Table 16.13 from (1982AJ01): Resonances in $^{12}C + \alpha$

No.	E_α (MeV $\pm$ keV)	$\Gamma_{c.m.}$ (keV)	Outgoing particles [a] (x)	Γ_x	Γ_α/Γ	$^{16}O^*$ (MeV)	$J^\pi; T$	Refs. [b]
						8.87		(1977MC08) [k]
1	3.322 ± 30	400	γ_0	23 ± 3 meV		9.65 [h]	1^-	(1977MC08)
			α_0		≈ 1			
2	3.575 ± 10	0.625 ± 0.100	γ_0	5.9 ± 0.6 meV		9.842	2^+	
			γ_3	2.2 ± 0.4 meV				
			α_0					
3	4.256 ± 11	27 ± 4	γ_0			10.353	4^+	
			γ_3	58 ± 7 meV				
			α_0		1			
4	5.245 ± 8	0.28 ± 0.05	γ_2	3.1 ± 1.3 meV		11.094	4^+	
			γ_3	2.5 ± 0.6 meV				
			α_0					
5	5.47	2500	α_0			(11.26)	(0^+)	
6	5.809 ± 18	73 ± 5	γ_0	0.65 ± 0.08 eV		11.52	2^+	
			γ_3	29 ± 7 meV				
			α_0		1			
7	5.92 ± 20	800 ± 100	α_0		1	11.60	3^-	
8	6.518 ± 10	1.5 ± 0.5	α_0			12.049	0^+	
9	7.045 ± 5 [c]	99 ± 7	γ_0	9.5 ± 1.7 eV [e]		12.444	$1^-; 0$	(1976OP02)
			γ_1	0.12 ± 0.06 eV [e]				
			p	1.1 keV				
			α_0	92 ± 8 keV	1.0			
			α_1	0.025 keV				
10	7.82 ± 10	150 ± 11	γ_0	[f]		13.02	2^+	
			α_0	150 ± 11 keV	0.8			
11	7.915 ± 10 [d]	130 ± 5	γ_0	44 ± 8 eV [g]		13.085 [i]	$1^-; 1$	(1976OP02)

Table 16.13 from (1982AJ01): Resonances in $^{12}C + \alpha$ (continued)

No.	E_α (MeV $\pm$ keV)	$\Gamma_{c.m.}$ (keV)	Outgoing particles [a] (x)	Γ_x	Γ_α/Γ	$^{16}O^*$ (MeV)	$J^\pi; T$	Refs. [b]
			γ_4	1.35 ± 0.4 eV				
			p	100 keV				
			α_0	45 ± 18 keV	0.3			
			α_1	1 keV				
12	7.960 ± 10	110 ± 30	γ_0	> 0.01 eV		13.129	$3^-; 0$	
			p	1 keV				
			α_0	90 ± 14 keV	0.7			
			α_1	≈ 20 keV				
13	8.130 ± 15	26 ± 7	γ			13.257	$3^-; 1$	
			p	4.5 keV				
			α_0	9 ± 4 keV				
			α_1	7.5 keV				
			$\gamma_{4.4}$					
14	8.960 ± 10	75 ± 7	α_0	49 keV	0.65 ± 0.05	13.879 ± 8	4^+	
			α_1	23 keV				
15	9.1	4800	α_0			(14.0)	(0^+)	
16	9.164 ± 15	200 ± 50	α_0	≈ 200 keV	> 0.9	14.032	0^+	
17	9.3 ± 100	750 ± 200	α_0		0.2 ± 0.1	14.1	3^-	
			α_1					
18	9.948	487 ± 12	α_0		0.8 ± 0.1	14.620 ± 11	(4^+)	(1979AMZU)
			α_1					
19	10.002	672 ± 11	α_0		≈ 0.95	14.660 ± 11	5^-	(1979AMZU)
			α_1					
20	10.195 ± 7	70 ± 8	α_0	22 keV	0.45 ± 0.05	14.805	6^+	
			α_1	48 keV				
21	10.544	166 ± 30	α_0, α_1, p_0		0.35	15.066 ± 11	0^+	(1979AMZU)

