

Energy Levels of Light Nuclei $A = 7$

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Abstract: An evaluation of $A = 5-10$ was published in *Nuclear Physics A*413 (1984), p. 1. This version of $A = 7$ 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. Also, [Reference](#) key numbers have been changed to the NNDC/TUNL format.

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⁷H
(Not illustrated)

⁷H has not been observed. Attempts have been made to detect it in the spontaneous fission of ²⁵²Cf (1982AL1H) and in the ⁷Li(π^- , π^+) reaction (1981EV01, 1981SE1J, 1981SE1B). See also (1979AJ01).

⁷He
(Fig. 10)

GENERAL: (See also (1979AJ01).)

Reactions involving pions: (1978FU09, 1979BA1M, 1979PE1C).

Hypernuclei: (1978DA1A, 1978SO1A, 1979BU1C, 1981WA1J, 1982KO11).

Other topics: (1979BE1H, 1981AV02, 1982AW02, 1982NG01).

1. ⁷Li(π^- , γ)⁷He $Q_m = 128.36$

See (1979AJ01).

Table 7.1: Energy levels of ⁷He

E_x (MeV)	$J^\pi; T$	$\Gamma_{c.m.}$ (keV)	Decay	Reactions
g.s.	$(\frac{3}{2})^-; \frac{3}{2}$	160 ± 30	n ^a	1, 2, 3, 4

^a Q_0 for ⁷Li(t, ³He)⁷He is -11.18 MeV. This leads to 26.11 ± 0.03 MeV for the atomic mass excess of ³He: Q_m for ⁷He_{g.s.} \rightarrow ⁶He + n is then 0.44 ± 0.03 MeV: see (1979AJ01).

2. ⁷Li(n, p)⁷He $Q_m = -10.42$

At $E_n = 14.8$ MeV a proton group is reported corresponding to ⁷He_{g.s.}: $\Gamma < 0.2$ MeV: see (1979AJ01). See also (1981BR1K).

3. ⁷Li(t, ³He)⁷He $Q_m = -11.18$

The ${}^3\text{He}$ particles to the ground state of ${}^7\text{He}$ have been observed at $E_t = 22$ MeV. The width of the ground state is 160 ± 30 keV; for a radius of 2.2 fm and $l_n = 1$, this width is 0.22 of the Wigner limit. The angular distribution is peaked in the forward direction. No other states of ${}^7\text{He}$ were observed for $E_x < 2.4$ MeV: see (1979AJ01).

4. ${}^9\text{Be}({}^6\text{Li}, {}^8\text{B}){}^7\text{He}$ $Q_m = -23.60$

At $E({}^6\text{Li}) = 80.0$ and 93.3 MeV the ground state of ${}^7\text{He}$ is strongly populated, indicating negative parity, as expected. There is no indication of relatively sharp states of ${}^7\text{He}$ with $E_x \leq 10$ MeV (1977WE03).

⁷Li
(Figs. 8 and 10)

GENERAL: (See also (1979AJ01).)

Shell model: (1978FU13, 1978MI13, 1979MA11, 1981BO1Y, 1982BA52, 1982FI13).

Cluster and α -particle models: (1978MI13, 1979MA11, 1979VE08, 1980KA16, 1980SU04, 1981BE27, 1981EL06, 1981FI1A, 1981HA1Y, 1981KR1J, 1981RA1M, 1981SR01, 1982DE12, 1982FI13, 1982MU10, 1983DU1B, 1983KA1K).

Special states: (1978MI13, 1979BU14, 1978DU1C, 1979KI10, 1980GO1Q, 1980SH1N, 1981BE27, 1981BO1Y, 1982BA52, 1982FI13, 1982MU10, 1983DU1B, 1983GO1R).

Electromagnetic transitions, giant resonances: (1978FU13, 1979DO17, 1981BO1Y, 1982BA52, 1982PE06, 1983WA1M).

Astrophysical questions: (1978BU1B, 1978CA1C, 1978DW1A, 1978HA1E, 1978OR1A, 1978ST1C, 1978ST1D, 1979BA1P, 1979MA1F, 1979MC1A, 1979MO04, 1979RA1C, 1979RO1A, 1979WI1D, 1979YA1C, 1980CA1C, 1980CO1R, 1980FR1G, 1980LA1G, 1980RE1B, 1980SC1K, 1981AU1D, 1981AU1G, 1981GA1C, 1981SC1M, 1982BA80, 1982PA1G, 1982SP1B).

Applied work: (1978BR34, 1979AN1B, 1979FO1F, 1979FU1E, 1979GR1E, 1979JA1B, 1979RE1B, 1979WI1C, 1980CO1H, 1981EG1B, 1981KO1D, 1981ZU1A, 1983ST1J).

Complex reactions involving ⁷Li: (1978BH03, 1978DU1B, 1978HE1C, 1978KN1C, 1979AL22, 1979DY01, 1979GA04, 1979GE1A, 1979GO11, 1979LO11, 1979MO22, 1979SC08, 1979SC1D, 1979ST1D, 1979VI05, 1979WE06, 1980BO31, 1980GR10, 1980GU1E, 1980ME1F, 1980MI01, 1980MO28, 1980ST06, 1980WI1L, 1980ZU01, 1981BH02, 1981BL1G, 1981BO1X, 1981CH18, 1981CI03, 1981EG1E, 1981HN02, 1981ME13, 1981MO20, 1981MU10, 1981PH1D, 1981TA22, 1981ZU1B, 1982BO1J, 1982BO1Q, 1982BO35, 1982BO1Y, 1982DE1Y, 1982FU04, 1982GL01, 1982GO1E, 1982GU1H, 1982JA1C, 1982LU01, 1982LY1A, 1982MO13, 1982MO1N, 1982MU10, 1982NI03, 1982OH09, 1982WU1B, 1983FU04, 1983KW01, 1983MO03, 1983SA06, 1983TH04).

Muon and neutrino capture and reactions: (1977GR1C, 1978BA54, 1978BR1C, 1979BE1G, 1979DO1E, 1981AV1A, 1981PR1F, 1982BA80, 1982KR1E).

