Revised Manuscript *15 February 2021*

Energy Levels of Light Nuclei
$A = 13$

F. Ajzenberg-Selove

University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396

Abstract: An evaluation of $A = 13$–15 was published in *Nuclear Physics A*449 (1986), p. 1. This version of $A = 13$ differs from the published version in that we have corrected some errors discovered after the article went to press. Figures and introductory tables have been omitted from this manuscript. Reference key numbers have been changed to the NNDC/TUNL format.

(References closed June 1, 1985)

The original work of Fay Ajzenberg-Selove was supported by the US Department of Energy [DE-AC02-76-ER02785]. Later modification by the TUNL Data Evaluation group was supported by the US Department of Energy, Office of High Energy and Nuclear Physics, under: Contract No. DEFG05-88-ER40441 (North Carolina State University); Contract No. DEFG05-91-ER40619 (Duke University).

Table of Contents for $A = 13$

Below is a list of links for items found within the PDF document. Figures from this evaluation have been scanned in and are available on this website or via the link below.

^{13}He

(Not illustrated)

^{13}He has not been observed. See also (1983ANZQ; theor.).

^{13}Li

(Not illustrated)

^{13}Li has not been observed. The calculated value of its mass excess is 60.34 MeV [see (1981AJ01)]: ^{13}Li would then be unstable with respect to ^{11}Li + 2n by 3.26 MeV. (1980BO31) have not observed ^{13}Li in the bombardment of ^{124}Sn by 6.7 GeV protons but state that the statistics were poor in the region of interest and that it is not excluded that ^{13}Li may be stable. See also (1983ANZQ; theor.).

^{13}Be

(Not illustrated)

^{13}Be is reported in the ^{14}C(^{7}Li, ^{8}B) reaction at $E(^{7}\text{Li}) = 82$ MeV: the atomic mass excess of ^{13}Be is 35.0 ± 0.5 MeV. It is then unstable with respect to breakup into ^{12}Be + n by 1.9 MeV (1983AL20). See also (1981AJ01), (1984BE1C) and (1981SE06, 1982KA1D, 1983ANZQ, 1984VA06; theor.).

^{13}B

(Reactions on which no new work is reported are not always discussed.)

(Figs. 1 and 4)

GENERAL: (See also (1981AJ01).)

Model calculations: (1981SE06, 1984VA06).

Complex reactions involving ^{13}*B*: (1983EN04, 1983MA06, 1983OL1A, 1983WI1A, 1984HI1A).

Muon and neutrino capture and reactions: (1984KO1U).

Pion capture and reactions (See also reactions 4 and 5.): (1981OS04, 1982CH16, 1983LI15).

Hypernuclei: (1983FE07).

Other topics: (1981SE06, 1981WA1J, 1982NG01, 1984PO11).

Ground-state properties of ^{13}*B*: (1980FU1G, 1982NG01, 1983ANZQ, 1984KU07).

Mass of ^{13}*B*: From the Q_0 of the ^{11}B(t, p)^{13}B reaction [-233.4 ± 1.0 keV], the atomic mass excess of ^{13}B is 16561.3 ± 1.4 keV.

$Q = 0.0478$ (46) b (1978LEZA),

$\mu = +3.17778$ (51) nm (1978LEZA).

1. ^{13}B(β^-)^{13}C $Q_m = 13.436$

The half-life of ^{13}B is 17.36 ± 0.16 msec: see (1981AJ01). The branching ratios to various ^{13}C states are shown in Table 13.2: they indicate $J^\pi = \frac{1}{2}^-$ or $\frac{3}{2}^-$ for ^{13}B$_{\text{g.s.}}$. See also (1981KO27; theor.).

2. ^{7}Li(^{7}Li, p)^{13}B $Q_m = 5.963$

Observed proton and γ-ray groups are shown in Table 13.3. See also ^{14}C.

3. ^{11}B(t, p)^{13}B $Q_m = -0.2324$

$Q_0 = -233.36 \pm 1.00$ keV (1983AN1Q).
Observed proton groups are displayed in Table 13.3.

4. ^{13}C(γ, π^+)^{13}B $Q_m = -153.004$

Differential cross sections have been measured to ^{13}B$_{\text{g.s.}}$ ($E_{\pi^+} = 18$, 29, 42 MeV) and the unresolved structure at $E_x \approx 3.5 - 3.7$ MeV ($E_{\pi^+} = 42$ MeV) (1982LE26) and to ^{13}B$_{\text{g.s.}}$ (1983SH01; $E_\gamma = 194$ MeV, $E_{\pi^+} \approx 40$ MeV) [see the latter for a discussion of the comparison of the results with DWIA]. At $E_e = 195$ MeV the ^{13}B E_x region to 12 MeV has been studied by (1983MI06): they find that the photopion reaction predominantly excites M2 states at low q and M4 states at high q. Fits to the data are obtained by assuming the excitation of ^{13}B$_{\text{g.s.}}$ and ^{13}B*(3.5, 6.4, 9.0) [the latter are clearly due to unresolved groupings of levels]. Comparisons are made with the ^{13}C(e, e′) work in the analog region in ^{13}C (1983MI06). [For $T = \frac{3}{2}$ states see Table 13.6.] See also reaction 43 in ^{13}C and the "General" section here.

5. ^{13}C(n, p)^{13}B $Q_m = -12.654$

See (1985FO1C, 1985FO1D).

Table 13.1: Energy levels of ^{13}B

E_x (MeV ± keV)	$J^\pi; T$	τ or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
g.s.	$\frac{3}{2}^-; \frac{3}{2}$	$\tau_{1/2} = 17.36 \pm 0.16$ msec	β^-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
3.4828 ± 4.5	[a]		(γ)	3, 6
3.5346 ± 3.1	[a]	$\tau_m > 0.3$ psec	γ	2, 3, 6
3.6810 ± 4.5	[a]		(γ)	3, 6, 8
3.7126 ± 4.5	[a]	$\tau_m < 0.38$ psec	γ	2, 3, 6, 8
4.131 ± 6		$\tau_m = 0.062 \pm 0.050$ psec	γ	2, 3
4.829 ± 6			(γ)	2, 3
5.024 ± 6				2, 3
5.106 ± 10		$\Gamma = 60 \pm 10$ keV		3
5.388 ± 6		10 ± 10		2, 3
(5.557 ± 7)				2
6.167 ± 6				2, 3, 4
6.425 ± 7		36 ± 5		2, 3, 4, 6
6.934 ± 9	[a]	55 ± 15		2, 3, 4, 6
(7.516 ± 8)				2, 6
(7.859 ± 20)				2, 6
8.133 ± 7		100 ± 15		2, 3
8.683 ± 7		89 ± 20		2, 3
9.44 ± 30		81 ± 25		3, 4
10.22 ± 20		210 ± 20		3, 6
10.89 ± 20				3
(11.80)				3

[a] See Table 13.3 and reaction 5.

Table 13.2: Beta decay of ^{13}B [a]

Decay to ^{13}C* (MeV)	J^π	Branch (%)	log ft [b]
0	$\frac{1}{2}^-$	92.1 ± 0.8	4.01 ± 0.01
3.09	$\frac{1}{2}^+$	≤ 0.7	≥ 5.7
3.68	$\frac{3}{2}^-$	7.6 ± 0.8	4.45 ± 0.04
3.85	$\frac{5}{2}^+$	≤ 0.7	≥ 5.5
7.55	$\frac{5}{2}^-$	0.094 ± 0.020	5.33 ± 0.08
8.86	$\frac{1}{2}^-$	0.16 ± 0.03	4.60 ± 0.08
9.90	$\frac{3}{2}^-$	0.022 ± 0.007	4.95 ± 0.12

[a] For references see Table 13.2 in (1981AJ01).

[b] Log ft shown here are based on $\tau_{1/2} = 17.33 \pm 0.17$ msec.

6. ^{13}C(π^-, γ)^{13}B $\qquad Q_{\rm m} = 126.131$

Gamma rays have been observed which are associated with the ^{13}B ground state; an unresolved doublet at $E_{\rm x} \approx 3.5 - 3.7$ MeV; sharp states at $E_{\rm x} \approx 6.5$ and 7.6 MeV; a broad level (or unresolved levels) at ≈ 10.2 MeV (1983MA16; see for radiative capture branching ratios). The analogs of the peaks at $E_{\rm x} = 6.5$, 7.6 and 10.2 MeV, calculated to be at ^{13}C*(21.6, 22.7, 25.3), are attributed to a $\Delta L = 1$, $\Delta S = 1$, $\Delta T = 1$ spin-isospin giant dipole resonance of ^{13}C (1983MA16). See also the "General" section here.

7. ^{13}C(^{7}Li, ^{7}Be)^{13}B $\qquad Q_{\rm m} = -14.298$

See (1982AL1G, 1984GL1G; E(^{7}Li) = 78 MeV).

8. ^{14}C(d, ^{3}He)^{13}B $\qquad Q_{\rm m} = -15.337$

See (1981AJ01).

9. ^{14}C(t, α)^{13}B $\qquad Q_{\rm m} = -1.016$

At $E_{\rm t} = 23$ MeV the angular distribution for α_0 has been analyzed by (1979SE07): the DWBA fit is poor. The extracted $S(\frac{3}{2}) = 5.7$, near that predicted for a filled $p_{3/2}$ shell.

Table 13.3: Proton groups from ^{7}Li(^{7}Li, p)^{13}B and ^{11}B(t, p)^{13}B [a]

^{7}Li(^{7}Li, p)^{13}B	^{11}B(t, p)^{13}B				
	A			B	
E_x (MeV ± keV)	E_x (MeV ± keV)	L	J^π	E_x (MeV ± keV)	$\Gamma_{c.m.}$ (keV)
0	0	0	$\frac{3}{2}^-$	0	
	3.483 ± 5	1	$(\frac{1}{2}, \frac{3}{2}, \frac{5}{2})^+$ [g]	3.482 ± 10	
3.5363 ± 4.2 [b]	3.533 ± 5	2	$(\frac{1}{2}, \frac{5}{2}, \frac{7}{2})^-$ [g]	3.531 ± 10	
	3.681 ± 5	1	$(\frac{1}{2}, \frac{3}{2}, \frac{5}{2})^+$ [g]	3.681 ± 10	
[c]	3.712 ± 5	2	$(\frac{1}{2}, \frac{5}{2}, \frac{7}{2})^-$ [g]	3.715 ± 10	
4.1334 ± 7.8 [b,d]	4.13 ± 10	2	$(\frac{1}{2}, \frac{5}{2}, \frac{7}{2})^-$ [g]	4.128 ± 10	
4.833 ± 10 [e]	4.82 ± 10			4.834 ± 10	
5.033 ± 8	5.01 ± 10	1	$(\frac{1}{2}, \frac{3}{2}, \frac{5}{2})^+$ [g]	5.023 ± 10	
				5.106 ± 10	60 ± 10
5.391 ± 8	5.38 ± 10 [f]			5.393 ± 10	10 ± 10
5.557 ± 8				[h]	
6.169 ± 8	6.17 ± 20			6.164 ± 10	
6.419 ± 8				6.434 ± 10	36 ± 5
6.939 ± 15				6.932 ± 10 [i]	55 ± 15
7.516 ± 8				[h]	
7.859 ± 20				[h]	
8.129 ± 10				8.138 ± 10	100 ± 15
8.682 ± 9				8.684 ± 10	89 ± 20
				9.44 ± 30	81 ± 25
				10.22 ± 20	210 ± 20
				10.89 ± 20	
				(11.80)	

A: $E_t = 11$ MeV.
B: $E_t = 23$ MeV.
[a] For references see (1981AJ01).
[b] E_γ; $\tau_m > 0.3$ psec.
[c] The decay is primarily by γ_0: the upper limit to the cascade via ^{13}B*(3.5) is 10%; $\tau_m < 0.38$ psec.
[d] The γ-decay is (75 ± 10)%, (25 ± 10)% and < 10%, respectively to ^{13}B*(0, 3.5, 3.7); $\tau_m = 62\pm50$ fsec.
[e] All values in this column from this entry down are based on $E_x = 4131$ keV for ^{13}B*(4.13).
[f] $\Gamma = 15 \pm 5$ keV.
[g] See, however, (1978AJ02), p. 1289.
[h] Not observed.
[i] $L \geq 4$.

10. ^{18}O(d, ^{7}Be)^{13}B $Q_{\rm m} = -19.976$

See (1984NE1A).

^{13}C

(Figs. 2 and 4)

GENERAL: (See also (1981AJ01)).

Nuclear models: (1982KU1B, 1983JA09, 1983SH38, 1983VA31, 1984VA06, 1984ZW1A).

Special states: (1980RI06, 1981KO1Q, 1981LI19, 1983AU1B, 1983GO1R, 1983MI08, 1983VA31, 1984GO1M, 1984RO05, 1984VA06, 1984ZW1A, 1985HA1J, 1985WE02).

Electromagnetic transitions: (1980BA54, 1980RI06, 1981KN06, 1981KO1Q, 1981LI19, 1982AW02, 1983AD1B, 1983MI08, 1984KU07, 1984MA67, 1984MO1D, 1984SC09).

Astrophsical questions: (1980AU1D, 1980GA1Q, 1980WA1M, 1981CR1B, 1981GU1D, 1981LA1L, 1981SC1M, 1981SN1B, 1981WA1N, 1981WA1Q, 1981WI1G, 1982IB1B, 1982JO1B, 1982NO1D, 1983AL23, 1983BO1F, 1983IB1A, 1983SW1A, 1984HA1R, 1984HA1Z, 1984LA1J, 1984LI1L, 1984TR1C, 1984WE1C, 1985GU1A).

Applied work: (1980SE1E, 1981DE2B, 1981FR1D, 1982FR1L, 1982ST1C, 1982ZA1C, 1983AM1A, 1983DO1H, 1983GI1E, 1983JU1B, 1983SC1B, 1983SU1C, 1984AR1C, 1984BO1T, 1984DE1T, 1984DO1B, 1984GI1K, 1984GI1M, 1984HO1E, 1984LE1G, 1984NA1R, 1984RA1J, 1984SH2A, 1984SU1H, 1984SU1J, 1985AR1N).

Complex reactions involving ^{13}C: (1980GR10, 1980RI06, 1981FR02, 1981GR08, 1981ME13, 1981OL1C, 1982LY1A, 1982TA02, 1983CH23, 1983EN04, 1983FR1A, 1983GA01, 1983JA05, 1983MA06, 1983OL1A, 1983SA06, 1983VO04, 1983WI1A, 1984GR08, 1984HI1A, 1984HO23, 1984VO06, 1985GU1A, 1985MO08, 1985ST1J, 1985UT1B).

Muon and neutrino capture and reactions: (1981MU1E, 1981PH1C, 1982SC11, 1982WE02, 1983GM1A, 1984AA1B, 1984KO1U, 1985MI1P).

Pion capture and reactions (See also reactions 8, 28 and 44): (1978MO01, 1979BA16, 1979ME2A, 1980BA27, 1980BU15, 1980DE1X, 1980EI01, 1980GO1M, 1980LE17, 1981AU1C, 1981BA1J, 1981CR1A, 1981FE2A, 1981GI1A, 1981GO1G, 1981HAZU, 1981HI06, 1981KE1A, 1981LI02, 1981LI1B, 1981LO1B, 1981MO11, 1981NI1B, 1981OS04, 1981PE1C, 1981PO10, 1981SI1D, 1981WH01, 1982AS05, 1982BE51, 1982BE1D, 1982CH16, 1982CO07, 1982CO1Z, 1982DE1K, 1982DO01, 1982DO02, 1982DO10, 1982FE1A, 1982FR02, 1982GI1B, 1982GR1F, 1982GR1K, 1982HO1C, 1982IN1A, 1982IQ1A, 1982KE1D, 1982KI1D, 1982LE26, 1982LI1K, 1982LO1K, 1982MA1F, 1982MA1U, 1982NA1K, 1982SO1B, 1982THZZ, 1982WA1G, 1983CH54, 1983GE12, 1983GM1A, 1983KA19, 1983LI1M, 1983LI1Q, 1983LI15, 1983LI1X, 1983MA16, 1983MA40, 1983MI06, 1983PE14, 1983SH01, 1983THZZ, 1983TI1A, 1983TO17, 1983TR1J, 1983ZE1C, 1984AN11, 1984BA2Y, 1984COZY, 1984GO1F, 1984GR27, 1984KE02, 1984LI1U, 1984MI1K, 1984SA1H, 1984ST16, 1984TI02).

Kaon capture and reactions: (1979LI1A, 1981BA1H, 1981DA1C, 1981MA27, 1981MI1F, 1982BA1R, 1982BE1U, 1982DO1C, 1982DO1M, 1982MA1Y, 1982ZH1C, 1983AU1A, 1983FE07, 1983LI1Q, 1983PO1D, 1984GI1E, 1984MI1C, 1984SI13).

Table 13.4: Energy levels of ^{13}C [a]

E_x in ^{13}C (Mev ± keV)	$J^\pi; T$	τ_m or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
g.s.	$\frac{1}{2}^-; \frac{1}{2}$		stable	5, 6, 7, 8, 10, 12, 13, 14, 18, 19, 20, 21, 22, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84
3.089443 ± 0.020	$\frac{1}{2}^+$	$\tau_m = 1.55 \pm 0.15$ fsec [b]	γ	6, 7, 10, 12, 18, 20, 22, 28, 29, 30, 32, 33, 34, 36, 43, 44, 45, 46, 47, 48, 49, 53, 64, 65, 66, 68, 69, 71, 72, 73, 74, 75, 77
3.684507 ± 0.019	$\frac{3}{2}^-$	1.59 ± 0.13 fsec [b]	γ	5, 6, 7, 8, 12, 13, 18, 20, 22, 28, 29, 30, 32, 33, 34, 39, 43, 44, 45, 46, 47, 48, 49, 53, 64, 65, 66, 68, 69, 70, 71, 72, 74, 75, 77, 78
3.853807 ± 0.019	$\frac{5}{2}^+$	12.4 ± 0.2 psec [c]	γ	6, 7, 12, 18, 20, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 44, 45, 46, 47, 48, 49, 53, 64, 65, 66, 68, 71, 72, 75, 77
6.864 ± 3	$\frac{5}{2}^+$	$\Gamma = 6$	γ, n	5, 6, 7, 11, 12, 18, 20, 23, 28, 29, 43, 46, 48, 49, 71, 72, 74
7.492 ± 10	$(\frac{7}{2}^+)$	< 5		5, 7, 11, 13, 18, 20, 29, 36, 48, 49, 70, 71, 72

Table 13.4: Energy levels of ^{13}C [a] (continued)

E_x in ^{13}C (Mev $\pm$ keV)	$J^\pi; T$	τ_m or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
7.547 ± 3	$\frac{5}{2}^-$	1.2 ± 0.3	γ, n	5, 7, 13, 18, 20, 23, 29, 36, 39, 43, 44, 46, 48, 49, 70, 71, 72, 74
7.686 ± 6	$\frac{3}{2}^+$	70 ± 5	γ, n	18, 20, 23, 29, 40, 48, 49, 68, 72
8.2 ± 100	$\frac{3}{2}^+$	1000 ± 300	γ, n	7, 23, 29, 40
8.860 ± 20	$\frac{1}{2}^-$	150 ± 30	γ, n	18, 23, 29, 39, 40, 43, 44, 46, 48, 49, 68, 71, 72, 74
9.4997 ± 0.1	$\frac{9}{2}^+$	5	(γ), n	5, 7, 11, 18, 23, 28, 29, 44, 46, 48, 49, 71, 72, 74
9.897 ± 5	$\frac{3}{2}^-$	26 ± 3	γ, n	5, 11, 18, 23, 29, 39, 40, 43, 46, 48
10.46		200	n	23
10.753 ± 4	$\frac{7}{2}^-$	55 ± 2	n	11, 18, 23, 29, 46, 48, 72
10.818 ± 5	$(\frac{5}{2}^-)$	24 ± 3	n	5, 7, 11, 18, 23, 29, 48, 72
10.996 ± 6	$\frac{1}{2}^+$	37 ± 4	γ, n, α	2, 18, 23, 29, 40, 72
11.080 ± 5	$\frac{1}{2}^-$	< 4	γ, n, α	2, 18, 23, 29, 40, 43, 46, 48, 49, 72, 74
11.748 ± 10	$\frac{3}{2}^-$	110 ± 15	n	13, 18, 23, 29, 72
11.851 ± 5	$(\frac{3}{2}^-)$	68 ± 4	n	13, 29, 44, 46, 49, 68, 70, 71, 74
11.95 ± 40	$\frac{5}{2}^+$	500 ± 80	n, α	2, 23, 29
12.106 ± 5	$\frac{3}{2}^+$	540 ± 70	(γ), n, (α)	2, 23, 29, 40, 72
12.13 ± 50	$\frac{5}{2}^-$	80 ± 30	n, (α)	2, 23
12.14 ± 70	$\frac{1}{2}^+$	430 ± 70	n, (α)	2, 23
12.27 ± 70	$\frac{3}{2}^-$	190 ± 50	n, (α)	2, 23
12.438 ± 12	$\frac{7}{2}^-$	140 ± 30	n, α	2, 23, 74
13.0 ± 1000		broad	γ, n	40

Table 13.4: Energy levels of ^{13}C [a] (continued)

E_x in ^{13}C (Mev $\pm$ keV)	$J^\pi; T$	τ_m or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
(13.28)	$(\frac{3}{2}^-)$	340	α	4
13.41	$(\frac{9}{2}^-)$	35 ± 3	n, α	2, 4
13.57	$\frac{7}{2}^-$	620 ± 50	n, α	2, 4, 23
13.76	$(\frac{5}{2}, \frac{3}{2})^+$	≈ 300	n, α	2, 4
14.13	$\frac{3}{2}^-$	≈ 150	n, α	2, 4, 23
14.390 ± 15	$(\frac{1}{2}, \frac{5}{2})^-$	280 ± 70	n, α	2, 46
14.582 ± 10		230 ± 50	n, α	2
14.983 ± 10	$\frac{7}{2}^-$	380 ± 60	n, α	2, 23
15.1082 ± 1.2 [d]	$\frac{3}{2}^-; \frac{3}{2}$	5.49 ± 0.25	γ, n, α	2, 4, 5, 18, 40, 43, 46, 48, 66, 74
15.27	$\frac{9}{2}^+$		n	23
15.526 ± 11	$(\frac{3}{2}^-)$	150 ± 30	n, α	2, 23
16.080 ± 7	$(\frac{7}{2}^+)$	150 ± 15	(γ), n, α	2, 23, 43, 44, 48
16.15 ± 50	$(\frac{5}{2}^-)$	230	n, α	2, 23, 46
16.95 ± 50		330	n, α	2
17.36 ± 100		190	n, α	2
17.699 ± 5		170	n, α	2
(17.92 ± 50)				44
18.30 ± 50		300	n, α	2
18.699 ± 5		100 ± 15	γ, n, p, α	2, 41
19.5		≈ 450	n, d	15, 23
19.9		≈ 600	n, p, d	15, 16
20.021 ± 13		230 ± 30	(γ), n, (p), d, α	15, 17
20.429 ± 8		116 ± 10	(γ), n, p, d	14, 15, 16
(20.52 ± 70)		510 ± 70	γ, n, p	22, 40, 41
(21.1 ± 600)		4200 ± 400	γ, n, p	22, 40, 41, 42
21.28 ± 15		159 ± 15	n, p, d	15, 16, 44
21.466 ± 8		270 ± 20		44, 46
21.81 ± 20		114 ± 21	n, d	15
22		≈ 1000	(γ), n, (p), d	14, 15, 41

Table 13.4: Energy levels of ^{13}C [a] (continued)

E_x in ^{13}C (Mev ± keV)	$J^\pi; T$	τ_m or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
23		≈ 1000	(γ), n, (p)	23, 29, 41
24		≈ 4000	γ, n, p	29, 40, 41, 43
(26)		broad	γ, p	41
26.8			n, d	15
27.5		≈ 1000	n, p, d, t	9, 15
30			γ, n	40

[a] See also Table 13.5.
[b] From Table 13.5 in (1981AJ01).
[c] Weighted mean of values displayed in Table 13.5 in (1981AJ01) and in (1981RU04).
[d] See Table 13.6.

Antiproton reactions: (1981YA1C).

Hypernuclei: (1980IW1A, 1980ZH1C, 1981AU05, 1981DA1C, 1981MA27, 1981MI1A, 1981MI1F, 1981RA18, 1981WA1J, 1981ZH1B, 1982BE1U, 1982DO1C, 1982DO1M, 1982GR1P, 1982JO1C, 1982KA1U, 1982KA1D, 1982MA1Y, 1982PI1J, 1982RA1L, 1982SH1P, 1982ZH1C, 1983AU1A, 1983BA2K, 1983CH1T, 1983DO1B, 1983FE07, 1983GA17, 1983JO1E, 1983KO1V, 1983KO1D, 1983LI1Q, 1983MA1F, 1983PO1D, 1983SH1E, 1984AS1D, 1984BA2Y, 1984BA1N, 1984BO1A, 1984CH1G, 1984DA03, 1984DA1D, 1984MI1C, 1984SH1J, 1985AH1A, 1985BA2N).

Other topics: (1979LI1A, 1980BA54, 1981AU05, 1981PL03, 1982AW02, 1982HU1D, 1982LU02, 1982NG01, 1983CO09, 1983GO1R, 1983GU09, 1984PO11).

Ground state of ^{13}*C*: (1980BA54, 1981AV02, 1982LO13, 1982NG01, 1983AD1B, 1983ANZQ, 1983AU1A, 1983AU1B, 1983BU07, 1983CO09, 1983VA31, 1984FR13, 1984KA25, 1984KU07, 1984WE04, 1985HA18, 1985FA01).

$\mu = +0.702411$ (1) nm (1978LEZA),

$\langle r^2 \rangle^{1/2} = 2.4795$ (20) fm (1982SC11). See also (1984AA1B).

Natural abundance: $(1.10 \pm 0.03)\%$ (1984DE53).

The neutron rms radius is 2.35 (3) fm (1979JO08). See also (1981AJ01).

^{13}*C*(3.85)*: g is negative (1976DY05). From the γ-ray due to the transition ^{13}C*($3.85 \rightarrow 3.68$), $\Delta E_x = 169.356 \pm 0.020$ keV (1984SC09). See, however, footnote [c] in Table 13.11.

Table 13.5: Summary of results on the total radiation widths of low-lying levels of ^{13}C-^{13}N [a]

$J^\pi_i \to J^\pi_f$	^{13}C* (MeV)	Γ_γ (eV)	^{13}N* (MeV)	Γ_γ (eV)
$\frac{1}{2}^+ \to \frac{1}{2}^-$	3.09 [b]	0.43 ± 0.04	2.37	0.64 ± 0.07
$\frac{3}{2}^- \to \frac{1}{2}^-$	3.68 [c]	0.41 ± 0.04	3.51 [f]	0.70
$\frac{5}{2}^+ \to \frac{1}{2}^-$	3.85 [d]	$(5.32 \pm 0.09) \times 10^{-5}$ [e]	3.55	$< 2 \times 10^{-3}$

[a] See also Tables 13.12 and 13.17. For references see Table 13.6 in (1981AJ01).

[b] $E_x = 3089.443 \pm 0.020$ keV, $E_\gamma = 3089.049 \pm 0.020$ keV* (1980WA24): here, and in footnote [d], measured values are asterisked; the others are derived.

[c] Branching ratio for cascade via ^{13}C*(3.09) is $0.75 \pm 0.04\%$ (1980WA24), $(0.74 \pm 0.05)\%$ (1982MU14). $E_x = 3684.482 \pm 0.023$ keV, $E_\gamma = 3683.921 \pm 0.023$ keV. $\delta(\mathrm{E2/M1}) = -0.094 \pm 0.009$. E_γ for the transition to ^{13}C*(3.09) is 595.013 ± 0.011 keV (1980WA24).

[d] Branching ratios for cascades via ^{13}C*(3.68, 3.09) are $(36.3 \pm 0.6)\%$ and $(1.20 \pm 0.04)\%$, respectively (1980WA24). $E_x = 3853.783 \pm 0.022$ keV, $E_\gamma = 3853.170 \pm 0.022$ keV; E_γ for the transitions to ^{13}C*(3.09, 3.68) are 764.316 ± 0.010 keV* and 169.300 ± 0.004 keV* (1980WA24) [169.356 ± 0.020 keV (1984SC09)].

[e] The ground-state branching ratio is $(62.5 \pm 0.6)\%$ (1980WA24) and $\delta(\mathrm{E3/M2}) = +0.12 \pm 0.03$ (1966PO11).

[f] Branching ratio for cascade via ^{13}N*(2.37) is $(8 \pm 1)\%$ (1974RO29). See also footnote [g] in Table 13.17.

1. (a) ^{6}Li(^{7}Li, γ)^{13}C $\quad Q_m = 25.867$
   (b) ^{6}Li(^{7}Li, n)^{12}C $\quad Q_m = 20.921$ $\quad E_b = 25.867$
   (c) ^{6}Li(^{7}Li, p)^{12}B $\quad Q_m = 8.334$
   (d) ^{6}Li(^{7}Li, d)^{11}B $\quad Q_m = 7.189$
   (e) ^{6}Li(^{7}Li, t)^{10}B $\quad Q_m = 1.992$
   (f) ^{6}Li(^{7}Li, α)^{9}Be $\quad Q_m = 15.220$

The yield curves for d_0($E(^6\mathrm{Li}) = 4$ to 14 MeV), t_0($E(^7\mathrm{Li}) = 5$ to 14 MeV) and α_0($E(^6\mathrm{Li}) = 4$ to 14 MeV) show broad, uncorrelated structures. Energy-averaged differential cross sections are also reported for a number of ^{12}B, ^{11}B and ^{10}B states. Total cross-section measurements have been measured for $E(^7\mathrm{Li}) = 3.8$ to 6.0 MeV for $p_0 \to p_2, p_{3+4}, p_5$; $d_0 \to d_3, d_{4+5}, d_6$; $t_0 \to t_2$; and α_0: the total cross sections generally increase smoothly with energy without showing any structure: see (1981AJ01). For reaction (b) see (1981NOZW). See also (1983KAZF).

2. (a) ^{9}Be(α, n)^{12}C $\quad Q_m = 5.7013$ $\quad E_b = 10.6476$
   (b) ^{9}Be(α, 2n)^{11}C $\quad Q_m = -13.020$

Resonances for n_0 and n_1, for γ-rays from ^{12}C*(4.4, 12.7, 15.1) and resonances in the total neutron cross section are given in Table 13.7. In addition the yield of neutrons to ^{12}C*(7.65, 9.64) has been measured in the range $E_\alpha = 2.9 - 6.4$ MeV. The n_0 and n_1 excitation functions exhibit weak resonance anomalies at $E_\alpha = 6.44$ MeV corresponding to the $J^\pi = \frac{3}{2}^-$, $T = \frac{3}{2}$ state at $E_x = 15.11$ MeV: see Tables 13.6 and 13.7 (1978HI06). The thick-target yield of neutrons has been measured for $E_\alpha = 3.0$ to 9.0 MeV by (1979BA48). Polarization measurements have been reported for E_α to 100 MeV: see (1981AJ01). Reaction (b) has been studied at a number of energies for $E_\alpha = 17$ to 44 MeV [see (1981AJ01)] and at $E_\alpha = 19.5$ to 32.1 MeV (1981AN16). See also (1982WE16; applied).

