pm$ 5	4 <sup>+</sup>
(11.607 $\pm$ 19)	( $\approx$ 80)	( $\alpha_0$ )	(0.19 $\pm$ 0.05)	(0.25)	(14.015 $\pm$ 15)	(1 <sup>-</sup> )
(11.663 $\pm$ 19)	(150 $\pm$ 50)	( $\alpha_0$ )	(0.24 $\pm$ 0.05)	(0.6)	(14.060 $\pm$ 15)	(2 <sup>+</sup> )
11.732 $\pm$ 4	42 $\pm$ 6	$\alpha_0, \gamma_{6.9+7.1}$	0.71 $\pm$ 0.06	0.5	14.115 $\pm$ 5	2 <sup>+</sup>
11.925 $\pm$ 7	92 $\pm$ 9	$\alpha_0$	0.64 $\pm$ 0.04	1.6	14.270 $\pm$ 10	4 <sup>+</sup>
11.968 $\pm$ 8	60 $\pm$ 13	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$	0.31 $\pm$ 0.05	1.9	14.304 $\pm$ 10	(6 <sup>+</sup> )
11.977 $\pm$ 6	117 $\pm$ 8	$\alpha_0$	0.82 $\pm$ 0.04	9.6	14.311 $\pm$ 5	6 <sup>+</sup>
11.979 $\pm$ 15	$\approx$ 45	$\alpha_0$	0.13 $\pm$ 0.06	0.1	14.313 $\pm$ 15	(3 <sup>-</sup> )
12.148 $\pm$ 28	$\approx$ 95	$\alpha_0$	0.18 $\pm$ 0.06 <sup>e</sup>	0.3	14.448 $\pm$ 25	(0 <sup>+</sup> , 2 <sup>+</sup> )
12.156 $\pm$ 4	$\approx$ 15	$\alpha_0$	0.09 $\pm$ 0.04	0.05	14.454 $\pm$ 5	5 <sup>-</sup>
12.322 $\pm$ 25	140 $\pm$ 50	$\alpha_0$	0.45 $\pm$ 0.08	0.9	14.587 $\pm$ 20	1 <sup>-</sup>
12.329 $\pm$ 13	260 $\pm$ 25	$\alpha_0, \gamma_{6.9+7.1}$	0.79 $\pm$ 0.04	5.3	14.593 $\pm$ 10	4 <sup>+</sup>
12.447 $\pm$ 11	90 $\pm$ 30	$\alpha_0$	0.35 $\pm$ 0.06	0.6	14.687 $\pm$ 10	(3 <sup>-</sup> )
12.502 $\pm$ 10	60 $\pm$ 25	$\alpha_0$	0.25 $\pm$ 0.06	0.4	14.731 $\pm$ 10	(4 <sup>+</sup> )