Pion capture and reactions involving pions: (1978DY01, 1978ER1A, 1978FU09, 1978KI13, 1978KN1C, 1978SI1D, 1979AK02, 1979AL1J, 1979BA17, 1979BA1M, 1979BO1F, 1979BO1G, 1979BO23, 1979CO1C, 1979DO17, 1979EN1C, 1979IN1A, 1979KI1G, 1979MA02, 1979ME07, 1979MI1C, 1979NA04, 1979PE1D, 1979RE1A, 1979SI16, 1979TI1A, 1980BA27, 1980BO03, 1980ER01, 1980JO06, 1980JO1D, 1980KA11, 1980LE02, 1980PE1C, 1980SA04, 1980SC24, 1980WH1A, 1981AS07, 1981BE63, 1981BE13, 1981BL1F, 1981DU1H, 1981EV01, 1981HE1H, 1981IO01, 1981IS11, 1981OS04, 1981SE1H, 1981SE11, 1981SE1B, 1981SI1D, 1981WH01, 1981WH1C, 1981WH1D, 1982AL31, 1982AP1A, 1982BL1G, 1982DO02, 1982IS10, 1982LEZY, 1982OS01, 1982RI1A, 1982SE08, 1982WA1G, 1982WH1A, 1983HU02, 1983IRZZ, 1983PIZW, 1983RI1C, 1983SEZV).

Reactions involving kaons: (1978DA1A, 1979GA1E, 1980AU1C, 1980DO1E, 1980GA1C, 1981BE17, 1981BE45, 1981BO09, 1981HU1C, 1982DEZQ, 1982MA1Y, 1982MO1Q, 1982PI1J, 1982PO1C).

Reactions involving antiprotons: (1981BL1F, 1981YA1C).

Hypernuclei: (1978DA1A, 1978PO1A, 1978SO1A, 1979GA1D, 1979GA1E, 1980AU1C, 1980GA1P, 1980IW1A, 1981BE45, 1981BE17, 1981BO09, 1981DA1C, 1981WA1J, 1982DEZQ, 1982DO1M, 1982ER1B, 1982ER1E, 1982JO1C, 1982KO11, 1982MA1Y, 1982MO1Q, 1982PI1J, 1982RA1L, 1983JO1E).

Other topics: (1978RO17, 1979BE1H, 1979BU14, 1980BO1N, 1980GA1P, 1980GO1Q, 1980SH1N, 1981AV02, 1981MU10, 1981MU1H, 1982BA2G, 1982NG01, 1983FI1J, 1983GO1R, 1983MO03).

Ground-state properties of ${}^7\text{Li}$: (1978HE1D, 1980BO1N, 1980KA16, 1980SU04, 1981BE27, 1981BO1Y, 1981EG1E, 1981EL06, 1981HN02, 1981MO08, 1981RA1M, 1981SA16, 1981SR01, 1982BA2G, 1982DE35, 1982FIZY, 1982FI13, 1982HN1A, 1982MO13, 1982MU10, 1982NG01, 1982PE06, 1983DU1B).

$$\mu = +3.256424 (2) \text{ nm}; \text{ see (1978LEZA)}$$

$$Q = (-34 \pm 6) e \cdot \text{mb}; \text{ see (1980EG03)}. \text{ See also (1978LEZA, 1982MO13)}.$$

$$B(E2: \frac{3}{2}^- \rightarrow \frac{1}{2}^-) = 8.3 \pm 0.6 e^2 \cdot \text{fm}^4; \text{ see (1973HA47)}. \text{ See also (1979AJ01) and (1982BA52, 1982PE06)}.$$

$$1. \text{}^3\text{H}(\alpha, \gamma){}^7\text{Li} \quad Q_m = 2.4681$$

Excitation functions and angular distributions have been studied for $E_\alpha = 0.5$ to 1.9 MeV. The cross section rises smoothly as expected for a direct-capture process: see (1966LA04). For calculations of the low-energy S -factor see (1981WI04). See also (1979YA1C; astrophysics).

$$2. \text{}^3\text{H}(\alpha, n){}^6\text{Li} \quad Q_m = 4.7820 \quad E_b = 2.4681$$

The cross section for this reaction has been measured for $E_\alpha = 11$ to 18 MeV: the data show the effect of ${}^7\text{Li}^*(7.46)$ and indicate a broad resonance near $E_\alpha = 16.8$ MeV [${}^7\text{Li}^*(9.6)$]. The level parameters derived from this reaction and from reaction 3 are displayed in Table 7.3. The yield of ${}^6\text{Li}$ ions at 0° (lab) has also been measured for $E_\alpha = 11.310$ to 11.930 MeV with 2–3% accuracy: the data were then reduced to obtain the cm differential cross sections at 0° and 180° for the inverse reaction in the energy region corresponding to formation of ${}^7\text{Li}^*(7.46)$ (1977BR21). See also (1977KN1A).

Table 7.2: Energy levels of ${}^7\text{Li}$

E_x (MeV \pm keV)	$J^\pi; T$	τ_m or $\Gamma_{c.m.}$ (keV)	Decay	Reactions
g.s.	$\frac{3}{2}^-; \frac{1}{2}$		stable	1, 4, 5, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 44, 45, 46, 47, 48
0.477612 ± 0.003	$\frac{1}{2}^-; \frac{1}{2}$	$\tau_m = 105 \pm 5$ fsec ^a	γ	4, 5, 6, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 24, 27, 28, 29, 30, 31, 32, 33, 34, 37, 38, 39, 41, 43, 45, 46, 47, 48
4.630 ± 9	$\frac{7}{2}^-; \frac{1}{2}$	$\Gamma = 93 \pm 8$ keV	t, α	3, 5, 11, 12, 15, 16, 17, 18, 19, 20, 21, 31, 32, 34, 39, 42, 47
6.68 ± 50	$\frac{5}{2}^-; \frac{1}{2}$	875_{-100}^{+200}	t, α	3, 12, 15, 16, 17, 18, 32, 39
7.4597 ± 1.2	$\frac{5}{2}^-; \frac{1}{2}$	89 ± 7	n, t, α	2, 3, 7, 10, 12, 13, 15, 16, 18, 21, 29, 31, 32, 39
9.67 ± 100 ^b	$\frac{7}{2}^-; \frac{1}{2}$	≈ 400	n, t, α	2, 3, 7, 12, 16, 18, 32
9.85	$\frac{3}{2}^-; \frac{1}{2}$	≈ 1200	n, α	7, 10, 29
11.24 ± 30	$\frac{3}{2}^-; \frac{3}{2}$	260 ± 35	n, p	7, 8, 15, 31

^a See Table 7.2 in (1979AJ01) and Table 7.5.

^b See also reactions 7 and 13 for additional states.