3. (a) ^{9}Be(α, d)^{11}B $\quad Q_m = -8.0312 \quad E_b = 10.6476$
   (b) ^{9}Be(α, t)^{10}B $\quad Q_m = -13.2281$

Excitation curves have been measured for $E_\alpha = 15$ to 27.5 MeV for reaction (a) [involving d_0, d_1 and at the higher energies d_2, d_3, d_{4+5}, d_6] and at 26.0 to 27.5 MeV for reaction (b) [t_0, t_1, t_3]: no structures are observed. See (1981AJ01).

4. ^{9}Be(α, α)^{9}Be $\quad E_b = 10.6476$

A number of excitation functions have been measured for elastically scattered α-particles for $E_\alpha = 1.4$ to 20 MeV: these show considerable resonance structure with the variations being most prominent below 10 MeV but persisting up to 20 MeV. The parameters resulting from a best fit of the excitation functions are displayed in Table 13.8: see the footnotes to that table for a summary of the most important caveats. A weak resonance is observed in the α_0 yield at $E_\alpha = 6.44$ MeV corresponding to the excitation of the first $T = \frac{3}{2}$ state at $E_x = 15.11$ MeV: see Table 13.6 for the parameters of that state (1978HI06). For inclusive cross sections see (1985AB02). See also (1981FR1T, 1985SR01; theor.).

5. ^{9}Be(^{6}Li, d)^{13}C $\quad Q_m = 9.1725$

A number of ^{13}C states have been studied at $E(^6\text{Li}) = 23.8$ MeV: see (1981AJ01).

6. ^{9}Be(^{7}Li, t)^{13}C $\quad Q_m = 8.1796$

Angular distributions for t_0, t_1, t_{2+3}, t_4 are reported at $E(^7\text{Li}) = 5.6$ to 6.2 MeV: see (1976AJ04).

Table 13.6: Parameters of the first $T = \frac{3}{2}$ states in ^{13}C and ^{13}N [a]

	^{13}C*(15.11)	^{13}N*(15.06)
E_x (MeV)	15.1082 ± 0.0012	15.06457 ± 0.0004
J^π	$\frac{3}{2}^-$	$\frac{3}{2}^-$
$\Gamma_{c.m.}$ (keV)	5.49 ± 0.25	0.932 ± 0.028
Γ_{γ_0} (eV)	22.4 ± 1.5 (M1), 0.6 ± 0.1 (E2)	24.2 ± 1.5 (M1) [e], 0.32 ± 0.12 (E2) [f]
Γ_{γ_1} (eV)	4.12 ± 0.74	$\leq 2.82 \pm 0.30$ [g]
$\Gamma_{\gamma_{2+3}}$ (eV)	18.2 ± 2.4	19.6 ± 1.4 [h]
Γ_{γ_0}/Γ (%)	0.396 ± 0.030 [b]	
$\Gamma_{p_0}\Gamma_{\gamma_0}/\Gamma$ (eV)		5.79 ± 0.20
$\Gamma_{\gamma_0}/\Gamma_{p_0}$ (%)		12.1 ± 1.1
Γ_{n_0} or Γ_{p_0} (keV) [c]	0.38 ± 0.10	0.228 ± 0.016 [i]
Γ_{n_1} or Γ_{p_1} (keV) [c]	1.43 ± 0.18	0.140 ± 0.014 [i]
Γ_{n_2} or Γ_{p_2} (keV) [c]	0.14 ± 0.10	0.049 ± 0.015 [i]
Γ_{p_3} (keV) [c]		0.089 ± 0.014 [i]
Γ_{p_5} (keV) [c]		0.15 ± 0.04 [i] [j]
Γ_{α_0} (keV) [d]	0.104 ± 0.028	0.046 ± 0.026 [i]
Γ_{α_1} (keV) [d]		0.036 ± 0.036 [i]
Γ_{α_2} (keV) [d]		0.067 ± 0.042 [i]

[a] For references see Table 13.7 in (1981AJ01).

[b] The decay width to ^{13}C*(7.55) is < 0.9 eV.

[c] Widths for ^{13}C*(15.11) $\rightarrow$ ^{12}C$_{g.s.}$ + n_0 or ^{13}N*(15.06) $\rightarrow$ ^{12}C$_{g.s.}$ + p_0 [n_1, p_1; n_2, p_2; and p_3 and p_5 refer to the decays to ^{12}C*(4.4, 7.7, 9.6, 10.8) respectively].

[d] Widths for ^{13}C*(15.11) $\rightarrow$ ^{9}Be$_{g.s.}$ + α_0 or ^{13}N*(15.06) $\rightarrow$ ^{9}B$_{g.s.}$ + α_0 [α_1 and α_2 refer to the decays to ^{9}B*((1.6), 2.4)].

[e] $\delta = -0.15 \pm 0.07$ (1978HI06). Here $\delta = B(^{13}\text{C})/B(^{13}\text{N}) - 1$.

[f] $\delta = 1.0 \pm 0.6$ (1978HI06).

[g] $\delta \geq 0.83 \pm 0.29$.

[h] $\delta = -0.04 \pm 0.14$.

[i] Based on measured branching ratios and on $\Gamma_{c.m.} = 0.932 \pm 0.028$ keV. See also footnote [d] in Table 13.18.

[j] The decay width to ^{12}C*(12.71) is $<$ 0.13 keV. It is expected to be $\approx$ 0.03 keV. The sum of the branching ratios for all measured decays of ^{13}N*(15.06) is $(92 \pm 8)\%$. It is apparent from the character of the decay modes of this state that 2s1d shell isospin admixtures are important.

Table 13.7: Resonances in ^{9}Be(α, n)^{12}C [a]

E_α [b] (MeV)	E_α [c] (MeV)	E_α [d] (MeV)	$\Gamma_{c.m.}$ (keV)	J^π	^{13}C* [e] (MeV)
0.52	0.52		≈ 55 [f]	$(\frac{1}{2}^+)$	11.01
0.60	0.60		< 4 [f]		11.06
1.9	1.905	1.92	130	$(\frac{7}{2}^-)$	11.97
2.24		2.25	280		12.20
2.58	2.6	2.58	≈ 200	$(\frac{1}{2}^-)$	12.43
4.00	3.98	4.00	35 ± 3 [g]		13.41
4.18			570	$(\frac{3}{2}^+)$	13.54
4.50	4.47	4.50	≈ 350	$(\frac{5}{2}^+)$	13.75
5.0	5.02	5.0	≈ 200		14.12
5.40 ± 0.10	5.3		260	$(\frac{1}{2}^-, \frac{5}{2}^-)$	14.39 ± 0.1
	5.75	5.75	210		14.63
6.20 ± 0.05			380	$(\frac{3}{2}^+)$	14.94 ± 0.05
	6.44 [h]			$\frac{3}{2}^-; T = \frac{3}{2}$	15.1086
7.10 ± 0.05	7.00		220		15.56 ± 0.05
	7.75	7.8	210		16.01
7.95 ± 0.05			230		16.15 ± 0.05
9.10 ± 0.05		9.1	330		16.95 ± 0.05
9.7 ± 0.10	9.70		190		17.36 ± 0.1
10.2 ± 0.05			170		17.71 ± 0.05
11.05 ± 0.05			300		18.30 ± 0.05
11.70 ± 0.03	11.60		70		18.75 ± 0.03

[a] For references see (1981AJ01).
[b] Resonances in total neutron yield.
[c] Resonances in n_1 group and for 4.4 MeV γ-rays.
[d] Resonances in total cross section.
[e] Not corrected for effects of Coulomb barrier penetration.
[f] $\omega\gamma = 3.79$ and 0.88 eV, respectively (1968DA05).
[g] J.L. Weil, private communication.
[h] Anomalies in n_0 and n_1 yields at $E_\alpha = 6443.5 \pm 2.0$ keV: see Table 13.6 for parameters of 15.11 MeV state (1978HI06).

Table 13.8: Resonances in ^{9}Be(α, α_0) [a]

E_α (MeV)	$\Gamma_{c.m.}$ (keV)	l_α	J^π	^{13}C* (MeV)
3.80	343	0, 2	$\frac{3}{2}^-$ [b]	13.28
4.00	58	(4, 6)	$(\frac{9}{2}^-)$	13.42
4.20	685	1, 3	$\frac{5}{2}^+$ [c]	13.56
4.50	247	1, 3	$\frac{3}{2}^+$ [c]	13.76
5.00	75	2, 4	$\frac{5}{2}^-$ [d]	14.11
5.075	73	3, 5	$\frac{7}{2}^+$ [d]	14.161
(5.50)	400	(1, 3)	$(\frac{5}{2}^+)$	(14.46)
6.44	[e]		$\frac{3}{2}^-$; $T = \frac{3}{2}$	15.11

[a] (1973GO15): from analysis in the single-level approximation. This assumes the J^π ordering suggested by (1965LI09). See also (1981AJ01).

[b] Favored by the analysis but the assignment is not certain and more than one state may be involved.

[c] The ordering of these two J^π values is not clear.

[d] An equally good fit to the data is obtained with a $\frac{7}{2}^-$ state at 5.0 MeV and a $(\frac{3}{2}, \frac{5}{2}, \frac{7}{2})^+$ state at 5.08 MeV.

[e] Weak anomaly at $E_\alpha = 6443.5 \pm 2.0$ keV: see Table 13.6 for parameters of 15.11 MeV state, and reaction 2 (1978HI06).

7. ^{9}Be(^{12}C, ^{8}Be)^{13}C $\qquad Q_m = 3.2810$

Angular distributions have been measured at $E(^{12}\text{C}) = 12$ and 15 MeV and at $E(^{9}\text{Be}) = 20$ MeV [see (1981AJ01)] and at $E(^{12}\text{C}) = 10.5$, 12.0 and 13.5 MeV (1982TA21; ^{13}C$_{\text{g.s.}}$). In the earlier work the neutron spectroscopic factors for the first four states of ^{13}C are 1.15, 0.95, 0.20, 1.02. At $E(^{9}\text{Be}) = 50$ MeV several higher states are also populated. For yield measurements see (1981AJ01) and (1982HU06, 1982TA21). See also (1983DEZW; theor.).

8. ^{10}B(^{3}He, π^+)^{13}C $\qquad Q_m = -115.710$

At $E(^{3}\text{He}) = 260$ and 280 MeV ^{13}C$_{\text{g.s.}}$ and an unresolved group at $E_x \approx 3.6$ MeV are observed. The cross section for this reaction at $\theta_{lab} = 20°$ has been measured (1984WI06).

9. (a) ^{10}B(t, p)^{12}B $\qquad Q_m = 6.342 \qquad E_b = 23.8757$

(b) ^{10}B(t, d)^{11}B $\quad Q_m = 5.1969$

(c) ^{10}B(t, α)^{9}Be $\quad Q_m = 13.2281$

Yields have been measured for $E_t = 0.5$ to 2.0 MeV: there is no evidence of resonance behavior (1981AJ01). The yield of protons for $E_t = 3$ to 12 MeV shows a structure at $E_t = 5.4$ MeV ($\Gamma \approx 1$ MeV) which may be connected with a state at ≈ 28 MeV (1984GUZY). See also (1980BO1T; theor.).

10. ^{10}B(α, p)^{13}C $\quad Q_m = 4.0617$

Angular distributions of p_0 have been measured at many energies up to $E_\alpha = 30.4$ MeV [see (1970AJ04)] and at 31.2 MeV (1984KO1Q; also p_{1+2+3}), and for p_1 at $E_\alpha = 2.58$ to 3.06 MeV (1983CS03). For γ-decay measurements see Table 13.6 (1980WA24). See also ^{14}N.

11. ^{10}B(^{6}Li, ^{3}He)^{13}C $\quad Q_m = 8.0800$

Comparisons of the relative intensities of the ^{3}He groups in this reaction and of the triton groups in the mirror reaction (see reaction 7 in ^{13}N) at $E(^{6}\text{Li}) = 18$ MeV suggest that the following states are analogs: $6.86 - 6.36$, $7.49 - 7.16$, $9.50 - 9.00$, $9.90 - 9.48$, $(10.82 + 10.75) - (10.36 + 10.36)$ [the first (set of) E_x is in ^{13}C, the second in ^{13}N]: see (1981AJ01).

12. ^{10}B(^{7}Li, α)^{13}C $\quad Q_m = 21.4076$

Angular distributions have been measured at $E(^{7}\text{Li}) = 5.20$ MeV for the α_0, α_1, α_{2+3} and α_4 groups: see (1981AJ01).

13. ^{10}B(^{14}N, ^{11}C)^{13}C $\quad Q_m = 1.139$

At $E(^{10}\text{B}) = 100$ MeV angular distributions are reported for the transitions to ^{13}C*(0, 3.68, 7.5, 11.8): see (1981AJ01).

14. ^{11}B(d, γ)^{13}C $\quad Q_m = 18.6788$

Table 13.9: Resonant structure in $^{11}B + d$ [a]

Resonant structure in yield of (MeV ± keV)							$\Gamma_{c.m.}$ (keV)	E_x (MeV)
γ_0	n_0	n_1	n_2	n_3	$\gamma_{15.1}$	α [b]		
		1.2						19.7 [d]
	1.45						≈ 600	19.90
	1.6	1.8				1.85	≈ 200	20.24
2.0 ± 100 [c]								20.4
		2.2			2.180 ± 10		116 ± 10	20.52
					3.080 ± 15		159 ± 15	21.28
	3.6				3.71 ± 20		114 ± 21	21.81
4.0 ± 100 [c]	4.23	4.0	4.1		4.4		≈ 1000	22.1
		(5.2)						(23.1)
	9.6	9.6	9.6	9.6				26.8
	10.4		10.4	10.4				27.5

[a] For references see Table 13.10 in (1981AJ01).
[b] Yield of α_0, α_1, α_2, α_3.
[c] (1981KA16): part of the GDR.
[d] $J^\pi = \frac{5}{2}^-$ is suggested.

The 90° γ_0 excitation curve measured for $E_d = 1.0$ to 12.0 MeV shows resonant structure at $E_d = 2.0 \pm 0.1$ and 4.0 ± 0.1 MeV, $\Gamma \approx 0.6$ and ≈ 1 MeV, corresponding to states at $E_x = 20.4$ and 22.1 MeV: see Table 13.9. The results are consistent with the hypothesis of the isospin splitting of the giant dipole resonance in ^{13}C (1981KA16). See also (1981AJ01, 1984WO05).

15. (a) $^{11}B(d, n)^{12}C$ $\quad Q_m = 13.7325$ $\quad E_b = 18.6788$
(b) $^{11}B(d, 2n)^{11}C$ $\quad Q_m = -4.989$

The yield of neutrons and 15.1 MeV γ-rays has been measured in the range $E_d = 0.2$ to 11 MeV: see Table 13.9. For polarization measurements see (1981AJ01). The thick-target yield in reaction (b) has been measured for $E_d = 7.00$ to 16.01 MeV (1981AN16). See also (1981NO1G; applied.).

16. (a) $^{11}B(d, p)^{12}B$ $\quad Q_m = 1.145$ $\quad E_b = 18.6788$

(b) ^{11}B(d, d)^{11}B

The results from the measurements of the proton and γ-ray yields are not consistent: see reaction 19 and Table 13.10 in (1981AJ01). An activation analysis is reported by (1984GUZY) for $E_d = 3$ to 12 MeV. See also (1980HU1D, 1981HU1G). For reaction (b) see (1981AJ01).

17. ^{11}B(d, α)^{9}Be $\quad Q_m = 8.031 \quad E_b = 18.6788$

At low energies the excitation functions for α_0 and α_1 increase monotonically: see (1970AJ04). Then at $E_d = 1.85$ MeV a pronounced resonance is observed in the α_0, α_1, α_2 and α_3 yields: see Table 13.9. Some gross structure is also observed in these yields for $E_d = 1.0$ to 3.2 MeV: see (1981AJ01). See also ^{9}Be in (1984AJ01).

18. ^{11}B(^{3}He, p)^{13}C $\quad Q_m = 13.1853$

Levels derived from proton groups are displayed in Table 13.11 of (1981AJ01). [The only level parameters included in the values of Table 13.4 are $E_x = 7500 \pm 12$ keV and $\Gamma_{c.m.} < 5$, 70 ± 10 and 150 ± 30 keV for ^{13}C*(7.49, 7.69, 8.86).] The neutron decay of ^{13}C*(6.86, 9.90, 11.75) are to ^{12}C$_{g.s.}$ $(99 \pm 9)\%$ and $(100 \pm 20)\%$ for the first two states, and to ^{12}C*(0, 4.4) $(67 \pm 16)\%$ and $(33 \pm 8)\%$ for the third (1973AD02). The decay parameters for the first $T = \frac{3}{2}$ state, ^{13}C*(15.11), are shown in Table 13.6. The reduced asymmetries $B(^{13}\text{C})/B(^{13}\text{N}) - 1$ are -0.07 ± 0.13, $0.82^{+1.2}_{-0.6}$, $\geq 0.83 \pm 0.29$ and -0.04 ± 0.14 for the γ_0(M1), γ_0(E2), γ_1(E1) and γ_2(M1) transitions. Changes in the wave functions due to binding energy differences in ^{13}C and ^{13}N do not account for the observed asymmetry of the E1 decays of the first excited states in ^{13}C and ^{13}N (1977MA16): see Table 13.5. See, however, (1980BA54).

19. ^{11}B(α, d)^{13}C $\quad Q_m = -5.1679$

Angular distributions of the d_0 group have been measured at $E_\alpha = 15.1$ to 25.2 MeV [see (1981AJ01)], at 29.5 MeV (1983VA28) and at 31.2 MeV (1984KO1Q; also d_{1+2+3}). See also (1983BE1Q; theor.).

20. ^{11}B(^{6}Li, α)^{13}C $\quad Q_m = 17.2037$

Angular distributions have been reported at $E(^{6}\text{Li}) = 4.72$ MeV for α_0, α_1, α_{2+3}, α_4, α_{5+6+7}: see (1981AJ01).

21. ^{11}B(^{14}N, ^{12}C)^{13}C $\qquad Q_{\rm m} = 8.4064$

See ^{12}C in (1985AJ01) and (1984CL09; theor.).

22. ^{12}C(n, γ)^{13}C $\qquad Q_{\rm m} = 4.94634$

$$Q_0 = 4946.362 \pm 0.021 \text{ keV (1981VA1P, 1980WA24).}$$
$$Q_0 = 4946.336 \pm 0.014 \text{ keV [see (1983CO09)].}$$

The thermal capture cross section is 3.53 ± 0.07 mb (1982JU01). See also (1981PR04, 1982MU14). The capture is $(67.47 \pm 0.92)\%$, $(0.16 \pm 0.01)\%$ and $(32.36 \pm 0.44)\%$ via ^{13}C*(0, 3.09, 3.68) (1982MU14). (1982JU01) report $(68.6 \pm 0.9)\%$ and $(31.0 \pm 0.4)\%$ via ^{13}C*(0, 3.68). (1981VA1P; prelim.) find recoil-corrected $\mathrm{C} \rightarrow 0$, $\mathrm{C} \rightarrow 3.68$ and $3.68 \rightarrow 0$ energies of 4946.397 ± 0.031, 1261.854 ± 0.006 and 3684.516 ± 0.030 keV. Folding in the (1980WA24) value for $3.85 \rightarrow 0$ (see Table 13.11) leads to weighted mean adjusted energies for these three transitions of 4946.362 ± 0.021, 1261.855 ± 0.006 and 3684.507 ± 0.019 keV [E.K. Warburton, private communication]. Other recent E_γ measurements of ground-state transitions are 3089.3 ± 0.3 and 3684.6 ± 0.1 keV (1982MU14; see also for cascade γ-rays). The branching ratios for the decay of ^{13}C*(3.68) to ^{13}C*(0, 3.09) are $(99.3 \pm 2.0)\%$ and $(0.74 \pm 0.05)\%$, respectively (1982MU14).

(1984WO05) have determined the angular distributions and analyzing powers of γ_0 for $E_{\vec{\rm n}} = 12.0$ to 18.8 MeV. The data were used to analyze results from the ^{13}C(γ, n$_0$)^{12}C reaction. These can be understood in terms of two doorway states at $E_{\rm x} = 21.1 \pm 0.6$ and 20.52 ± 0.07 MeV with $\Gamma = 4.2 \pm 0.4$ and 0.51 ± 0.07 MeV, respectively (1984WO05). See also (1981AJ01) for the earlier work, (1981MUZQ, 1983SH2K) and (1983HO17, 1985HO1M; theor.).

23. (a) ^{12}C(n, n)^{12}C $\qquad E_{\rm b} = 4.94634$

(b) ^{12}C(n, n$'$)^{12}C

(c) ^{12}C(n, n$'$)^{4}He^{4}He^{4}He $\qquad Q_{\rm m} = -7.27476$

The coherent scattering length (thermal, bound) $a_{\rm coh} = 6.6535 \pm 0.0014$ fm; $\sigma_{\rm scatt} = 4.7456 \pm 0.0020$ b (1979KO26).

Total cross sections have been measured in the range 1 keV to 273 GeV/c [see (1981AJ01)] and at $E_{\rm n} = 24$ keV (1983AI01; isotopic C), 0.509, 1.024 and 2.003 MeV (1982PO05; to $\pm(0.2 - 0.4)\%$), 2.5 to 40 MeV (1979KEZU and R.B. Schwartz, private communication; isotopic C; to $\pm(1 - 3)\%$) and 200 to 600 MeV (1980FR1K; prelim.). Differential cross sections are reported to the 4.4 MeV γ-ray to $E_{\rm n} \approx 200$ MeV and for the 15.1 MeV γ-ray to $E_{\rm n} = 36$ MeV (1985WE1D; prelim.). Integrated cross sections for n$_1$ and n$_2$ are reported at $E_{\rm n} = 14.7$ MeV

(1981GU12). Total non-elastic cross sections have been measured at $E_{\rm n} = 40.3$ and 50.4 MeV (1981ZA03). See also (1983CI1E) and see (1981AJ01) for the earlier work. (1983DA22) report elastic differential cross sections for $E_{\rm n} = 9$ to 15 MeV for isotopic carbon and derive predictions for $\sigma_{\rm R}$ and $\sigma_{\rm T}$. Polarization measurements have been reported for $E_{\rm n} = 1.5$ to 15.9 MeV [see (1976AJ04, 1981AJ01)] and at $E_{\vec{\rm n}} = 8.9$ to 14.9 MeV (1983WO02; $\rm n_0$, $\rm n_1$) and 16.34 MeV (1984BE1X; $\rm n_0$), and at $E_{\rm n} = 15.85$ MeV (1980TH07; $\rm n_0$, $\rm n_1$) and 15.95 MeV (1981TO1E; $\rm n_0$). See also (1983ANZY).

Observed resonances are displayed in Table 13.10 here, and in Table 13.13 in (1981AJ01) [the latter for (n, $\rm n'\gamma_{4.4}$)]. In Table 13.10 the newer work comes from phase-shift analyses ($\sigma(\theta)$ and analyzing power) in the range $E_{\rm n} = 7.0$ to 12.0 MeV by (1983TO19, 1985TO02). A multilevel-multichannel R-matrix analysis is also reported by (1982KN02).

Table 13.10: Resonances in ^{12}C(n, n)^{12}C [a]

$E_{\rm res}$ (MeV ± keV)	$\Gamma_{\rm c.m.}$ (keV)	^{13}C* (MeV)	J^π	$\Gamma_{\rm n}/\Gamma$
2.079 ± 3	6	6.864	$\frac{5}{2}^+$	
2.819 ± 3	1.2 ± 0.3	7.546		
2.94 ± 10	124 ± 7	7.66	$\frac{3}{2}^+$	
3.472 ± 15	1000 ± 50	8.149	$\frac{3}{2}^+$	
4.259 ± 15	210 ± 15	8.874	$\frac{1}{2}^-$	1.00
4.93707 ± 0.07 [b]	1.9 ± 0.15 [b]	9.4997	$(\frac{9}{2}^+)$ [c]	1.00
5.368 ± 5	26 ± 3	9.897	$\frac{3}{2}^-$	0.70 ± 0.10
6.294 ± 5	53 ± 4	10.751	$\frac{7}{2}^-$ [c]	0.70 ± 0.10
6.5		10.9		
6.558 ± 8	37 ± 4	10.994	$(\frac{1}{2}^+)$	0.40 ± 0.10
6.7		11.1		
7.35 ± 50 [d]	129 ± 40	11.72	$\frac{3}{2}^-$	0.80 ± 0.08
7.62 ± 90 [d]	494 ± 80	11.97	$\frac{5}{2}^+$	0.51 ± 0.06
7.78 ± 80 [d]	538 ± 65	12.12	$\frac{3}{2}^+$	0.28 ± 0.05
7.79 ± 50 [d]	77 ± 30	12.13	$\frac{5}{2}^-$	0.43 ± 0.06
7.80 ± 70 [d]	426 ± 70	12.14	$\frac{1}{2}^+$	0.50 ± 0.07
7.94 ± 70 [d]	186 ± 50	12.27	$\frac{3}{2}^-$	0.73 ± 0.08
8.12 ± 50 [d]	114 ± 40	12.43	$\frac{7}{2}^-$	0.42 ± 0.06
9.35	619 ± 50	13.57	$\frac{7}{2}^-$	0.18 ± 0.03
9.96		14.13	$\frac{3}{2}^-$	
10.88	450	14.98	$\frac{7}{2}^-$	

Table 13.10: Resonances in ^{12}C(n, n)^{12}C [a] (continued)

E_{res} (MeV ± keV)	$\Gamma_{c.m.}$ (keV)	^{13}C* (MeV)	J^{π}	Γ_n/Γ
11.20		15.27	$\frac{9}{2}^+$	
11.40		15.46	$\frac{3}{2}^-$	
12.1	230	16.1	$(\frac{5}{2}^- + \frac{7}{2}^+)$	
15.8	≈ 460	19.5	$(\frac{1}{2}, \frac{3}{2})^-$	
19.6 ± 200	≈ 1000	23.0		

a For earlier references and additional information see Tables 13.10 in (1970AJ04), 13.16 in (1976AJ04) and 13.12 in (1981AJ01). See the discussion in (1985TO02). See also (1982KN02) for an R-matrix analysis to $E_n \approx 9$ MeV.

b Derived from a lorentzian probability plot (1980CI03).

c See (1982KN02).

d (1983TO19).

For reaction (c) see (1983AN02, 1984BR19) and (1984HA48). See also ^{12}C in (1985AJ01) and (1980SA34, 1980WE1F, 1982GOZZ, 1984MA2D), (1979CO1B, 1982DI1E, 1983AF01, 1983HA1U, 1985BA2R; applied), (1980LI1M, 1981IN1B, 1981MUZQ, 1981WA1G, 1982FU1F, 1982HA1A, 1983GO1H, 1983SH2K, 1985HO1J) and (1979OL04, 1979ZH1B, 1980DM1A, 1980RI05, 1981DM1A, 1981FL04, 1981SH1A, 1982AZ01, 1982PL1A, 1983HO17, 1983KO44, 1983OL04, 1985MA1U; theor.).

24. ^{12}C(n, 2n)^{11}C $Q_m = -18.721$ $E_b = 4.94634$

Excitation functions for $E_n = 22.8$ to 33.6 MeV are reported by (1981AN16). See also (1981AJ01), (1981WEZZ) and (1979CO1B; applied).

25. ^{12}C(n, p)^{12}B $Q_m = -12.587$ $E_b = 4.94634$

The cross section exhibits a weak resonance corresponding to $E_x \approx 20.5$ MeV and a stronger structure at $E_x \approx 21.5$ MeV: see (1976AJ04). Polarization measurements are reported at $E_n = 50$ MeV [see (1981AJ01)] and 18 MeV (1982DE16). For proton emission at $E_n \approx 545$ MeV see (1985FR07). See also ^{12}B in (1985AJ01), (1983SU07), (1983SH2K) and (1981OL1B; theor.).

26. (a) ^{12}C(n, d)^{11}B $\quad Q_m = -13.732 \quad E_b = 4.94634$

(b) ^{12}C(n, t)^{10}B $\quad Q_m = -18.9293$

(c) ^{12}C(n, ^{3}He)^{10}Be $\quad Q_m = -19.4670$

For deuteron and triton emission at $E_n \approx 545$ MeV see (1985FR07). See also (1983SU07) and (1981AJ01, 1983SH2K).

27. ^{12}C(n, α)^{9}Be $\quad Q_m = -5.7013 \quad E_b = 4.94634$

The cross section for the α_0 group shows a broad structure at $E_n \approx 8$ MeV: see (1981AJ01). For cross sections for α_0 and total α-emission at $E_n = 14.1$ MeV see (1984HA48). See also (1982KN02) in reaction 23, (1983SU07) and (1983SH2K).

28. ^{12}C(p, π^+)^{13}C $\quad Q_m = -135.4033$

At $E_p = 156.4$ to 200 MeV angular distributions are reported to ^{13}C*(0, 3.09, 3.68, 3.85, 6.86, 9.5). The energy dependence of the angular distributions and of the cross sections are different for the single-particle states [^{13}C*(0, 3.09, 3.85)] and the 2p2h states [^{13}C*(3.68, 6.86, 9.5)] (1981SO04). At $E_p = 200$ to 250 MeV the analyzing-power angular distributions for ^{13}C*(0, $3.09 + 3.68 + 3.85$, $6.86 + 7.50$, $9.50 + 9.90$) are found to be energy dependent (1982LO03). Angular distributions have also been measured at $E_{\vec{p}} = 147$ to 159 MeV (1981SJ02) and $E_p = 185$ MeV [see (1981AJ01)], 200 MeV (1980HO20; to ^{13}C*(0, 3.09, 3.68, 3.85)) and 200 to 250 MeV (1982LO03, 1984LO13; to ^{13}C*(0, $3.09 + 3.68 + 3.85$) and A_y). Polarization measurements have also been reported at $E_{\vec{p}} = 147$ to 159 MeV (1981SJ02; ^{13}C*(0, 3.09, 3.68+3.85) and 170, 183 and 190 MeV (1982GRZY). See (1981AJ01) for the earlier work. See also (1980SO05, 1981NAZY, 1982GR1M), (1983VI01) and the "General" section here.

29. (a) ^{12}C(d, p)^{13}C $\quad Q_m = 2.7218$

(b) ^{12}C(d, np)^{12}C $\quad Q_m = -2.2246$

Measurements of proton groups and γ-rays are summarized in Table 13.11. Angular distributions have been studied at many energies to $E_d = 80.2$ MeV [see (1981AJ01)] and more recently in the range $E_d = 0.56$ to 2.5 MeV (1980HA1X; $p_{0\to3}$), 17.7 MeV (1984PE24; to ^{13}C*(9.50)) and at $E_d = 16$ MeV to ^{13}C*(3.09) [$J^\pi = \frac{1}{2}^+$] and to (^{12}C+ n) with zero relative energy (1983WI1D) [the two angular distributions are very similar] as well as at $E_d = 56$ MeV (1984HA26; $p_0 \to p_3$). See also (1982SA29) and ^{14}N.

