

Table 20.21 from (1972AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^{16}\text{O}$  <sup>a</sup>

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\theta^2$ (%)	$E_x$ (MeV)	$J^\pi$	Refs.
2.490 $\pm$ 10	19	$\alpha_0$	22	6.721	0 <sup>+</sup>	(1953CA44)
3.045 $\pm$ 10	8	$\alpha_0$	36	7.165	3 <sup>-</sup>	(1953CA44)
3.090 $\pm$ 10	4	$\alpha_0$	1.1	7.201	0 <sup>+</sup>	(1953CA44)
3.380 $\pm$ 10	8	$\alpha_0$	4.7	7.433	2 <sup>+</sup>	(1953CA44)
3.885 $\pm$ 10	2	$\alpha_0$	0.6	7.837	2 <sup>+</sup>	(1953CA44)
$\approx$ 4.9	> 800	$\alpha_0$	$\approx$ 70	$\approx$ 8.6	0 <sup>+</sup>	(1960MC09)
5.002	2.5	$\alpha_0$	0.23	8.730	1 <sup>-</sup>	(1960MC09)
5.058 $\pm$ 3	(110 $\pm$ 25) $\times$ 10 <sup>-3</sup>	$\alpha_0$	8.5 $\pm$ 1.5	8.775	6 <sup>+</sup>	(1972HA07)
$\approx$ 5.1	> 800	$\alpha_0$	$\approx$ 95	$\approx$ 8.8	2 <sup>+</sup>	(1960MC09)
5.11	< 1	$\alpha_0$		8.82	(5 <sup>-</sup> )	(1960MC09)
5.152 $\pm$ 5	19	$\alpha_0$	1.1	8.850	1 <sup>-</sup>	(1960MC09, 1969JO18)
5.395 $\pm$ 5	3	$\alpha_0$	3.9	9.044	4 <sup>+</sup>	(1960MC09, 1969JO18)
5.486 $\pm$ 5	3.2	$\alpha_0$	0.49	9.117	3 <sup>-</sup>	(1960MC09, 1969JO18)
5.955 $\pm$ 10	24	$\alpha_0$	1.4	9.492	2 <sup>+</sup>	(1960MC09, 1967HU06, 1969JO18)
6.569 $\pm$ 10	97	$\alpha_0$	17	9.983	4 <sup>+</sup>	(1967HU06, 1969JO18)
6.912 $\pm$ 5	141	$\alpha_0$	66	10.257	5 <sup>-</sup>	(1967HU06, 1969JO18)
7.092 $\pm$ 5	81	$\alpha_0$	4.8	10.401	3 <sup>-</sup>	(1967HU06, 1969JO18)
7.276 $\pm$ 5	16	$\alpha_0$	1.8	10.548	4 <sup>+</sup>	(1969JO18)
7.314 $\pm$ 10	24	$\alpha_0$	0.85	10.579	2 <sup>+</sup>	(1965MC02, 1967HU06, 1969JO18)
7.580 $\pm$ 100	349	$\alpha_0$	33	10.79	4 <sup>+</sup>	(1967HU06, 1969JO18)
7.635 $\pm$ 5	13	$\alpha_0$	0.42	10.836	2 <sup>+</sup>	(1965MC02, 1967HU06, 1969JO18)
7.636	45	$\alpha_0$	2.1	10.836	3 <sup>-</sup>	(1969JO18)
(7.75)	80	$\alpha_0$		(10.93)		(1967HU06)
7.80 $\pm$ 150	576	$\alpha_0$	14	10.97	0 <sup>+</sup>	(1969JO18)