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
12.539 $\pm$ 2	7.3 $\pm$ 4.8	$\alpha_0$	0.18 $\pm$ 0.05	0.1	14.761 $\pm$ 5	6 <sup>+</sup>
12.597 $\pm$ 4	86 $\pm$ 7	$\alpha_0$	0.95 $\pm$ 0.04	6.5	14.807 $\pm$ 5	6 <sup>+</sup>
12.608 $\pm$ 5	117 $\pm$ 13	$\alpha_0$	0.69 $\pm$ 0.04	3.1	14.816 $\pm$ 5	5 <sup>-</sup>
12.637 $\pm$ 8	79 $\pm$ 15	$\alpha_0$	0.45 $\pm$ 0.05	0.9	14.839 $\pm$ 10	(4 <sup>-</sup> )
12.699 $\pm$ 12	100 $\pm$ 30	$\alpha_0$	0.44 $\pm$ 0.06	0.7	14.888 $\pm$ 10	2 <sup>+</sup>
12.897 $\pm$ 10	66 $\pm$ 20	$\alpha_0$	0.31 $\pm$ 0.06	0.3	15.047 $\pm$ 10	2 <sup>+</sup>
12.930 $\pm$ 12	160 $\pm$ 25	$\alpha_0$	0.40 $\pm$ 0.04	2.3	15.073 $\pm$ 10	5 <sup>-</sup>
13.016 $\pm$ 20	$\approx$ 60	$\alpha_0$	$\approx$ 0.12	0.11	15.142 $\pm$ 15	(2 <sup>+</sup> )
13.056 $\pm$ 10	230 $\pm$ 25	$\alpha_0$	0.70 $\pm$ 0.04	5.5	15.174 $\pm$ 10	5 <sup>-</sup>
(13.238 $\pm$ 10)	(130 $\pm$ 20)	( $\alpha_0$ )	(0.99 $\pm$ 0.08)		(15.319 $\pm$ 10)	(1 <sup>-</sup> )
(13.266 $\pm$ 12)	(50 $\pm$ 25)	( $\alpha_0$ )	(0.69 $\pm$ 0.17)		(15.342 $\pm$ 10)	(0 <sup>+</sup> )
13.237 $\pm$ 29	280 $\pm$ 40	$\alpha_0$	0.39 $\pm$ 0.04	20	15.319 $\pm$ 25	7 <sup>-</sup>
13.251 $\pm$ 6	34 $\pm$ 10	$\alpha_0$	0.29 $\pm$ 0.05	0.2	15.330 $\pm$ 5	4 <sup>+</sup>
13.296 $\pm$ 5	110 $\pm$ 10	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$	0.71 $\pm$ 0.04	14	15.366 $\pm$ 5	7 <sup>-</sup>
13.384 $\pm$ 15 <sup>d</sup>	85 $\pm$ 35	$\alpha_0$	0.26 $\pm$ 0.05	0.4	15.436 $\pm$ 15	(3 <sup>-</sup> )
13.58		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$			15.59	
13.73		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$			15.71	(6 <sup>+</sup> )
14.05		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$			15.97	(6 <sup>+</sup> )
14.26		$\gamma_{6.13}, \gamma_{6.9+7.1}$			16.14	
14.40		$\gamma_{6.13}$			16.25	
14.501 $\pm$ 15	45	$\alpha_0, \alpha_{1+2}$			16.329 $\pm$ 11	4 <sup>+</sup>
14.636 $\pm$ 15 <sup>g</sup>	35	$\alpha_0, \alpha_{1+2}, \alpha_3$			16.437 $\pm$ 11	(0, 2, 4) <sup>+</sup>
14.721 $\pm$ 15	24 $\pm$ 4	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.36 $\pm$ 0.03	0.38 $\pm$ 0.07	16.505 $\pm$ 15	6 <sup>+</sup>

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
14.789 $\pm$ 18	90 $\pm$ 30	$\alpha_0$	0.16 $\pm$ 0.03	0.37 $\pm$ 0.13	16.559 $\pm$ 15	5 <sup>-</sup>
14.816 $\pm$ 15	92 $\pm$ 8	$\alpha_0, \alpha_3$	0.45 $\pm$ 0.03	4.1 $\pm$ 0.5	16.581 $\pm$ 15	7 <sup>-</sup>
14.875 $\pm$ 22	80 $\pm$ 25	$\alpha_0$	0.18 $\pm$ 0.04	0.22 $\pm$ 0.08	16.628 $\pm$ 20	3 <sup>-</sup>
14.924 $\pm$ 20	100 $\pm$ 25	$\alpha_0, (\alpha_3)$	0.23 $\pm$ 0.03	0.42 $\pm$ 0.11	16.667 $\pm$ 15	4 <sup>+</sup>
14.987 $\pm$ 18	$\approx$ 25	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.08 $\pm$ 0.03	$\approx$ 0.05	16.717 $\pm$ 15	5 <sup>-</sup>
15.023 $\pm$ 33	160 $\pm$ 50	$\alpha_0$	0.10 $\pm$ 0.02	4.8 $\pm$ 1.9	16.746 $\pm$ 25	8 <sup>+</sup>
15.149 $\pm$ 16	16 $\pm$ 8	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.11 $\pm$ 0.02	0.04 $\pm$ 0.02	16.847 $\pm$ 15	5 <sup>-</sup>
15.179 $\pm$ 25	350 $\pm$ 50	$\alpha_0$	0.28 $\pm$ 0.03	3.9 $\pm$ 0.7	16.871 $\pm$ 20	6 <sup>+</sup>
15.430 $\pm$ 21	180 $\pm$ 30	$\alpha_0$	0.32 $\pm$ 0.03	1.0 $\pm$ 0.2	17.072 $\pm$ 20	4 <sup>+</sup>
15.535 $\pm$ 15	26 $\pm$ 5	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.22 $\pm$ 0.02	0.13 $\pm$ 0.03	17.155 $\pm$ 15	5 <sup>-</sup>
15.607 $\pm$ 19	225 $\pm$ 30	$\alpha_0$	0.32 $\pm$ 0.02	1.2 $\pm$ 0.2	17.213 $\pm$ 15	4 <sup>+</sup>
15.696 $\pm$ 20	86 $\pm$ 25	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.16 $\pm$ 0.03	0.20 $\pm$ 0.07	17.284 $\pm$ 15	3 <sup>-</sup>
15.710 $\pm$ 17	200 $\pm$ 25	$\alpha_0$	0.26 $\pm$ 0.02	11.6 $\pm$ 1.4	17.295 $\pm$ 15	8 <sup>+</sup>
15.828 $\pm$ 15 <sup>f</sup>	< 10	$\alpha_{1+2}$			17.390 $\pm$ 15	
15.878 $\pm$ 18	220 $\pm$ 25	$\alpha_0$	0.24 $\pm$ 0.01	48 $\pm$ 6	17.430 $\pm$ 15	9 <sup>-</sup>
16.017 $\pm$ 16	86 $\pm$ 9	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.45 $\pm$ 0.03	1.3 $\pm$ 0.2	17.541 $\pm$ 15	6 <sup>+</sup>
16.099 $\pm$ 17	140 $\pm$ 20	$\alpha_0, \alpha_4$	0.36 $\pm$ 0.03	1.05 $\pm$ 0.15	17.606 $\pm$ 15	5 <sup>-</sup>
16.302 $\pm$ 23	$\approx$ 125	$\alpha_0$	0.13 $\pm$ 0.03	$\approx$ 0.3	17.769 $\pm$ 20	4 <sup>+</sup>
16.405 $\pm$ 17	200 $\pm$ 30	$\alpha_0$	0.38 $\pm$ 0.03	1.6 $\pm$ 0.3	17.851 $\pm$ 15	5 <sup>-</sup>
16.598 $\pm$ 15 <sup>f</sup>	< 10	$\alpha_0, \alpha_{1+2}$			18.005 $\pm$ 15	7 <sup>-</sup>
16.622 $\pm$ 6	34 $\pm$ 7	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.34 $\pm$ 0.04	0.23 $\pm$ 0.06	18.024 $\pm$ 5	5 <sup>-</sup>
16.695 $\pm$ 30	140 $\pm$ 60	$\alpha_0$	0.20 $\pm$ 0.05	0.4 $\pm$ 0.2	18.083 $\pm$ 25	4 <sup>+</sup>
16.748 $\pm$ 6	29 $\pm$ 6	$\alpha_0, \alpha_{1+2}, \alpha_3, \alpha_4$	0.46 $\pm$ 0.06	0.8 $\pm$ 0.2	18.125 $\pm$ 5	7 <sup>-</sup>