Table 13.11: Levels of ^{13}C from ^{12}C(d, p)^{13}C [a]

^{13}C (MeV ± keV)	$\Gamma_{\text{c.m.}}$ (keV)	l_n	J^π	S [b]
0		1	$\frac{1}{2}^-$	0.58 ± 0.04
3.089443 ± 0.020 [c]		0	$\frac{1}{2}^+$	0.36 ± 0.02
3.684482 ± 0.023 [c]		1	$\frac{3}{2}^-$	0.10
3.853783 ± 0.022 [c]		2	$\frac{5}{2}^+$	1.1
6.86		2	$\frac{5}{2}^+$	0.04
7.470 ± 20				
7.533 ± 20				
7.641 ± 20	70 ± 15			
8.4 ± 300	1100 ± 300	2	$\frac{3}{2}^+$	1.0
8.86		1	$\frac{1}{2}^-$	0.5
9.500 ± 20		(1)	$(\frac{3}{2}^-)$ [f]	
9.897 ± 20		1	$\frac{3}{2}^-$	0.1
10.755 ± 5	56 ± 2			
10.818 ± 5	24 ± 3			
10.997 ± 8	82 ± 15			
11.080 ± 5	8			
11.748 ± 10	107 ± 14			
11.851 ± 5	68 ± 4			
11.97 ± 40 [d]	≈ 260			
12.108 ± 5	81 ± 8			
22.3 ± 200 [d,e]	200 ± 50	(1)	$(\frac{3}{2}^-)$	
23.1 ± 200 [d,e]	500 ± 100			
23.8 ± 200 [d,e]	120 ± 40			

[a] For references and additional information see Table 13.14 in (1981AJ01).

[b] Preliminary values at E_d = 17.7 MeV are 0.50, 0.21, 0.50, 0.16, 0.54 for ^{13}C*(0, 3.68, 8.9, 9.9, 11.1) (1984PEZW).

[c] (1980WA24): E_γ for the 3.85 → 3.68 transition is 169.300 ± 0.004 keV. Using $E_x = 3684.507 \pm 0.019$ keV [see reaction 22] and this value for E_γ, E_x for the higher state is 3853.807 ± 0.019 keV, which we adopt. I am indebted to Dr. E.K. Warburton for his comments. See also Table 13.5 and the "General" section here.

[d] May correspond to unresolved states.

[e] (1983SA1M; preliminary): $E_d = 56$ and 60 MeV.

[f] Known to be $\frac{9}{2}^+$.

(1981RU04) determine $|g| = 0.558 \pm 0.015$ and $\tau_m = 12.2 \pm 0.4$ psec for ^{13}C*(3.85). For other τ_m measurements see Table 13.5 in (1981AJ01), and for γ-decay see Table 13.6. For reaction (b) see (1981AJ01). For a fragmentation study at 9.1 GeV/c see (1985AB1J). See also ^{14}N, (1983JI04, 1981OZ1A), (1981OS1H) and (1980BA54, 1982GO05, 1982TA19, 1982TH02, 1982TH06; theor.).

30. ^{12}C(t, d)^{13}C $\qquad Q_m = -1.3109$

See (1981AJ01).

31. ^{12}C(^{3}He, 2p)^{13}C $\qquad Q_m = -2.7718$

See (1981AJ01).

32. ^{12}C(α, ^{3}He)^{13}C $\qquad Q_m = -15.6314$

Angular distributions of the ^{3}He particles to the first three states of ^{13}C have been measured in the range $E_\alpha = 56$ to 139 MeV. The ground-state distributions in this, and in the mirror reaction ^{12}C(α, t)^{13}N, have also been compared: see (1981AJ01).

33. ^{12}C(^{7}Li, ^{6}Li)^{13}C $\qquad Q_m = -2.304$

Angular distributions at $E(^7\text{Li}) = 48$ MeV to ^{13}C*(0, 3.09, 3.68, 3.85) have been analyzed and yield spectroscopic factors of 0.80, 0.44, 0.17 and 0.74, respectively: see (1981AJ01). An angular distribution and TAP measurements are reported at $E(\overrightarrow{^7\text{Li}}) = 21.1$ MeV (1984MO06). See also (1980BA54; theor.).

34. ^{12}C(^{9}Be, ^{8}Be)^{13}C $\qquad Q_m = 3.2810$

Excitation curves involving ^{13}C*(0, 3.09, 3.68 + 3.85) have been studied by (1983JA09). See also (1980HU1E) and (1983KA17; theor.).

35. ^{12}C(^{12}C, ^{11}C)^{13}C $\qquad Q_m = -13.775$

Angular distributions have been reported at $E(^{12}\mathrm{C}) = 93.8$ MeV [to ^{13}C*(0, 3.85)] [see (1981AJ01)] and at 72.5 MeV to $^{13}\mathrm{C}_{\mathrm{g.s.}}$ (1981CH1R).

36. (a) ^{12}C(^{14}N, ^{13}N)^{13}C $\quad Q_{\mathrm{m}} = -5.6071$
(b) ^{12}C(^{14}N, p^{12}C)^{13}C $\quad Q_{\mathrm{m}} = -7.5506$

Angular distributions have been reported in the range $E(^{14}\mathrm{N}) = 28$ to 154.8 MeV involving ^{13}C*(0, 3.09, 3.85, 7.3 ± 0.3): see (1981AJ01). For a study of fragmentation at $E(^{14}\mathrm{N}) = 48$ MeV, see (1983QU02). See also (1980BA54, 1980IZ1B, 1980TA1K, 1983OS08; theor.).

37. ^{12}C(^{16}O, ^{15}O)^{13}C $\quad Q_{\mathrm{m}} = -10.7176$

See (1981AJ01).

38. (a) ^{12}C(^{17}O, ^{16}O)^{13}C $\quad Q_{\mathrm{m}} = 0.8027$
(b) ^{12}C(^{18}O, ^{17}O)^{13}C $\quad Q_{\mathrm{m}} = -3.098$

See (1981AJ01).

39. ^{13}B(β^-)^{13}C $\quad Q_{\mathrm{m}} = 13.436$

See ^{13}B and Table 13.2.

40. (a) ^{13}C(γ, n)^{12}C $\quad Q_{\mathrm{m}} = -4.94634$
(b) ^{13}C(γ, 2n)^{11}C $\quad Q_{\mathrm{m}} = -23.668$

The main features of the cross section is a sharp peak corresponding to the $T = \frac{3}{2}$ state ^{13}C*(15.11)[$\Gamma_{\gamma_0} = 19.7 \pm 2.0$ eV], the broad pigmy resonance at $E_{\mathrm{x}} = 13$ MeV [on which peaks are superimposed at $E_{\mathrm{x}} = 11.0$, 13.8, 16.5 and 17.8 MeV] and the giant resonance at $E_{\mathrm{x}} = 24$ MeV ($\sigma_{\mathrm{max}} = 9.5$ mb) [surrounded by shoulder resonances at $E_{\mathrm{x}} = 20.8$ and ≈ 30 MeV, both of which appear to decay substantially to highly excited states of ^{12}C]. There is also some evidence for a weak resonance at ≈ 37 MeV superimposed on the high-energy tail of the GDR. A study of the angular distributions of n_0 suggests states at $E_{\mathrm{x}} = 7.70$ ($\frac{3}{2}^+$), 7.95 ($\frac{3}{2}^+$), 8.95(($\frac{1}{2}^-$)), 10.0 (($\frac{3}{2}^-$)), 11.0 (($\frac{1}{2}^+$)) and 12.05 MeV (($\frac{3}{2}^+$)). See (1981AJ01) for references and for additional information. See also (1982JU03) and (1980JO1E, 1982KI1H; theor.).

41. ^{13}C(γ, p)^{12}B $\qquad\qquad$ $Q_m = -17.534$

The integrated cross section for $E_\gamma = 17.5$ (threshold) to 28 MeV is 36 ± 5 MeV · mb. Resonances are observed at $E_x = 18.6$, (19.7), 20.7, (22), 23.5, 24.5 and (26) MeV. [σ_{max} at $E_x \approx 23$ MeV is 8 mb]. Below ≈ 18 MeV the cross section is dominated by transitions involving $T_<$ states. The states at 18.6 and 20.7 MeV have a significant $T_>$ component. The two isospin components of the GDR appear to be split by 6.8 MeV (1983ZU02). For the earlier work see (1981AJ01).

42. ^{13}C(γ, γ)^{13}C

See (1981AJ01).

43. (a) ^{13}C(e, e$'$)^{13}C
(b) ^{13}C(e, ep)^{12}B $\qquad\qquad$ $Q_m = -17.534$

The elastic scattering has been studied for $E_e = 120$ to 750 MeV [see (1981AJ01)] and 80 to 338 MeV (1982HI07). The form factor for M1 elastic scattering is enhanced above $q \approx 2$ fm^{-1} (1982HI07). See also (1983SI11) and (1985SI05; theor.). A number of inelastic groups are seen: see Table 13.12. [The data (1980SO1B) shown in Table 13.16 of (1981AJ01) have not been published.] A distinct splitting of the giant resonance into two large peaks near $E_x = 20.5$ and 24.5 MeV, with widths of ≈ 3 and ≈ 4 MeV, respectively, is observed. It is suggested that these are groupings of narrower peaks. The $E_x = 20.5$ and 24.5 MeV resonances are probably $T = \frac{1}{2}$ and $T = \frac{3}{2}$, although the 4 MeV splitting is somewhat smaller than expected: see (1981AJ01). For reaction (b) see (1981AJ01). See also (1981SI1B, 1982DE1K, 1984DO20, 1984LI25, 1985HI04) and (1981DE07, 1981DE1U, 1981IS11, 1981LI13, 1981SU03, 1981SU08, 1982CH16, 1982LIZW, 1983CH15, 1983CH1N, 1983GM1A, 1984SA1H; theor.).

44. (a) ^{13}C(π^-, π^-)^{13}C
(b) ^{13}C(π^+, π^+)^{13}C

Angular distributions have been measured at $E_\pi = 20$ to 180 MeV: see (1981AJ01) and Table 13.13. At $E_{\pi^\pm} = 162$ MeV angular distributions have been measured to many states (or groups of states) of ^{13}C with E_x up to 22 MeV [see Table 13.13]. Enhanced in π^- scattering are ^{13}C*(0, 3.09, 3.85, 9.50, 21.60 ± 0.05), the latter very strongly but with a large uncertainty. Enhanced in π^+ scattering are ^{13}C*(3.68, 7.55, 8.86, 11.82, 16.05 ± 0.05, 17.92 ± 0.05, 21.37 ± 0.05). The data for ^{13}C*(9.50, 21.60, 16.05, 21.37) indicate pure neutron particle-hole excitations for the first two states and pure proton excitation for the latter two, however with large uncertainties except

Table 13.12: Electromagnetic transitions [a] in ^{13}C from ^{13}C(e, e$'$)^{13}C

E_x (MeV ± keV)	J^π	Mult.	$\Gamma_{\gamma 0}$ (eV)	$\Gamma_{\gamma 0}/\Gamma_W$ (W.u.)
3.08 ± 30 [b]	$\frac{1}{2}^+$	C1	0.68 ± 0.23	0.062
3.69 ± 20	$\frac{3}{2}^-$	C2	$(3.61 \pm 0.40) \times 10^{-3}$	3.52
		M1	0.358 ± 0.047	0.339
6.85 ± 60	$\frac{5}{2}^+$	M2	$(6.9 \pm 3.6) \times 10^{-5}$	0.055
7.54 ± 20	$\frac{5}{2}^-$	M3	(1.01×10^{-5})	(35)
		C2	0.115 ± 0.007 [d]	3.15
8.86 ± 20 [c]	$\frac{1}{2}^-$	M1	3.36 ± 0.47 [e]	0.230
		E0	2.09 [f]	
9.50 [b]	$\frac{9}{2}^+$			
9.90 ± 30	$\frac{3}{2}^-$	C2	$(6.3 \pm 1.1) \times 10^{-3}$	0.045
		M1	0.324 ± 0.038	0.0159
11.07 ± 20	$\frac{1}{2}^-$	M1	1.02 ± 0.12	0.0359
		E0	2.62 [f]	
	$\frac{3}{2}^-$	C2	0.256 ± 0.047	1.03
		M1	0.172 ± 0.020	0.006
15.11 ± 20	$\frac{3}{2}^-$	C2	0.6 ± 0.1	0.50
		M1	22.4 ± 1.5	0.31
16.1 [b]				

[a] For references see Table 13.15 in (1981AJ01). See also (1984MO1D) and Tables 13.4 and 13.5.

[b] See (1984HIZX, 1985HI04).

[c] $\Gamma = 190 \pm 35$ keV.

[d] 0.11 ± 0.015 eV (1980HO11; ^{13}C(γ, n)).

[e] 5.4 ± 0.5 eV (1980HO11); $\Gamma_{\gamma 0}$ for ^{13}C*(7.69, 8.2) are reported to be 0.6 ± 0.1 and 7.0 ± 0.9 eV, respectively (1980HO11).

[f] Monopole matrix element in fm^2.

Table 13.13: Summary of recent ^{13}C(π, π) angular distributions

E_{π^+} (MeV)	E_{π^-} (MeV)	Angular distributions to ^{13}C	Refs.
	20, 30, 40, 50	g.s.	(1981KA1N)
48.6		g.s.	(1978DY01)
65, 80	65, 80	g.s.	(1983BL11)
100	100	g.s., 3.7, 7.6, 9.5	(1982ANZW)
162	162	g.s., 3.09, 3.68, 3.85, 7.55, 8.86, 9.5, 11.82, 16.05, 17.92, 21.37, 21.60	(1982SE04, 1983SE15)
180	180	g.s., 3.68, 7.55, 9.5, 11.7, 15.0, 17.5	(1979SC25)

for ^{13}C*(9.5). Spin assignments are $\frac{9}{2}^+$ for ^{13}C*(9.50); $\frac{7}{2}^+$ or $\frac{9}{2}^+$ for ^{13}C*(16.05, 17.92, 21.37, 21.60); $\frac{5}{2}^+$ and/or $\frac{7}{2}^+$ for ^{13}C*(11.82) [unresolved doublet?]. The π^-/π^+ asymmetry near 21.5 MeV suggests that there is isospin mixing between $T = \frac{1}{2}$ and $\frac{3}{2}$ states of $J^\pi = \frac{7}{2}^+$ and/or $\frac{9}{2}^+$ (1982SE04, 1983SE15). See also (1981AJ01), (1981SE08), (1984LI1T; theor.) and the "General" section here.

45. ^{13}C(n, n)^{13}C

Angular distributions have been measured at $E_{\rm n} = 4.5$ to 11 MeV (1982REZX; n_0, n_1), 5.7 to 8.25 MeV (1982REZY; n_2, n_3), 9.97, 11.96, 13.94, 15.94 and 17.92 MeV (1982DA05, 1983DA22; n_0; and n_1, n_{2+3} at 9.97 MeV). See also (1981AJ01), ^{14}C and (1984PEZV, 1985DI1B; theor.).

46. (a) ^{13}C(p, p)^{13}C

(b) ^{13}C(p, pn)^{12}C $\qquad Q_{\rm m} = -4.94634$

Angular distributions have been studied at $E_{\rm p} = 1.37$ MeV to 1 GeV [see (1981AJ01)] and at $E_{\rm p} = 135$ MeV (1982CO08; to ^{13}C*(0, 3.09, 3.68, 3.85, 7.55, 8.86, 9.50, 9.90, 10.75, 11.08 [$J^\pi = \frac{1}{2}^-$], 15.11; DWBA) [see also (1982RI05)], $E_{\vec{\rm p}} = 200$ MeV (1981ME02; elastic; also $A_{\rm y}$) and 547 MeV (1984SE12; ^{13}C*(0, 3.09, 3.68, 3.85, 6.86, 7.55, 8.86, 9.50; also $A_{\rm y}$). At $E_{\rm p} = 135$ MeV ^{13}C*(6.86 [weak], 11.85, 14.39, 16.15, 21.4) are also populated (1982CO08). See also (1982PEZY). For reaction (b) see (1981AJ01). For breakup see (1983GL1D). See also ^{14}N, (1983PE14, 1983SC1G) adn (1982BA14, 1984PEZV; theor.).

47. ^{13}C(d, d)^{13}C

Angular distributions have been measured at $E_d = 0.71$ to 13.6 MeV [see (1981AJ01)], at $E_d = 17.7$ MeV (1984PE24; d_0) and at $E_d = 56$ MeV (1984HA26; d_0). See also ^{15}N.

48. ^{13}C(^{3}He, ^{3}He)^{13}C

Angular distributions of elastically scattered ^{3}He ions have been studied at $E(^3\text{He}) = 12$ to 41 MeV: see (1981AJ01). Angular distributions have also been reported at $E(^3\text{He}) = 43.6$ MeV for the ^{3}He ions to ^{13}C*(3.09, 3.68, 3.85, 6.86, $7.49 + 7.55$, 7.69, 8.86, 9.50, 9.90, $10.75 + 10.82$, 11.08, 11.85, 15.11, 16.0) [and these have been compared to the analog states reached in the ^{13}C(^{3}He, t)^{13}N reaction] (1981PE08). See (1981AJ01) for the earlier work and (1983PE14).

49. ^{13}C(α, α)^{13}C

Angular distributions have been studied at $E_\alpha = 15$ to 40.5 MeV [see (1981AJ01)] and at $E_\alpha = 35.5$ MeV (1981PE08; to ^{13}C*(3.09, 3.68, 3.85, 6.86, $7.49 + 7.55$, 7.69, 8.86, 9.50, 11.08, 11.85)). For ^{13}C*(7.69), $E_x = 7686 \pm 6$ keV, $\Gamma_{\text{c.m.}} = 70 \pm 5$ keV (1980FU04; also line shapes). $\Gamma_\gamma/\Gamma \leq 3 \times 10^{-4}$ and $(3.0 \pm 0.6) \times 10^{-4}$ for ^{13}C*(6.86, $7.49 + 7.55$), respectively (1984DEZR). See also (1981AJ01) for the earlier work and (1982BU1D, 1983GO27; theor.).

50. (a) ^{13}C(^{6}Li, ^{6}Li)^{13}C
(b) ^{13}C(^{7}Li, ^{7}Li)^{13}C

Angular distributions of elastically scattered Li ions have been studied at $E(\text{Li}) = 4.5$ to 34 MeV and $E(^6\text{Li}) = 28$ MeV (1980CU03), 40 MeV [see (1981AJ01)] as well as at $E(^7\text{Li}) = 34$ MeV (1983STZS). For fusion and breakup cross sections see (1982DE30, 1982TA23). See also (1983BI13, 1984CA39, 1984HA53) and (1981ME1F, 1984AG1B; theor.).

51. ^{13}C(^{9}Be, ^{9}Be)^{13}C

The elastic scattering has been studied at $E(^{13}\text{C}) = 28.1$ and 36.2 MeV: see (1981AJ01). For total reaction cross sections see (1984DA17). See also (1981GR17; theor.).

52. (a) ^{13}C(^{10}B, ^{10}B)^{13}C
(b) ^{13}C(^{11}B, ^{11}B)^{13}C

Elastic angular distributions have been measured at $E(^{10}B) = 18$, 25, 32, 39 and 46 MeV (1982MA20) and at 42.5, 62.3 and 80.9 MeV (1985MA10). For fusion and breakup cross sections see (1981MA18, 1982MA20, 1983DA20, 1983MA53, 1984DEZX, 1984FR1A, 1984HAZK, 1985MA10). See also (1983BI13, 1983DU13, 1984HA53) and (1984HA43; theor.).

53. (a) $^{13}C(^{12}C, ^{12}C)^{13}C$
(b) $^{13}C(^{13}C, ^{13}C)^{13}C$
(c) $^{13}C(^{14}C, ^{14}C)^{13}C$

Angular distributions for reaction (a) have been reported for $E(^{12}C) = 10$ to 87 MeV and $E(^{13}C) = 12$ and 36 MeV [see (1981AJ01)] and at $E(^{13}C) = 21.7$, 24.6, 27.4 MeV (1984FR05; $^{13}C^*$(0, 3.09, 3.85)) and 260 MeV (1985BO2F; $^{12}C^*$(0, 4.4)). Elastic distributions for reactions (b) and (c) have been studied at $E(^{13}C) = 15$ to 24 MeV and at 15 MeV, respectively. See (1981AJ01) for references. At $E(^{13}C) = 32$ MeV the single and mutual inelastic excitation of $^{13}C^*(3.09)$ has been studied by (1984BA31): the mutual excitation is very much smaller than predicted using a molecular particle-core coupling model. For excitation functions, fusion and evaporation cross sections see (1981HE08, 1982CH05, 1982DA16, 1983FR04, 1983KO15, 1984BA31, 1984FR1A). For a spin-flip probability study see (1981TA21). See also ^{12}C in (1985AJ01), (1981PL1C, 1983HAZI), (1981ST1P, 1983BI13, 1983DU13, 1983GR1M, 1983VO1J, 1984FR1A, 1984HA53) and (1980BA54, 1982LO13, 1982OH05, 1982VO1F, 1983BA49, 1983CI08, 1983DE1U, 1983FR23, 1983HU1C, 1983LA1E, 1983RO16, 1984HA43, 1984IN03, 1984MAZT, 1984SA31, 1984VO11, 1985VO01; theor.).

54. (a) $^{13}C(^{14}N, ^{14}N)^{13}C$
(b) $^{13}C(^{15}N, ^{15}N)^{13}C$

Elastic angular distributions (reaction (a)) have been measured at $E(^{14}N) = 19.3$ MeV [see (1981AJ01)] and 28 and 35 MeV (1983SR01) and at $E(^{13}C) = 105$ MeV (1980PR09). For excitation curves and fusion cross sections see (1982DI13, 1983SR01). See also (1981AJ01), (1983BI13, 1983DU13, 1984FR1A, 1984HA53) and (1983GO13; theor.).

55. (a) $^{13}C(^{16}O, ^{16}O)^{13}C$
(b) $^{13}C(^{17}O, ^{17}O)^{13}C$
(c) $^{13}C(^{18}O, ^{18}O)^{13}C$

Elastic angular distributions have been measured for reaction (a) at $E(^{16}O) = 10$ to 30 MeV and at $E(^{13}C) = 36$ and 105 MeV: see (1981AJ01). Those for reaction (b) are reported at

$E(^{17}O) = 29.8$ and 32.3 MeV [see (1981AJ01)] and at 85.4, 120 and 140 MeV (1982HE07); and those for reaction (c) at $E(^{18}O) = 15$, 20, 24 and 31 MeV [see (1981AJ01)]. For breakup yield and fusion measurements see (1980RA12, 1982HE07, 1983DA02, 1983FR17, 1984RA10) and (1981AJ01). See also (1982LE1N, 1983BI13, 1983DU13, 1984FR1A, 1984HA53, 1985GA1M) and (1983AB08, 1983CI08, 1983PA1G, 1984AB1A, 1984HA43, 1984IN03, 1985PAZY; theor.).

56. ^{13}C(^{22}Ne, ^{22}Ne)^{13}C

See (1983DU13).

57. ^{13}C(^{24}Mg, ^{24}Mg)^{13}C

See (1980LI13, 1983CH01, 1984LI14; theor.).

58. ^{13}C(^{28}Si, ^{28}Si)^{13}C

Backward elastic angular distributions are reported at $E(^{28}Si) = 77.6$ to 94.6 MeV: see (1981AJ01). For an excitation function study see (1982CH02).

59. (a) ^{13}C(^{32}S, ^{32}S)^{13}C
(b) ^{13}C(^{36}S, ^{36}S)^{13}C

For an excitation function study (reaction (a)) see (1982CH02). For reaction (b) see (1983DU13).

60. ^{13}C(^{40}Ar, ^{40}Ar)^{13}C

See (1983DU13, 1986MO15).

61. (a) ^{13}C(^{40}Ca, ^{40}Ca)^{13}C
(b) ^{13}C(^{48}Ca, ^{48}Ca)^{13}C

See (1981AJ01, 1982HO1E) and (1980JA1C, 1980MA34, 1981KU09, 1981KU03, 1981LA04, 1984HU1Q; theor.).

62. ^{13}N(β^+)^{13}C $\quad Q_m = 2.2205$

See ^{13}N.

63. ^{14}C(γ, n)^{13}C $\quad Q_m = -8.1765$

See (1985KU01) and ^{14}C.

64. ^{14}C(p, d)^{13}C $\quad Q_m = -5.9519$

Angular distributions have been measured at $E_p = 12$ to 27 MeV: see (1981AJ01).

65. ^{14}C(d, t)^{13}C $\quad Q_m = -1.9192$

Angular distributions for $t_0 \rightarrow t_3$ have been studied at $E_d = 12$ and 14 MeV: see (1981AJ01).

66. ^{14}C(^{3}He, α)^{13}C $\quad Q_m = 12.4013$

Angular distributions have been measured at $E(^3\text{He}) = 3$ to 44.8 MeV: see (1981AJ01).

67. (a) ^{14}C(^{12}C, ^{13}C)^{13}C $\quad Q_m = -3.2301$
(b) ^{14}C(^{14}C, ^{15}C)^{13}C $\quad Q_m = -6.9584$
(c) ^{14}C(^{16}O, ^{17}O)^{13}C $\quad Q_m = -4.0329$

Angular distributions have been measured at $E(^{16}\text{O}) = 20$, 25 and 30 MeV: see (1981AJ01). For reactions (a) and (b) see (1985KO04).

68. (a) ^{14}N(γ, p)^{13}C $\quad Q_m = -7.5506$
(b) ^{14}N(γ, np)^{12}C $\quad Q_m = -12.4970$

Angular distributions measured in the giant resonance region of ^{14}N are consistent with the proton decay of $(p_{1/2})^{-1}$(2s1d) giant dipole states to $^{13}C_{g.s.}$ and of $(p_{3/2})^{-1}$(2s1d) states to ^{13}C*(3.68). The population of ^{13}C*(3.09, 3.85) [and of ^{13}C*(7.55) (1983VA1K)] is also reported. For E_{bs} = 15.5 to 29.5 MeV a large fraction of the neutron yield appears to be associated with sequential decay to ^{12}C via ^{13}C*(7.75, 8.86, 11.80): see (1981AJ01). See also ^{14}N.

69. ^{14}N(n, d)^{13}C $\qquad Q_m = -5.3260$

Angular distributions have been determined at $E_n = 10.1$ to 14.7 MeV: see (1981AJ01).

70. ^{14}N(p, 2p)^{13}C $\qquad Q_m = -7.5506$

At $E_p = 46$ MeV, the summed proton spectrum shows transitions to ^{13}C*(0, 3.68, 7.5, 11.9); see (1981AJ01).

71. ^{14}N(d, ^{3}He)^{13}C $\qquad Q_m = -2.0571$

At $E_d = 52$ MeV, angular distributions have been measured for the ^{3}He particles to ^{13}C*(0, 3.09, 3.68, 6.86, 7.5, 8.86, 9.50, 11.9 ± 0.15) and analyzed by DWBA: $J^\pi = \frac{5}{2}^-, \frac{1}{2}^-, \frac{3}{2}^-$ and $\frac{3}{2}^-$, respectively, are assigned to ^{13}C*(7.5, 8.86, 9.50, 11.9). [However ^{13}C*(9.50) is known to have $J^\pi = \frac{9}{2}^+$.] As expected, angular distributions of ^{3}He and of tritons (from ^{14}N(d, t)^{13}N) to analog states are closely the same: this has been shown for the ground state ^{3}He and triton groups as well as groups to ^{13}C*($8.9 + 9.5$) and ^{13}N*(9.2): see (1981AJ01). Analyzing powers are reported at $E_d = 52$ MeV to ^{13}C*(0, 7.55) (1981MA14).

72. ^{14}N(t, α)^{13}C $\qquad Q_m = 12.2634$

Observed α groups at $E_t = 2.6$ MeV are displayed in Table 13.22 of (1976AJ04).

73. (a) ^{14}N(^{6}Li, ^{7}Be)^{13}C $\qquad Q_m = -1.945$
(b) ^{14}N(^{6}Li, ^{3}He α)^{13}C $\qquad Q_m = -3.5322$

An angular distribution has been obtained at $E(^{6}\text{Li}) = 32$ MeV for the transition to $^{13}C_{g.s.}$ and ^{7}Be*(0, 0.43) [for the mirror reaction see reaction 33 in ^{13}N]: the relative cross sections show a deviation from isospin symmetry which is attributed to Coulomb effects. ^{13}C*(3.09) was also populated: see (1981AJ01). For reaction (b) see (1984ET01).

74. ^{15}N(p, ^{3}He)^{13}C $Q_m = -10.6658$

At $E_p = 43.7$ MeV ^{3}He groups have been observed to eleven states of ^{13}C: see Table 13.17 in (1981AJ01). See also (1976AJ04).

75. ^{15}N(d, α)^{13}C $Q_m = 7.6874$

See (1970AJ04, 1976AJ04).

76. ^{15}N(α, ^{6}Li)^{13}C $Q_m = -14.6842$

At $E_\alpha = 42$ MeV, the angular distribution of the ^{6}Li particles to ^{13}C$_{g.s.}$ has been measured: see (1981AJ01).

77. ^{16}O(n, α)^{13}C $Q_m = -2.2156$

Angular distributions have been measured for E_n to 18.8 MeV for α_0, α_1, α_{2+3}: see (1981AJ01).

78. ^{16}O(p, p^{3}He)^{13}C $Q_m = -22.7934$

See (1977GR04).

79. ^{16}O(α, ^{7}Be)^{13}C $Q_m = -21.2058$

At $E_\alpha = 42$ MeV the angular distributions of the reaction involving ^{13}C$_{g.s.}$ and ^{7}Be*$(0 + 0.43)$ has been measured: see (1981AJ01).

80. ^{16}O(^{14}N, ^{17}F)^{13}C $Q_m = -6.9502$

See ^{17}F in (1982AJ01).

81. ^{16}O(^{17}O, ^{20}Ne)^{13}C $Q_m = -1.625$

See ^{20}Ne in (1983AJ01).

82. ^{18}O(d, ^{7}Li)^{13}C $\qquad Q_{\rm m} = -5.678$

Angular distributions at $E_{\rm d} = 13.6$ MeV involving $^{13}{\rm C}_{\rm g.s.}$ and ^{7}Li*(0, 0.48) are reported by (1980GA1K). See also (1984NE1A).

83. ^{19}F(d, ^{8}Be)^{13}C $\qquad Q_{\rm m} = 3.5817$

An angular distribution involving $^{13}{\rm C}_{\rm g.s.}$ is reported at $E_{\rm d} = 13.6$ MeV (1980GA26). See also (1984NE1A).

84. ^{23}Na(d, ^{12}C)^{13}C $\qquad Q_{\rm m} = 0.4794$

At $E_{\rm d} = 13.6$ MeV an angular distribution has been reported by (1984GO1H).

^{13}N
(Figs. 3 and 4)

GENERAL: (See also (1981AJ01)).

Nuclear models: (1983SH38).

Special states: (1981KO1Q, 1983AU1B, 1983WI15, 1984RO05).

Electromagnetic transitions: (1980BA54, 1980RI06, 1981KO1Q, 1983AD1B, 1984MA67).

Astrophysical questions: (1980BA1P, 1983LI01, 1985GI1C).

Applied work: (1982BO1N, 1982HA1V, 1982HI1H, 1982MA1T, 1982PI1H, 1982YA1C, 1983HA1W, 1983KO1Q, 1984HI1D, 1984MO1Q, 1984MO1R, 1984NI1C).

Complex reactions involving ^{13}N: (1982LY1A, 1983FR1A, 1983OL1A, 1983WI1A, 1984HI1A).

Muon and neutrino reactions: (1985MI1P).