Table 7.3: ${}^7\text{Li}$ levels from ${}^3\text{H} + {}^4\text{He}$ ^a

E_x (MeV + keV)	J^π	l_α	LS term	R (fm)	θ_α^2 ^b	$\theta_{n_0}^2$
4.65 ± 20	$\frac{7}{2}^-$	3	${}^2\text{F}_{7/2}$	4.0	0.57 ± 0.04	
$\left\{ \begin{array}{l} 6.64 \pm 100 \\ 6.79 \pm 90 \end{array} \right.$	$\frac{5}{2}^-$	3	${}^2\text{F}_{5/2}$	4.0	1.36 ± 0.13	0.000 ± 0.002
	$\frac{5}{2}^-$	3	${}^2\text{F}_{5/2}$	4.4	0.52	
7.47 ± 30	$\frac{5}{2}^-$	3	${}^4\text{P}_{5/2}$	4.0	0.011 ± 0.001	0.26 ± 0.02
9.67 ± 100	$\frac{7}{2}^-$	3	${}^4\text{D}_{7/2}$	4.0	0.53 ± 0.22	2.3 ± 0.7 ^c

^a For references see Table 7.3 in (1979AJ01).

^b $\gamma^2 / (\frac{3}{2}\hbar^2 / \mu a^2)$.

^c $\theta_{n_1}^2$ to ${}^6\text{Li}^*(2.19)$.

3. ${}^3\text{H}(\alpha, \alpha){}^3\text{H}$

$$E_b = 2.4681$$

The excitation curves for the elastic scattering show the effects of ${}^7\text{Li}^*(4.63, 6.68, 7.46, 9.67)$. The derived level parameters are displayed in Table 7.3. Angular distributions have been studied for $E_\alpha = 2.13$ to 2.98 MeV [see (1979AJ01)] and $E_t = 6.0$ to 17 MeV (1977BR21, 1980JA1F, 1981JA1G; very accurate $\sigma(\theta)$). Analyzing power measurements are reported for $E_t = 6.0$ to 17 MeV (1976HA17, 1980JA1F, 1981JA1G): a polarization extremum ($A_y = -1$) occurs near $E_t = 11.1$ MeV, $\theta_{c.m.} = 95^\circ$. There is some suggestion for a $J^\pi = \frac{1}{2}^-$ state in ${}^7\text{Li}$ at $E_x = 9.6$ MeV (1981JA1G; N. Jarmie, private communication): see also reaction 7. The breakup of ${}^7\text{Li}$ [at kinematic energy of 70 MeV] into $\alpha + t$ proceeds sequentially via ${}^7\text{Li}^*(4.63)$ when ${}^{12}\text{C}$ is bombarded. When ${}^{208}\text{Pb}$ is hit by ${}^7\text{Li}$, both this sequential process and breakup in the nuclear field of the ${}^{208}\text{Pb}$ nucleus appear to occur (1981SH01). See also (1977KN1A, 1978BR1A) and (1977HA1E, 1978MI13, 1978TA1A, 1978TH1A, 1979LE1B, 1979WI1B, 1981AO02, 1981BE01, 1981FR1N, 1982FU01, 1982KA11, 1983AO03; theor.).

4. ${}^4\text{He}(\alpha, p){}^7\text{Li}$

$$Q_m = -17.3459$$

Angular distributions have been reported at $E_\alpha = 39.9$ to 49.5 MeV (p_0, p_1) and 60.2, 92.4 and 140.0 MeV (p_{0+1}) [see (1979AJ01)] and at $E_\alpha = 37.5$ to 43.0 MeV (1982SL01; p_0, p_1). See also (1978GL03, 1979AL1F), (1982RA1M; astrophys.) and ${}^8\text{Be}$.

5. ${}^4\text{He}({}^3\text{He}, \pi^+){}^7\text{Li}$

$$Q_m = -137.118$$

At $E({}^3\text{He}) = 266.5$ and 280.5 MeV, ${}^7\text{Li}^*(0 + 0.48, 4.63)$ are populated (1982BI06). See also (1982GE1C, 1982LE1L) and (1982KL1B; theor.).

6. ${}^6\text{Li}(n, \gamma){}^7\text{Li}$

$$Q_m = 7.2501$$

The thermal capture cross section is 38.5 ± 3.0 mb (1981MUZQ). Gamma rays are observed corresponding to transitions to ${}^7\text{Li}^*(0, 0.48)$ with branching ratios of (61 ± 3) and $(39 \pm 2)\%$. ${}^7\text{Li}^*(4.63)$ is not involved in the decay [$\lesssim 2\%$]: see (1979AJ01). See also (1980BA34; theor.).

7. ${}^6\text{Li}(n, n){}^6\text{Li}$

$$E_b = 7.2501$$

The scattering amplitude (bound) $a = 2.2 \pm 0.25i$ fm, $\sigma_{\text{free}} = 0.45 \pm 0.08$ b. The thermal scattering cross section $= 0.75 \pm 0.02$ b (1981MUZQ). The total cross section has been measured from $E_n = 4$ eV to 49.6 MeV [see (1976GAYV)]. Recent measurements include those of (1982SM02: $E_n = 0.1$ to 0.8 MeV) and (1979LA1D, 1980KE1L; $E_n = 2.99$ to 49.64 MeV) and the integrated cross sections of (1979KN01; n_0 ; 4.1 to 7.5 MeV) and (1979HO11; n_0 and n_1 ; 7.47 to 13.94 MeV). A pronounced resonance occurs at $E_n = 244.5 \pm 1.0$ keV with a peak cross section of 11.2 ± 0.2 b (1982SM02): see Table 7.4 [$E_x = 7459.7 \pm 1.2$ keV]. No other clearly defined resonance is observed to $E_n = 49.6$ MeV although the total cross section exhibits a broad maximum at $E_n \approx 4.5$ MeV (J.A. Harvey and N.W. Hill, private communication). The analyzing power has been measured for $E_n = 1.48$ to 4.38 MeV (1982DR06) and at 2 to 5 MeV (1975HO01, 1981CH12). An R -matrix analysis of the latter results as well as σ_t , $\sigma(\theta)$ and (n, α) results leads to a set of parameters for ${}^7\text{Li}$ states. These include a bound $\frac{1}{2}^+$ and an unbound $\frac{3}{2}^+$ state (at 9.38 ± 0.03 MeV) [neither reported in other reactions] as well as the $\frac{5}{2}^-$ state at 7.46 MeV [$\Gamma_\alpha = 33 \pm 1$ keV, reduced width 0.96 ± 0.01 MeV], a $\frac{3}{2}^-$ state at 9.16 ± 0.14 MeV [$\Gamma_\alpha = 2.09 \pm 0.18$ MeV, $\gamma^2 = 0.13 \pm 0.05$ MeV] and a $\frac{1}{2}^-$ state at 9.74 ± 0.05 MeV [no significant Γ_α , $\gamma^2 = 1.87 \pm 0.18$ MeV] (1981CH12). Another recent R -matrix analysis (1983KN1G) suggests an unbound $\frac{1}{2}^+$ state at 8.81 MeV, a $\frac{3}{2}^+$ state at 9.97 MeV and a $\frac{1}{2}^-$ state at 10.31 MeV, in addition to the previously known states. The spectroscopic factors for the $l = 0$ decay to ${}^6\text{Li}_{\text{g.s.}}$ are $S = 0.2$ and 0.8 for ${}^7\text{Li}^*(8.81, 9.97)$. The states suggested by (1983KN1G) are very broad and cannot be seen directly in reaction or compound nucleus cross-section work (see also reaction 13). The two positive-parity states in ${}^7\text{Li}$ are consistent with the ${}^6\text{Li} + n$ scattering and reaction cross sections and provide an explanation for the anisotropy of the ${}^6\text{Li}(n, t)\alpha$ reaction at low energies (1983KN1G). See also (1982ST15; theor.).