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
16.949 $\pm$ 13	190 $\pm$ 30	$\alpha_0, \alpha_4$	0.32 $\pm$ 0.02	1.7 $\pm$ 0.3	18.286 $\pm$ 10	6 <sup>+</sup>
17.129 $\pm$ 24	185 $\pm$ 40	$\alpha_0, (\alpha_{1+2}), \alpha_3, \alpha_4$	0.19 $\pm$ 0.02	1.8 $\pm$ 0.4	18.430 $\pm$ 20	7 <sup>-</sup>
17.210 $\pm$ 21	130 $\pm$ 30	$\alpha_0, \alpha_3$	0.21 $\pm$ 0.03	0.5	18.494 $\pm$ 20	5 <sup>-</sup>
17.368 $\pm$ 23	185 $\pm$ 30	$\alpha_0, \alpha_4$	0.24 $\pm$ 0.03	5.5 $\pm$ 1.1	18.621 $\pm$ 20	8 <sup>+</sup>
17.524 $\pm$ 29	140 $\pm$ 50	$\alpha_0, \alpha_{1+2}$	0.17 $\pm$ 0.04	0.6 $\pm$ 0.3	18.745 $\pm$ 25	6 <sup>+</sup>
17.552 $\pm$ 24	140 $\pm$ 35	$\alpha_0$	0.22 $\pm$ 0.03	1.5 $\pm$ 0.4	18.768 $\pm$ 20	7 <sup>-</sup>
17.793 $\pm$ 29	200 $\pm$ 60	$\alpha_0$	0.15 $\pm$ 0.02	3.2 $\pm$ 1.1	18.960 $\pm$ 25	8 <sup>+</sup>
17.906 $\pm$ 18	$\approx$ 90	$\alpha_0, \alpha_{1+2}$	0.18 $\pm$ 0.03	$\approx$ 0.3	19.051 $\pm$ 15	5 <sup>-</sup>
18.03 $\pm$ 20	200 $\pm$ 50	$\alpha_0, \alpha_1, (\alpha_2), \alpha_4, \alpha_5$	0.38 $\pm$ 0.04 <sup>d</sup>	$\approx$ 2	19.15 $\pm$ 20	6 <sup>+</sup>
18.198 $\pm$ 17	140 $\pm$ 25	$\alpha_1, (\alpha_5)$	0.12 $\pm$ 0.02 <sup>h</sup>		19.284 $\pm$ 15	6 <sup>+</sup>
18.216 $\pm$ 30	430 $\pm$ 60	$\alpha_0$	0.36 $\pm$ 0.03	6.4 $\pm$ 1.1	19.298 $\pm$ 25	7 <sup>-</sup>
18.397 $\pm$ 11	130 $\pm$ 15	$\alpha_0, \alpha_3, \alpha_4$	0.38 $\pm$ 0.01 <sup>h</sup>		19.443 $\pm$ 10	6 <sup>+</sup>
18.514 $\pm$ 29	250 $\pm$ 60	$\alpha_0, \alpha_2, \alpha_3$	0.27 $\pm$ 0.04	1.6 $\pm$ 0.4	19.536 $\pm$ 25	6 <sup>+</sup>
(18.563 $\pm$ 25)	(140 $\pm$ 50)	( $\alpha_1$ )	(0.09 $\pm$ 0.02) <sup>h</sup>		(19.576 $\pm$ 20)	(7 <sup>-</sup> )
18.662 $\pm$ 23	140 $\pm$ 35	$\alpha_1$	0.14 $\pm$ 0.02 <sup>h</sup>		19.655 $\pm$ 20	6 <sup>+</sup>
18.757 $\pm$ 28	330 $\pm$ 60	$\alpha_0, (\alpha_2), \alpha_3$	0.23 $\pm$ 0.02	6.3 $\pm$ 1.2	19.731 $\pm$ 20	8 <sup>+</sup>
18.900 $\pm$ 48	360 $\pm$ 120	$\alpha_0$	0.18 $\pm$ 0.03	1.4 $\pm$ 0.5	19.845 $\pm$ 40	6 <sup>+</sup>
18.918 $\pm$ 11	170 $\pm$ 25	$\alpha_1$	0.26 $\pm$ 0.02 <sup>h</sup>		19.859 $\pm$ 10	5 <sup>-</sup>
18.949 $\pm$ 52	$\approx$ 120	$\alpha_0$	0.08 $\pm$ 0.03	$\approx$ 0.35	19.884 $\pm$ 40	7 <sup>-</sup>
19.083 $\pm$ 39	130 $\pm$ 100	$\alpha_0, \alpha_2, (\alpha_5)$	0.11 $\pm$ 0.04	0.19 $\pm$ 0.04	19.991 $\pm$ 30	4 <sup>+</sup>
19.128 $\pm$ 16	80 $\pm$ 35	$\alpha_1, \alpha_4$	0.10 $\pm$ 0.04 <sup>h</sup>		20.027 $\pm$ 15	6 <sup>+</sup>
19.227 $\pm$ 28	190 $\pm$ 35	$\alpha_1$	0.29 $\pm$ 0.03 <sup>h</sup>		20.106 $\pm$ 25	7 <sup>-</sup>
19.304 $\pm$ 47	285 $\pm$ 100	$\alpha_0, \alpha_3$	0.18 $\pm$ 0.04	1.1 $\pm$ 0.4	20.168 $\pm$ 35	6 <sup>+</sup>