Table 16.13 from (1982AJ01): Resonances in $^{12}C + \alpha$ (continued)

No.	E_α (MeV $\pm$ keV)	$\Gamma_{c.m.}$ (keV)	Outgoing particles [a] (x)	Γ_x	Γ_α/Γ	$^{16}O^*$ (MeV)	$J^\pi; T$	Refs. [b]
22	10.999	133 ± 7	α_0, α_1, p_0		0.58	15.408 ± 2	3^-	(1979AMZU)
23	11.560	703 ± 113	α_0, (α_1), $\gamma_{4.4}$		0.21	15.828 ± 30	3^-	(1979AMZU)
24	11.6	≈ 600	γ_0	$\Gamma_\alpha\Gamma_\gamma/\Gamma \approx 0.4$ eV		15.9	2^+	
25	12.156	422 ± 14	α_0		0.93	16.275 ± 7	6^+	(1979AMZU)
26	12.272	65 ± 45	α_0, α_1, α_2, p_0		0.07	16.362 ± 20	$(0^+, 1^-)$	(1979AMZU)
27	12.380	22 ± 3	γ_0, n, p_0, α_0, α_1, α_2, $\gamma_{4.4}$	$\Gamma_\alpha\Gamma_\gamma/\Gamma = 0.45$ eV	0.28	16.443 ± 2 [i]	2^+; (1)	(1979AMZU)
28	12.5	730	p_0, α_0			(16.5)		
29	12.915	567 ± 60	α_0		0.28	16.844 ± 21	4^+	(1979AMZU)
30	13.0	700	α_0			(16.9)	5^-	
31	13.05	≈ 280	α_2, ^{8}Be			16.94	2^+	(1979AMZU)
32	13.296	107 ± 14	n, p_0, α_0, α_1, $\gamma_{4.4}$		0.37	17.129 ± 5	2^+	(1979AMZU)
33	13.32	36 ± 5	α_0, α_1			17.15		(1979AMZU)
34	13.35	160 ± 60	α_2, ^{8}Be			17.17	2^+	(1979AMZU)
35	13.50	< 100	n			17.28		
36	13.805	182 ± 56	α_0, (α_1), α_2		0.16	17.510 ± 26	1^-	(1979AMZU)
37	13.865	178 ± 66	n, (α_0, α_1)		0.07	17.555 ± 21	(6^+)	(1979AMZU)
38	13.948	175 ± 55	p_0, α_0		0.32	17.618 ± 20	$0^+, 1^-$	(1979AMZU)
39	14.08	(≈ 75)	(p_0), ^{8}Be			17.72	$(0^+, 2^+)$	(1979AMZU)
40	14.170	396 ± 41	n, α_0, α_1, $\gamma_{4.4}$, ^{8}Be		0.34	17.784 ± 15	4^+	(1979AMZU)
41	14.480	14 ± 2	(n), p_0, α_0, α_1, $\gamma_{4.4}$, ^{8}Be		0.36	18.016 ± 1	4^+; (0)	(1979AMZU)
42	14.577	248 ± 90	(γ_0), n_0, p_0, α_0		0.31	18.089 ± 25	(0^+)	(1979AMZU, 1979MO03)
43	(14.62)	(≈ 45)				(18.12)	$(\neq 4^+)$	(1979AMZU)
44	14.85	≈ 300	γ_0, p_0, $(\alpha_1, \gamma_{4.4})$	$\Gamma_\alpha\Gamma_\gamma/\Gamma = 0.95$ eV		18.29		(1979AMZU)
45	14.997	544 ± 39	α_0		0.40	18.404 ± 12	5^-	(1979AMZU)
46	15.2	≈ 150	α_0, $(\alpha_1, \alpha_2, \gamma_{4.4})$			18.6	$(1^-, 5^-)$	(1979AMZU)
47	15.2	≈ 300	α_2, ^{8}Be			18.6	(4^+)	(1979AMZU)

Table 16.13 from (1982AJ01): Resonances in $^{12}C + \alpha$ (continued)