Pion and kaon capture and reactions (See also reactions 23, 24 and 25): (1980CR03, 1980EI01, 1981HI06, 1981LI02, 1981OS04, 1981PO10, 1982BE1D, 1982IN1A, 1982LI1K, 1983JEZZ, 1983KA19, 1983TR1J, 1984AL1L, 1984GI1E, 1984MI1K, 1984SA1H, 1984SI13, 1984TI02).

Hypernuclei: (1981KO1V, 1981WA1J, 1982KA1D, 1983SH38, 1984AS1D).

Other topics: (1980BA54, 1982NG01).

Ground state of ^{13}N: (1980BA54, 1982NG01, 1983AD1B, 1983ANZQ, 1983AU1B, 1983BU07, 1984KA25, 1985HA18, 1985FA01).

$$\mu = -0.32224 \pm 0.00035 \text{ nm (1978LEZA)}.$$

1. ^{13}N(β^+)^{13}C $\qquad Q_m = 2.2205$

The weighted mean of $\tau_{1/2}$ measurements is 9.965 ± 0.004 min. The decay is entirely to $^{13}C_{g.s.}$: log $ft = 3.667 \pm 0.001$. See (1981AJ01), (1980AN40), (1982KA1C; applied), (1981BA2G, 1982CO1D, 1983LI01, 1984DA1H, 1984HA1M, 1985KL1A; astrophys.) and (1980AF1A; theor.).

2. ^{10}B(^{3}He, γ)^{13}N $\qquad Q_m = 21.6366$

The 90° cross sections for γ_0 and γ_{2+3} have been measured for $E(^3\text{He}) = 4.8$ to 14 MeV: no pronounced structures are observed: see (1981AJ01).

Table 13.14: Energy levels of ^{13}N

E_x (MeV $\pm$ keV)	$J^\pi; T$	$\Gamma_{c.m.}$ (keV)	Decay	Reactions
g.s.	$\frac{1}{2}^-; \frac{1}{2}$	$\tau_{1/2} = 9.965 \pm 0.004$ min	β^+	1, 2, 6, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39
2.3649 ± 0.6	$\frac{1}{2}^+$	$\Gamma_{c.m.} = 31.7 \pm 0.8$	γ, p	6, 9, 10, 11, 15, 16, 22, 26, 27, 30, 32, 33, 35
3.511 ± 2	$\frac{3}{2}^-$	62 ± 4	γ, p	2, 6, 8, 9, 10, 11, 15, 16, 18, 20, 23, 26, 27, 28, 29, 30, 31, 32, 34, 35
3.547 ± 4	$\frac{5}{2}^+$	47 ± 7	p	2, 6, 8, 9, 11, 15, 16, 18, 20, 22, 23, 26, 27, 28, 30, 32
6.364 ± 9	$\frac{5}{2}^+$	11	p	7, 9, 11, 16, 27, 32, 34
6.886 ± 8	$\frac{3}{2}^+$	115 ± 5	p	7, 9, 11, 27, 32
7.155 ± 5	$\frac{7}{2}^+$	9 ± 0.5	p	7, 9, 11, 16, 27, 32
7.376 ± 9	$\frac{5}{2}^-$	75 ± 5	p	7, 8, 9, 11, 16, 27, 28, 29, 30, 31, 32, 34
7.9	$\frac{3}{2}^+$	≈ 1500	p	9, 11, 16, 32
8.918 ± 11	$\frac{1}{2}^-$	230	p	9, 11, 16, 29, 30, 31, 32, 34
9.00	$\frac{9}{2}^+$	280 ± 30		7, 16, 26, 27, 31
9.476 ± 8	$\frac{3}{2}^-$	30	p	7, 9, 11, 16, 27, 29, 31
10.25 ± 150	$(\frac{1}{2}^+)$	≈ 280	γ, p	10
10.36	$\frac{5}{2}^-$	30	p	7, 9, 11, 16, 27, 29
10.36	$\frac{7}{2}^-$	76	p	7, 11, 16, 27
10.833 ± 9	$\frac{1}{2}^-$			7, 9, 27, 34
11.530 ± 12	$\frac{5}{2}^+$	430 ± 35	p	7, 9, 11
11.70 ± 30	$\frac{5}{2}^-$	115 ± 30	p	11
11.74 ± 40	$\frac{3}{2}^+$	240 ± 30	γ, p	10, 11
11.74 ± 50	$\frac{3}{2}^-$	530 ± 80	p	11
11.878 ± 12	$\frac{3}{2}^-$	380 ± 50	p	8, 9, 11, 30, 34

Table 13.14: Energy levels of ^{13}N (continued)

E_x (MeV $\pm$ keV)	$J^\pi; T$	$\Gamma_{c.m.}$ (keV)	Decay	Reactions
12.13 ± 50	$\frac{7}{2}^-$	250 ± 30	p	11, 16, 35
12.558 ± 23		> 400		9
12.937 ± 24		> 400		9
13.5 ± 200	$\frac{3}{2}^+$	≈ 6500	γ, p	10, 11
14.05 ± 20	$\frac{3}{2}^+; \frac{1}{2}$	165 ± 20	γ, p, α	10, 11, 14
15.06457 ± 0.4 [a]	$\frac{3}{2}^-; \frac{3}{2}$	0.86 ± 0.12	γ, p, α	9, 10, 11, 14, 26, 27, 34
15.3 ± 200	$(\frac{3}{2}^+)$	350 ± 150	γ, p	10
15.99 ± 30	$\frac{7}{2}^+; \frac{1}{2}$	135 ± 90	p, α	11, 14, 27
16.0		≈ 500	p	11
17.5			γ, p	10, 11
18.15 ± 30	$\frac{3}{2}^+; \frac{1}{2}$	320 ± 80	p	11
18.17 ± 20	$\frac{1}{2}^-; \frac{1}{2}$	225 ± 50	p, α	11, 14
18.406 ± 5	$\frac{3}{2}^+; \frac{3}{2}$	66 ± 8	p, α	9, 11, 14
18.961 ± 10	$\frac{3}{2}^-$ or $\frac{7}{2}^+; \frac{3}{2}$	23 ± 5	p, α	9, 11, 14
19.83	$\frac{5}{2}^-; \frac{1}{2}$	1000	p, α	11, 14
19.88	$\frac{7}{2}^+; \frac{1}{2}$	750	p	11
20.2	$\frac{5}{2}^-$	1000	p	11
20.9 ± 300	$\frac{1}{2}^+$	1200	γ, p	10, 11
21.4	$\frac{5}{2}^-$	750	p	11
21.7	$\frac{3}{2}^+$		p	11
22.4 ± 500	$\frac{1}{2}^+$		p	11
23			γ, p	10
23.3		400	p, ^{3}He	3
23.83 ± 50		350 ± 50	p, ^{3}He	3
24.4		700	p, ^{3}He	3
(24.6)		120	p, ^{3}He	3
25.6 ± 100	$(\frac{3}{2})^-$	240 ± 80	p, ^{3}He	3, 11
25.9		1000	(n), p, d, ^{3}He, α	3, 4, 5
26.84			p	11

Table 13.14: Energy levels of ^{13}N (continued)

E_x (MeV ± keV)	$J^\pi; T$	$\Gamma_{c.m.}$ (keV)	Decay	Reactions
28			(γ), p, ^{3}He, (α)	2, 3, 5
(31)			p	11
32		≈ 2000	γ, d, ^{3}He, α	2, 4, 5, 10

[a] See also Table 13.7.

3. (a) ^{10}B(^{3}He, n)^{12}N $\quad Q_m = 1.573 \quad E_b = 21.6366$
   (b) ^{10}B(^{3}He, p)^{12}C $\quad Q_m = 19.6931$

Activation cross sections (reaction (a)) have been reported for $E(^3\text{He}) = 1$ to 30.6 MeV: there is some evidence for broad structures. Observed resonances in the yield of proton groups and of 12.7 and 15.1 MeV γ-rays are displayed in Table 13.15. See also (1981AJ01).

4. ^{10}B(^{3}He, d)^{11}C $\quad Q_m = 3.196 \quad E_b = 21.6366$

For resonances see Table 13.15. See also (1981AJ01).

5. ^{10}B(^{3}He, α)^{9}B $\quad Q_m = 12.141 \quad E_b = 21.6366$

Excitation functions for α_0 and α_1 have been measured for $E(^3\text{He}) = 2$ to 19 MeV. Observed resonances are displayed in Table 13.15. See also (1981AJ01).

6. ^{10}B(α, n)^{13}N $\quad Q_m = 1.0588$

Angular distributions have been measured in the range $E_\alpha = 1.5$ to 20.2 MeV: see (1981AJ01).

7. ^{10}B(^{6}Li, t)^{13}N $\quad Q_m = 5.8410$

Table 13.15: Structures in $^{10}B + ^{3}He$ [a]

E_{res} (MeV ± keV)	Γ (keV)	Res. in	$^{13}N^*$ (MeV)
2.1	500	p_0, (p_1)	23.3
2.85 ± 50	450 ± 50	$\gamma_{15.1}$	23.83
3.6	700	p_0, p_1	24.4
3.9	120	p_0	24.6
(4.6)	150	p_0, (p_1)	(25.2)
5.2 ± 100	240 ± 80	p_0, $\gamma_{15.1}$, p_2, p_3	25.6
5.6	1000 [c]	(n), p_0, p_2, p_3, $\gamma_{12.7}$, $\gamma_{15.1}$, d_0, α_0	25.9
8.5	[d]	(γ_0), p_0, $\gamma_{12.7}$, $\gamma_{15.1}$, (α_0)	28
13.5 [b]	≈ 2000	(γ_0), d_{4+5}, α_1	32

[a] For references and comments see Table 13.19 in (1981AJ01).
[b] This may correspond to more than one state.
[c] $J \geq \frac{3}{2}$.
[d] $J \geq \frac{7}{2}$.

At $E(^{6}Li) = 18$ MeV the known states of ^{13}N with $6.3 < E_x < 11.7$ MeV are observed, with the exception of $^{13}N^*(7.9, 8.92)$. In addition, evidence is presented for a ^{13}N state at $E_x = 9.00$ MeV with $\Gamma_{c.m.} = 280 \pm 30$ keV: it is very strongly excited and its angular distribution is similar to that for $^{13}C^*(9.50)$ in the mirror reaction (^{6}Li, ^{3}He) suggesting that these two states are analogs. Other analog assignments made on the basis of corresponding intensities in the mirror reaction are given in reaction 11 of ^{13}C. The widths of $^{13}N^*(6.89, 7.38)$ are, respectively, 120 ± 30 and 70 ± 30 keV (1974HO06).

8. $^{10}B(^{14}N, ^{11}B)^{13}N$ $\qquad Q_m = 0.901$

At $E(^{10}B) = 100$ MeV, angular distributions are reported for the transitions to $^{13}N^*(0, 3.5, 7.4, 11.9)$: see (1981AJ01).

9. $^{11}B(^{3}He, n)^{13}N$ $\qquad Q_m = 10.1824$

Neutron groups have been observed to a number of states of ^{13}N: see Table 13.16. The parameters of the first $T = \frac{3}{2}$ state at $E_x = 15.06$ MeV are displayed in Table 13.6 where they are compared with the corresponding quantities for $^{13}C^*(15.11)$: see (1981AJ01).

Table 13.16: States of ^{13}N from ^{11}B(^{3}He, n)^{13}N [a]

E_x (MeV ± keV)	$\Gamma_{c.m.}$ (keV)	L	J^π
0		2	$\frac{1}{2}^-$
2.358 ± 10		1	$\frac{1}{2}^+$
3.502 ± 10		0, 2	$\frac{3}{2}^-$
3.55 ± 18			
6.353 ± 9		1, 3	$\frac{5}{2}^+$
6.875 ± 10		1, 3	$\frac{3}{2}^+$
7.145 ± 9		3, 5	$\frac{7}{2}^+$
7.363 ± 8		2, 4	$\frac{5}{2}^-$
8.2 ± 22			
8.918 ± 11			
9.476 ± 8		0, 2	$\frac{3}{2}^-$
10.381 ± 8		2, 4	$\frac{5}{2}^-$
10.833 ± 9			
11.530 ± 12			
11.878 ± 12		0, 2	$\frac{3}{2}^-$
12.558 ± 23	> 400		
12.937 ± 24	> 400		
15.068 ± 8 [b]	< 15		$\frac{3}{2}^-; T = \frac{3}{2}$
18.44 ± 40			$T = \frac{3}{2}$
18.98 ± 20	40 ± 20		$T = \frac{3}{2}$

[a] For references see Table 13.20 in (1981AJ01).

[b] See also Table 13.6.

10. (a) ^{12}C(p, γ)^{13}N $\qquad Q_{\rm m} = 1.9435$

(b) ^{12}C(p, γp$'$)^{12}C

Resonances for capture radiation are displayed in Table 13.17. No resonance is observed at $E_{\rm p} = 1.73$ MeV [^{13}N*(3.55)]: $\omega\Gamma_\gamma < 0.006$ eV.

Excitation functions have been measured for $E_{\rm p} = 150$ to 2500 keV. In addition to the first two resonances, direct radiative capture is observed. In reaction (b), studied for $E_{\rm p} = 610$ to 2700 keV the capture γ-ray yield is dominated by a direct capture process to ^{13}N*(2.36). The cascade decay ^{13}N*(3.51 $\rightarrow$ 2.36) has an intensity of (8 ± 1)%. Extrapolating the cross section to $E_{\rm c.m.} = 25$ keV yields a cross-section factor $S = 1.45 \pm 0.20$ keV$\cdot$ b. [A reanalysis of the data by (1980BA54) suggests $S = 1.54^{+0.15}_{-0.10}$ kev $\cdot$ b.] See also (1984MA36, 1985LA06; theor.).

Differential cross sections for the transitions to the ground state have been measured for $E_{\vec{\rm p}} = 10$ to 17 MeV. The total E2 capture cross section is ≈ 0.2 μb and no resonance effects are observed. The E2 energy-weighted sum rule depleted over this energy range is (8.5 ± 3.3)% (1980HE04). At $E_{\rm p} = 14.2$ MeV, capture radiation from the first $T = \frac{3}{2}$ state, ^{12}N*(15.06) is reported: see Table 13.6 for the parameters and the decay modes of this state. The angular distributions of the γ-rays determine $J = \frac{3}{2}$ for ^{13}N*(15.06). The interference between the M1(E2) $T = \frac{3}{2}$ resonance (^{13}N*(15.06)) and the E1 GDR has been studied by (1980SN01): the E1 capture is found to be predominantly d-wave (1980SN01). See (1981AJ01) for the earlier references.

Excitation functions for γ-rays have also been measured at $E_{\rm p} = 8.7$ to 37 MeV (γ_0), 19.9 to 24.4 MeV (γ_1, γ_{2+3}) and 23 to 37 MeV (γ_{2+3}). At $E_{\rm p} = 40$ to 100 MeV most of the γ-strength is due to transitions to ^{13}N*(3.5), probably to ^{13}N*(3.55) [$J^\pi = \frac{5}{2}^+$] because of its single-particle character. Transitions to higher states may also be indicated. Excitation functions, γ-ray angular distributions and analyzing powers for γ_0, γ_{2+3} are reported by (1984BL10) for $E_{\vec{\rm p}} \approx 25$ to 40 MeV. At $E_{\vec{\rm p}} = 40$ and 50 MeV analyzing powers to ^{13}N*(0, 3.5) are reported by (1983NO1D, 1983NO1G, 1985EJ1A; prelim.).

See also (1980AN40, 1982KR05, 1984AN1J, 1984JEZY, 1984WA1L), (1980BA2M, 1981BA2F, 1982BA80, 1984BO1Q, 1984TR1C; astrophys.), (1981SN1A, 1982MA2C, 1984WO05, 1985BL1B) and (1980JO1E, 1980SO1D, 1981HA01, 1982DU1A, 1984SE16, 1985MA1V; theor.).

11. (a) ^{12}C(p, p)^{12}C $\qquad E_{\rm b} = 1.9435$

(b) ^{12}C(p, pd)^{10}B	$Q_{\rm m} = -25.1866$
(c) ^{12}C(p, 2p)^{11}B	$Q_{\rm m} = -15.9570$
(d) ^{12}C(p, pt)^{9}B	$Q_{\rm m} = -27.366$
(e) ^{12}C(p, p^{3}He)^{9}Be	$Q_{\rm m} = -26.2790$
(f) ^{12}C(p, pα)^{8}Be	$Q_{\rm m} = -7.36665$
(g) ^{12}C(p, 3p)^{10}Be	$Q_{\rm m} = -27.1859$

Yield curves for elastic protons, protons inelastically scattered to ^{12}C*(4.4, 7.7, 9.6, 12.7, 15.1) and for γ-rays from ^{12}C*(4.4, 12.7, 15.1) have been studied at many energies: see Table 13.18

Table 13.17: Resonances in ^{12}C(p, γ)^{13}N [a]

E_p (MeV ± keV)	$\Gamma_{c.m.}$ (keV)	Γ_{γ_0} (eV)	^{13}N* (MeV)	Res. in yield of	J^π
0.4568 ± 0.5	31.7 ± 0.8 [f]	0.64 ± 0.07 [h]	2.3649±0.0006	γ_0	$\frac{1}{2}^+$
1.699 ± 2 [b]	62 ± 4 [g]	0.64 [i]	3.511	γ_0	$\frac{3}{2}^-$
9.01 ± 150	≈ 280		10.25	γ_0	$(\frac{1}{2}^+)$
10.62 ± 120	200 ± 50	≈ 4.2 [j]	11.74	γ_0	$\frac{3}{2}^+$
12.5 ± 200	6500	≥ 1100	13.5	γ_0	$\frac{3}{2}^+$
13.12 ± 90	160 ± 20	3.7 ± 1.0 [k]	14.04	γ_0	$\frac{3}{2}^+$
14.2	[see Table 13.6]		15.0	γ_0, γ_{2+3}	$\frac{3}{2}^-$; $T = \frac{3}{2}$
14.5 ± 200 [c]	350 ± 140	≥ 0.5	15.3	γ_1	$(\frac{3}{2}^+)$
16.9			17.5	γ_0	
20 [d]			20	γ_1, γ_{2+3}	
20.5 [e]	≈ 3700		20.8	γ_0	
23			23	γ_0	
24.5			24.5	γ_{2+3}	
32.5	broad		31.9	γ_0, γ_{2+3}	

[a] For references and other comments see Table 13.21 in (1981AJ01).

[b] For a thick-target study see (1984PO13).

[c] This peak may be due to an unresolved doublet.

[d] Giant resonance for γ_1.

[e] Main dipole strength is concentrated in this peak.

[f] Recalculated on the basis of $\Gamma_{c.m.} = 33.3 \pm 1.8$ keV from (1974BL06) and 31.4 ± 0.9 keV from (1968RI16) [the value reported in (1968RI16) was Γ_{lab}; I am indebted to Prof. F.C. Barker for his comments].

[g] (1985BR06) have studied this resonance with polarized protons and analyzed the results with R-matrix theory: the E2/M1 mixing ratio is -0.102 ± 0.003 and the total width (lab) is calculated to be 62 keV. An extranuclear direct capture background appears to be necessary to explain the data.

[h] G. Fox *et al.*: see p. 662 in (1985LA06).

[i] Recalculated on the basis of total $\Gamma_{lab} = 67 \pm 4$ keV. I am indebted to Prof. F.C. Barker for his comments [see (1980BA54)].

[j] A value of 0.30 ± 0.05 is assumed for Γ_{p_0}/Γ: see Table 13.18.

[k] A value of 126 keV is taken for Γ_{p_0}.

for a display of the observed structure. Cross sections for the 4.4 MeV γ-rays for $E_p = 5.1$ to 23 MeV have been measured by (1981DY03; see also for astrophysical considerations). A phase-shift analysis of the elastic scattering analyzing power for $E_{\vec{p}} = 11.5$ to 18.1 MeV shows four $T = \frac{1}{2}$ states with $E_x = 14.06$, 16.00, 18.16, and 18.18 MeV, with $J^\pi = \frac{3}{2}^+, \frac{7}{2}^+, \frac{3}{2}^+, \frac{1}{2}^-$: see Table 13.18. At $E_{\vec{p}} = 19.15$ to 23.34 MeV, measurements of the elastic group and the protons to ^{12}C*(4.4, 12.7) locate $\frac{1}{2}^+$(E1), $\frac{5}{2}^-$(E2) and $\frac{7}{2}^+$(E3) resonances below 21 MeV, $\frac{3}{2}^+$(E1) and $\frac{5}{2}^-$ resonances with $21 < E_x < 22$ MeV and $\frac{1}{2}^+$ and $\frac{3}{2}^+$ resonances above 22 MeV: see Table 13.18. For other polarization measurements see Tables 13.26 in (1970AJ04), 13.28 in (1976AJ04), 13.19 here, (1981AJ01) and (1984BY04, 1984BY05, 1985BAZZ).

Nuclear time delays of the order of 10^{-20} sec as a function of E_γ have been extracted from the bremsstrahlung cross section near the 1.7 MeV reaonance (1982LI12, 1982TA09, 1982TA11). For other bremsstrahlung studies see (1981AJ01) and (1982LE03, 1983PEZW, 1983SU1G, 1983TR1G). Variation of the K-shell vacancy production probability as a function of energy across the 460 keV resonance is not observed (1982ME13).

For reaction (b) see (1977GR04, 1982REZZ). For reactions (d, e) see (1977GR04). For reaction (g) see (1980KO40). For inclusive data from the quasielastic peak to outgoing proton momenta of ≈ 350 MeV/c see (1984MC02; $E_p = 800$ MeV). For σ_T measurements see (1981PE01). For production of pions and other mesons see (1981AK01, 1981AL1K, 1981NA1E, 1983AK1A, 1985DI01) and reaction 28 in ^{13}C. For hadron multiple production see (1980AK1D, 1981ER07, 1981NA1E, 1981TA03, 1982BA78, 1982FI1E, 1984BA2R, 1984BA1T, 1984BA2X).

Table 13.18: ^{13}N levels from ^{12}C(p, p), ^{12}C(p, p$'$), ^{12}C(p, α) [a]

E_p (MeV ± keV)	^{13}N* (MeV)	$\Gamma_{c.m.}$ (keV)	l_p	J^π	
					[b]
0.461 ± 3	2.369 [c]	31 [c]	0	$\frac{1}{2}^+$	$\theta^2 = 0.54$
1.686 ± 6	3.499 [c]	60 [c]	1	$\frac{3}{2}^-$	0.031
1.734 ± 6	3.543 [c]	50 [c]	2	$\frac{5}{2}^+$	0.21
4.808 ± 10	6.378	11	2	$\frac{5}{2}^+$	0.0031
5.370 ± 10	6.896	115 ± 5	2	$\frac{3}{2}^+$	0.13
5.65 ± 10	7.155	9 ± 0.5	4	$\frac{7}{2}^+$	0.016
5.891	7.38	75 ± 5	3	$\frac{5}{2}^-$	0.069
6.5	7.9	≈ 1500	2	$\frac{3}{2}^+$	0.14
7.54	8.90	230	1	$\frac{1}{2}^-$	0.02
8.18	9.49	30	1	$\frac{3}{2}^-$	0.001
9.13	10.36	30	3	$\frac{5}{2}^-$	
9.13	10.36	76	3	$\frac{7}{2}^-$	
10.35 ± 50	11.49	430 ± 35	2	$\frac{5}{2}^+$	$\Gamma_p/\Gamma = 0.70 \pm 0.05$

Table 13.18: ^{13}N levels from ^{12}C(p, p), ^{12}C(p, p′), ^{12}C(p, α) [a] (continued)

E_p (MeV ± keV)	^{13}N* (MeV)	$\Gamma_{c.m.}$ (keV)	l_p	J^π	
10.58 ± 30	11.70	115 ± 30	3	$\frac{5}{2}^-$	0.60 ± 0.04
10.62 ± 40	11.74	250 ± 30	2	$\frac{3}{2}^+$	0.30 ± 0.05
10.62 ± 50	11.74	530 ± 80	1	$\frac{3}{2}^-$	0.55 ± 0.05
10.75 ± 40	11.86	380 ± 50	0	$\frac{1}{2}^+$	0.35 ± 0.05
11.05 ± 50	12.13	250 ± 30	3	$\frac{7}{2}^-$	0.30 ± 0.05
12.5	13.5	≈ 500			
13.13 ± 20	14.05	180 ± 35	2	$\frac{3}{2}^+; T = \frac{1}{2}$	0.29 ± 0.07
14.23075 ± 0.2	15.06457 ± 0.4	0.932 ± 0.028 [d]	1	$\frac{3}{2}^-; T = \frac{3}{2}$	
15.24 ± 40 [e]	15.99	135 ± 90	4	$\frac{7}{2}^+; T = \frac{1}{2}$	0.05 ± 0.04
15.2	16.0	≈ 500			
16.8 [e]	17.4				
17.58 ± 30	18.15	322 ± 75	2	$\frac{3}{2}^+; T = \frac{1}{2}$	0.08 ± 0.02
17.60 ± 20	18.17	225 ± 50	1	$\frac{1}{2}^-; T = \frac{1}{2}$	0.24 ± 0.06
17.857 ± 5 [f]	18.406	66 ± 8	2	$\frac{3}{2}^+; T = \frac{3}{2}$	
18.460 ± 10 [f]	18.961	23 ± 5		$\frac{3}{2}^-$ or $\frac{7}{2}^+$; $T = \frac{3}{2}$	
19.40 [g]	19.83	1000	3	$\frac{5}{2}^-; T = \frac{1}{2}$	
19.46	19.88	750	4	$\frac{7}{2}^+; T = \frac{1}{2}$	
19.8 [f]	20.2	1000		$\frac{5}{2}^-$	
20.6 ± 300 [e,f]	20.9	1200		$\frac{1}{2}^+$	
21.1	21.4	750		$\frac{5}{2}^-$	
21.4	21.7			$\frac{3}{2}^+$	
22.2 ± 500 [h]	22.4	≈ 1000		$\frac{1}{2}^+$	
24.0	24.1	≤ 500			
25.7	25.6			$(\frac{3}{2}^-)$	
27.02	26.84				
32 [g]	31				

[a] For references see Tables 13.22 in (1981AJ01) and 13.27 in (1976AJ04).
[b] A dispersion analysis leads to a spectroscopic factor of 0.53 ± 0.08 for $^{13}N_{g.s.}$.
[c] The older values for ^{13}N*(3.50, 3.54) have been reanalyzed by (1980BA54). An R-matrix analysis had led to $E_x = 2.367$, 3.501 and 3.547 MeV, and $\Gamma_{c.m.} = 33$, 55 and 50 keV for these states. $^{13}N_{g.s.}$ appears to have an appreciable effect on the low-energy scattering: see (1981AJ01). (1984BUZO; prelim.) report $E_{res} = 1.74 \pm 0.01$ MeV, $\Gamma = 50$ keV.
[d] $\Gamma_p = 263 \pm 15$ eV (1980TH05). See discussion in (1981BR24): if the ^{12}C nucleus were part of an atom the width of the resonance would be smeared out by an amount of the order of ≈ 0.5 keV (A.M. Lane, private communication). See also Table 13.6.
[e] Resonance in yield of 12.7 MeV γ-rays.
[f] Resonance in yield of 15.1 MeV γ-rays.
[g] Resonance in yield of 4.4 MeV γ-rays.
[h] A $\frac{3}{2}^+$ state is indicated in this region.

See also ^{12}C in (1985AJ01), (1980LE28, 1980ZU1B, 1981CHZP, 1983KOZX, 1983SEZW, 1984KOZZ, 1984ZU01), (1981DY03, 1983LE28; astrophys.), (1978AL1G, 1980KE14, 1981BA1F, 1981BA1R, 1983HA1H, 1983MO1K, 1984RE14, 1985HO1J, 1985WE1D) and (1979FO18, 1979MA48, 1980CH32, 1980DE2F, 1980DI10, 1980HA56, 1980MA06, 1980ST1K, 1981BR21, 1981BR24, 1981CI03, 1981DE1P, 1981FR1R, 1981KH07, 1981KL1D, 1981KR15, 1981OL02, 1981SH1A, 1981WA20, 1981YA08, 1982AM1B, 1982BR1A, 1982MO18, 1982MO24, 1982NA13, 1982YE01, 1983BA1V, 1983DI1B, 1983GY1A, 1983KA37, 1983KO44, 1983OL04, 1983TZ01, 1983ZA09, 1984BE01, 1984BU1T, 1984CA1T, 1984GO04, 1984HU1P, 1984KO37, 1984KW01, 1984PH02, 1984PI05, 1984RI03, 1984SH14, 1985BA1Z, 1985CL1B, 1985DY03, 1985GO1V, 1985IN01, 1985SP03; theor.).

12. (a) ^{12}C(p, n)^{12}N $\quad Q_m = -18.120 \quad E_b = 1.9435$
(b) ^{12}C(p, pn)^{11}C $\quad Q_m = -18.7215$

The cross section for reaction (a) has been measured from threshold to $E_p = 50$ MeV. Resonant structure is observed corresponding to $E_x = 21$, 24 and, possibly, ≈ 27 MeV: see (1981AJ01). At $E_{\vec{p}} = 160$ MeV A_y for the n_0 group is similar to that for the (p, p′) group to the analog state ^{12}C*(15.1) (1981GOZX; prelim.). For spin transfer coefficient, $K_y^{y'}(0°)$, measurements at $E_{\vec{p}} = 65$ MeV see (1984SA12). See also (1984BA1R, 1984SH04) and ^{12}N in (1985AJ01).

Cross sections for reaction (b) have been measured to 300 GeV: see (1981AJ01). See also (1984NA06, 1981OL1B; theor.).

13. ^{12}C(p, d)^{11}C $\quad Q_m = -16.4969 \quad E_b = 1.9435$

For polarization measurements see (1981AJ01), (1980HO18; $E_{\vec{p}} = 65$ MeV; d_0, d_1), (1984OH06; $E_{\vec{p}} = 497$ MeV; d_0) and (1981CHZP, 1981IR1A). See also ^{11}C in (1985AJ01), (1984BA1L) and (1981VE15; theor.).

14. ^{12}C(p, α)^{9}B $\qquad Q_{\rm m} = -7.5517 \qquad E_{\rm b} = 1.9435$

Yield curves for α_0 have been measured over the 14.2 MeV resonance, corresponding to the first $T = \frac{3}{2}$ state at $E_{\rm x} = 15.06$ MeV, and from $E_{\rm p} = 17$ to 20 MeV. The yield for the α_1 group has been determined for $E_{\rm p} = 17$ to 21.5 MeV. Parameters of observed resonances are displayed in Table 13.18. Excitation functions for α_0 have also been measured for $E_{\rm p} = 18.5$ to 44 MeV at a number of angles: they exhibit structures which are typically 1 MeV broad: see (1981AJ01). For polarization measurements see Table 13.19.

15. (a) ^{12}C(d, n)^{13}N $\qquad Q_{\rm m} = -0.2811$

(b) ^{12}C(d, pn)^{12}C $\qquad Q_{\rm m} = -2.2458$

Angular distributions have been measured for $E_{\rm d} = 0.5$ to 17 MeV [see (1981AJ01)] and at $E_{\rm d} = 7.0$, 9.1 and 13.0 MeV (1984SC04; n$_0$, n$_1$, n$_{2+3}$). Reaction (b) is dominated at $E_{\rm d} = 5.0$ to 6.5 MeV and at 9.20 and 9.85 MeV by sequential decay via ^{13}N*(3.51 + 3.55). At the lower energies ^{13}N*(2.36) participates also: see (1976AJ04). See also ^{14}N, (1981BR1E), (1984BA2N; applied) and (1980BA54, 1983MU13, 1984PE1C; theor.).