Table 20.18 from (1987AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^a$  (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\Gamma_{\alpha_0}/\Gamma$	$\theta^2$ (%)	$E_x$ (MeV $\pm$ keV)	$J^\pi$
19.464 $\pm$ 19	255 $\pm$ 40	$\alpha_1, \alpha_5$	0.28 $\pm$ 0.03 <sup>h</sup>		20.296 $\pm$ 15	7 <sup>-</sup>
19.521 $\pm$ 22	190 $\pm$ 40	$\alpha_1$	0.26 $\pm$ 0.03 <sup>h</sup>		20.341 $\pm$ 20	5 <sup>-</sup>
19.524 $\pm$ 16	135 $\pm$ 35	$\alpha_0, \alpha_3$	0.25 $\pm$ 0.04	1.1 $\pm$ 0.3	20.344 $\pm$ 15	7 <sup>-</sup>
19.618 $\pm$ 39	215 $\pm$ 90	$\alpha_0$	0.14 $\pm$ 0.03	0.6 $\pm$ 0.3	20.419 $\pm$ 30	6 <sup>+</sup>
19.651 $\pm$ 32	370 $\pm$ 55	$\alpha_1$	0.32 $\pm$ 0.03 <sup>h</sup>		20.445 $\pm$ 25	6 <sup>+</sup>
19.679 $\pm$ 35	280 $\pm$ 70	$\alpha_0, \alpha_2$	0.20 $\pm$ 0.03	0.86 $\pm$ 0.25	20.468 $\pm$ 30	5 <sup>-</sup>
19.952 $\pm$ 8	78 $\pm$ 11	$\alpha_0, \alpha_1, \alpha_2, \alpha_3$	0.33 $\pm$ 0.03 <sup>j</sup>	4.5 $\pm$ 0.8	20.686 $\pm$ 6	9 <sup>-</sup>
20.04	240 $\pm$ 50	$\alpha_0, \alpha_1, \alpha_4$	0.2 <sup>j</sup>	1.8 $\pm$ 0.5	20.76 $\pm$ 30	7 <sup>-</sup>
20.095 $\pm$ 32	170 $\pm$ 60	$\alpha_1$	0.11 $\pm$ 0.02 <sup>h</sup>		20.800 $\pm$ 25	5 <sup>-</sup>
20.28	300 $\pm$ 50	$\alpha_0, \alpha_1$	0.23 $\pm$ 0.03 <sup>j</sup>	2.1 $\pm$ 0.6	20.95 $\pm$ 40	7 <sup>-</sup>
20.423 $\pm$ 8 <sup>g</sup>	60 $\pm$ 6	$\alpha_0, \alpha_3$	0.46 $\pm$ 0.03	4.1 $\pm$ 0.5	21.062 $\pm$ 6	9 <sup>-</sup>
20.7	300	$\alpha_0$			21.3	7 <sup>-</sup>
21.3 $\pm$ 200	300	$\alpha_0$			21.8 $\pm$ 150	7 <sup>-</sup>
22.0 $\pm$ 200	500	$\alpha_0$			22.3 $\pm$ 150	7 <sup>-</sup>
22.5 $\pm$ 250	500	$\alpha_0$			22.7 $\pm$ 200	9 <sup>-</sup>
22.65 $\pm$ 125	250	$\alpha_0$			22.84 $\pm$ 100	9 <sup>-</sup>
23.3 $\pm$ 250	500	$\alpha_0$			23.4 $\pm$ 200	8 <sup>+</sup>
24.24 $\pm$ 150	350	$\alpha_0$			24.11 $\pm$ 100	8 <sup>+</sup>
25.4 $\pm$ 300	600	$\alpha_0$			25.0 $\pm$ 250	8 <sup>+</sup>
26.2 $\pm$ 200	400	$\alpha_0$			25.7 $\pm$ 150	
28.1 $\pm$ 350	700	$\alpha_0$			27.2 $\pm$ 300	
29	1600	$\alpha_0$			28	8 <sup>+</sup>
29.4 $\pm$ 350	700	$\alpha_0$			28.2 $\pm$ 300	