No.	E_α (MeV $\pm$ keV)	$\Gamma_{c.m.}$ (keV)	Outgoing particles [a] (x)	Γ_x	Γ_α/Γ	$^{16}O^*$ (MeV)	$J^\pi; T$	Refs. [b]
48	15.490	215 ± 45	p_0, α_0		0.26	18.773 ± 22	1^-	(1979AMZU)
49	15.506	260 ± 16	n, p_0, α_0, (α_1), ^{8}Be		0.48	18.785 ± 6	4^+	(1979AMZU)
50	15.8	≈ 550	(α_0), α_1, $\gamma_{4.4}$			19.0	(5^-)	(1979AMZU)
51	15.96	41	(n), α_0			(19.12)	$(2^+, 4^+)$	
52	16.130	50 ± 45	(n), (α_0)		0.04	19.253 ± 30	(5^-)	(1979AMZU)
53	16.137	155 ± 23	p_0, α_0, (α_1)		0.34	19.257 ± 9	2^+	(1979AMZU)
54	16.219	63 ± 33	p_0, (α_0), α_1, α_2, ^{8}Be		0.07	19.319 ± 14	(6^+)	(1979AMZU)
55	16.293	23 ± 4	p_0, α_0, α_1, α_2		0.23	19.375 ± 2	4^+	(1979AMZU)
56	16.496	255 ± 75	(n), α_0, (α_1, α_2)		0.20	19.527 ± 26	2^+	(1979AMZU)
57	16.799	286 ± 44	p_0, α_0, α_1		0.29	19.754 ± 16	2^+	(1979AMZU)
58	(16.92)	(≈ 175)	α_2			(19.85)		(1979AMZU)
59	(17.05)	(≈ 30)	(α_0)			(19.94)	$(\neq 3^-)$	(1979AMZU)
60	17.201	432 ± 40	γ_0, n, (p_0), α_0, (α_1)		0.43	20.055 ± 13	2^+	(1979AMZU)
61	(17.27)	(≈ 45)	(α_0)			(20.11)	$(\neq 3^-)$	(1979AMZU)
62	17.5	≈ 1500	p_0			(20.3)		
63	(17.66)	(≈ 150)	n, (p_0), α_2			(20.40)	(4^+)	(1979AMZU)
64	(17.8)	(≈ 300)	(α_0), α_1			(20.5)		(1979AMZU)
65	17.849	11 ± 2	p_0, α_0, α_1, α_2		0.14 ± 0.02	20.541 ± 2	5^-	(1979AMZU)
66	17.875	< 5	α_0			20.560 ± 2	even	(1979AMZU)
67	17.948	< 10	α_0			20.615 ± 3	even	(1979AMZU)
68	(18.2)	(≈ 60)	n, (p_0)			(20.8)		(1979AMZU)
69	18.271	904 ± 55	α_0		0.60	20.857 ± 14	7^-	(1979AMZU)
70	(18.3)		α_0			(20.9)	(2^+)	(1979AMZU)
71	(18.48)	(≈ 50)	n, p_0, (α_0)			(21.01)		(1979AMZU)
72	18.50 ± 25	240 ± 80	γ_0, (α_0, α_1)		0.20	21.03	(1^-)	(1979AMZU)
73	18.5	900	α_0			(21.0)	(5^-)	

Table 16.13 from (1982AJ01): Resonances in $^{12}C + \alpha$ (continued)