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$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\theta^2$ (%)	$E_x$ (MeV)	$J^\pi$	Refs.
7.860 $\pm$ 10	24	$\alpha_0$	2.0	11.015	4 <sup>+</sup>	(1965MC02, 1967HU06, 1969JO18)
8.132 $\pm$ 30	172	$\alpha_0$	4.2	11.233	1 <sup>-</sup>	(1969JO18)
8.246 $\pm$ 10	53	$\alpha_0$	1.5	11.324	2 <sup>+</sup>	(1965MC02, 1967HU06, 1969JO18)
( $\approx$ 8.6)	$\approx$ 500	$\alpha_0$		( $\approx$ 11.6)	(2 <sup>+</sup> )	(1967HU06)
8.930 $\pm$ 20	46	$\alpha_0$	1.1	11.871	2 <sup>+</sup>	(1969JO18)
8.997 $\pm$ 5	0.44 $\pm$ 0.15	$\alpha_0, \gamma_{6.13}$	0.04 $\pm$ 0.01	11.925	4 <sup>+</sup>	(1972HA07)
9.026 $\pm$ 5	(35 $\pm$ 10) $\times$ 10 <sup>-3</sup>	$\alpha_0$	1.0 $\pm$ 0.3	11.948	8 <sup>+</sup>	(1972HA07)
9.033 $\pm$ 10	24	$\alpha_0$	1.4	11.953	1 <sup>-</sup>	(1969JO18)
9.055 $\pm$ 8	29 $\pm$ 8	$\alpha_0$		11.971	1 <sup>-</sup>	(1967HU06, 1972HA07)
(9.25 $\pm$ 40) <sup>b</sup>		$\alpha$		(12.13)		(1964PE05)
9.365 $\pm$ 20	142	$\alpha_0$	6.6	12.219	4 <sup>+</sup>	(1964PE05, 1967HU06, 1969JO18)
9.530 $\pm$ 100		$\alpha_0$		12.35	2 <sup>+</sup>	(1969JO18)
9.550 $\pm$ 10 <sup>b,c</sup>	46 $\pm$ 16	$\alpha_0$	1.2	12.367	3 <sup>-</sup>	(1964PE05, 1969JO18)
9.605 $\pm$ 5	$\leq$ 8	$\alpha_0$	< 0.15	12.411	0 <sup>+</sup>	(1969JO18)
9.790 $\pm$ 10	101	$\alpha_0$	23	12.559	6 <sup>+</sup>	(1967HU06, 1969JO18)
9.860 $\pm$ 100		$\alpha_0$		12.61		(1969JO18)
9.944 $\pm$ 15	97	$\alpha_0$	7.3	12.682	5 <sup>-</sup>	(1969JO18)
10.050 $\pm$ 100 <sup>d</sup>	100	$\alpha_0$		12.77	4 <sup>+</sup>	(1967ME10, 1969JO18)
10.14 $\pm$ 70	55	$\alpha_0, \gamma_{6.13}$		12.84		(1967ME10)
10.32 $\pm$ 75	60	$\alpha_0, \gamma_{6.13}$		12.98	(4 <sup>+</sup> )	(1967ME10)
10.43 $\pm$ 90	70	$\alpha_0, \gamma_{6.13}$		13.07	(4 <sup>+</sup> )	(1967ME10)
10.57 $\pm$ 75	60	$\alpha_0, \gamma_{6.13}$		13.18	(4 <sup>+</sup> )	(1967ME10)
10.759 $\pm$ 6	(80 $\pm$ 30) $\times$ 10 <sup>-3</sup>	$\alpha_0$		13.333	7 <sup>-</sup>	(1972HA07)
10.770 <sup>e</sup>	20	$\alpha_0, \gamma_{6.13}$		13.342	4 <sup>+</sup>	(1967ME10, 1972HA07)

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$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\theta^2$ (%)	$E_x$ (MeV)	$J^\pi$	Refs.
10.83 $\pm$ 50	40	$\gamma_{6.13}$		13.39		(1967ME10)
10.87 $\pm$ 140	110	$\alpha_0, \gamma_{6.13}$		13.42	(4 <sup>+</sup> )	(1967ME10)
11.20 $\pm$ 400	320	$\alpha_0, \gamma_{6.13}$		13.7	(3, 7) <sup>-</sup>	(1967ME10)
11.51 $\pm$ 125	400	$\alpha_0, \gamma_{6.13}$		13.93	(6 <sup>+</sup> )	(1967ME10)
11.77		$\alpha_0, \gamma_{6.9+7.1}$		14.14		(1967ME10)
11.97 $\pm$ 300	240	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		14.3	6 <sup>+</sup>	(1967ME10)
(12.06)		$\alpha_0, \gamma_{6.9+7.1}$		(14.37)		(1967ME10)
12.31 $\pm$ 300	240	$\alpha_0, \gamma_{6.9+7.1}$		14.6	(4 <sup>+</sup> )	(1967ME10)
12.66 $\pm$ 150	120	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		14.85		(1967ME10)
12.86 $\pm$ 150	120	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		15.01		(1967ME10)
13.165 $\pm$ 150	120	$\alpha_0, \gamma_{6.13}$		15.26		(1967ME10)
13.22		$\alpha_0$		15.30		(1967ME10)
13.37 $\pm$ 470	380	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		15.4	7 <sup>-</sup>	(1967ME10)
13.58		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		15.59		(1967ME10)
13.73		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		15.71		(1967ME10)
14.05		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		15.96		(1967ME10)
14.26		$\gamma_{6.13}, \gamma_{6.9+7.1}$		16.13		(1967ME10)
14.40		$\gamma_{6.13}$		16.24		(1967ME10)
14.53		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		(16.35)		(1967ME10)
14.69		$\alpha_0, \gamma_{6.9+7.1}$		16.48		(1967ME10)
14.782		$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		16.58		(1967ME10)
(14.91)		$\alpha_0$		(16.65)	(1 <sup>-</sup> )	(1967ME10)
15.18 $\pm$ 400	320	$\alpha_0, \gamma_{6.9+7.1}$		16.9	6 <sup>+</sup>	(1967ME10)
15.673 $\pm$ 340	270	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		17.3	2 <sup>+</sup>	(1967ME10)