<sup>a</sup> For earlier references see Tables [20.23 in \(1978AJ03\)](#) and [20.21 in \(1983AJ01\)](#). For  $K\pi$  assignments see [Table 20.15](#) here. The uncertainties in the excitation energies are calculated by taking the uncertainty in the  $E_\alpha$  in the c.m. [ $\frac{3}{4} \times$  uncertainty in the lab] and adding the uncertainty in  $E_b$  [2 keV], in quadrature, rounding upwards. I am indebted to Prof. H.T. Richards for many very useful comments.

<sup>b</sup>  $\Gamma_{\text{c.m.}} = \Gamma_\alpha$ .

<sup>c</sup> [\(1985JA17\)](#).

<sup>d</sup> Resonances with  $9.25 \leq E_\alpha \leq 13.39$  MeV are from [\(1985CA09\)](#), except for the states labelled <sup>f</sup>. Certain values are rounded upwards. See also [\(1983CA1F\)](#) and [Table 20.21 in \(1983AJ01\)](#).

<sup>e</sup>  $(2J + 1)\Gamma_{\alpha_0}\Gamma_{\alpha_2}/\Gamma_g = 81 \pm 12$  eV and  $14 \pm 2$  eV, respectively, for  $^{20}\text{N}^*(12.14, 12.25)$  [for the latter see [Table 20.17](#)] [\(1980FI01\)](#).

<sup>f</sup> See [Table 20.21 in \(1983AJ01\)](#).

<sup>g</sup> Resonances with  $14.6 < E_\alpha < 20.4$  MeV are from the re-analysis of the data of [\(1979BI10\)](#) by [\(1984RI06\)](#). Certain values are rounded upwards.

<sup>h</sup>  $(\Gamma_{\alpha_0}\Gamma_{\alpha_1})^{1/2}/\Gamma$ .

<sup>i</sup> [\(1984RI07\)](#).

<sup>j</sup> For information on the  $\alpha_1$  strength see [\(1984RI06\)](#).