The excitation function for 3.56 MeV γ -rays exhibits an anomaly, also seen in the (n, p) reaction (reaction 8). The data are well fitted assuming $E_{\text{res}} = 3.50$ and 4.60 MeV [$E_x = 10.25 \pm 0.10$ and 11.19 ± 0.05 MeV], $T = \frac{1}{2}$ and $\frac{3}{2}$, $\Gamma_{\text{c.m.}} = 1.40 \pm 0.10$ and 0.27 ± 0.05 MeV, respectively; both $J^\pi = \frac{3}{2}^-$. The reduced widths for the $T = \frac{3}{2}$ state [${}^7\text{Li}^*(11.19)$] are $\theta_n^2 = 2 \times 10^{-4}$, $\theta_{n''}^2 = 0.16$ [to ${}^6\text{Li}^*(3.56)$] and $\theta_p^2 = 0.09$: see also (1979AJ01) for a discussion of these and other (unpublished) data.

See also ${}^6\text{Li}$, (1979CZ1A, 1980MI02, 1982SA1F), (1977DE1C, 1977KN1A, 1981JA1C) and (1977HA1E, 1978KO12, 1978TA1A, 1980BA34, 1982LE10, 1983FU06; theor.).

Table 7.4: Resonance parameters for 7.5-7.2 MeV levels in ${}^7\text{Li}$ and ${}^7\text{Be}$ ^a

Reaction	${}^6\text{Li} + \text{n}$	${}^6\text{Li} + \text{p}$
E_r (keV, lab)	262 ^b	1840
$\Gamma(E_r)$ (keV, c.m.)	154	836
E_λ (keV above g.s.)	7700	7580
$\Gamma_{\text{n,p}}(E_r)$ (keV, c.m.)	118	798
radius (n, p) in fm	3.94	4.08
$\gamma_{\text{n,p}}^2$ (MeV · fm)	4.85	5.02
$\theta_{\text{n,p}}^2$	0.26	0.28
$\Gamma_\alpha(E_r)$ (keV, c.m.)	36	38
radius (α) in fm	4.39	4.39
γ_α^2 (MeV · fm)	0.101	0.101
θ_α^2	0.012	0.012

^a These states are believed to have a ${}^4\text{P}_{5/2}$ character, consistent with their large θ_{n}^2 and θ_{p}^2 . For references see Table 7.4 in (1979AJ01).

^b 244.5 ± 1.0 keV (1982SM02). See also (1981CH12).

$$\begin{array}{lll}
 8. \text{ (a) } {}^6\text{Li}(\text{n}, 2\text{n}){}^5\text{Li} & Q_{\text{m}} = -5.66 & E_{\text{b}} = 7.2501 \\
 \text{ (b) } {}^6\text{Li}(\text{n}, \text{p}){}^6\text{He} & Q_{\text{m}} = -2.724 &
 \end{array}$$

For reaction (a) see (1976GO12). The excitation function, measured from threshold to $E_{\text{n}} = 8.9$ MeV, exhibits an anomaly at $E_{\text{n}} = 4.6$ MeV. The excitation function, at forward angles, of p_0 is approximately constant for $E_{\text{n}} = 4.4$ to 7.25 MeV: see (1979AJ01). See also ${}^6\text{He}$, (1980MI02) and (1982SH1K; applied).

$$9. {}^6\text{Li}(\text{n}, \text{d}){}^5\text{He} \quad Q_{\text{m}} = -2.37 \quad E_{\text{b}} = 7.2501$$

The excitation function, at forward angles, of deuterons increases monotonically for $E_{\text{n}} = 5.4$ to 6.8 MeV: see (1979AJ01), ${}^5\text{He}$ and (1982SH1K).

$$10. {}^6\text{Li}(\text{n}, \alpha){}^3\text{H} \quad Q_{\text{m}} = 4.7820 \quad E_{\text{b}} = 7.2501$$

The isotopic thermal cross section is 940 ± 4 b: see (1981MUZQ). See also (1981EN01). Below 5 keV, the total cross section is given by $\sigma = (149.5/\sqrt{E} \text{ (eV)}) + 0.696$ b: see (1979AJ01). See also (1981IN1B). The $1/v$ dependence of the cross section (strong $l = 0$ waves) is not understood in terms of the known level structure of ${}^7\text{Li}$: see e.g. (1982SM02). In the 1 eV to 10 keV energy region, the ORNL results give an energy dependence for the asymmetry in the forward-to-backward 66° cone (lab) of the form $A = 1 + 0.0055\sqrt{E_n}$, where E_n is the energy in eV (J.A. Harvey and I.G. Schroder, private communication). See, however, reaction 7.