Table 20.21 from (1972AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^{16}\text{O}$  <sup>a</sup> (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\theta^2$ (%)	$E_x$ (MeV)	$J^\pi$	Refs.
16.01 $\pm$ 230	180	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		17.3		(1967ME10)
16.30 $\pm$ 230	180	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		17.76		(1967ME10)
(16.3)		$\alpha_0$		(17.95)		(1967ME10)
16.70 $\pm$ 180	140	$\alpha_0, \gamma_{6.13}$		18.08	6 <sup>+</sup>	(1967ME10)
16.98 $\pm$ 300	240	$\alpha_0, \gamma_{6.13}, \gamma_{6.9+7.1}$		18.31	(6 <sup>+</sup> )	(1967ME10)
17.45	600	$\alpha_0, \gamma_{6.13}$		18.7	(6 <sup>+</sup> )	(1967ME10)
18.05 $\pm$ 250	200	$\alpha_0, \gamma_{6.9+7.1}$		19.16	(6 <sup>+</sup> )	(1967ME10)
18.35 $\pm$ 350	280	$\alpha_0$		19.40	6 <sup>+</sup>	(1967ME10)
18.90 $\pm$ 350	280	$\alpha_0$		19.84	6 <sup>+</sup>	(1967ME10)
19.30 $\pm$ 120	250	$\alpha_0$		20.16	7 <sup>-</sup>	(1971BE17)
19.6 $\pm$ 180	360	$\alpha_0$		20.4	6 <sup>+</sup>	(1971BE17)
19.6 $\pm$ 100	200	$\alpha_0$		20.4	7 <sup>-</sup>	(1971BE17)
19.95 $\pm$ 60	120	$\alpha_0$		20.68	9 <sup>-</sup>	(1971BE17)
20.18		$\alpha_0$		20.9		(1971BE17)
20.4 $\pm$ 100	200	$\alpha_0$		21.0	7 <sup>-</sup>	(1971BE17)
20.45 $\pm$ 40	80	$\alpha_0$		21.08	9 <sup>-</sup>	(1971BE17)
20.70	300	$\alpha_0$		21.3	7 <sup>-</sup>	(1962JO14, 1971BE17, 1971TA05)
21.3 $\pm$ 200	300	$\alpha_0$		21.8	7 <sup>-</sup>	(1971BE17, 1971TA05)
22.0 $\pm$ 200	500	$\alpha_0$		22.3	7 <sup>-</sup>	(1971BE17, 1971TA05)
22.5 $\pm$ 250	500	$\alpha_0$		22.7	9 <sup>-</sup>	(1971BE17)
22.65 $\pm$ 125	250	$\alpha_0$		22.84	9 <sup>-</sup>	(1971BE17)
23.3 $\pm$ 250	500	$\alpha_0$		23.4	8 <sup>+</sup>	(1971BE17, 1971TA05)
24.24 $\pm$ 150	350	$\alpha_0$		24.11	8 <sup>+</sup>	(1971BE17, 1971TA05)
25.4 $\pm$ 300	600	$\alpha_0$		25.0	8 <sup>+</sup>	(1971BE17)

Table 20.21 from (1972AJ02): Resonances in  $^{16}\text{O}(\alpha, \alpha)^{16}\text{O}$  <sup>a</sup> (continued)

$E_\alpha$ (MeV $\pm$ keV)	$\Gamma_{\text{c.m.}}$ (keV)	Outgoing particles	$\theta^2$ (%)	$E_x$ (MeV)	$J^\pi$	Refs.
26.2 $\pm$ 200	400	$\alpha_0$		25.7		(1971BE17)
28.1 $\pm$ 350	700	$\alpha_0$		27.2		(1971BE17)
29.	1600	$\alpha_0$		28.	8 <sup>+</sup>	(1969CO19, 1970CO13)
29.4 $\pm$ 350	700	$\alpha_0$		28.2		(1971BE17)

<sup>a</sup> See also (1959AJ76).

<sup>b</sup>  $^{20}\text{Ne}^*(12.11, 12.37)$  decays by  $\alpha_2$  to  $^{16}\text{O}^*(6.13)$  with  $\omega\Gamma_\alpha\Gamma'_\alpha/\Gamma = 100 \pm 50$  eV and  $\omega\Gamma_\alpha\Gamma'_\alpha/\Gamma = 3 \pm 1$  keV, respectively (1964PE05).

<sup>c</sup>  $\omega\gamma \lesssim 1$  and  $\lesssim 4$  eV to  $^{20}\text{Ne}^*(0, 1.63)$ , respectively;  $\omega\Gamma_\alpha\Gamma'_\alpha/\Gamma = 3 \pm 1$  keV (1964PE05).

<sup>d</sup> Values quoted are taken preferentially from the elastic scattering results (1967ME10).

<sup>e</sup>  $\theta_0^2 = 0.7 \pm 0.2$ ,  $\theta_1^2 = 6 \pm 3$  % (1972HA07).