16. (a) ^{12}C(^{3}He, d)^{13}N $\qquad Q_{\rm m} = -3.5500$

(b) ^{12}C(^{3}He, pd)^{12}C $\qquad Q_{\rm m} = -5.49353$

Angular distributions have been studied at E(^{3}He) to 81.4 MeV [see (1981AJ01)] and at 13 MeV (1984CA06; d$_0$, d$_1$, d$_{2+3}$) and 43.6 MeV (1980PE13). The spectroscopic factors derived by (1980PE13) for ^{13}N*(0, 2.36, 3.55, 6.36, 6.89, 7.16, 7.38, 8.0, 8.92, 9.0, 9.48, 10.36, 10.78) are $S = 0.48$, 0.14, 0.53, 0.007, 0.015, < 0.009, 0.024, 0.13, < 0.005, < 0.005, < 0.002, < 0.001, 0.064, respectively. Evidence is presented for the assignment of $J^\pi = \frac{9}{2}^+$ to ^{13}N*(9.0) (1980PE13). For other values of S, see (1981AJ01) and (1984CA06). The energies and widths for the first three excited states are $E_{\rm x} = 2368.2 \pm 2.8$, 3507.8 ± 7.6 and 3549.1 ± 5.0 keV, with $\Gamma_{\rm c.m.} = 36.1 \pm 2.8$, 54.8 ± 11.5 and 46.5 ± 7.1 keV respectively (1974BL06). Spectra obtained at E(^{3}He) = 36 MeV at forward angles show the broad d$_{3/2}$ state at $E_{\rm x} = 7.9$ MeV. Interfering with it is the 120 keV $\frac{3}{2}^+$ state at 6.89 MeV. The line shape of the $\frac{5}{2}^+$ state at 6.36 MeV is said to show a pronounced interference pattern (1979FU03). For the inclusive deuteron spectra at E(^{3}He) = 52 MeV see (1984AA01). For reaction (b) see (1983CA07, 1983DR06). See also (1983PE07) and (1980BA54, 1982CO20, 1983MU13; theor.).

17. ^{12}C(α, t)^{13}N $\qquad Q_{\rm m} = -17.8705$

Table 13.19: Polarization measurements in ^{12}C(p, p) and ^{12}C(p, α) [a]

$E_{\vec{p}}$ (MeV)	A_y to ^{12}C* (MeV) or ^{9}B	Refs.
24.1, 26.2, 28.7	4.4 [b]	(1981FU12, 1983FU1J)
25, 35	g.s.	(1984BAZZ)
65	g.s., 4.4, 7.7	(1985KA10)
65	12.7, 15.1	(1983HO1L)
65	continuum	(1980SA20)
72	inclusive (p, α)	(1981KO33)
72	continuum (p, α)	(1980LE19, 1982LE21)
95 $\rightarrow$ 571	g.s.	(1983AP1A)
107 $\rightarrow$ 754	inclusive	(1982RA20)
120	0, 4.4, 11.8, 12.7, 15.1, 16.1, 16.6	(1981CO20, 1981CO21)
122, 160	g.s.	(1983ME02)
122, 160, 200	4.4	(1983HU06)
150	12.7, 15.1	(1982CA08)
159.4	g.s., 4.4	(1983TA12)
200	g.s.	(1981ME02)
200	12.7, 15.1	(1981CO10)
200	4.4, 7.7, 9.6, 10.8, 11.8, 12.7, 13.4, 14.1, 15.1, 15.4, 16.1, 16.6, 18.4, 19.2, 19.7, 20.5	(1982CO21)
398, 597, 698	18.3, 19.4 [c]	(1983JO08)
500	12.7, 15.1 [d]	(1984MC01)
800	inclusive	(1984MC04)
1 GeV	inclusive	(1983BE16)

[a] See also (1981AJ01) and Tables 13.26 in (1970AJ04) and 13.28 in (1976AJ04) for the earlier work. See also (1979ZH1A).

[b] Also studied polarization and spin-flip asymmetry.

[c] Also angular distribution of the spin-flip probability at 398 MeV.

[d] Measured all the polarization transfer observables.

Angular distributions of the t_0 group have been measured at $E_{\alpha} = 56$ and 104 MeV: see (1981AJ01).

18. $^{12}C(^{7}Li, ^{6}He)^{13}N$ $Q_m = -8.031$

Angular distributions have been obtained at $E(^{7}Li) = 36$ MeV for the ^{6}He ions to ^{13}N*(0, $3.51 + 3.55$). The spectroscopic factor for $^{13}N_{g.s.}$ is 0.72: see (1981AJ01). See also (1980BA54; theor.).

19. $^{12}C(^{10}B, ^{9}Be)^{13}N$ $Q_m = -4.6424$

See (1976AJ04) and (1980BA54; theor.).

20. $^{12}C(^{12}C, ^{11}B)^{13}N$ $Q_m = -14.0135$

At $E(^{12}C) = 93.8$ MeV angular distributions involving ^{13}N*(0, $3.51 + 3.55$) and various ^{11}B states have been measured by (1979FU04). For an excitation function see (1980CO10). See also (1981CH1R) and (1981XU1A; theor.).

21. $^{12}C(^{14}N, ^{13}C)^{13}N$ $Q_m = -5.6071$

See ^{13}C.

22. $^{12}C(^{16}O, ^{15}N)^{13}N$ $Q_m = -10.1841$

At $E(^{16}O) = 128$ MeV angular distributions are reported to ^{13}N*(0, 2.36, 3.55) (1979PR07; also see for reduced widths).

23. $^{13}C(\gamma, \pi^-)^{13}N$ $Q_m = -141.7878$

Differential cross sections were measured for 48 MeV pions for ^{13}N*(0, 3.5) (1984ST16). See also (1982LE06).

24. ^{13}C(π^+, π^0)^{13}N $\qquad Q_m = 2.384$

The angular distribution of the IAS group is reported by (1982DO10). See also (1980BA27, 1982DO02).

25. ^{13}C(π^+, γ)^{13}N $\qquad Q_m = 137.3468$

Differential cross sections for γ_0 have been measured at $E_{\pi^+} = 115.5$ MeV: no evidence is observed for nascent pion condensation (1984MA45).

26. (a) ^{13}C(p, n)^{13}N $\qquad Q_m = -3.0028$

(b) ^{13}C(p, pn)^{12}C $\qquad Q_m = -4.94634$

Angular distributions of the n_0, n_1 and n_{2+3} groups have been measured for $E_p = 3.1$ to 50 MeV [see (1981AJ01)], 10.1 to 16.75 MeV (1981BY01), 35 MeV (1985OR1H; n_1: prelim.) and 800 MeV (1984JEZZ, 1983KI1B, 1985KI1L; not n_1). (1984TA07) have measured the transverse spin-transfer coefficient [$D_{NN}(0°)$] at 160 MeV for the groups to ^{13}N*(0, 3.51). [^{13}N*(15.1) is also populated (1984TA07) as is ^{13}N*(9.0) (1982PEZY; $E_p = 26$ MeV).] The major $\frac{1}{2} \rightarrow \frac{3}{2}$ transition is significantly more quenched than the $\frac{1}{2} \rightarrow \frac{1}{2}$ transition, as is also the case in the ^{15}N(p, n) reaction (1985GO02; $E_p = 160$ MeV). In reaction (b) at $E_p = 7.9$ to 12 MeV one or both of the ^{13}N states at $E_x = 3.5$ MeV appear to be involved: see (1981AJ01). See also ^{14}N, (1984HE20), (1982GO1C, 1982TA03, 1983PE14, 1984TAZS, 1985OR1G), and (1982BA14, 1983KR10; theor.).

27. ^{13}C(^{3}He, t)^{13}N $\qquad Q_m = -2.2391$

At $E(^3\text{He}) = 43.6$ MeV angular distributions are reported to ^{13}N*(0, 2.36, 3.51 + 3.55, 6.36, 6.89, 7.16, 7.38, 9.0, 9.48, 10.36, 10.83, 11.8, 15.07, 16.02). The results are compared with the analog reaction ^{13}C(^{3}He, ^{3}He)^{13}C [see reaction 48 in ^{13}C]; they are consistent with $J^\pi = \frac{9}{2}^+$ for one of the unresolved states at $E_x = 9.0$ MeV and with $\frac{1}{2}^-$ and $\frac{7}{2}^+$ for ^{13}N*(10.83, 16.02) (1981PE08). [Earlier work (see (1981AJ01)) had assigned $L = 2$ [$J^\pi = \frac{5}{2}^-, \frac{1}{2}^-, \frac{3}{2}^-, \frac{3}{2}^-$] for the transitions to ^{13}N*(7.38, 8.92, 11.85, 15.07).] See also ^{16}O in (1982AJ01, 1986AJ04), (1983EL05) and (1983PE14).

28. (a) ^{13}C(^{6}Li, ^{6}He)^{13}N $\qquad Q_m = -5.727$

(b) ^{13}C(^{7}Li, ^{7}He)^{13}N $\qquad Q_m = -13.42$

Angular distributions to ^{13}N*(0, $3.51 + 3.55$) have been measured at $E(^6\text{Li}) = 31.8$ MeV: see (1981AJ01). These two reactions have been studied at $E(^6\text{Li}) = 93$ MeV and $E(^7\text{Li}) = 78$ MeV by (1984GL06): ^{13}N*(0, 3.5, 7.3) are most intensely populated.

29. ^{13}O(β^+)^{13}N $\qquad Q_{\text{m}} = 17.765$

See ^{13}O.

30. ^{14}N(p, d)^{13}N $\qquad Q_{\text{m}} = -8.3289$

Angular distributions have been measured for deuteron groups to ^{13}N*(0, 2.36, $3.51 + 3.55$, 7.38, 8.92, 11.88) at many energies up to $E_{\text{p}} = 155.6$ MeV [see (1981AJ01)] and at $E_{\vec{\text{p}}} = 21$ MeV (1982AO05; d$_0$, d$_{2+3}$). See also (1982MA1H).

31. ^{14}N(d, t)^{13}N $\qquad Q_{\text{m}} = -4.2962$

Angular distributions of the tritons to ^{13}N*(0, 3.51, 7.38, $8.92 + (9.00) + 9.48$, 11.8) have been obtained at $E_{\text{d}} = 52$ MeV and analyzed by DWBA. The spectroscopic factors for the ^{13}N states [and the mirror states reached in the ^{14}N(d, ^{3}He)^{13}C reaction] are in good agreement with theory and are additional evidence for the J^π assignments of $\frac{1}{2}^-$, $\frac{3}{2}^-$, $\frac{5}{2}^-$, $\frac{1}{2}^-$, $\frac{3}{2}^-$ and $\frac{3}{2}^-$ to these states: see (1981AJ01).

32. (a) ^{14}N(^{3}He, α)^{13}N $\qquad Q_{\text{m}} = 10.0243$
(b) ^{14}N(^{3}He, pα)^{12}C $\qquad Q_{\text{m}} = 8.0808$

Alpha particle groups have been observed to the first seven excited states of ^{13}N, including two at $E_{\text{x}} = 7.166$ and 7.388 MeV [± 8 keV]. Angular distributions have been studied at many energies up to $E(^3\text{He}) = 45$ MeV: see (1981AJ01). Reaction (b), studied at $E(^3\text{He}) = 8$ MeV, appears to involve some states of ^{13}N, possibly ^{13}N*(7.93, 8.92, 11.87): see (1981AJ01).

33. (a) ^{14}N(^{6}Li, ^{7}Li)^{13}N $\qquad Q_{\text{m}} = -3.303$
(b) ^{14}N(^{6}Li, tα)^{13}N $\qquad Q_{\text{m}} = -5.7713$

An angular distribution has been measured at $E(^6\text{Li}) = 32$ MeV for the transition to $^{13}\text{N}_{\text{g.s.}}$ and ^{7}Li*(0, 0.48). ^{13}N*(2.36) was also populated: see (1981AJ01). For reaction (b) see (1984ET01).

34. ^{15}N(p, t)^{13}N $\qquad Q_m = -12.9049$

At $E_p = 43.7$ MeV, angular distributions have been obtained for the tritons corresponding to the ground state of ^{13}N and the excited states at 3.51 ($\frac{3}{2}^-$), 6.38 ± 0.03 ($\frac{5}{2}^+$), 7.38 ($\frac{5}{2}^-$), 8.93 ± 0.05 ($\frac{1}{2}^-$), 10.78 ± 0.06 ($\frac{1}{2}^-$), 11.88 ± 0.04 ($\frac{3}{2}^-$) and 15.06 ($\frac{3}{2}^-$; $T = \frac{3}{2}$) MeV [J^π values in parentheses, as determined by DWBA analyses using intermediate-coupling wave functions to obtain the two-nucleon structure factors]. Detailed comparisons have been made with the (p, ^{3}He) reaction to the mirror states in ^{13}C: see (1981AJ01) for references and other information.

35. ^{16}O(p, α)^{13}N $\qquad Q_m = -5.2184$

Angular distributions of the α_0, α_1 and α_2 groups have been measured for E_p to 54.1 MeV: see (1970AJ04, 1976AJ04). In addition the distribution of the α-particles to a state with $E_x = 12.13 \pm 0.06$ MeV, $\Gamma_{c.m.} \approx 300$ keV [$J^\pi = \frac{7}{2}^-$] is reported at 54.1 MeV: see (1981AJ01). (1983PE07) have compared $(d\sigma/d\Omega)_{max}$ for the groups observed at $E_p = 54.1$ MeV in this reaction and at $E(^3\text{He}) = 19.6$ MeV in the ^{12}C(^{3}He, d)^{13}N reaction. Groups strongly populated in one reaction are weakly populated in the other. See also (1980KO1Q).

36. ^{16}O(p, pt)^{13}N $\qquad Q_m = -25.0325$

See (1978GO14, 1983GO10; theor.).

37. ^{16}O(^{3}He, ^{6}Li)^{13}N $\qquad Q_m = -9.2368$

Ground-state angular distributions have been reported at $E(^3\text{He}) = 30$ and 40.7 MeV: see (1981AJ01).

38. ^{16}O(α, ^{7}Li)^{13}N $\qquad Q_m = -22.5644$

The angular distribution for the transition to $^{13}\text{N}_{\text{g.s.}} + {}^7\text{Li}_{\text{g.s.}+0.48}$ has been measured: see (1981AJ01).

39. ^{16}O(^{14}N, ^{17}O)^{13}N $\qquad Q_m = -6.4098$

See (1981AJ01) and (1980IZ1B; theor.).

Table 13.20: Energy levels of ^{13}O

E_x in ^{13}O (MeV)	$J^\pi; T$	$\tau_{1/2}$ (msec) or Γ (MeV)	Decay	Reactions
g.s.	$(\frac{3}{2}^-); \frac{3}{2}$	$\tau_{1/2} = 8.90 \pm 0.20$	β^+	1, 2, 3, 4
2.75 ± 0.04				2, 3
4.21				3
6.02 ± 0.08 [a]		$\Gamma = 1.2$ MeV		3

[a] Corresponds to broad or unresolved states.

^{13}O
(Figs. 3 and 4)

GENERAL: (See also (1981AJ01).)

(1982NG01, 1983ANZQ, 1983AU1B, 1983FR1A, 1983OL1A).

Mass of ^{13}*O*: We adopt the 1984 Wapstra atomic mass excess of 23111 ± 10 keV. ^{13}O is then bound with respect to ^{12}N + p and ^{11}C + 2p by 1.516 and 2.117 MeV, respectively. See also (1981AJ01).

1. ^{13}O(β^+)^{13}N $\qquad Q_m = 17.765$

The half-life of ^{13}O is 8.90 ± 0.20 msec. ^{13}O decays to a number of states of ^{13}N some of which subsequently decay to ^{12}C*(0, 4.4): see Table 13.21 (1970ES03). See also (1981AJ01) and (1981KO27; theor.).

2. ^{12}C(p, π^-)^{13}O $\qquad Q_m = -155.389$

At $E_p = 613$ MeV the ground state of ^{13}O and an excited state at $E_x = 2.82 \pm 0.24$ MeV are observed in addition to unresolved structures (1978CO15). [See Fig. 4 for analog region in ^{13}B.] The angular distribution of the π^- to ^{13}O$_{\text{g.s.}}$ has been measured at $E_p = 200$ MeV (1980HO20), as has A_y at $E_{\vec{p}} = 205$ MeV (1982JA05). See also (1981AU1C, 1982GR1K, 1982HO1C, 1982WA1G, 1984JA1F) and (1981CO1M; theor.).

3. ^{13}C(π^+, π^-)^{13}O $\qquad Q_m = -19.986$

Table 13.21: Beta decay of ^{13}O [a]

Decay to		E_p (c.m.) (MeV) to		Relative intensity	% of all β-decays	log ft
^{13}N* (MeV)	J^π	^{12}C*(g.s.)	^{12}C*(4.4)			
g.s.	$\frac{1}{2}^-$				88.1 ± 3.4 [b]	4.10 ± 0.02 [b]
3.51	$\frac{3}{2}^-$	observed		100	10.7 ± 3.1	4.52 ± 0.13
7.38	$\frac{5}{2}^-$	5.48 ± 0.05	not seen	0.33 ± 0.10	0.40 ± 0.19 [d]	5.22 ± 0.23
8.92	$\frac{1}{2}^-$	observed		3.5 ± 0.3		
					0.54 ± 0.16	4.73 ± 0.14
			2.56 ± 0.05	1.5 ± 0.3		
9.48	$\frac{3}{2}^-$	observed		0.8 ± 0.1		
					0.13 ± 0.04	5.18 ± 0.14
			3.12 ± 0.05	0.43 ± 0.15		
10.36	$\frac{5}{2}^-$	observed		0.05 ± 0.03 [c]		
					0.019 ± 0.012	5.8 ± 0.3
			3.97 ± 0.05	0.13 ± 0.07		

[a] (1970ES03). In addition there is some evidence for weak proton groups with $E_p = 3.44$ and 6.28 MeV (± 0.05 MeV).

[b] The ground-state ft was taken to be 1.15 times that for ^{13}B (1970ES03).

[c] Calculated value from the known ratio of the elastic and inelastic widths.

[d] Includes a calculated relative intensity of (3.4 ± 1.4) to ^{12}C*(4.4). I am indebted to Prof. F.C. Barker for this observation.

At $E_{\pi^+} = 164$ MeV excited states are reported at $E_x = 2.75 \pm 0.04$ and 4.21 MeV, as is a broad [$\Gamma = 1.2$ MeV] structure corresponding to one or more states at $E_x = 6.02 \pm 0.08$ MeV. At $E_{\pi^+} = 292$ MeV these states are not observed. Angular distributions have been studied at $E_{\pi^+} = 164$ and 292 MeV to $^{13}O_{g.s.}$ and at 164 MeV to ^{13}O*(4.21) (1984SE15). See also (1980BU15).

4. ^{16}O(^{3}He, ^{6}He)^{13}O $\qquad Q_m = -30.509$

See (1981AJ01).

^{13}F, ^{13}Ne, ^{13}Na
(Not illustrated)

These nuclei have not been observed: see (1983ANZQ; theor.).

References

(Closed 01 June 1985)

1965LI09 G.P. Lietz, S.F. Trevino, A.F. Behof and S.E. Darden, Nucl. Phys. 67 (1965) 193

1966PO11 A.R. Poletti, J.W. Olness and E.K. Warburton, Phys. Rev. 151 (1966) 812

1968DA05 C.N. Davids, Nucl. Phys. A110 (1968) 619

1968RI16 F. Riess, P. Paul, J.B. Thomas and S.S. Hanna, Phys. Rev. 176 (1968) 1140

1970AJ04 F. Ajzenberg-Selove, Nucl. Phys. A152 (1970) 1

1970ES03 J.E. Esterl, J.C. Hardy, R.G. Sextro and J. Cerny, Phys. Lett. B33 (1970) 287

1973AD02 E.G. Adelberger, A.B. McDonald, C.L. Cocke, C.N. Davids, A.P. Shukla, H.B. Mak and D. Ashery, Phys. Rev. C7 (1973) 889

1973GO15 J.D. Goss, S.L. Blatt, D.R. Parsignault, C.D. Porterfield and F.L. Riffle, Phys. Rev. C7 (1973) 1837

1974BL06 S.L. Blatt, G.L. Marolt and J.D. Goss, Phys. Rev. C10 (1974) 1319

1974HO06 C.H. Holbrow, H.G. Bingham, R. Middleton and J.D. Garrett, Phys. Rev. C9 (1974) 902

1974RO29 C. Rolfs and R.E. Azuma, Nucl. Phys. A227 (1974) 291

1976AJ04 F. Ajzenberg-Selove, Nucl. Phys. A268 (1976) 1

1976DY05 K. Dybdal, J.L. Eberhardt and N. Rud, Phys. Lett. B64 (1976) 414

1977GR04 J.Y. Grossiord, M. Bedjidian, A. Guichard, M. Gusakow, J.R. Pizzi, T. Delbar, G. Gregoire and J. Lega, Phys. Rev. C15 (1977) 843

1977MA16 R.E. Marrs, E.G. Adelberger and K.A. Snover, Phys. Rev. C16 (1977) 61

1978AJ02 F. Ajzenberg-Selove, E.R. Flynn and O. Hansen, Phys. Rev. C17 (1978) 1283

1978AL1G Alkhazov, Belostotsky and Vorobyov, Phys. Rept. C42 (1978) 89

1978CO15 P. Couvert, G. Bruge, R. Beurtey, A. Boudard, A. Chaumeaux, M. Garcon, D. Garreta, P.C. Gugelot, G.A. Moss, S. Platchkov, J.P. Tabet et al., Phys. Rev. Lett. 41 (1978) 530

1978DY01 S.A. Dytman, J.F. Amann, P.D. Barnes, J.N. Craig, K.G.R. Doss, R.A. Eisenstein, J.D. Sherman, W.R. Wharton, G.R. Burleson, S.L. Verbeck et al., Phys. Rev. C18 (1978) 2316

1978GO14 N.F. Golovanova and I.M. Ilin, Izv. Akad. Nauk SSSR Ser. Fiz. 42 (1978) 1528; Bull. Acad. Sci. USSR Phys. Ser. 42 (1978) 154

1978HI06 F. Hinterberger, R. Schonhagen, P. von Rossen, B. Schuller, F.E. Blumenberg, P.D. Eversheim and R. Gorgen, Nucl. Phys. A308 (1978) 61

1978LEZA C.M. Lederer, V.S. Shirley, E. Browne, J.M. Dairiki, R.E. Doebler, A.A. Shihab-Eldin, L.J. Jardine, J.K. Tuli and A.B. Buyrn, Table of Isotopes 7th Ed. (1978)

1978MO01 C.L. Morris, R.L. Boudrie, J.J. Kraushaar, R.J. Peterson, R.A. Ristinen, G.R. Smith, J.E. Bolger, W.J. Braithwaite, C.F. Moore and L.E. Smith, Phys. Rev. C17 (1978) 227

1979BA16 B. Bassalleck, H.-D. Engelhardt, W.D. Klotz, F. Takeutchi, H. Ullrich and M. Furic, Nucl. Phys. A319 (1979) 397

1979BA48 J.K. Bair and J. Gomez del Campo, Nucl. Sci. Eng. 71 (1979) 18

1979CO1B Coyne and Goodman, 6th Symp. on Microdosimetry Pt. II, Brussels, Belgium (1978) 699

1979FO18 M. Fox, I. Morrison, K. Amos and D. Weiss, Phys. Lett. B86 (1979) 121

1979FU03 H. Fuchs, T.S. Bhatia, P. Doll, H. Hafner and C.J. Wagner, J. Phys. (London) G5 (1979) 797

1979FU04 C.B. Fulmer, R.M. Wieland, D.C. Hensley, S. Raman, G.R. Satchler, A.H. Snell, P.H. Stelson and R.G. Stokstad, Phys. Rev. C20 (1979) 670

1979JO08 R.R. Johnson, T. Masterson, B. Bassalleck, W. Gyles, T. Marks, K.L. Erdman, A.W. Thomas, D.R. Gill, E. Rost, J.J. Kraushaar et al., Phys. Rev. Lett. 43 (1979) 844

1979KEZU J.D. Kellie, G.P. Lamaze and R.B. Schwartz, Proc. Int. Conf. on Nucl. Cross Sect. for Tech., Knoxville, TN, 1979 (1980) 48

1979KO26 L. Koester, K. Knopf and W. Waschkowski, Z. Phys. A292 (1979) 95

1979LI1A Li and Shen, Phys. Energ. Fortis Phys. Nucl. 3 (1979) 327

1979MA48 S.I. Manaenkov, Pisma Zh. Eksp. Teor. Fiz. 30 (1979) 360; JETP Lett. 30 (1979) 334

1979ME2A D.F. Measday, G.A. Miller, Ann. Rev. Nucl. Part. Sci. 29 (1979) 121

1979OL04 V.S. Olkhovskii and G.A. Prokopets, Yad. Fiz. 30 (1979) 95; Sov. J. Nucl. Phys. 30 (1979) 48

1979PR07 G. Proudfoot and W.D.M. Rae, Nucl. Phys. A329 (1979) 271

1979SC25 E. Schwarz, J.-P. Egger, F. Goetz, P. Gretillat, C. Lunke, C. Perrin, B.M. Preedom and R.E. Mischke, Phys. Rev. Lett. 43 (1979) 1578

1979SE07 R.R. Sercely, R.J. Peterson, P.A. Smith and E.R. Flynn, Nucl. Phys. A324 (1979) 53

1979ZH1A Zhurkin et al., Yad. Fiz. 30 (1979) 299

1979ZH1B Zhivopistsev and Rzhevskii, Vestn. Mosk. Univ. Ser. 34 (1979) 64

1980AF1A Afzal, Ansari and Sergal, Lett. Nuovo Cim. 29 (1980) 350

1980AK1D Akhababyan, Grishin and Simic, Sov. J. Nucl. Phys. 32 (1980) 816

1980AN40 Yu.P. Antufev, V.M. Mishchenko, A.I. Popov, V.E. Storizhko and N.A. Shlyakhov, At. Energ. 49 (1980) 332; Sov. At. Energy 49 (1980) 794

1980AU1D Audouze, Chieze and Vangioni-Flam, Astron. Astrophys. 91 (1980) 49

1980BA1P J.N. Bahcall, S.H. Lubow, W.F. Huebner, N.H. Magee, A.L. Merts, M.F. Argo, P.D. Parker, B. Rozsnyai and R.K. Ulrich, Phys. Rev. Lett. 45 (1980) 945

1980BA27 H.W. Baer, J.D. Bowman, M.D. Cooper, F.H. Cverna, C.M. Hoffman, M.B. Johnson, N.S.P. King, J. Piffaretti, E.R. Siciliano, J. Alster et al., Phys. Rev. Lett. 45 (1980) 982

1980BA2M Bahcall, Proc. Int. School in Nucl. Phys., Progress in Particle and Nucl. Phys., Erice, Italy, Vol. 6 (1980) 111

1980BA54 F.C. Baker and N. Ferdous, Aust. J. Phys. 33 (1980) 691

1980BO1T Bondouk and Omar, Atomkernernerg. Kerntech. 35 (1980) 216, 219

1980BO31 V.I. Bogatin, E.A. Ganza, O.V. Lozhkin, Yu.A. Murin and V.S. Oplavin, Yad. Fiz. 32 (1980) 27; Sov. J. Nucl. Phys. 32 (1980) 14

1980BU15 G.R. Burleson, G.S. Blanpied, G.H. Daw, A.J. Viescas, C.L. Morris, H.A. Thiessen, S.J. Greene, W.J. Braithwaite, W.B. Cottingame, D.B. Holtkamp et al., Phys. Rev. C22 (1980) 1180

1980CH32 H.C. Chiang and J. Hufner, Nucl. Phys. A349 (1980) 466

1980CI03 S. Cierjacks, F. Hinterberger, G. Schmalz, D. Erbe, P.V. Rossen and B. Leugers, Nucl. Instrum. Meth. 169 (1980) 185

1980CO10 T.M. Cormier and B.R. Fulton, Phys. Rev. C22 (1980) 565

1980CR03 J.F. Crawford, M. Daum, G.H. Eaton, R. Frosch, H. Hirschmann, R. Horisberger, J.W. McCulloch, E. Steiner, R. Hausammann, R. Hess et al., Phys. Rev. C22 (1980) 1184

1980CU03 A. Cunsolo, A. Foti, G. Imme, G. Pappalardo, G. Raciti, F. Rizzo and N. Saunier, Phys. Rev. C21 (1980) 952

1980DE1X Delorme, Figureau and Guichon, Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 121

1980DE2F de Swiniarski and Dinh-lien Pham, Z. Phys. A296 (1980) 367

1980DI10 N.G. DiGiacomo, R.M. DeVries and J.C. Peng, Phys. Rev. Lett. 45 (1980) 527

1980DM1A Dmitriev, Kosmach, Molchanov and Ostroumov, Yad. Fiz. 31 (1980) 119; Sov. J. Nucl. Phys. 31 (1980) 62

1980EI01 J.M. Eisenberg, J. Phys. (London) G6 (1980) 1265

1980FR1K Franz et al., Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 890

1980FU04 H. Fuchs, J.A. Nolen, G.J. Wagner, H. Lenske and G. Baur, Nucl. Phys. A343 (1980) 133

1980FU1G Furutani et al., Suppl. Prog. Theor. Phys. 68 (1980) 193

1980GA1K Gass et al., Ukr. Fiz. Zh. 25 (1980) 1276, 1281

1980GA1Q Gardner, Godfrey and Williams, Monthly Notices of the Royal Astron. Soc. 193 (1980) 713

1980GA26 A.S. Gass, O.Yu. Goryunov, V.N. Dobrikov, O.F. Nemets and A.T. Rudchik, Yad. Fiz. 32 (1980) 902

1980GO1M Goodman et al., Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 709

1980GR10 R.E.L. Green and R.G. Korteling, Phys. Rev. C22 (1980) 1594

1980HA1X Han et al., Phys. Energ. Fortis Phys. Nucl. 4 (1980) 210, 227

1980HA56 F. Hachenberg, H.C. Chiang and J. Hufner, Phys. Lett. B97 (1980) 183

1980HE04 R.L. Helmer, M.D. Hasinoff, J.E. Bussoletti, K.A. Snover and T.A. Trainor, Nucl. Phys. A336 (1980) 219

1980HO11 R.J. Holt, R.M. Laszewski, H.E. Jackson, J.E. Monahan and J.R. Specht, Phys. Rev. C21 (1980) 1699; Erratum Phys. Rev. C23 (1981) 1841

1980HO18 K. Hosono, M. Kondo, T. Saito, N. Matsuoka, S. Nagamachi, T. Noro and H. Shimizu, Nucl. Phys. A343 (1980) 234

1980HO20 B. Hoistad, P.H. Pile, T.P. Sjoreen, R.D. Bent, M.C. Green and F. Soga, Phys. Lett. B94 (1980) 315

1980HU1D Hugg and Hanna, Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 891

1980HU1E Hugi et al., Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 508

1980IW1A Iwao, Lett. Nuovo Cim. 29 (1980) 40

1980IZ1B Izumoto, Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 566

1980JA1C Jadraque, Lozano and Madurga, Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 413