A resonance occurs at $E_n = 241 \pm 3$ keV with $\sigma_{\max} = 3.15 \pm 0.08$ b (1978LA23; $E_n = 3$ to 800 keV), 3.36 ± 0.6 b (1978RE1B; $E_n = 80$ to 470 keV). The resonance is formed by p-waves, $J^\pi = \frac{5}{2}^-$, and has a large neutron width and a small α -width: see Table 7.4. Above the resonance the cross section decreases monotonically to $E_n = 18.2$ MeV (1983BA17), except for a small bump near $E_n \approx 1.8$ MeV [see (1976GAYV, 1979AJ01)] and an inflection near $E_n = 3.5$ MeV, corresponding, presumably, to the anomaly reported in (n, n' γ)—see reaction 7—[${}^7\text{Li}^*(10.25)$, $J^\pi = \frac{3}{2}^-$, $T = \frac{1}{2}$] (1979BA37; $E_n = 2.2$ to 9.7 MeV). See also (1980BA39).

Angular distributions have been measured at many energies in the range $E_n = 0.1$ to 7.3 MeV [see (1979AJ01)], 2 and 24 keV (1979ST03), 2.0 to 3.5 MeV (1982KNZZ), 2.16 to 9.66 MeV (1980BA39) and at 14.1 MeV (1982HI06). See also (1977HA1J).

(1979BO1E) report a right-left asymmetry for polarized thermal neutrons of $(0.95 \pm 0.4) \times 10^{-4}$. Polarization measurements are reported by (1977KA06) for $E_n = 0.2$ to 2.4 MeV: the data suggest interference between s-waves and the p-wave resonance at 0.25 MeV. Interference between this $\frac{5}{2}^-$ state and a broad $\frac{3}{2}^-$ state 2 MeV higher also appears to contribute. At the higher energies A_y is close to +0.9 near 90° and varies slowly with E_n (1977KA06). See also (1982KNZZ).

See also (1977GA1A, 1980CZ1A), (1979DA1C, 1980BR1L, 1980UC1A, 1981HA1N, 1982SH1K; applications), (1977DE1C, 1977HA1E, 1977KN1A, 1982HA1X) and (1977HA1H, 1978KO12, 1979WE03, 1980BA34; theor.).

$$11. {}^6\text{Li}(p, \pi^+){}^7\text{Li} \quad Q_m = -133.100$$

At $E_p = 600$ MeV, the reaction preferentially excites ${}^7\text{Li}^*(4.63)$. Angular distributions have been obtained for the pions to ${}^7\text{Li}^*(0, 0.48, 4.63)$ at $E_p = 600$ MeV (1977BA37) and 800 MeV (1981NA1C). The $T = \frac{3}{2}$ state ${}^7\text{Li}^*(11.24)$ is not observed (1977BA37). See also (1980KE1D, 1981WI1F, 1982LE1L, 1982NA1K, 1982LO1B) and (1979ME2A, 1980WH1A).

$$\begin{aligned} 12. \text{(a) } {}^6\text{Li}(d, p){}^7\text{Li} & \quad Q_m = 5.0255 \\ \text{(b) } {}^6\text{Li}(d, np){}^6\text{Li} & \quad Q_m = -2.22458 \\ \text{(c) } {}^6\text{Li}(d, pt){}^4\text{He} & \quad Q_m = 2.5574 \end{aligned}$$

Angular distributions of proton groups have been studied for $E_d = 0.12$ to 15 MeV [see (1966LA04, 1974AJ01, 1979AJ01)] and at 698 MeV (1981BO03; $p_0 \rightarrow p_3$). $S = 0.90$ and

1.15 for ${}^7\text{Li}^*(0, 0.48)$ [DWBA analysis]; J^π of ${}^7\text{Li}^*(0.48)$ is $\frac{1}{2}^-$. The two higher states have $E_x = 4.630 \pm 0.009$ and 7.464 ± 0.010 MeV, $\Gamma_{\text{c.m.}} = 93 \pm 8$ and 91 ± 8 keV. ${}^7\text{Li}^*(7.46)$ appears to be a ${}^{24}\text{P}$ state: see (1974AJ01). Reaction (b) at $E_d = 10$ MeV appears to proceed via ${}^7\text{Li}^*(7.46)$ and possibly ${}^7\text{Li}^*(9.6)$ [$\Gamma = 0.5 \pm 0.1$ MeV]. Reaction (c) strongly involves ${}^7\text{Li}^*(4.63, 7.46)$ ($E_d = 7.5 \rightarrow 10.5$ MeV): see (1979AJ01). See also (1979HO04). For the breakup involving ${}^3\text{He}$ emission see (1979HO04). See also ${}^8\text{Be}$, (1981CE04) and (1979ME2A, 1980WH1A, 1982LO1B).

13. (a) ${}^7\text{Li}(\gamma, n){}^6\text{Li}$	$Q_m = -7.2501$
(b) ${}^7\text{Li}(\gamma, 2n){}^5\text{Li}$	$Q_m = -12.91$
(c) ${}^7\text{Li}(\gamma, p){}^6\text{He}$	$Q_m = -9.975$
(d) ${}^7\text{Li}(\gamma, pn){}^5\text{He}$	$Q_m = -11.84$
(e) ${}^7\text{Li}(\gamma, d){}^5\text{He}$	$Q_m = -9.62$
(f) ${}^7\text{Li}(\gamma, t){}^4\text{He}$	$Q_m = -2.4681$
(g) ${}^7\text{Li}(\gamma, pt){}^3\text{H}$	$Q_m = -22.2821$

The total photoneutron cross section rises sharply from 10 MeV to reach a broad plateau at about 15 mb from 14 to 20 MeV, decreases more slowly to about 0.5 mb at 25 MeV and then decreases further to about 0.3 mb at $E_\gamma = 30$ MeV (monoenergetic photons): there are indications of weak structure throughout the entire region. Differential cross sections for n_0 and n_1 have been reported for $E_\gamma = 7$ to 25 MeV. The integrated cross section to 23 MeV is 39 ± 4 MeV · mb for the n_0 transition and 17 ± 4 MeV · mb for the n_1 transition: together these account for 0.4 of the exchange augmented dipole sum of ${}^7\text{Li}$: see (1979AJ01). The integrated cross section for formation of ${}^6\text{Li}^*(3.56)$ is 4 ± 1 MeV · mb to 30 MeV and 11 ± 3 MeV · mb to 55 MeV (1978DE13).

The total absorption cross section for *natural* Li in the range 10 to 340 MeV shows a broad peak at ≈ 30 MeV ($\sigma_{\text{max}} \approx 3$ mb), a minimum centered at ≈ 150 MeV at ≈ 0.3 mb and a fairly smooth increase in cross section to ≈ 3 mb at ≈ 320 MeV (1979AH1A, 1979ZI1A). See also the references in (1979AJ01).