No.	E_α (MeV $\pm$ keV)	$\Gamma_{c.m.}$ (keV)	Outgoing particles [a] (x)	Γ_x	Γ_α/Γ	$^{16}O^*$ (MeV)	$J^\pi; T$	Refs. [b]
74	18.531	205 ± 14	α_0		0.50	21.052 ± 6	6^+	(1979AMZU)
75	18.593	306 ± 46	(α_0)		0.21	(21.098)	4^+	(1979AMZU)
76	19.14	61 ± 32	(n), α_0, α_2			21.52	7^-	(1979AMZU, 1981FR11)
77	19.327	115 ± 8	n, α_0, α_1, α_2		0.41	21.648 ± 3	6^+	(1979AMZU)
78	19.498	43 ± 20	n, p_0, α_0, α_1, α_2		0.07	21.776 ± 9	3^-	(1979AMZU)
79	19.85	60	n			22.04		
80	19.89	340	n			22.07		
81	19.95	< 150	n, ^{8}Be			22.11		
82	20.49	375	n			22.52		
83	20.71	60	n, ^{8}Be			22.68		
84	20.760 ± 5	12.5 ± 2.5	n_0, p_0, α_0, α_2			22.721	$0^+; T = 2$	
85	21.28	≈ 20	α_0, α_1, ^{8}Be			23.11		
86	21.3	≤ 500	^{8}Be			23.1	6^+	
87	21.67	< 40	n			23.40		
88	21.85	300	α_0, α_1			23.54		
89	22.0	1500	$\gamma_{12.71}$			23.6		
90	22.14	120	n			23.75		
91	22.306 ± 6	26 ± 4	p_0, α_0, α_1, α_2, ^{8}Be	[j]	0.06 ± 0.02	23.879	6^+	
92	22.37	165	n			23.93		
93	22.75	$\lesssim 500$	^{8}Be			24.21		
94	23.2	750	$\gamma_{12.71}$, $\gamma_{15.11}$			24.5	$T = 1$	
95	24.1	450	$\gamma_{15.11}$			25.2	$T = 1$	
96	24.6	450	$\gamma_{15.11}$			25.6	$T = 1$	
97	25.5	450	$\gamma_{15.11}$			26.3	$T = 1$	
98	25.6	1200	α_0, $\gamma_{12.71}$	$\Gamma_\alpha\Gamma_\gamma/\Gamma = 1.2$ eV		26.3	2^+	
99	29 [l]	4 MeV	α_0, α_1, p_3			29		(1978BU27)

[a] p_0 corresponds to ^{15}N(0). α_0, α_1 correspond to ^{12}C*(0, 4.4) and $\gamma_{4.4}$ corresponds to the γ-ray from the decay of ^{12}C*(4.4); γ_0, γ_1, γ_2, γ_3, γ_4 correspond to the transitions to ^{16}O*(0, 6.05, 6.13, 6.92, 7.12).

[b] Previous references are listed in Tables 16.11 (1971AJ02) and 16.12 (1977AJ02). Please note that (1979AMZU) is an unpublished thesis. (1982AM02) has been submitted for publication.

[c] 7040 ± 5 keV (1976OP02).

[d] 7880 ± 15 keV (1976OP02).

[e] Branching ratios to ^{16}O*(0, 6.05) = 98.8% and 1.2%.

[f] $\Gamma_{\gamma_0} = 0.7 \pm 0.2$ eV (1971KE09), based on $\Gamma_{\alpha_0}/\Gamma = 1.0$ (1968MO08) and $\Gamma_{\rm c.m.} = 190 \pm 40$ keV (1971KE09).

[g] $\Gamma_{\alpha_0}\Gamma_{\gamma_0}/\Gamma^2 = (1.49 \pm 0.17) \times 10^{-4}$ (1971KE09).

[h] $\theta_\alpha^2(7.12)/\theta_\alpha^2(9.63) = 0.19^{+0.16}_{-0.11}$ (1974KO06). See also reactions 9 and 12.

[i] See column 2 and footnote [d].

[j] $\Gamma_{^8\rm Be}$, Γ_{α_0} and $\Gamma_{\alpha_2} \approx 3.5$, 1.5 ± 0.5 and ≈ 6 keV, respectively (1976BR07).

[k] An attempt is reported by (1977MC08) to observe a 0^+ state in the vicinity of the known 2^- state at 8.87 MeV. No such state is seen: $\theta_\alpha^2 \leq 2 \times 10^{-4}$.

[l] See (1981SA07) for $(\alpha,\gamma_{14.8})$ measurements which indicate an 8^+ GQR built on the 6_1^+ state ^{16}O*(14.82).