1980JO1E Johnson, Proc. Int. Conf. on Nucl. Cross Sect. for Tech, Knoxville, TN, 1979 (1980) 52

1980KE14 J. Kelly, W. Bertozzi, T.N. Buti, F.W. Hersman, C. Hyde, M.V. Hynes, B. Norum, F.N. Rad, A.D. Bacher, G.T. Emery et al., Phys. Rev. Lett. 45 (1980) 2012

1980KO1Q Kober, Gruhle and Hillen, Nucl. Instrum. Meth. Phys. Res. 174 (1980) 173

1980KO40 V.I. Komarov, G.E. Kosarev, H. Muller, D. Netzband, S. Tesch and T. Stiehler, Yad. Fiz. 32 (1980) 1476; Sov. J. Nucl. Phys. 32 (1980) 763

1980LE17 T.-S.H. Lee and D. Kurath, Phys. Rev. C22 (1980) 1670

1980LE19 Z. Lewandowski, E. Loeffler, R. Wagner, F. Brunner, H.H. Muller, W. Reichart, P. Schober and M. Kozlowski, Phys. Lett. B95 (1980) 207

1980LE28 A.A. Levkovsky and E.F. Dreiman, Yad. Fiz. 31 (1980) 569; Sov. J. Nucl. Phys. 31 (1980) 295

1980LI13 Q.K.K. Liu and P.J. Ellis, Phys. Rev. C22 (1980) 540

1980LI1M Lisowski, Moore, morgan and Shamu, Proc. Int. Conf. on Nucl. Cross Scet. for Tech., Knoxville, TN, 1979 (1980) 524

1980MA06 S.I. Manaenkov, Yad. Fiz. 31 (1980) 359; Sov. J. Nucl. Phys. 31 (1980) 189

1980MA34 G. Madurga, M. Lozano and A. Jadraque, Phys. Lett. B95 (1980) 358

1980PE13 R.J. Peterson and J.J. Hamill, Phys. Rev. C22 (1980) 2282

1980PR09 G. Proudfoot, H.S. Bradlow, P.S. Fisher, N.S. Godwin, J. King, D. Sinclair and W.D.M. Rae, Nucl. Phys. A345 (1980) 278

1980RA12 W.D. Rae, R.G. Stokstad, B.G. Harvey, A. Dacal, R. Legrain, J. Mahoney, M.J. Murphy and T.J.M. Symons, Phys. Rev. Lett. 45 (1980) 884

1980RI05 L. Rikus and K. Amos, J. Phys. (London) G6 (1980) 1535

1980RI06 W.A. Richter and P.R. de Kock, Z. Phys. A297 (1980) 343

1980SA20 H. Sakai, K. Hosono, N. Matsuoka, S. Nagamachi, K. Okada, K. Maeda and H. Shimi, Nucl. Phys. A344 (1980) 41

1980SA34 M.V. Savin, Yu.A. Khokhlov, I.N. Paramonova, V.A. Chirkin, V.N. Ludin and N.N. Zalyalov, At. Energ. 49 (1980) 236; Sov. At. Energy 49 (1980) 686

1980SE1E Sellschop, Bull. Amer. Phys. Soc. 25 (1980) 800

1980SN01 K.A. Snover, P. G.Ikossi, E.G. Adelberger and K.T. Lesko, Phys. Rev. Lett. 44 (1980) 927

1980SO05 F. Soga, R.D. Bent, P.H. Pile, T.P. Sjoreen and M.C. Green, Phys. Rev. C22 (1980) 1348

1980SO1B Sober et al., Private Communiations (1980)

1980SO1D Sowinski and Marvis, Polarization, Santa Fe (1980) 76

1980ST1K Strikman and Frankfurt, Yad. Fiz. 32 (1980) 1403

1980TA1K Tamura, Udagawa and Mermaz, Phys. Rept. 65 (1980) 345

1980TH05 W.J. Thompson, J.F. Wilkerson, T.B. Clegg, J.M. Feagin, E.J. Ludwig and E. Merzbacher, Phys. Rev. Lett. 45 (1980) 703

1980TH07 M. Thumm, H. Lesiecki, G. Mertens, K. Schmidt and G. Mack, Nucl. Phys. A344 (1980) 446

1980WA1M Wannier, Ann. Rev. Astro. Astrophys. 18 (1980) 399

1980WA24 E.K. Warburton, D.E. Alburger and D.J. Millener, Phys. Rev. C22 (1980) 2330

1980WE1F Weil, Burrows and McDaniel, Proc. Int. Conf. on Nucl. Cross Sections for Tech., Knoxville, TN, 1979 (1980) 985

1980ZH1C Zheng, Li and Shen, Transactions of the N.Y. Acad. of Sci. 40 (1980) 274

1980ZU1B Zul'karneev, Kutuev and Murtazaev, Yad. Fiz. 32 (1980) 889

1981AJ01 F. Ajzenberg-Selove, Nucl. Phys. A360 (1981) 1

1981AK01 Yu.K. Akimov, I.I. Gaysak, F.F. Guber, V.A. Krasnov, A.B. Kurepin, S.I. Merzlyakov, K.O. Oganesyan, E.A. Pasyuk, S.Yu. Porokhovoy AND A.I. Reshetin, Yad. Fiz. 33 (1981) 33; Sov. J. Nucl. Phys. 33 (1981) 17

1981AL1K Alma-ata et al., Sov. J. Nucl. Phys. 33 (1981) 552

1981AN16 B. Anders, P. Herges and W. Scobel, Z. Phys. A301 (1981) 353

1981AU05 E.H. Auerbach, A.J. Baltz, C.B. Dover, A. Gal, S.H. Kahana, L. Ludeking and D.J. Millener, Phys. Rev. Lett. 47 (1981) 1110

1981AU1C Auld, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 93

1981AV02 I.K. Averyanov, A.I. Golubev and A.A. Sadovoy, Yad. Fiz. 33 (1981) 66

1981BA1F Bacher, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 220

1981BA1H Bart et al., Bull. Amer. Phys. Soc. 26 (1981) 605

1981BA1J Baer et al., Nucl. Instrum. Meth. 180 (1981) 445

1981BA1R Bayukov et al., Yad. Fiz. 33 (1981) 183

1981BA2F Barnes, Prog. Part. Nucl. Phys. 6 (1981) 235

1981BA2G Bahcall, Prog. Part. Nucl. Phys. 6 (1981) 111

1981BR1E Brooks, Lister, Nelson and Dhuga, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 656

1981BR21 H. Brody, S. Frankel, W. Frati, O.B. Van Dyck, Phys. Rev. C24 (1981) 2157

1981BR24 J.S. Briggs and A.M. Lane, Phys. Lett. B106 (1981) 436

1981BY01 R.C. Byrd, C.E. Floyd, K. Murphy, P.P. Guss, R.L. Walter and S.R. Cotanch, Nucl. Phys. A351 (1981) 189

1981CH1R Chu et al., Chin. Phys. 1 (1981) 421

1981CHZP C.C. Chang, Bull. Amer. Phys. Soc. 26 (1981) 1136, CD6

1981CI03 M.A. Cirit and F. Yazici, Phys. Rev. C23 (1981) 2627

1981CO10 J.R. Comfort, R.E. Segel, G.L. Moake, D.W. Miller and W.G. Love, Phys. Rev. C23 (1981) 1858

1981CO1M Couvert and Dillig, Proc. Versailles Conf. (1981) 195

1981CO20 J.R. Comfort, G.L. Moake, C.C. Foster, P. Schwandt, C.D. Goodman, J. Rapaport and W.G. Love, Phys. Rev. C24 (1981) 1834

1981CO21 J.R. Comfort, Phys. Rev. C24 (1981) 1844

1981CR1A Crowe et al., Proc. Versailles Conf. (1981) 405

1981CR1B Crutcher and Watson, Astrophys. J. 244 (1981) 855

1981DA1C R.H. Dalitz, Nucl. Phys. A354 (1981) 101

1981DE07 J. Delorme, A. Figureau and P. Guichon, Phys. Lett. B99 (1981) 187

1981DE1P R.M. DeVries and N.J. Digiacomo, J. Phys. (London) G7 (1981) L51

1981DE1U J. Delorme, Nucl. Phys. A358 (1981) 73

1981DE2B Des Marais, Donchin, Nehring and Truesdell, Nature 292 (1981) 826

1981DM1A Dmitriev, Kosmach and Ostroumov, Yad. Fiz. 33 (1981) 1158

1981DY03 P. Dyer, D. Bodansky, A.G. Seamster, E.B. Norman and D.R. Maxson, Phys. Rev. C23 (1981) 1865

1981ER07 J. Ero, Z. Fodor, P. Koncz, Z. Seres and M. Csatlos, Nucl. Phys. A367 (1981) 419

1981FE2A H.W. Fearing, Prog. Part. Nucl. Phys. 7 (1981) 113

1981FL04 C.E. Floyd, P.P. Guss, K. Murphy, R.C. Byrd, G. Tungate, S.A. Wender, R.L. Walter and T.B. Clegg, Phys. Rev. Lett. 47 (1981) 1042

1981FR02 M.A. Franey and P.J. Ellis, Phys. Rev. C23 (1981) 787

1981FR1D Francey, Nature 290 (1981) 232

1981FR1R S. Frankel and W. Frati, Phys. Rev. C24 (1981) 2739

1981FR1T Frankfurt and Strikman, Phys. Rept. 76 (1981) 215

1981FU12 T. Fujisawa, N. Kishida, T. Kubo, T. Wada, Y. Toba, T. Hasegawa, M. Sekiguchi, N. Ueda, M. Yasue, F. Soga et al., J. Phys. Soc. Jpn 50 (1981) 3198

1981GI1A Gibbs, Stephenson and Dubach, Bull. Amer. Phys. Soc. 26 (1981) 566

1981GO1G Goetz et al., Proc. Versailles Conf. (1981) 320

1981GOZX C.A. Goulding, C.D. Goodman, C.C. Foster, J. Rapaport, J. Tadeleucci, E. Sugarbaker, C. Gaarde, J. Larson, D. Horen and T. Masterson, Bull. Amer. Phys. Soc. 26 (1981) 623, JI3

1981GR08 K. Grotowski, P. Belery, Th. Delbar, Y. El Masri, Gh. Gregoire, R. Janssens, J. Vervier, G. Paic, M. Albinska, J. Albinski et al., Phys. Rev. C23 (1981) 2513

1981GR17 K.A. Gridnev, K. Mikulas, V.M. Semenov and E.F. Khefter, Izv. Akad. Nauk SSSR Ser. Fiz. 45 (1981) 134

1981GU12 K. Gul, M. Anwar, M. Ahmad, S.M. Saleem and N.A. Khan, Phys. Rev. C24 (1981) 2458

1981GU1D Guzik, Astrophys. J. 244 (1981) 695

1981HA01 D. Halderson and R.J. Philpott, Phys. Rev. Lett. 46 (1981) 100

1981HAZU C. Harvey, H.W. Baer, C.L. Morris, D.B. Holtkamp, S.J. Seestrom-Morris, D. Dehnhard and S.J. Greene, Bull. Amer. Phys. Soc. 26 (1981) 582, EH7

1981HE08 B. Heusch, C. Beck, J.P. Coffin, R.M. Freeman, A. Gallmann, F. Haas, F. Rami, P. Wagner and D.E. Alburger, Phys. Rev. C23 (1981) 1527

1981HI06 M. Hirata, Phys. Rev. C24 (1981) 1604

1981HU1G Hugg anf Hanna, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 662

1981IN1B Int. Nucl. Data Comm. INDC-36/LN (1981)

1981IR1A Irom et al., Proc. Versailles Conf. (1981) 546

1981IS11 B.S. Ishkhanov, I.M. Kapitonov, V.G. Neudachin and R.A. Eramzhyan, Fiz. Elem. Chastits At. Yadra 12 (1981) 905; Sov. J. Part. Nucl. 12 (1981) 362

1981KA16 G. Kajrys, W. Del Bianco, J. Kim, S. Landsberger, R. Lecomte, S. Monaro and P. Paradis, Can. J. Phys. 59 (1981) 781

1981KA1N Kaletka et al., Proc. Versailles Conf. (1981) 300

1981KE1A Keister and Kisslinger, Bull. Amer. Phys. Soc. 26 (1981) 566

1981KH07 Z.A. Khan, Z. Phys. A303 (1981) 161

1981KL1D A. Klar, Nucl. Phys. A367 (1981) 369

1981KN06 W. Knupfer and A. Richter, Phys. Lett. B101 (1981) 375

1981KO1Q Kostin and Migalenya, Ukr. Fiz. Zh. SSSR 26 (1981) 803

1981KO1V Kolesnikov, Zhukhovitskii, Kopylov and Tarasov, Sov. J. Nucl. Phys. 34 (1981) 533

1981KO27 K. Koshigiri, H. Ohtsubo and M. Morita, Prog. Theor. Phys. 66 (1981) 358

1981KO33 M. Kozlowski, H.H. Mueller and R. Wagner, Phys. Lett. B107 (1981) 27

1981KR15 H. Krimm, A. Klar and H.J. Pirner, Nucl. Phys. A367 (1981) 333

1981KU03 K.-I. Kubo and P.E. Hodgson, Phys. Lett. B100 (1981) 453

1981KU09 K.-I. Kubo and P.E. Hodgson, Nucl. Phys. A366 (1981) 320

1981LA04 S. Landowne, Phys. Rev. C23 (1981) 1080

1981LA1L Lambert and Ries, Astrophys. J. 248 (1981) 228

1981LI02 L.C. Liu, Phys. Rev. C23 (1981) 814

1981LI13 C.K. Lin and L. Zamick, Nucl. Phys. A365 (1981) 411

1981LI19 R.A. Lindgren, M.A. Plum, W.J. Gerace, R.S. Hicks, B. Parker, G.A. Peterson, R. Singhal, C.F. Williamson, X.K. Maruyama and F. Petrovich, Phys. Rev. Lett. 47 (1981) 1266

1981LI1B Liljestrand et al., Proc. Versailles Conf. (1981) 544

1981LO1B Lolos et al., Santa Fe 1980, AIP Conf. Proc. 69 (1981) 550

1981MA14 G. Mairle, G.J. Wagner, K.T. Knopfle, Ken Pao Liu, H. Riedesel, V. Bechtold and L. Friedrich, Nucl. Phys. A363 (1981) 413

1981MA18 J.F. Mateja, A.D. Frawley, L.C. Dennis, K. Abdo and K.W. Kemper, Phys. Rev. Lett. 47 (1981) 311

1981MA27 M. May, H. Piekarz, R.E. Chrien, S. Chen, D. Maurizio, H. Palevsky, R. Sutter, Y.Xu, P. Barnes, B. Bassalleck et al., Phys. Rev. Lett. 47 (1981) 1106

1981ME02 H.O. Meyer, P. Schwandt, G.L. Moake and P.P. Singh, Phys. Rev. C23 (1981) 616

1981ME13 M.C. Mermaz, J. Barrette and H.E. Wegner, Phys. Rev. C24 (1981) 2148

1981ME1F Meyer and Elbaz, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 1083

1981MI1A Millener et al., Bull. Amer. Phys. Soc. 26 (1981) 605

1981MI1F Millener, Bull. Amer. Phys.Soc. 26 (1981) 1130

1981MO11 I. Morrison and K. Amos, Phys. Rev. C23 (1981) 1679

1981MU1E Mukhopadhyay and Hintermann, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 1068

1981MUZQ S.F. Mughabghab, M. Divadeenam and N.E. Holden, Neutron Cross Sections 1A (1981) Z=1–60

1981NA1E S. Nagamiya, M.-C. Lemaire, E. Moeller, S. Schnetzer, G. Shapiro, H. Steiner and I. Tanihata, Phys. Rev. C24 (1981) 971

1981NAZY H. Nann, K.K. Seth, S. Iversen and B. Hoistad, Bull. Amer. Phys. Soc. 26 (1981) 581, EH5

1981NI1B Niskanen, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 62

1981NO1G Norbeck, Nucl. Sci. Eng. 78 (1981) 412

1981NOZW E. Norbeck and P.L. Chung, Bull. Amer. Phys. Soc. 26 (1981) 1131, CB1

1981OL02 V.S. Olkhovskii, Yu.I. Totskii and V.A. Chinarov, Izv. Akad. Nauk SSSR Ser. Fiz. 45 (1981) 743

1981OL1B Olkhovskii and Chinarov, Proc. Samarkand Conf. (1981) 504

1981OL1C D.L. Olson, B.L. Berman, D.E. Greiner, H.H. Heckman, P.J. Lindstrom, G.D. Westfall and H.J. Crawford, Phys. Rev. C24 (1981) 1529

1981OS04 E. Oset and D. Strottman, Nucl. Phys. A355 (1981) 437

1981OS1H Osman, Atomkernernerg. Kerntech. 38 (1981) 212

1981OZ1A Ozkok, Rev. Fac. Sci. Univ. Istanbul Ser. C46 (1981) 17

1981PE01 J.C. Peng, R.M. DeVries and N.J. DiGiacomo, Phys. Lett. B98 (1981) 244

1981PE08 R.J. Peterson, J.R. Shepard and R.A. Emigh, Phys. Rev. C24 (1981) 826

1981PE1C F. Petrovich and W.G. Love, Nucl. Phys. A354 (1981) 499

1981PH1C Phan et al., Proc. Versailles Conf. (1981) 223

1981PL03 G.R. Plattner, R.D. Viollier, Nucl. Phys. A365 (1981) 8

1981PL1C Plattner and Sick, Eur. J. Phys. 2 (1981) 109

1981PO10 W.N. Polyzou, W.R. Gibbs and G.J. Stephenson, Jr., Phys. Rev. C23 (1981) 2648

1981PR04 W.V. Prestwich, M.A. Islam and T.J. Kennett, Nucl. Sci. Eng. 78 (1981) 182

1981RA18 M. Rayet, Nucl. Phys. A367 (1981) 381

1981RU04 A.J. Rutten, A. Holthuizen, W.A. Sterrenburg, C.P.M. Van Engelen and G. Van Middelkoop, Nucl. Phys. A359 (1981) 442

1981SC1M Schatzman, CERN 81-11

1981SE06 M. Seya, M. Kohno and S. Nagata, Prog. Theor. Phys. 65 (1981) 204

1981SE08 S.J. Seestrom-Morris, D. Dehnhard, D.B. Holtkamp and C.L. Morris, Phys. Rev. Lett. 46 (1981) 1447

1981SH1A C.S. Shastry and R.K. Satpathy, Proc. Indian Natl. Sci. Acad. A47 (1981) 373

1981SI1B I. Sick, Nucl. Phys. A354 (1981) 37

1981SI1D Singham and Tabakin, Proc. Versailles Conf. (1981) 129

1981SJ02 T.P. Sjoreen, P.H. Pile, R.E. Pollock, W.W. Jacobs, H.O. Meyer, R.D. Bent, M.C. Green and F. Soga, Phys. Rev. C24 (1981) 1135

1981SN1A Snover, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 321

1981SN1B Sneden, Lambert and Pilachowski, Astrophys. J. 247 (1981) 1052

1981SO04 F. Soga, P.H. Pile, R.D. Bent, M.C. Green, W.W. Jacobs, T.P. Sjoreen, T.E. Ward and A.G. Drentje, Phys. Rev. C24 (1981) 570

1981ST1P Stokstad, Nukleonika 26 (1981) 373

1981SU03 T. Suzuki, H. Hyuga, A. Arima and K. Yazaki, Nucl. Phys. A358 (1981) 421c

1981SU08 T. Suzuki, H. Hyuga, A. Arima and K. Yazaki, Phys. Lett. B106 (1981) 19

1981TA03 I. Tanihata, S. Nagamiya, S. Schnetzer and H. Steiner, Phys. Lett. B100 (1981) 121

1981TA21 M. Tanaka, J. Kawa, T. Fukuda, T. Shimoda, K. Katori, S. Nakayama, I. Miura and H. Ogata, Phys. Lett. B106 (1981) 293

1981TO1E Tornow, Woye and Walter, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 1320

1981VA1P van der Leun, de Wit and Alderliesten, in Neutron-Capture Gamma-Ray Spectrosc. & Related Topics 1981, London, No. 62 (1981) 548

1981VE15 L. Vegh, B.Z. Kopeliovich, L.I. Lapidus, Yad. Fiz. 33 (1981) 366; Sov. J. Nucl. Phys. 33 (1981) 178

1981WA1G Walter, Santa Fe 1980, AIP Conf. proc. 69 (1981) 344

1981WA1J Wang, Zhang, Li and Ruan, Proc. Versailles Conf. (1981) 374

1981WA1N Wannier, Linke and Penzias, Astrophys. J. 247 (1981) 522 and Astrophys. J. 254 (1982) 419

1981WA1Q Wallace and Woosley, Astrophys. J. Suppl. 45 (1981) 389

1981WA20 D. Waxman, C. Wilkin, J.-F. Germond and R.J. Lombard, Phys. Rev. C24 (1981) 578

1981WEZZ P. Welch, J. Johnson, G. Randers-Pehrson and J. Rapaport, Bull. Amer. Phys. Soc. 26 (1981) 708, G3

1981WH01 W.R. Wharton and B.D. Keister, Phys. Rev. C23 (1981) 1141

1981WI1G Wilson, Langer and Goldsmith, Astrophys. J. 243 (1981) L47

1981XU1A Xu et al., Phys. Energ. Fortis Phys. Nucl. 5 (1981) 607

1981YA08 M. Yabe, A. Mori and K.-I. Kubo, Phys. Lett. B104 (1981) 343

1981YA1C Yavin, CEA-N-2211 (1981)

1981ZA03 C.I. Zanelli, P.P. Urone, J.L. Romero, F.P. Brady, M.L. Johnson, G.A. Needham, J.L. Ullmann and D.L. Johnson, Phys. Rev. C23 (1981) 1015

1981ZH1B Zhang, Yu and Li, Proc. Versailles Conf. (1981) 368

1982AJ01 F. Ajzenberg-Selove, Nucl. Phys. A375 (1982) 1

1982AL1G Aleksandrov et al., in Kiev (1982) 358

1982AM1B Amelin, Glagolev and Lykasov, Fiz. Elem. Chastits At. Yadra 13 (1982) 130

1982ANZW L.E. Antonuk, D. Bovet, E. Bovet, J.-P. Egger, F. Goetz, P. Gretillat, C. Lunke and E. Schwarz, Bull. Amer. Phys. Soc. 27 (1982) 721, DD8

1982AO05 Y. Aoki, S. Kunori, K. Nagano, Y. Toba and K. Yagi, Nucl. Phys. A382 (1982) 269

1982AS05 E. Aslanides, P. Baumann, G. Bergdoldt, P. Fassnacht, F. Hibou, T. Bressani, G.A. Puddu, E. Chiavassa, M. Gallio, A. Musso et al., Lett. Nuovo Cim. 34 (1982) 385

1982AW02 A.M. Awin and P.E. Shanley, Nucl. Phys. A386 (1982) 101

1982AZ01 A.A. Azzam, M.A. Fawzy, Indian J. Phys. A56 (1982) 1

1982BA14 A.G. Baryshnikov, E.I. Dolinsky and S.P. Krekoten, Izv. Akad. Nauk SSSR Ser. Fiz. 46 (1982) 166

1982BA1R P.D. Barnes, Nucl. Phys. A374 (1982) 415

1982BA78 V.N. Baturin, V.V. Vikhrov, M.M. Makarov, V.V. Nelyubin, A.A. Naberezhnov, V.V. Sulimov and L.N. Uvarov, Pisma Zh. Eksp. Teor. Fiz. 36 (1982) 370; JETP Lett. 36 (1982) 448

1982BA80 J.N. Bahcall, W.F. Huebner, S.H. Lubow, P.D. Parker and R.K. Ulrich, Revs. Mod. Phys. 54 (1982) 767

1982BE1D A.M. Bernstein, Proc. Int. School of Intermediate Energy Nucl. Phys., Verona, Italy, July 1981; Eds., R. Bergere, S. Costa and C. Schaerf (1982) 125

1982BE1U Bertini, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 359

1982BE51 B. Bellinghausen, A. Christ, H.J. Gassen, G. Goerigk, R. Muller, G. Noldeke, T. Reichelt, H. Stanek and P. Stipp, Z. Phys. A309 (1982) 65

1982BO1N Boyd, Bull. Amer. Phys. Soc. 27 (1982) 761

1982BR1A Braun and Vechernin, Sov. J. Nucl. Phys. 36 (1982) 357

1982BU1D Burtebeav, Duisebaev and Ivanov, in Kiev (1982) 327

1982CA08 T.A. Carey, J.M. Moss, S.J. Seestrom-Morris, A.D. Bacher, D.W. Miller, H. Nann, C. Olmer, P. Schwandt, E.J. Stephenson and W.G. Love, Phys. Rev. Lett. 49 (1982) 266

1982CH02 Y.-d. Chan, R.J. Puigh, W.L. Lynch, M.T. Tsang and J.G. Cramer, Phys. Rev. C25 (1982) 850

1982CH05 J.L. Charvet, R. Dayras, J.M. Fieni, S. Joly and J.L. Uzureau, Nucl. Phys. A376 (1982) 292

1982CH16 I.-T. Cheon, Z. Phys. A306 (1982) 353

1982CO07 E.D. Cooper and H.S. Sherif, Phys. Rev. C25 (1982) 3024

1982CO08 S.F. Collins, G.G. Shute, B.M. Spicer, V.C. Officer, I. Morrison, K.A. Amos, D.W. Devins, D.L. Friesel and W.P. Jones, Nucl. Phys. A380 (1982) 445

1982CO1D Cowan and Haxton, Science 216 (1982) 51

1982CO1Z Cooper and Sherif, AIP Conf. Proc. 79 (1982) 231

1982CO20 S.G. Cooper, R. Huby, D. Kelvin and J.R. Mines, J. Phys. (London) G8 (1982) 1689

1982CO21 J.R. Comfort, G.L. Moake, C.C. Foster, P. Schwandt and W.G. Love, Phys. Rev. C26 (1982) 1800

1982DA05 J.H. Dave, C.R. Gould, L.W. Seagondollar, C.R. Howell, R.S. Pedroni, F.O. Purser and R.L. Walter, Nucl. Sci. Eng. 80 (1982) 388

1982DA16 B. Dasmahapatra, B. Cujec and F. Lahlou, Nucl. Phys. A384 (1982) 257

1982DE16 A. Debroux, N. Defawe, R. Demeure, L. Grenacs, P. Lebrun, P. Leleux, L. Palffy, A. Possoz and L.Ph. Roesch, Phys. Rev. C25 (1982) 2883

1982DE1K D. Dehnhard, Nucl. Phys. A374 (1982) 377

1982DE30 L.C. Dennis, K.M. Abdo, A.D. Frawley and K.W. Kemper, Phys. Rev. C26 (1982) 981

1982DI13 D.E. DiGregorio, J. Gomez del Campo, Y.D. Chan, J.L.C. Ford, Jr., D. Shapira and M.E. Ortiz, Phys. Rev. C26 (1982) 1490

1982DI1E Dimbylow, Phys. Med. Biol. 27 (1982) 989

1982DO01 K.G.R. Doss, P.D. Barnes, N. Colella, S.A. Dytman, R.A. Eisenstein, C. Ellegaard, F. Takeutchi, W.R. Wharton, J.F. Amann, R.H. Pehl et al., Phys. Rev. C25 (1982) 962

1982DO02 A. Doron, J. Alster, A. Erell, S. Gilad, M.A. Moinester, R.A. Anderson, H.W. Baer, J.D. Bowman, M.D. Cooper, F.H. Cverna et al., Phys. Rev. Lett. 48 (1982) 989

1982DO10 A. Doron, J. Alster, A. Erell, M.A. Moinester, R.A. Anderson, H.W. Baer, J.D. Bowman, M.D. Cooper, F.H. Cverna, C.M. Hoffman et al., Phys. Rev. C26 (1982) 189

1982DO1C C.B. Dover, Nucl. Phys. A374 (1982) 359

1982DO1M Dover and Walker, Phys. Rept. 89 (1982) 1

1982DU1A Dubovoi and Chitanava, in Kiev (1982) 421

1982FE1A Fearing, AIP Conf. Proc. 79 (1982) 319

1982FI1E Finn et al., Bull. Amer. Phys. Soc. 27 (1982) 540

1982FR02 C.A. Fry, G.A. Beer, G.R. Mason, R.M. Pearce, P.R. Poffenberger, C.I. Sayre, A. Olin and J.A. Macdonald, Nucl. Phys. A375 (1982) 325

1982FR1L Francey and Farquhar, Nature 297 (1982) 28

1982FU1F Fu and Perey, ENDF-301, BNL-NCS-51619 (1982) 35

1982GI1B Gibbs, AIP Conf. Proc. 79 (1982) 297

1982GO05 S.A. Goncharov, Ya. Dobesh, E.I. Dolinsky, A.M. Mukhamedzhanov and Ya. Tseipek, Yad. Fiz. 35 (1982) 662

1982GO1C C. Goodman, Nucl. Phys. A374 (1982) 241

1982GOZZ M.S. Gordon, C.D. Zafiratos, P.N. Craig, R.S. Raymond and J.L. Ullmann, Bull. Amer. Phys. Soc. 27 (1982) 544, GYa16

1982GR1F S.J. Greene, W.J. Braithwaite, D.B. Holtkamp, W.B. Cottingame, C.F. Moore, G.R. Burleson, G.S. Blanpied, A.J. Viescas, G.H. Daw, C.L. Morris et al., Phys. Rev. C25 (1982) 927

1982GR1K Green, AIP Conf. Proc. 79 (1982) 131

1982GR1M Green et al., Bull. Amer. Phys. Soc. 27 (1982) 702

1982GR1P Grypeos and Koutroulos, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 167

1982GRZY M.C. Green, H.O. Meyer, R.E. Pollock, T.G. Throwe, R.D. Bent, J.R. Hall, W.W. Jacobs, J.J. Kehayias, W.K. Pitts, S.E. Vigdor et al., Bull. Amer. Phys. Soc. 27 (1982) 468, BF11

1982HA1A Haight, Proc. 4th Int. Symp. Grenoble, 1981 (1982) 510

1982HA1V Haight, Bull. Amer. Phys. Soc. 27 (1982) 760

1982HE07 B. Heusch, C. Beck, J.P. Coffin, P. Engelstein, R.M. Freeman, G. Guillaume, F. Haas and P. Wagner, Phys. Rev. C26 (1982) 542

1982HI07 R.S. Hicks, J. Dubach, R.A. Lindgren, B. Parker and G.A. Peterson, Phys. Rev. C26 (1982) 339

1982HI1H Highfill, Bull. Amer. Phys. Soc. 27 (1982) 777

1982HO1C Hoistad, AIP Conf. Proc. 79 (1982) 105

1982HO1E Hodgson, Contemp. Phys. 23 (1982) 495

1982HU06 M. Hugi, J. Lang, R. Muller, J. Sromicki, E. Ungricht, K. Bodek, L. Jarczyk, B. Kamys, A. Strzalkowski and H. Witala, Phys. Rev. C25 (1982) 2403

1982HU1D Huwe, Bull. Amer. Phys. Soc. 27 (1982) 532

1982IB1B Iben and Renzini, Astrophys. J. 263 (1982) L23

1982IN1A C.H.Q. Ingram, Nucl. Phys. A374 (1982) 319

1982IQ1A Iqbal and Walker, Bull. Amer. Phys. Soc. 27 (1982) 468

1982JA05 W.W. Jacobs, T.G. Throwe, S.E. Vigdor, M.C. Green, J.R. Hall, H.O. Meyer, W.K. Pitts and M. Dillig, Phys. Rev. Lett. 49 (1982) 855