The cross section for the (γ, p) reaction (reaction (c)) shows a maximum at ≈ 15.6 MeV with a width of ≈ 4 MeV: see (1974AJ01). It then decreases fairly smoothly to 27 MeV (1979JU02). The integrated cross section for $11 \rightarrow 28$ MeV is 13.2 ± 2.0 MeV · mb (1979JU02). For the earlier work see (1979AJ01). Differential cross sections for the $(\gamma, n_0 + n_2)$ and (γ, p_0) processes are reported by (1983SE07; $E_\gamma = 60$ to 120 MeV). Reaction (e) has been studied in the giant resonance reaction with $E_{\text{bs}} \lesssim 30$ MeV. Deuteron groups to ${}^5\text{He}_{\text{g.s.}}$ and possibly to the first excited state are reported. States of ${}^7\text{Li}$ with $E_x = 25 - 30$ MeV may be involved when $E_{\text{bs}} = 37$ to 50 MeV is used: see (1979AJ01). See also (1979JU02, 1982KIZW).

The cross section for reaction (f) at 90° displays a broad resonance at $E \approx 7.7$ MeV ($\Gamma = 7.2$ MeV) with an integrated cross section of 6.2 MeV · mb, a plateau for $12 \rightarrow 22$ MeV (at ≈ 0.6 the cross section at 7.7 MeV) and a gradual decrease to 48 MeV. The (γ, t) cross section integrated from threshold to 50 MeV is 8.1 MeV · mb (1979SK05; monoenergetic photons; angular distributions).

See also (1979JU02). For the earlier work on this reaction see (1966LA04, 1979AJ01). For reaction (g) see (1978VO03) and (1979AJ01). For pion production see (1979BO23, 1981BE13) and ${}^7\text{Be}$. See also (1980IS1E, 1981IS06), (1978CH1E, 1979MA1G, 1980AH1A) and (1978FI10, 1979KI1D, 1980BA34, 1980MO1M, 1980SU04, 1980TA1D, 1981DE18, 1981IS11, 1982DE12, 1983BU1F; theor.).

14. ${}^7\text{Li}(\gamma, \gamma){}^7\text{Li}^*$

See Table 7.4 in (1966LA04) [summary of early measurements] for τ_m of ${}^7\text{Li}^*(0.48) = 107 \pm 5$ fsec. See also (1980IS1E, 1981IS06) and (1983ZH1D); theor.).

15. (a) ${}^7\text{Li}(e, e'){}^7\text{Li}^*$

(b) ${}^7\text{Li}(e, \text{ep}){}^6\text{He} \quad Q_m = -9.975$

(c) ${}^7\text{Li}(e, \text{en}){}^6\text{Li} \quad Q_m = -7.251$

(d) ${}^7\text{Li}(e, \text{et}){}^4\text{He} \quad Q_m = -2.467$

The electric form factor measurements for $E_e = 100$ to 600 MeV are well accounted for by a simple harmonic oscillator shell model with a quadrupole contribution described by an undeformed p-shell: $R_{\text{rms}} = 2.39 \pm 0.03$ fm, $|Q| = 42 \pm 2.5$ mb. From results obtained for $E_e = 24.14$ to 97.19 MeV, $R_{\text{rms}} = 2.35 \pm 0.10$ fm (model independent), 2.29 ± 0.04 fm (shell model). A study of the ratio of the electric charge scattering from ${}^6\text{Li}$ and from ${}^7\text{Li}$ as a function of (momentum transfer)² yields $\langle r^2 \rangle_6^{1/2} / \langle r^2 \rangle_7^{1/2} = 1.001 \pm 0.008$. The rms radius of the ground-state magnetization density distribution, $\langle r^2 \rangle_M^{1/2} = 2.98 \pm 0.05$ fm. From the ratio of transverse inelastic and elastic cross sections at 180° , $B(\text{M1}, \uparrow; 0.48) = 2.50 \pm 0.12 \mu_N^2$. The cross section for the longitudinal excitation of ${}^7\text{Li}^*(0.48)$ has been found from the scattering through angles of 90° to 150° , $B(\text{C2}, \uparrow; 0.48) = 7 \pm 4 \text{ fm}^4$: see (1979AJ01) for references. The form factor for ${}^7\text{Li}^*(0.48)$ has been measured at $\theta = 180^\circ$ for $0.4 < q < 0.75 \text{ fm}^{-1}$ (1982BU09): $\Gamma_0(\text{M1}) = (7.5 \pm 1.7) \times 10^{-3}$ eV, in good agreement with earlier values. Form factors for ${}^7\text{Li}^*(0, 0.48)$ are also reported for $0.8 < q < 2.9 \text{ fm}^{-1}$ (1983LI07).

Inelastic scattering studies show peaks corresponding to ${}^7\text{Li}^*(4.63, 6.68, 7.46, 11.24)$ in addition to ${}^7\text{Li}^*(0.48)$: see (1974AJ01) and Table 7.5. Quasi-elastic processes have been studied by (1978KU06; $250 \rightarrow 580 \text{ MeV}/c$). At $E_e = 700$ MeV the proton separation spectra (reaction (b)) are similar to those observed in (p, 2p) (1978NA05). See also (1980AS02) and ${}^6\text{He}$, ${}^6\text{Li}$ for reactions (b) and (c). At $E_e = 450$ to 1096 MeV (1980TI05) have studied the contributions of longitudinal and transverse components of the cross section for inelastic scattering: the effect of meson-exchange currents is observed.

See also (1979AF1A), (1979AJ01, 1979WA1D) and (1978FU13, 1979DO17, 1980ER01, 1980KA16, 1981DE1T, 1981EL06, 1981IS11, 1981LI25, 1981RA1M, 1981SR01, 1982BO1G, 1982KA11, 1982MU10, 1982PE06; theor.).

Table 7.5: Levels of ${}^7\text{Li}$ from ${}^7\text{Li}(e, e')$ ^a

E_x (MeV)	$J^\pi; T$	Γ_{γ_0} (eV)	Type	$\Gamma_{\gamma_0}/\Gamma_W$
0.48	$\frac{1}{2}^-; \frac{1}{2}$	$(2.8 \pm 1.6) \times 10^{-7}$	E2	17
		$(6.30 \pm 0.31) \times 10^{-3}$	M1	2.8
4.63 ± 0.05 ^b	$\frac{7}{2}^-; \frac{1}{2}$		E2 ^d	
6.6 ± 0.1 ^c	$\frac{5}{2}^-; \frac{1}{2}$		E2	
7.5 ± 0.08	$\frac{5}{2}^-; \frac{1}{2}$	0.6 ± 0.3	E2	
		0.9 ± 0.4 ^e		

^a For a summary of $B(E2\uparrow)$ measurements, see Table 7.6 in (1966LA04) and ${}^7\text{Li}$, the “GENERAL” section. For references see (1979AJ01). See also (1982PE06, 1983LI07).

^b $B(E2\uparrow)[\frac{3}{2}^- \rightarrow \frac{7}{2}^-] = 17.5 e^2 \cdot \text{fm}^4$ (1982PE06).

^c $\Gamma_{\text{c.m.}} = 875_{-100}^{+200}$ keV.

^d Purely longitudinal.

^e From ${}^7\text{Li}(\gamma, n)$.

16. ${}^7\text{Li}(\pi, \pi'){}^7\text{Li}^*$

Angular distributions have been measured at $E_{\pi^+} = 49.7$ MeV (1978DY01; elastic), $E_{\pi^\pm} = 143$ MeV (1982GI01; to ${}^7\text{Li}^*(0, 0.48, 4.63, 6.68, 7.46, 9.67)$) and 164.4 MeV (1979BO1F, 1979BO1G; to ${}^7\text{Li}^*(0, 0.48, 4.63, 6.68)$). Total cross sections for π on Li (from which partial cross sections were then derived) have been obtained for π^+ and π^- at several energies in the range 85 \rightarrow 315 MeV (1981AS07, 1979NA04). See also (1982OS01; theor.) and the “GENERAL” section here.

17. (a) ${}^7\text{Li}(n, n'){}^7\text{Li}^*$

(b) ${}^7\text{Li}(n, nt){}^4\text{He} \quad Q_m = -2.467$

Angular distributions have been measured at $E_n = 1.5$ to 14.6 MeV [see (1979AJ01)] and at $E_n = 4.1$ to 7.5 MeV (1979KN01; n_{0+1}), 6.97 to 13.94 MeV (1979HO11; n_{0+1}), 8.96 to 13.94 MeV (1979HO11; n_2), 9.1 MeV (1977BI12; n_{0+1} , n_2) and 10 to 18 MeV (1981DA1K; n_0). Reaction (b) at $E_n = 14.4$ MeV proceeds primarily via ${}^7\text{Li}^*(4.63)$ although some involvement of ${}^7\text{Li}^*(6.68)$ may also occur: see (1979AJ01). See also ${}^8\text{Li}$, (1979BA1R), (1980KA1R; applications) and (1982KO1U); theor.).

18. (a) ${}^7\text{Li}(p, p'){}^7\text{Li}^*$

(b) ${}^7\text{Li}(p, 2p){}^6\text{He}$	$Q_m = -9.975$
(c) ${}^7\text{Li}(p, pd){}^5\text{He}$	$Q_m = -9.62$
(d) ${}^7\text{Li}(p, p\alpha){}^3\text{H}$	$Q_m = -2.4681$
(e) ${}^7\text{Li}(p, p2d){}^3\text{H}$	$Q_m = -26.3148$

Angular distributions of protons have been measured for $E_p = 49.8$ to 155 MeV: see (1974AJ01) and at $E_p = 24.4$ MeV (1982PE06; p_0, p_1, p_2). Inelastic proton groups have been observed corresponding to ${}^7\text{Li}^*(0.48, 4.63, 6.68, 7.46, 9.6 \pm 0.2)$: see (1952AJ38, 1974AJ01).

For reaction (b) see (1980CH05; 800 MeV), ${}^6\text{He}$ and (1979AJ01). For reaction (c) see (1981ER10; 670 MeV) and ${}^5\text{He}$. Reaction (d) proceeds sequentially via ${}^7\text{Li}^*(4.63, 6.68)$. At $E_p = 100$ MeV (1977RO02) find $S_\alpha = 0.94 \pm 0.05$, using a DWIA analysis, a value close to that predicted by simple LS -coupling shell-model predictions. See also (1978LA11, 1980KI1D, 1982GO1H) and (1979AJ01). For reaction (e) see (1979AJ01) and (1982ER06; 670 MeV). See also ${}^8\text{Be}$, (1982YA1A) and (1978BA1C, 1978WO1A, 1979KI10, 1980KO1V, 1981IS11, 1982BA1W; theor.).

19. ${}^7\text{Li}(d, d'){}^7\text{Li}^*$

Angular distributions have been reported for $E_d = 1.0$ to 28 MeV: see (1974AJ01, 1979AJ01). See also ${}^9\text{Be}$.

20. ${}^7\text{Li}({}^3\text{He}, {}^3\text{He}){}^7\text{Li}$

Angular distributions are reported at $E({}^3\text{He}) = 11$ MeV (elastic) [see (1974AJ01)], at 44.04 MeV (1979GO07; g.s.) and at $E({}^3\text{He}) = 33.3$ MeV (1981BA37; ${}^7\text{Li}^*(0, 0.48, 4.63)$). See also ${}^{10}\text{B}$ and (1979KA1G). At $E({}^3\text{He}) = 37.5$ MeV, the three-body final states which are most strongly populated are the ${}^3\text{He} + \alpha + t$ and ${}^3\text{He} + d + {}^5\text{He}$ branches. Detection of ${}^3\text{He}-t$ coincidences lead to a most probable momentum for the spectator α -particle of 60 MeV/ c ; the $d-{}^3\text{He}$ breakup results suggest the unlikelihood of deuteron clusters in ${}^7\text{Li}$: see (1979AJ01).

21. (a) ${}^7\text{Li}(\alpha, \alpha'){}^7\text{Li}^*$

(b) ${}^7\text{Li}(\alpha, 2\alpha){}^3\text{H}$	$Q_m = -2.4681$
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Angular distributions (reaction (a)) have been reported for $E_\alpha = 3.6$ to 29.4 MeV [see (1974AJ01)] and at 5 and 6 MeV (1982WA23). Reaction (b) has been studied at $E_\alpha = 18$ to 64.3 MeV: see (1974AJ01) and (1980KI1D, 1980ZH1A). ${}^7\text{Li}^*(4.63)$ is strongly involved in the sequential decay. ${}^7\text{Li}^*(7.46)$ may also be involved. For pion production see (1981AB04). See also (1979ST25),

(1979AJ01), (1978GU16, 1981BA20, 1981GU1B, 1982GU1E; theor.) and ^{11}B in (1980AJ01, 1985AJ01).