1982JO1B Johnson, O'Brien and Climenhaga, Astrophys. J. 254 (1982) 175

1982JO1C Johnstone and Thomas, J. Phys. (London) G8 (1982) L105

1982JU01 E.T. Jurney, P.J. Bendt, J.C. Browne, Phys. Rev. C25 (1982) 2810

1982JU03 J.W. Jury, B.L. Berman, J.G. Woodworth, M.N. Thompson, R.E. Pywell and K.G. McNeill, Phys. Rev. C26 (1982) 777

1982KA1C K. Kakihara, Y. Kasida and T. Ido, Radioisotopes 31 (1982) 357

1982KA1D K. Kar and J.C. Parikh, Pramana 19 (1982) 555

1982KA1U Kahana, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 97

1982KE1D Keister, AIP Conf. Proc. 79 (1982) 265

1982KI1D Kisslinger, AIP Conf. Proc. 79 (1982) 243

1982KI1H Kirkhbakh, Izv. Akad. Nauk SSSR Ser. Fiz. 46 (1982) 2132

1982KN02 H.D. Knox and R.O. Lane, Nucl. Phys. A378 (1982) 503

1982KR05 H. Krawinkel, H.W. Becker, L. Buchmann, J. Gorres, K.U. Kettner, W.E. Kieser, R. Santo, P. Schmalbrock, H.P. Trautvetter, A. Vlieks et al., Z. Phys. A304 (1982) 307

1982KU1B Kukulin and Neudatchin, in Kiev (1982) 389

1982LE03 P.M.S. Lesser, C.C. Trail, C.C. Perng and M.K. Liou, Phys. Rev. Lett. 48 (1982) 308

1982LE06 J.J. LeRose, K. Min, D. Rowley, B.O. Sapp, P. Stoler, E.J. Winhold, P.F. Yergin, A.M. Bernstein, K.I. Blomqvist, S. Dytman et al., Phys. Rev. C25 (1982) 1702

1982LE1N R. Legrain, Nucl. Phys. A387 (1982) 219

1982LE21 Z. Lewandowski, E. Loeffler, R. Wagner, H.H. Mueller, W. Reichart and P. Schober, Nucl. Phys. A389 (1982) 247

1982LE26 J. LeRose, K. Min, D. Rowley, B.O. Sapp, P. Stoler, P.-K. Teng, E.J. Winhold, P.F. Yergin, A.M. Bernstein, K.I. Blomqvist et al., Phys. Rev. C26 (1982) 2554

1982LI12 C.K. Liu, M.K. Liou, C.C. Trail and P.M.S. Lesser, Phys. Rev. C26 (1982) 723

1982LI1K Liu and Zhang, Chin. Phys. 2 (1982) 185

1982LIZW C.K. Lin and L. Zamick, Bull. Amer. Phys. Soc. 27 (1982) 530, GE10

1982LO03 G.J. Lolos, P.L. Walden, E.L. Mathie, G. Jones, E.G. Auld, W.R. Falk and R.B. Taylor, Phys. Rev. C25 (1982) 1086

1982LO13 M. Lozano, J.I. Escudero and G. Madurga, J. Phys. (London) G8 (1982) 1259

1982LO1K Lolos, AIP Conf. Proc. 79 (1982) 201

1982LU02 F.Q. Lu, J.Y. Tang and B.I. Deutch, Phys. Rev. C25 (1982) 1476

1982LY1A U. Lynen, H. Ho, W. Kuhn, D. Pelte, U. WinklerW. F.J. Muller, Y. -T. Chu, P. Doll, A. Gobbi, K. Hildenbrand et al., Nucl. Phys. A387 (1982) 129

1982MA1F Maleki and Mukhopadhyay, Bull. Amer. Phys. Soc. 27 (1982) 467

1982MA1H Mazitov, Radiok and Rasulov, in Kiev (1982) 309

1982MA1T Mathews, Haight and White, Bull. Amer. Phys. Soc. 27 (1982) 702

1982MA1U Maleki and Mukhopadhyay, Bull. Amer. Phys. Soc. 27 (1982) 696

1982MA1Y May, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 63

1982MA20 J.F. Mateja, A.D. Frawley, L.C. Dennis, K. Abdo and K.W. Kemper, Phys. Rev. C25 (1982) 2963

1982MA2C Massa and Vannini, Riv. Nuovo Cim. 5 (1982) 1

1982ME13 W.E. Meyerhof, G. Astner, D. Hofmann, K.O. Groeneveld and J.F. Chemin, Z. Phys. A309 (1982) 93

1982MO18 J.M. Moss, Phys. Rev. C26 (1982) 727

1982MO24 A. Mori, M. Yabe and K. Kubo, Prog. Theor. Phys. 68 (1982) 1217

1982MU14 S.F. Mughabghab, M.A. Lone and B.C. Robertson, Phys. Rev. C26 (1982) 2698

1982NA13 S. Nanda and C. Glashausser, Phys. Rev. C26 (1982) 758

1982NA1K Nann, AIP Conf. Proc. 79 (1982) 219

1982NG01 Nguyen Tien Nguyen and I. Ulehla, Czech. J. Phys. B32 (1982) 1040

1982NO1D Norman, Astrophys. J. 258 (1982) 41

1982OH05 S. Ohkubo, Phys. Rev. C25 (1982) 2498

1982PEZY R.J. Peterson, J.L. Ullmann, P.N. Craig, C.D. Zafiratos, D.A. Lind and R.S. Raymond, Bull. Amer. Phys. Soc. 27 (1982) 461, AYa13

1982PI1H Pinto, Bull. Amer. Phys. Soc. 27 (1982) 792

1982PI1J Piekarz, Conf. on Hypernuclear and Kaon Phys., Heidelberg, June 1982 (1982) 72

1982PL1A Pliuko and Chinarov, in Kiev (1982) 417

1982PO05 W.P. Poenitz and J.F. Whalen, Nucl. Phys. A383 (1982) 224

1982RA1L Rahman Khan, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 115

1982RA20 R.D. Ransome, C.L. Hollas, P.J. Riley, B.E. Bonner, W.D. Cornelius, O.B. van Dyck, E.W. Hoffman, S.A. Wood and K. Toshioka, Nucl. Instrum. Meth. Phys. Res. 201 (1982) 315

1982REZX D.A. Resler, P.E. Koehler, H.D. Knox, G. Randers-Pehrson and R.O. Lane, Bull. Amer. Phys. Soc. 27 (1982) 716, CE2

1982REZY D.A. Resler, P.E. Koehler, H.D. Knox and R.O. Lane, Bull. Amer. Phys. Soc. 27 (1982) 628, H4

1982REZZ L.B. Rees, N.S. Chant, P.G. Roos, J.S. Wesick, A. Nadasen, D.W. Devins, D.L. Friesel, B.S. Flanders, L.C. Welch, W.P. Jones et al., Bull. Amer. Phys. Soc. 27 (1982) 509, EF8

1982RI05 L. Rikus, S.F. Collins, K.A. Amos, B.M. Spicer, G.G. Shute, I. Morrison, V.C. Officer, R. Smith, D.W. Devins, D.L. Friesel et al., Aust. J. Phys. 35 (1982) 9; Erratum Aust. J. Phys. 35 (1982) 351

1982SA29 H. Sakamoto, M. Nakamura, K. Hatanaka, T. Noro and S. Kobayashi, Bull. Inst. Chem. Res., Kyoto Univ. 60 (1982) 197

1982SC11 L.A. Schaller, L. Schellenberg, T.Q. Phan, G. Piller, A. Ruetschi and H. Schneuwly, Nucl. Phys. A379 (1982) 523

1982SE04 S.J. Seestrom-Morris, D. Dehnhard, M.A. Franey, G.S. Kyle, C.L. Morris, R.L. Boudrie, J. Piffaretti and H.A. Thiessen, Phys. Rev. C26 (1982) 594

1982SH1P Shi Yi-Jin and Zhuang Fei, Phys. Energ. Fortis Phys. Nucl. 6 (1982) 750

1982SO1B Soga and Dillig, AIP Conf. Proc. 79 (1982) 289

1982ST1C Stepanenko et al., in Kiev (1982) 493

1982TA02 N. Takahashi, T. Yamaya, R.E. Tribble, E. Takada, Y.-W. Lui, D.M. Tanner and K. Nagatani, Phys. Lett. B108 (1982) 177

1982TA03 T.N. Taddeucci, J. Rapaport, D.E. Bainum, C.D. Goodman, C.C. Foster, C. Gaarde, J. Larsen, C.A. Goulding, D.J. Horen, T. Masterson et al., Phys. Rev. C25 (1982) 1094

1982TA09 H. Taketani, M. Adachi, N. Endo and T. Suzuki, Phys. Lett. B113 (1982) 11

1982TA11 H. Taketani, N. Endo, G. Ishikawa, T. Suzuki, M. Adachi, T. Kohno, A. Makishima and T. Ikuta, Nucl. Instrum. Meth. Phys. Res. 196 (1982) 283

1982TA19 M. Tanifuji, O. Mikoshiba and T. Terasawa, Nucl. Phys. A388 (1982) 621

1982TA21 K. Takimoto, S. Shimoura, M. Tanaka, T. Murakami, M. Fukada and A. Sakaguchi, Bull. Inst. Chem. Res., Kyoto Univ. 60 (1982) 147

1982TA23 S.L. Tabor, L.C. Dennis and K. Abdo, Nucl. Phys. A391 (1982) 458

1982TH02 I.J. Thompson, Phys. Scr. 25 (1982) 475

1982TH06 I.J. Thompson, J. Phys. (London) G8 (1982) 937

1982THZZ T.G. Throwe, W.W. Jacobs, S.E. Vigdor, M.C. Green, J.R. Hall, H.O. Meyer, W.K. Pitts and M. Dillig, Bull. Amer.Phys. Soc. 27 (1982) 468, BF12

1982VO1F von Oertzen and Imanishi, Bad Honnef Symp., 1981 (1982) 388, 405

1982WA1G P.L. Walden, Nucl. Phys. A374 (1982) 277

1982WE02 D.L. Weiss and G.E. Walker, Phys. Rev. C25 (1982) 991

1982WE16 D. West and A.C. Sherwood, Ann. Nucl. Energy 9 (1982) 551

1982YA1C Yamada, Bull. Amer. Phys. Soc. 27 (1982) 813

1982YE01 Ye Wenchuan, Zhao Xuan and Zeng Fanan, Chin. J. Nucl. Phys. 4 (1982) 216

1982ZA1C Zabel, Bull. Amer. Phys. Soc. 27 (1982) 780

1982ZH1C Zhang, Li and Yu, Phys. Lett. B108 (1982) 261

1983AB08 Y. Abe and J.Y. Park, Phys. Rev. C28 (1983) 2316

1983AD1B E.G. Adelberger, Proc. NATO Advanced Study Institute on Symmetries in Nucl. Struct., 16-28 Aug. 1982, Dronten, Netherlands; Eds., Abrahams, Allaart and Dieperink (1983) 55

1983AF01 A. Aframian, J. Phys. (London) G9 (1983) 985

1983AI01 O. Aizawa, T. Matsumoto and H. Kadotani, J. Nucl. Sci. Tech. 20 (1983) 354

1983AJ01 F. Ajzenberg-Selove, Nucl. Phys. A392 (1983) 1; Erratum Nucl. Phys. A413 (1984) 168

1983AK1A Akimenko et al., Sov. J. Nucl. Phys. 38 (1983) 732

1983AL20 D.V. Aleksandrov, E.A. Ganza, Yu.A. Glukhov, V.I. Dukhanov, I.B. Mazurov, B.G. Novatsky, A.A. Ogloblin, D.N. Stepanov, V.V. Paramonov and A.G. Trunov, Yad. Fiz. 37 (1983) 797; Sov. J. Nucl. Phys. 37 (1983) 474

1983AL23 J. Almeida and F. Kappeler, Astrophys. J. 265 (1983) 417

1983AM1A Amsel and Davies, Nucl. Instrum. Meth. Phys. Res. 218 (1983) 177

1983AN02 B. Antolkovic, I. Slaus, D. Plenkovic, P. Macq, J.P. Meulders, Nucl. Phys. A394 (1983) 87

1983AN1Q Antony, Britz, Bueb and Pape, J. Phys. (London) G9 (1983) L245

1983ANZQ Y. Ando, M. Uno and M. Yamada, JAERI-M-83-025 (1983)

1983ANZY R.E. Anderson, C.R. Gould, B.C. Karp, K. E.Nash, R.S. Pedroni, H.G. Pfutzner and R.L. Walter, Bull. Amer. Phys. Soc. 28 (1983) 648, AF1

1983AP1A April-Giboni et al., Nucl. Instrum. Meth. Phys. Res. 215 (1983) 147

1983AU1A Auerbach et al., Ann. Phys. 148 (1983) 381

1983AU1B Auerbach, Phys. Rept. 98 (1983) 273

1983BA1V Bandyopadhyay and Mahalanobis, Phys. Rev. C27 (1983) 628

1983BA2K Bando, Ikeda and Motoba, Prog. Theor. Phys. 69 (1983) 918

1983BA49 A.B. Balantekin, S.E. Koonin and J.W. Negele, Phys. Rev. C28 (1983) 1565

1983BE16 S.L. Belostotsky, Yu.V. Dotsenko, J. Ero, Z. Fodor, L.G. Kudin, N.P. Kuropatkin, A.A. Lobodenko, O.V. Miklukho, V.N. Nikulin, O.E. Prokofev et al., Phys. Lett. B124 (1983) 469

1983BE1Q Belyaeva, in Moscow (1983) 478

1983BI13 J.R. Birkelund and J.R. Juizenga, Ann. Rev. Nucl. Part. Sci. 33 (1983) 265

1983BL11 M. Blecher, K. Gotow, R.L. Burman, M.V. Hynes, M.J. Leitch, N.S. Chant, L. Rees, P.G. Roos, F.E. Bertrand, E.E. Gross et al., Phys. Rev. C28 (1983) 2033

1983BO1F Boyd, Wiescher, Newsom and Collins, Private Communication (1983)

1983BU07 B. Buck, S.M. Perez, Phys. Rev. Lett. 50 (1983) 1975; Erratum Phys. Rev. Lett. 51 (1983) 1395

1983CA07 G. Calvi, M. Lattuada, C. Spitaleri, F. Riggi, D. Vinciguerra, C.M. Sutera and A. Pantaleo, Lett. Nuovo Cim. 36 (1983) 475

1983CH01 S. Chakravarti, P.J. Ellis, B.F. Bayman and Q.K.K. Liu, Phys. Rev. C27 (1983) 143; Erratum Phys. Rev. C28 (1983) 2546

1983CH15 I.-T. Cheon, Phys. Lett. B124 (1983) 451

1983CH1N Cheon, New Phys. 23 (1983) 92

1983CH1T Chen, Zhuang, Jin and King, in Florence (1983) 44, 45

1983CH23 B. Chambon, D. Drain, C. Pastor, A. Dauchy, A. Giorni and C. Morand, Z. Phys. A312 (1983) 125

1983CH54 I.-T. Cheon, Lett. Nuovo Cim. 38 (1983) 555

1983CI08 O. Civitarese, B.V. Carlson, M.S. Hussein and A. Szanto de Toledo, Phys. Lett. B125 (1983) 22

1983CI1E Cierjacks et al., Proc. Int. Conf., Antwerp, Belgium, 1982 (1983) 383

1983CO09 E.R. Cohen, A.H. Wapstra, Nucl. Instrum. Meth. 211 (1983) 153

1983CS03 J. Cseh, A.Z. Kiss, E. Koltay, B. Nyako and E. Pintye, Nucl. Phys. A410 (1983) 147

1983DA02 B. Dasmahapatra, B. Cujec and F. Lahlou, Nucl. Phys. A394 (1983) 301

1983DA20 B. Dasmahapatra, B. Cujec and F. Lahlou, Nucl. Phys. A408 (1983) 192

1983DA22 J.H. Dave and C.R. Gould, Phys. Rev. C28 (1983) 2212

1983DE1U Dennis, Phys. Rev. C27 (1983) 2641; Erratum Phys. Rev. C28 (1983) 2547

1983DEZW L.C. Dennis, A.D. Frawley and J.F. Mateja, Bull. Amer. Phys. Soc. 28 (1983) 669, BF1

1983DI1B Dietrich and Petrovich, AIP Conf. Proc. 97 (1983) 148

1983DO1B C.B. Dover and A. Gal, Ann. Phys. 146 (1983) 309

1983DO1H Donahue et al., Radiocarbon 25 (1983) 719

1983DR06 P.V. Drumm, J.B.A. England, O. Karban, J.M. Nelson, J.M. Barnwell and N.E. Sanderson, Phys. Lett. B126 (1983) 155

1983DU13 G.G. Dussel, A.O. Gattone and E.E. Maqueda, Phys. Rev. Lett. 51 (1983) 2366

1983EL05 C. Ellegaard, C. Gaarde, J.S. Larson, C. Goodman, I. Bergqvist, L. Carlen, P. Ekstrom, B. Jakobsson, J. Lyttkens, M. Bedjidian et al., Phys. Rev. Lett. 50 (1983) 1745

1983EN04 Y.M. Engel and R.D. Levine, Phys. Rev. C28 (1983) 2321

1983FE07 V.N. Fetisov, L. Majling, J. Zofka and R.A. Eramzhyan, Z. Phys. A314 (1983) 239

1983FR04 A.D. Frawley, N.R. Fletcher, L.C. Dennis and K.M. Abdo, Nucl. Phys. A394 (1983) 292

1983FR17 R.M. Freeman, C. Beck, F. Haas, B. Heusch and J.J. Kolata, Phys. Rev. C28 (1983) 437

1983FR1A Friedman and Lynch, Phys. Rev. C28 (1983) 950

1983FR23 H. Friedrich and K. Langanke, Phys. Rev. C28 (1983) 1385

1983FU1J Fujisawa, Sci. Rap. Inst. Phys. Chem. Res. 77 (1983) 113

1983GA01 A. Gavron, J.R. Beene, B. Cheynis, R.L. Ferguson, F.E. Obenshain, F. Plasil, G.R. Young, G.A. Petitt, C.F. Maguire, D.G. Sarantites et al., Phys. Rev. C27 (1983) 450

1983GA17 A. Gal, Phys. Rev. C28 (1983) 2186

1983GE12 P.M. Gensini, Lett. Nuovo Cim. 38 (1983) 469

1983GI1E Gillespie, Hedges and White, Radiocarbon 25 (1983) 729

1983GL1D Glashausser, McGill and Morris, in Orsay (1983) 99

1983GM1A M. Gmitro, H.R. Kissener, P. Truol and R.A. Eramzhyan, Fiz. Elem. Chastits At. Yadra 14 (1983) 773; Sov. J. Part. Nucl. 14 (1983) 323

1983GO10 N.F. Golovanova, E.T. Ibraeva and V.G. Neudachin, Yad. Fiz. 37 (1983) 883; Sov. J. Nucl. Phys. 37 (1983) 526

1983GO13 J. Gomez del Campo and G.R. Satchler, Phys. Rev. C28 (1983) 952

1983GO1H C.R. Gould, J. Dave and R.L. Walter, Proc. Int. Conf. on Nucl. Data for Sci. and Tech., Antwerp, Belgium, 6-10 Sept. 1982 (1983) 766

1983GO1R Gontcharova, Kissener and Eramzhian, in Moscow (1983) 188

1983GO27 V.G. Gonchar and V.V. Tokarevsky, Izv. Akad. Nauk SSSR Ser. Fiz. 47 (1983) 2156

1983GR1M W. Greiner, Nucl. Phys. A409 (1983) 395

1983GU09 P.A.M. Guichon, Nucl. Phys. A402 (1983) 541

1983GY1A M. Gyulassy, Nucl. Phys. A400 (1983) 31

1983HA1H Hanna, Proc. Int. Conf. on Nucl. Phys., Florence, Aug.-Sept. 1983; Eds., P. Blasi and R.A. Ricci; Vol. 2 (1983) 473

1983HA1U Harrison, Mignerey, Moghadami and Gokmen, Proc. Int. Conf., Antwerp, Belgium, 1982 (1983) 919

1983HA1W Haight et al., IEEE Trans. Nucl. Sci. 30 (1983) 1160

1983HAZI M.N. Harakeh, D.H. Dowell, K.A. Snover, G. Feldman, E.F. Garman, J.L. Osborne and R. Loveman, Bull. Amer. Phys. Soc. 28 (1983) 965, AB4

1983HO17 Y.K. Ho and M.A. Lone, Nucl. Phys. A406 (1983) 18

1983HO1L Hosono et al., Proc. RCNP Int. Symp. on Light Ion Reaction Mechanism, Osaka (1983) 246

1983HU06 M. Hugi, W. Bauhoff and H.O. Meyer, Phys. Rev. C28 (1983) 1

1983HU1C Hussein, Phys. Lett. B127 (1983) 165

1983IB1A Iben, Astrophys. J. 275 (1983) L65

1983JA05 U. Jahnke, G. Ingold, H. Homeyer, M. Burgel, Ch. Egelhaaf, H. Fuchs and D. Hilscher, Phys. Rev. Lett. 50 (1983) 1246

1983JA09 L. Jarczyk, B. Kamys, Z. Rudy, A. Strzalkowski, H. Witala, M. Hugi, J. Lang, R. Muller, J. Sromicki and H.H. Wolter. Phys. Rev. C28 (1983) 700

1983JEZZ D.A. Jenkins, M.A. Pickar, A. Bacher, G.T. Emery and P.T. Debevec, Bull. Amer. Phys. Soc. 28 (1983) 34, GE2

1983JI04 Jiang Chenglie, Han Shukui, Guo Qingjiang and Li Qingli, Chin. Phys. 3 (1983) 675; Chin. J. Nucl. Phys. 5 (1983) 8

1983JO08 K.W. Jones, C. Glashausser, S. Nanda, R. de Swiniarski, T.A. Carey, W. Cornelius, J.M. Moss, J.B. McClelland, S.J. Seestrom-Morris, J.R. Comfort et al., Phys. Lett. B128 (1983) 281

1983JO1E J.A. Johnstone and A.W. Thomas, Nucl. Phys. A392 (1983) 409

1983JU1B Jull, Donahue and Zabel, Nucl. Instrum. Meth. Phys. Res. 218 (1983) 509

1983KA17 B. Kamys, L. Jarczyk, Z. Rudy, A. Strzalkowski, H.H. Wolter, J. Lang, R. Muller and J. Sromicki, Nucl. Phys. A406 (1983) 193

1983KA19 W.B. Kaufmann and W.R. Gibbs, Phys. Rev. C28 (1983) 1286

1983KA37 S.G. Kadmenskyii and Yu.L. Ratis, Izv. Akad. Nauk SSSR Ser. Fiz. 47 (1983) 2254

1983KAZF J.V. Kane, Bull. Amer. Phys. Soc. 28 (1983) 661, AY5a

1983KI1B King et al., in Orsay (1983) 82

1983KO15 S.K. Korotky, K.A. Erb, R.L. Phillips, S.J. Willett and D.A. Bromley, Phys. Rev. C28 (1983) 168

1983KO1D Koutroulos, in Florence (1983) 689

1983KO1Q Koh et al., Bull. Amer. Phys. Soc. 28 (1983) 131

1983KO1V Kolesnikov, Zakharov, Kolesov and Tarasov, in Moscow (1983) 240

1983KO44 H. Kobayashi, Prog. Theor. Phys. 70 (1983) 1283

1983KOZX M.A. Kovash, J.M. Finn, R. Lourie, P. Ulmer, J. Wiggins, S.L. Blatt, T.R. Donoghue, H.J. Hausman, D. Marchlenski, A.D. Bacher et al., Bull. Amer. Phys. Soc. 28 (1983) 690, DG5

1983KR10 J. Kronenfeld, A. Gal and J.M. Eisenberg, Nucl. Phys. A402 (1983) 569

1983LA1E S. Landowne, Nucl. Phys. A409 (1983) 55

1983LE28 Letaw, Silberberg and Tsao, Astrophys. J. 51 (1983) 271

1983LI01 K.F. Liu and F. Gabbard, Phys. Rev. C27 (1983) 93

1983LI15 Bo Liu and Huanqing Chiang, Chin. J. Nucl. Phys. 5 (1983) 190

1983LI1M Liu and Chiang, in Florence (1983) 399

1983LI1Q Li, Jiang and Wang, Kexue Tongbao 28 (1983) 460

1983LI1X Liu and Chiang, Commun. Theor. Phys. 2 (1983) 1477

1983MA06 S. Marsh, Phys. Lett. B121 (1983) 238

1983MA16 C.J. Martoff, J.A. Bistirlich, C.W. Clawson, K.M. Crowe, M. Koike, J.P. Miller, S.S. Rosenblum, W.A. Zajc, H.W. Baer, A.H. Wapstra et al., Phys. Rev. C27 (1983) 1621

1983MA1F Majling, Zofka, Fetisov and Eramzhyan, in Orsay (1983) 19

1983MA40 S. Maleki, Nucl. Phys. A403 (1983) 607

1983MA53 J.F. Mateja, J. Garman and A.D. Frawley, Phys. Rev. C28 (1983) 1579

1983ME02 H.O. Meyer, P. Schwandt, W.W. Jacobs and J.R. Hall, Phys. Rev. C27 (1983) 459

1983MI06 K. Min, E.J. Winhold, K. Shoda, M. Torikoshi, M. Yamazaki, O. Sasaki, H. Tsubota and B.N. Sung, Phys. Rev. C28 (1983) 464

1983MI08 D.J. Millener, J.W. Olness, E.K. Warburton and S.S. Hanna, Phys. Rev. C28 (1983) 497

1983MO1K Moss, AIP Conf. Proc. 97 (1983) 414

1983MU13 A.M. Mukhamedzhanov, R. Yarmukhamedov and P.O. Dzhamalov, Yad. Fiz. 37 (1983) 1405; Sov. J. Nucl. Phys. 37 (1983) 838

1983NO1D Noumachi et al., in Orsay (1983) 21

1983NO1G Noumachi et al., Proc. RCNP Int. Symp. on Light Ion Reaction Mech., Osaka, Japan (1983) 870

1983OL04 V.S. Olkhovsky and V.A. Chinarov, Ukr. Fiz. Zh. 28 (1983) 1141

1983OL1A Olson et al., Phys. Rev. C28 (1983) 1602

1983OS08 A. Osman and S.A. Saleh, Acta Phys. Acad. Sci. Hung. 54 (1983) 25

1983PA1G Park and Rae, in Florence (1983) 627

1983PE07 F. Pellegrini, D. Trivisonno, S. Avon, R. Bianchin and R. Rui, Phys. Rev. C28 (1983) 42

1983PE14 R.J. Peterson, Phys. Scr. T5 (1983) 190

1983PEZW C.C. Perng, Z.M. Ding, P.M.S. Lesser, M.K. Liou and C.C. Trail, Bull. Amer. Phys. Soc. 28 (1983) 657, AX3b

1983PO1D Povh, Proc. Int. Conf. on Nucl. Phys., Florence, Aug.-Sept. 1983; Eds., P. Blasi and R.A. Ricci; Vol. 2 (1983) 455

1983QU02 J.L. Quebert, D. Bertault, M. Boumart, P. Humbert and J.N. Scheurer, Nucl. Phys. A403 (1983) 166

1983RO16 G. Royer and B. Remaud, J. Phys. (London) G9 (1983) 1103

1983SA06 M. Sato, M. Sasagase, Y. Nagashima, J. Schimizu, T. Nakagawa, Y. Fukuchi and T. Mikumo, Phys. Rev. C27 (1983) 2621

1983SA1M Sakai, Hatanaka, Matsuoka and Saito, in Orsay (1983) 22

1983SC1B Schell, Science 219 (1983) 1068

1983SC1G Schwandt, AIP Conf. Proc. 97 (1983) 110

1983SE15 S.J. Seestrom-Morris, D. Dehnhard, M.A. Franey, C.L. Morris, R.L. Boudrie and H.A. Thiessen, Phys. Rev. C28 (1983) 1301

1983SEZW R.E. Segel, A. Hassan, S.M. Levenson, S. Mukhopadhyay, P. Zupranski, J.V. Maher and P.P. Singh, Bull. Amer. Phys. Soc. 28 (1983) 691, DG10

1983SH01 K. Shoda, M. Yamazaki, M. Torikoshi, H. Tsubota, K. Min, E.J. Winhold and A.M. Bernstein, Phys. Rev. C27 (1983) 443

1983SH1E Shi and Zhuang, Phys. Energ. Fortis Phys. Nucl. 7 (1983) 605

1983SH2K Shibata, JAERI-M 83-221 (1983)

1983SH38 Shi Yi-Jin, Phys. Rev. C28 (1983) 2452

1983SI11 R.P. Singhal, J. Dubach, R.S. Hicks, R.A. Lindgren, B. Parker and G.A. Peterson, Phys. Rev. C28 (1983) 513

1983SR01 J. Sromicki, M. Hugi, J. Lang, R. Muller, E. Ungricht, L. Jarczyk, B. Kamys, A. Magiera, Z. Rudy, A. Strzalkowski et al., Nucl. Phys. A406 (1983) 390

1983STZS M.N. Stephens and K.W. Kemper, Bull. Amer. Phys. Soc. 28 (1983) 994

1983SU07 T.S. Subramanian, J.L. Romero, F.P. Brady, J.W. Watson, D.H. Fitzgerald, R. Garrett, G.A. Needham, J.L. Ullmann, C.I. Zanelli, D.J. Brenner et al., Phys. Rev. C28 (1983) 521

1983SU1C Suter et al., IEEE Trans. Nucl. Sci. 30 (1983) 1528

1983SU1G Suzuki et al., Proc. RCNP Int. Symp. on Light Ion Reaction Mech., Osaka (1983) 888

1983SW1A Swart et al., Science 220 (1983) 406

1983TA12 T.N. Taddeucci, J. Rapaport, C.C. Foster and J.R. Comfort, Phys. Rev. C28 (1983) 969

1983THZZ T.G. Throwe, S.E. Vigdor, W.W. Jacobs, M.C. Green, C.W. Glover, B.P. Hichwa and T.E. Ward, Bull. Amer. Phys. Soc. 28 (1983) 672, BG9

1983TI1A Tiator, Phys. Lett. B125 (1983) 367

1983TO17 G. Toker and F. Tabakin, Phys. Rev. C28 (1983) 1725

1983TO19 W. Tornow, J. Phys. (London) G9 (1983) 1507

1983TR1G Trail, Lesser and Liou, IEEE Trans. Nucl. Sci. 30 (1983) 1124

1983TR1J Truol, Proc. Int. Conf. on Nucl. Phys., Aug.-Sept. 1983, Florence; Eds., P. Blasi and R.A. Ricci; Vol. 2 (1983) 247

1983TZ01 Y. Tzeng and T. Tamura, Phys. Lett. B129 (1983) 379

1983VA1K Van Otten et al., in Florence (1983) 347

1983VA28 O.I. Vasileva, V.M. Lebedev, A.V. Spassky, I.B. Teplov and L.N. Fateeva, Izv. Akad. Nauk SSSR, Ser. Fiz. 47 (1983) 2248; Bull. Acad. Sci. USSR Phys. Ser. 47 (1983) 156

1983VA31 A.G.M. van Hees and P.W.M. Glaudemans, Z. Phys. A314 (1983) 323

1983VI01 S.E. Vigdor, T.G. Throwe, M.C. Green, W.W. Jacobs, R.D. Bent, J.J. Kehayias, W.K. Pitts and T.E. Ward, Nucl. Phys. A396 (1983) 61c

1983VO04 W. von Oertzen, E.R. Flynn, J.C. Peng, J.W. Sunier and R.E. Brown, Z. Phys. A310 (1983) 275

1983VO1J W. von Oertzen, Nucl. Phys. A409 (1983) 91

1983WI15 J.F. Wilkerson, R.E. Anderson, T.B. Clegg, E.J. Ludwig and W.J. Thompson, Phys. Rev. Lett. 51 (1983) 2269

1983WI1A Wilczynski, Proc. Int. Conf. on Nucl. Phys., Florence, August-Sept. 1983; Eds., P. Blasi and R.A. Ricci; Vol. 2 (1983) 305

1983WI1D Wick et al., in Florence (1983) 238

1983WO02 E. Woye, W. Tornow, G. Mack, C.E. Floyd, P.P. Guss, K. Murphy, R.C. Byrd, S.A. Wender, R.L. Walter, T.B. Clegg et al., Nucl. Phys. A394 (1983) 139

1983ZA09 N.I. Zaika and V.A. Shityuk, Yad. Fiz. 38 (1983) 1173; Sov. J. Nucl. Phys. 38 (1983) 706

1983ZE1C B. Zeidman and D.F. Geesaman, Nucl. Phys. A396 (1983) 419

1983ZU02 D. Zubanov, R.A. Sutton, M.N. Thompson and J.W. Jury, Phys. Rev. C27 (1983) 1957

1984AA01 E.H.L. Aarts, R.A.R.L. Malfliet, R.J. De Meijer and S.Y. Van Der Werf, Nucl. Phys. A425 (1984) 23

1984AA1B Aas et al., in Panic (1984) L12

1984AB1A Abe and Park, RIFP-508 (1984)

1984AG1B Agodi, Pappalardo and Cardella, Lett. Nuovo Cim. 41 (1984) 465

1984AJ01 F. Ajzenberg-Selove, Nucl. Phys. A413 (1984) 1

1984AL1L Alma-Ata et al Collaboration, in Panic (1984) N11

1984AN11 L.E. Antonuk, D. Bovet, E. Bovet, J.-P. Egger, J.-F. Germond, F. Goetz, P. Gretillat, C. Lunke, E. Schwarz, K. Masutani et al., Nucl. Phys. A420 (1984) 435

1984AN1J Antufev et al., in Alma Ata (1984) 557

1984AR1C Arthur, Nature 310 (1984) 450

1984AS1D Asai, Bando and Sano, Phys. Lett. B145 (1984) 19

1984BA1L Bayukov et al., Sov. J. Nucl. Phys. 39 (1984) 938

1984BA1N Bassalleck, AIP Conf. Proc. 123 (1984) 867

1984BA1R V.N. Baturin, A.V. Khanzadeev, V.P. Koptev, E.M. Maev, M.M. Makarov, V.V. Nelyubin, G.V. Shcherbakov and V.V. Sulimov, in Panic (1984) I11

1984BA1T Bayukov et al., in Panic (1984) I16

1984BA2N Barit, Kazantsev and Kuzmin, in Alma Ata (1984) 558

1984BA2R Bayukov et al., in Panic (1984) E9

1984BA2X Bayukov et al., in Panic (1984) I18, I19

1984BA2Y Bando and Takai, in Panic (1984) M9

1984BA31 D.P. Balamuth, W.K. Wells, T. Chapuran, D.P. Bybell and C.M. Laymon, Phys. Lett. B140 (1984) 295

1984BAZZ N.L. Back, F.S. Dietrich, J.G. Woodworth, I.D. Proctor, C.H. Poppe, H.E. Conzett and C. Rioux, Bull. Amer. Phys. Soc. 29 (1984) 640, AK8

1984BE01 Yu.A. Berezhnoy, V.V. Pilipenko and G.A. Khomenko, J. Phys. (London) G10 (1984) 63

1984BE1C Belozerov et al., in Alma Ata 84 (1984) 379

1984BE1X Benetskii et al., in Alma Ata (1984) 312

1984BL10 S.L. Blatt, H.J. Hausman, L.G. Arnold, R.G. Seyler, R.N. Boyd, T.R. Donoghue, P. Koncz, M.A. Kovash, A.D. Bacher and C.C. Foster, Phys. Rev. C30 (1984) 423

1984BO1A Bodmer, Usmani and Carlson, Phys. Rev. C29 (1984) 684

1984BO1Q Boyd, Newsom, Collins and Wiescher, Science 225 (1984) 508

1984BO1T Bonani et al., Nucl. Instrum. Meth. Phys. Res. B233 (1984) 284

1984BR19 D.J. Brenner and R.E. Prael, Nucl. Sci. Eng. 88 (1984) 97

1984BU1T Busza and Goldhaber, Phys. Lett. B139 (1984) 235

1984BUZO I.E. Burkova and A.A. Yatis, in Alma Ata (1984) 564

1984BY04 J. Bystricky, J. Deregel, F. Lehar, A. de Lesquen, L. van Rossum, J.M. Fontaine, F. Perrot, T. Hasegawa, C. Newsom, Y. Onel et al., Lett. Nuovo Cim. 40 (1984) 466

1984BY05 J. Bystricky, J. Deregel, F. Lehar, A. De Lesquen, L. van Rossum, J.M. Fontaine, F. Perrot, T. Hasegawa, C.R. Newsom, W. Leo et al., Lett. Nuovo Cim. 41 (1984) 285

1984CA06 G. Calvi, M. Lattuada, C. Spitaleri, F. Riggi, D. Vinciguerra and D. Miljanic, Nuovo Cim. A79 (1984) 45

1984CA1T Campi, Desbois and Lipparini, Phys. Lett. B138 (1984) 353

1984CA39 G. Cardella, A. Cunsolo, A. Foti, G. Imme, G. Pappalardo, G. Raciti, F. Rizzo and N. Saunier, Lett. Nuovo Cim. 41 (1984) 429

1984CH1G Chen, Zhuang, Shi and Jin, Chin. J. Nucl. Phys. 6 (1984) 303

1984CL09 N.M. Clarke, J. Phys. (London) G10 (1984) 1219

1984COZY J. Conte and M. Dillig, Bull. Amer. Phys. Soc. 29 (1984) 627, AF8

1984DA03 C.B. Daskaloyannis, M.E. Grypeos, C.G. Koutroulos, S.E. Massen and D.S. Saloupis, Phys. Lett. B134 (1984) 147

1984DA17 B. Dasmahapatra, B. Cujec and F. Lahlou, Nucl. Phys. A427 (1984) 186

1984DA1D Daskaloyannis, Koutroulos, Grypeos and Saloupis, in Panic (1984) M5

1984DA1H Davis, in AIP Conf. Proc. 123 (1984) 1037

1984DE1T Deineko, Zaliobovskii, Malakhov and Sarana, in Alma Ata (1984) 396

1984DE53 P. De Bievre, M. Gallet, N.E. Holden and I.L. Barnes, J. Phys. Chem. Ref. Data 13 (1984) 809

1984DEZR A.E. Denisov, R.P. Kolalis, S.I. Lashaev, V.S. Sadkovsky and G.A. Feofilov, in Alma Ata (1984) 352

1984DEZX L.C. Dennis and J.S. Hanspal, Bull. Amer. Phys. Soc. 29 (1984) 1047, DB3

1984DO1B Donahue, Jull and Zabel, Nucl. Instrum. Meth. Phys. Res. B233 (1984) 162

1984DO20 T.W. Donnelly and I. Sick, Rev. Mod. Phys. 56 (1984) 461

1984ET01 M.C. Etchegoyen, A. Etchegoyen and E. Blemont Moreno, J. Phys. (London) G10 (1984) 823

1984FR05 H. Frohlich, N. Bischof, W. Tiereth, H. Voit, W. Von Oertzen and B. Imanishi, Nucl. Phys. A420 (1984) 124

1984FR13 H. Friedrich, Phys. Lett. B146 (1984) 135

1984FR1A Frobrich, Phys. Rept. 116 (1984) 337

1984GI1E Gibbs, AIP Conf. Proc. 123 (1984) 859

1984GI1K Gillespie, Hedges and Perry, Nucl. Instrum. Meth. Phys. Res. B233 (1984) 167

1984GI1M Gillespie and Hedges, Nucl. Instrum. Meth. Phys. Res. B233 (1984) 294

1984GL06 Yu.A. Glukhov, A.S. Demyanova, A.A. Ogloblin, S.B. Sakuta and V.V. Sukharevsky, Yad. Fiz. 40 (1984) 62; Sov. J. Nucl. Phys. 40 (1984) 41

1984GL1G Glukov et al., in Alma Ata (1984) 385

1984GO04 A. Gokmen, G.J. Mathews and V.E. Viola, Jr., Phys. Rev. C29 (1984) 1606

1984GO1F Goetz et al., in Panic (1984) F17

1984GO1H Gorionov et al., in Alma Ata (1984) 335

1984GO1M Goncharova, Kissener and Eramzhain, in Alma Ata (1984) 152

1984GR08 R.E.L. Green, R.G. Korteling and K.P. Jackson, Phys. Rev. C29 (1984) 1806

1984GR27 S.J. Greene, C.J. Harvey, P.A. Seidl, R. Gilman, E.R. Siciliano and M.B. Johnson, Phys. Rev. C30 (1984) 2003

1984GUZY B.Ya. Guzhovsky, S.N. Abramovich and V.A. Pereshivkin, in Alma Ata (1984) 357

1984HA1M Haxton, AIP Conf. Proc. 123 (1984) 1026

1984HA1R Harris and Lambert, Astrophys. J. 281 (1984) 739

1984HA1Z Harris and Lambert, Astrophys. J. 285 (1984) 674

1984HA26 K. Hatanaka, N. Matsuoka, T. Saito, K. Hosono, M. Kondo, S. Kato, T. Higo, S. Matsuki, Y. Kadota and K. Ogino, Nucl. Phys. A419 (1984) 530

1984HA43 Q. Haider and B. Cujec, Nucl. Phys. A429 (1984) 116

1984HA48 R.C. Haight, S.M. Grimes, R.G. Johnson and H.H. Barschall, Nucl. Sci. Eng. 87 (1984) 41

1984HA53 Q. Haider and F.B. Malik, At. Data Nucl. Data Tables 31 (1984) 185

1984HAZK J.S. Hanspal, L.C. Dennis, A.D. Frawley and R.A. Parker, Bull. Amer. Phys. Soc. 29 (1984) 1047

1984HE20 W. Heeringa, H.O. Klages, H. Dobiasch, R. Fischer, B. Haesner, P. Schwarz, J. Wilczynski and B. Zeitnitz, Nucl. Instrum. Meth. Phys. Res. A227 (1984) 509

1984HI1A Hirsch et al., Phys. Rev. C29 (1984) 508

1984HI1D Hichwa, Bull. Amer. Phys. Soc. 29 (1984) 1072

1984HIZX R.S. Hicks, M.A. Plum, R.A. Lindgren, G.A. Peterson, H.A. Thiessen, D.I. Sober and H. Crannell, Bull. Amer. Phys. Soc. 29 (1984) 717, GG12

1984HO1E Hofmann et al., Nucl. Instrum. Meth. Phys. Res. B233 (1984) 254

1984HO23 H. Homeyer, M. Burgel, Ch. Egelhaaf, H. Fuchs and G. Thoma, Z. Phys. A319 (1984) 143

1984HU1P Hufner and Klar, Phys. Lett. B145 (1984) 167

1984HU1Q Hussein, Baltz and Carlson, Phys. Rept. 113 (1984) 133

1984IN03 M. Inoue and S.E. Koonin, Phys. Rev. C30 (1984) 175

1984JA1F Jacobs, AIP Conf. Proc. 123 (1984) 1090

1984JEZY S.M. Jensen, S.L. Blatt, H.J. Hausman, R.N. Boyd, T.R. Donoghue, R.G. Seyler, D.G. Marchlenski, T.W. Rackers, P. Schmalbrock, M.A. Kovash et al., Bull. Amer. Phys. Soc. 29 (1984) 1050, DD2

1984JEZZ R.G. Jeppesen, P.N. Craig, D.A. Lind, J.R. Shepard, J.L. Ullmann, C.D. Zafiratos, C.A. Goulding, N.S.P. King, P.W. Lisowski, G.L. Morgan et al., Bull. Amer. Phys. Soc. 29 (1984) 628

1984KA25 G. Karl, G.A. Miller, J. Rafelski, Phys. Lett. B143 (1984) 326

1984KE02 B.D. Keister, L.S. Kisslinger, Nucl. Phys. A412 (1984) 301

1984KO1Q Kong Xiang-Jing, Xie Xian-Liang and Sun Chung-Wei, Phys. Energ. Fortis Phys. Nucl. 8 (1984) 199

1984KO1U Koshigiri, Ohtsubo and Morita, in Panic (1984) H3

1984KO37 P. Kozma and P. Bem, Czech. J. Phys. B34 (1984) 1308

1984KOZZ M.A. Kovash, S. Hicks, M.T. McEllistrem, A.D. Bacher, D.L. Freisel, C.C. Foster, C. Olmer, S.L. Blatt, T.R. Donoghue, H.J. Hausman et al., Bull. Amer. Phys. Soc. 29 (1984) 627, AF6

1984KU07 D. Kurath and R.D. Lawson, Phys. Rev. C29 (1984) 2303

1984KW01 N.H. Kwong and J. Hufner, Phys. Lett. B146 (1984) 370

1984LA1J Langer, Graedel, Frerking and Armentrout, Astrophys. J. 277 (1984) 581

1984LE1G Lecolle, C R Acad. Sci. Ser. II-Mec. Phys. 298 (1984) 211

1984LI14 Q.K.K. Liu, P.J. Ellis and S. Chakravarti, Phys. Lett. B143 (1984) 60

1984LI1L Little-Marenin and Little, Astrophys. J. 283 (1984) 188

1984LI1T Lin Chun-Can and Ma Wei-Hsing, Phys. Energ. Fortis Phys. Nucl. 8 (1984) 589

1984LI1U Lin Chun-Can and Ma Wei-Hsing, Commun. Theor. 3 (1984) 429

1984LI25 R.A. Lindgren, J. Phys. (Paris) 34 (1984) C4-433

1984LO13 G.J. Lolos, E.G. Auld, W.R. Falk, G.L. Giles, G. Jones, B.J. McParland, R.B. Taylor, W. Ziegler and P.L. Walden, Phys. Rev. C30 (1984) 574

1984MA2D Mack, Bull. Amer. Phys. Soc. 29 (1984) 1077

1984MA36 T. Matulewicz and J. Toke, Acta Phys. Pol. 15 (1984) 569

1984MA45 C.J. Martoff, L. Van Elmbt, M. Lebrun, M. Schaad, U. Straumann, P. Truol, K.M. Crowe, C. Joseph, J.P. Perroud, D. Ruegger et al., Nucl. Phys. A430 (1984) 557

1984MA67 G.J. Mathews and F.S. Dietrich, Astrophys. J. 287 (1984) 969

1984MAZT F.B. Malik and Q. Haider, Bull. Amer. Phys. Soc. 29 (1984) 1047

1984MC01 J.B. McClelland, J.M. Moss, B. Aas, A. Azizi, E. Bleszynski, M. Bleszynski, J. Geaga, G. Igo, A. Rahbar, J.B. Wagner, et al., Phys. Rev. Lett. 52 (1984) 98; Erratum Phys.Rev.Lett. 52, 954 (1984)

1984MC02 J.A. McGill, G.W. Hoffmann, M.L. Barlett, R.W. Fergerson, E.C. Milner, R.E. Chrien, R.J. Sutter, T. Kozlowski and R.L. Stearns, Phys. Rev. C29 (1984) 204

1984MC04 J.A. McGill, C. Glashausser, K. Jones, S.K. Nanda, M. Barlett, R. Fergerson, J.A. Marshall, E.C. Milner and G.W. Hoffmann, Phys. Lett. B134 (1984) 157

1984MI1C Millener, Gal, Dover and Dalitz, in Panic (1984) M7

1984MI1K Mintz, in Panic (1984) A39

1984MO06 Z. Moroz, K. Rusek, P. Egelhof, S. Kossionides, K.-H. Mobius, G. Tungate, E. Steffens, G. Grawert, I. Koenig and D. Fick, Nucl. Phys. A417 (1984) 498

1984MO1D Montgomery, Yoo, Uberall and Bosco, Can. J. Phys. 62 (1984) 764

1984MO1Q Morrissey, Bull. Amer. Phys. Soc. 29 (1984) 1072

1984MO1R Morrissey, Nolen, Pursell and Tiedje, Nucl. Instrum. Meth. Phys. Res. A224 (1984) 238

1984NA06 T. Nakamura and Y. Uwamino, Phys. Rev. C29 (1984) 1317; Erratum Phys. Rev. C30 (1984) 413

1984NA1R Nakai et al., Nucl. Instrum. Meth. Phys. Res. B233 (1984) 171

1984NE1A Nemets, Rudchik and Chuvilski, in Alma Ata (1984) 334

1984NI1C Nickles, Bull. Amer. Phys. Soc. 29 (1984) 1072

1984OH06 H. Ohnuma, F. Irom, B. Aas, M. Haji-Saeid, G.J. Igo, G. Pauletta, A.K. Rahbar, A.T.M. Wang, C.A. Whitten, Jr., M.M. Gazzaly et al., Phys. Lett. B147 (1984) 253

1984PE1C Pessoa and de Toledo Piza, Phys. Rev. C29 (1984) 403

1984PE24 R.J. Peterson, H.C. Bhang, J.J. Hamill and T.G. Masterson, Nucl. Phys. A425 (1984) 469

1984PEZV J.S. Petler, R.W. Finlay, A.S. Meigooni, S.H. Mellema and F.S. Dietrich, Bull. Amer. Phys. Soc. 29 (1984) 749, JH14

1984PEZW R.J. Peterson, Bull. Amer. Phys. Soc. 29 (1984) 716, GG2

1984PH02 D.L. Pham and R. de Swiniarski, Nuovo Cim. A83 (1984) 294

1984PI05 A. Picklesimer, P.C. Tandy, R.M. Thaler and D.H. Wolfe, Phys. Rev. C29 (1984) 1582

1984PO11 D.N. Poenaru and M. Ivascu, J. Phys. (Paris) 45 (1984) 1099

1984PO13 V.A. Poyarkov and I.V. Sizov, Yad. Fiz. 40 (1984) 21; Sov. J. Nucl. Phys. 40 (1984) 13

1984RA10 W.D.M. Rae, A.J. Cole, B.G. Harvey and R.G. Stokstad, Phys. Rev. C30 (1984) 158

1984RA1J Ramstrom and Trostell, Nucl. Instrum. Meth. Phys. Res. 219 (1984) 438

1984RE14 S.M. Read and V.E. Viola, Jr., At. Data Nucl. Data Tables 31 (1984) 359

1984RI03 L. Rikus, K. Nakano and H.V. von Geramb, Nucl. Phys. A414 (1984) 413

1984RO05 I. Rotter, Phys. Rev. C29 (1984) 1119

1984SA12 H. Sakai, K. Hatanaka, N. Matsuoka, T. Saito, A. Shimizu, M. Ieiri, K. Imai and T. Motobayashi, J. Phys. (London) G10 (1984) L139

1984SA1H Sato and Ohtsubo, in Panic (1984) A37

1984SA31 Y. Sakuragi and M. Kamimura, Phys. Lett. B149 (1984) 307

1984SC04 H.R. Schelin, E. Farrelly Pessoa, W.R. Wylie, E.W. Cybulska, K. Nakayama, L.M. Fagundes and R.A. Douglas, Nucl. Phys. A414 (1984) 67

1984SC09 I. Schwanner, G. Backenstoss, W. Kowald, L. Tauscher, H.-J. Weyer, D. Gotta, H. Ullrich, Nucl. Phys. A412 (1984) 253

1984SE12 S.J. Seestrom-Morris, M.A. Franey, D. Dehnhard, D.B. Holtkamp, R.L. Boudrie, J.F. Amann, G.C. Idzorek and C.A. Goulding, Phys. Rev. C30 (1984) 270

1984SE15 P.A. Seidl, M.D. Brown, R.R. Kiziah, C.F. Moore, H. Baer, C.L. Morris, G.R. Burleson, W.B. Cottingame, S.J. Greene, L.C. Bland et al., Phys. Rev. C30 (1984) 1076

1984SE16 R.G. Seyler and H.R. Weller, Phys. Rev. C30 (1984) 1146

1984SH04 K. Shin, K. Hibi, M. Fujii, Y. Uwamino and T. Nakamura, Phys. Rev. C29 (1984) 1307

1984SH14 O.D. Sharma and B.B. Srivastava, J. Phys. (London) G10 (1984) 1239

1984SH1J M. Shoeb and M.Z. Khan, J. Phys. (London) G10 (1984) 1047

1984SH2A N.J. Shackleton, J. Backman, H. Zimmerman, D.V. Kent, M.A. Hall, D.G. Roberts, D. Schnitker, J.G. Baldauf, A. Desprairies, R. Homrighausen et al., Nature 307 (1984) 620

1984SI13 P.B. Siegel, W.B. Kaufmann and W.R. Gibbs, Phys. Rev. C30 (1984) 1256

1984ST16 P. Stoler, P.F. Yergin, A. Farah, P.C. Dunn, P.K.A. DeWitt-Huberts, A. Kaarsgaarn, J. Koch and B. Schoch, Phys. Lett. B143 (1984) 69

1984SU1H Suter, Balzer, Bonani and Wolfli, Nucl. Instrum. Meth. Phys. Res. B233 (1984) 242

1984SU1J Suter et al., Nucl. Instrum. Meth. Phys. Res. B233 (1984) 117

1984TA07 T.N. Taddeucci, T.A. Carey, C. Gaarde, J. Larsen, C.D. Goodman, D.J. Horen, T. Masterson, J. Rapaport, T.P. Welch and E. Sugarbaker, Phys. Rev. Lett. 52 (1984) 1960

1984TAZS Taddeucci, Bull. Amer. Phys. Soc. 29 (1984) 1032, BA4

1984TI02 L. Tiator and L.E. Wright, Phys. Rev. C30 (1984) 989

1984TR1C Truran, Ann. Rev. Nucl. Part. Sci. 34 (1984) 53

1984VA06 A.G.M. van Hees and P.W.M. Glaudemans, Z. Phys. A315 (1984) 223

1984VO06 W. von Oertzen, H. Lettau, H.G. Bohlen and D. Fick, Z. Phys. A315 (1984) 81

1984VO11 W. von Oertzen and B. Imanishi, Nucl. Phys. A424 (1984) 262

1984WA1L Wagenaar, Roberson, Weller and Tilley, Bull. Amer. Phys. Soc. 29 (1984) 664

1984WE04 E. Wesolowski, J. Phys. (London) G10 (1984) 321

1984WE1C Wegner, Astrophys. Space Sci. 104 (1984) 347

1984WI06 N. Willis, L. Bimbot, T. Hennino, J.C. Jourdain, Y. Le Bornec and F. Reide, Phys. Lett. B136 (1984) 334

1984WO05 J.G. Woodworth, R.A. August, N.R. Roberson, D.R. Tilley, H.R. Weller and J.W. Jury, Phys. Rev. C29 (1984) 1186

1984ZU01 R.Ya. Zulkarneev and R.Kh. Kutuev, Yad. Fiz. 39 (1984) 785; Sov. J. Nucl. Phys. 39 (1984) 495

1984ZW1A Zwarts, Unpublished Ph.D. Thesis, Utrecht Univ. (1984)

1985AB02 L.I. Abashidze, V.V. Avdeichikov, G.G. Beznogikh, V.V. Bogatin, V.A. Budilov, N.L. Gorshkova, T.F. Grabovskaya, A.P. Laricheva, V.D. Maisyukov, St. Mrowczynski et al., Nucl. Phys. A437 (1985) 573

1985AB1J Ableev et al., in Visby (1985) 157

1985AH1A Ahmad, Mian and Rahman Khan, Phys. Rev. C31 (1985) 1590

1985AJ01 F. Ajzenberg-Selove, Nucl. Phys. A433 (1985) 1; Erratum Nucl. Phys. A449 (1986) 155

1985AR1N Arthur, Dean and Claypool, Nature 315 (1985) 216

1985BA1Z Bauhoff, Phys. Rev. C31 (1985) 253

1985BA2N H. Bando and H. Takaki, Phys. Lett. B150 (1985) 409

1985BA2R Barschall, AIP Conf. Proc. 124 (1985) 286

1985BAZZ N.L. Back, F.S. Dietrich, J.G. Woodworth, I.D. Proctor, C.H. Poppe, H.E. Conzett and C. Rioux, Bull. Amer. Phys. Soc. 30 (1985) 702

1985BL1B Blatt, AIP Conf. Proc. 125 (1985) 570

1985BO2F Bohlen et al., in Visby (1985) 40

1985BR06 J.C. Brown, R.G. Seyler, T.L. Tsin and S.L. Blat, Phys. Rev. C31 (1985) 1607

1985CL1B Clark et al., AIP Conf. Proc. 124 (1985) 123

1985DI01 N.J. DiGiacomo, M.R. Clover, R.M. DeVries, J.C. Dousse, J.S. Kapustinsky, P.L. McGaughey, W.E. Sondheim, J.W. Sunier, M. Buenerd and D. Lebrun, Phys. Rev. C31 (1985) 292

1985DI1B Dietrich and Petrovich, AIP Conf. Proc. 124 (1985) 90

1985DY03 R. Dymarz, Phys. Lett. B155 (1985) 5

1985EJ1A Ejiri et al., AIP Conf. Proc. 125 (1985) 582

1985FA01 Fan Wang and C.W. Wong, Nucl. Phys. A432 (1985) 619

1985FO1C Ford et al., Bull. Amer. Phys. Soc. 30 (1985) 116

1985FO1D T.D. Ford, F.P. Brady, C.M. Castaneda, J.L. Romero, J.R. Drummond, B. McEachern, M.L. Webb, N.S.P. King, J. Martoff and K. Wang, AIP Conf. Proc. 124 (1985) 141

1985FR07 J. Franz, E. Rossle, C. Sauerwein, H. Schmitt, H.L. Woolverton, J. Ero, Z. Fodor, J. Kecskemeti, P. Koncz, Zs. Kovacs et al., Phys. Lett. B153 (1985) 382

1985GA1M Gazis, Papadopoulos and Xenoulis, in Visby (1985) 69

1985GI1C Gilliland, Astrophys. J. 290 (1985) 344

1985GO02 C.D. Goodman, R.C. Byrd, I.J. Van Heerden, T.A. Carey, D.J. Horen, J.S. Larsen, C. Gaarde, J. Rapaport, T.P. Welch, E. Sugarbaker et al., Phys. Rev. Lett. 54 (1985) 877; Erratum Phys. Rev. Lett. 54 (1985) 2060

1985GO1V Goned, Shalaby and Roushdy, J. Phys. (London) G11 (1985) 613

1985GU1A Guzik et al., Bull. Amer. Phys. Soc. 30 (1985) 762

1985HA18 S.S. Hanna and J.W. Hugg, Hyperfine Interactions 21 (1985) 59

1985HA1J H.J. Hauser, T. Rohwer, F. Hoyler, G. Staudt, S. Abd el-Kariem, P. Grasshoff, H.V. Klapdor, A. Korber, W. Leitner, V. Rapp et al., AIP Conf. Proc. 125 (1985) 701

1985HI04 R.S. Hicks, Nucl. Phys. A434 (1985) 97c

1985HO1J Hodgson and Satori, NEANDC0198-U INDC(NEA) (1985) 5

1985HO1M Ho and Lone, AIP Conf. Proc. 125 (1985) 362

1985IN01 A. Ingemarsson, J. Phys. (London) G11 (1985) 541

1985KA10 S. Kato, K. Okada, M. Kondo, K. Hosono, T. Saito, N. Matsuoka, K. Hatanaka, T. Noro, S. Nagamachi, H. Shimizu et al., Phys. Rev. C31 (1985) 1616

1985KI1L King et al., Bull. Amer. Phys. Soc. 30 (1985) 36

1985KL1A Klapdor, Fortschr. Phys. 33 (1985) 1

1985KO04 D. Konnerth, W. Trombik, K.G. Bernhardt, K.A. Eberhard, R. Singh, A. Strzalkowski and W. Trautmann, Nucl. Phys. A436 (1985) 538

1985KU01 P.C-K. Kuo, K.G. McNeill, N.K. Sherman, S. Landsberger, W.F. Davidson, J.W. Jury and J.R.C. Lafontaine, Phys. Rev. C31 (1985) 318

1985LA06 K. Langanke, O.S. Van Roosmalen and W.A. Fowler, Nucl. Phys. A435 (1985) 657; Erratum Nucl. Phys. A446 (1985) 750

1985MA10 J.F. Mateja, A.D. Frawley, D.G. Kovar, D. Henderson, H. Ikezoe, R.V.F. Janssens, G. Rosner, G.S.F. Stephans, B. Wilkins, K.T. Lesko et al., Phys. Rev. C31 (1985) 867

1985MA1U Mahaux, Bortignon, Broglia and Dasso, Phys. Rept. 120 (1985) 1

1985MA1V Matulewicz et al., AIP Conf. Proc. 125 (1985) 684

1985MI1P Mintz, Bull. Amer. Phys. Soc. 30 (1985) 767

1985MO08 M. Morjean, J.L. Charvet, J.L. Uzureau, Y. Patin, A. Peghaire, Y. Pranal, L. Sinopoli, A. Billerey, A. Chevarier, N. Chevarier et al., Nucl. Phys. A438 (1985) 547

1985OR1G Orihara, Bull. Amer. Phys. Soc. 30 (1985) 115

1985OR1H Orihara, AIP Conf. Proc. 124 (1985) 139

1985PAZY J.Y. Park and M.H. Cha, Bull. Amer. Phys. Soc. 30 (1985) 706, AG11

1985SI05 M.K. Singham, Phys. Rev. Lett. 54 (1985) 1642; Erratum Phys. Rev. Lett. 55 (1985) 1156

1985SP03 D.A. Sparrow, J. Piekarewicz, E. Rost, J.R. Shepard, J.A. McNeil, T.A. Carey and J.B. McClelland, Phys. Rev. Lett. 54 (1985) 2207

1985SR01 B.B. Srivastava and A. Saxena, Phys. Rev. C31 (1985) 745

1985ST1J Stephans et al., Bull. Amer. Phys. Soc. 30 (1985) 746

1985TO02 W. Tornow, R.L. Walter and R.C. Byrd, J. Phys. (London) G11 (1985) 379

1985UT1B Utsunomiya, in Visby (1985) 67

1985VO01 W. Von Oertzen, Phys. Lett. B151 (1985) 95

1985WE02 W.-M. Wendler and M. Micklinghoff, Nucl. Phys. A436 (1985) 477

1985WE1D Wender and Auchampaugh, AIP Conf. Proc. 125 (1985) 483

1986AJ04 F. Ajzenberg-Selove, Nucl. Phys. A460 (1986) 1

1986MO15 H. Morgenstern, W. Bohne, W. Galster and K. Grabisch, Z. Phys. A324 (1986) 443