22. (a) ${}^7\text{Li}({}^6\text{Li}, {}^6\text{Li}){}^7\text{Li}$
(b) ${}^7\text{Li}({}^7\text{Li}, {}^7\text{Li}){}^7\text{Li}$

For reaction (a) see (1981GU1B; theor.). The elastic angular distribution (reaction (b)) has been studied for $E({}^7\text{Li}) = 4.0$ to 6.5 MeV: see (1974AJ01).

23. ${}^7\text{Li}({}^9\text{Be}, {}^9\text{Be}){}^7\text{Li}$

The elastic angular distribution has been measured at $E({}^7\text{Li}) = 34$ MeV (1977KE09).

24. (a) ${}^7\text{Li}({}^{12}\text{C}, {}^{12}\text{C}){}^7\text{Li}$
(b) ${}^7\text{Li}({}^{13}\text{C}, {}^{13}\text{C}){}^7\text{Li}$

The elastic scattering (reaction (a)) has been studied at $E({}^7\text{Li}) = 4.5$ to 36 MeV [see (1975AJ02, 1979AJ01)] and at 48 , 63.0 , 78.7 MeV (1979ZE01, 1980ZE03; also ${}^7\text{Li}^*(0.48)$ [and ${}^{12}\text{C}^*(0, 4.4)$] and 89 MeV (1979BR04; and ${}^{12}\text{C}^*(0, 4.4)$). For elastic scattering studies involving ${}^{13}\text{C}$ see (1979AJ01, 1981AJ01). For fusion measurements and yield curves see (1982DE30, 1982TA23). See also (1981SH01) and (1979SU1F, 1981GU1B, 1982CO16; theor.).

25. (a) ${}^7\text{Li}({}^{15}\text{N}, {}^{15}\text{N}){}^7\text{Li}$
(b) ${}^7\text{Li}({}^{16}\text{O}, {}^{16}\text{O}){}^7\text{Li}$
(c) ${}^7\text{Li}({}^{20}\text{Ne}, {}^{20}\text{Ne}){}^7\text{Li}$

The elastic scattering has been studied at $E({}^7\text{Li}) = 28.8$ MeV (1982WO09; reaction (a)), 68 and [reaction (c)] 89 MeV (1979BR03). See also (1979AJ01, 1979VA1B), (1980KH09, 1981GU1B; theor.) and ${}^{20}\text{Ne}$ in (1983AJ01).

26. (a) ${}^7\text{Li}({}^{24}\text{Mg}, {}^{24}\text{Mg}){}^7\text{Li}$
(b) ${}^7\text{Li}({}^{25}\text{Mg}, {}^{25}\text{Mg}){}^7\text{Li}$
(c) ${}^7\text{Li}({}^{26}\text{Mg}, {}^{26}\text{Mg}){}^7\text{Li}$
(d) ${}^7\text{Li}({}^{27}\text{Al}, {}^{27}\text{Al}){}^7\text{Li}$

The elastic scattering has been studied at $E(^7\text{Li}) = 89$ MeV (1980CO11, 1980ST06, 1981CO05, 1982CO16, 1982CO18), and at 27 MeV (1982WO09; reaction (b)). See also (1982HN1A, 1982TA23) and (1983CO05; theor.).

27. (a) $^7\text{Li}(^{28}\text{Si}, ^{28}\text{Si})^7\text{Li}$
 (b) $^7\text{Li}(^{40}\text{Ca}, ^{40}\text{Ca})^7\text{Li}$
 (c) $^7\text{Li}(^{48}\text{Ca}, ^{48}\text{Ca})^7\text{Li}$

Angular distributions involving $^7\text{Li}^*(0, 0.48)$ and various states of ^{28}Si and ^{40}Ca have been studied at $E(^7\text{Li}) = 45$ MeV (1982EC01). The elastic scattering (reactions (b) and (c)) has been studied at $E(^7\text{Li}) = 28$ and 34 MeV (1977CU02), 88.7 MeV (1980ST06) and 89 MeV (1982NA14; also $^7\text{Li}^*(0.48)$). See also (1982HN1A) and (1982CO18, 1983CO05; theor.).

28. $^7\text{Be}(\epsilon)^7\text{Li} \quad Q_m = 0.862$

The decay proceeds to the ground and 0.48 MeV states. The branching ratio to $^7\text{Li}^*(0.48)$ is $10.39 \pm 0.06\%$: see Table 7.6. A recent value of $15.4 \pm 0.8\%$ has been suggested by (1982ROZS). However subsequently a number of groups have remeasured the branching ratio and find agreement with an earlier value. [In (1979AJ01) the value of (1974GO26) was improperly quoted; it is $(10.35 \pm 0.08)\%$]. The adopted half-life is 53.29 ± 0.07 d. Both transitions are superallowed: $\log ft = 3.32$ and 3.55 for the decays to $^7\text{Li}^*(0, 0.48)$. See (1978RA2A, 1979AJ01) for references.

The energy of the γ -ray is 477.605 ± 0.003 keV (1978HE21), 477.6064 ± 0.0026 keV (1983KU03) [E_x derived from the mean E_γ is 477.612 ± 0.002 keV]. See also (1978SA1B, 1981SA22), (1974AJ01, 1979HE19, 1980VA1D, 1981KH1E, 1982MC1D), (1975ZI1A, 1978BA1E, 1979DA1D, 1980PE1N, 1981BA1L, 1981BA2G, 1982BA80, 1982CO1D, 1983LI01, 1983TR1F; astrophysics) and (1979DE15; theor.).

29. $^9\text{Be}(\pi^-, 2n)^7\text{Li} \quad Q_m = 119.865$

The capture of stopped pions has been studied in a kinematically complete experiment: $^7\text{Li}^*(0, 0.48)$ are weakly populated. Two large peaks are attributed to the excitation of $^7\text{Li}^*(7.46, 10.25)$ [see, however, Table 7.2]. The recoil momentum distributions corresponding to these peaks are rather similar and both indicate a strong $L = 0$ component (1977BA51).

30. $^9\text{Be}(n, t)^7\text{Li} \quad Q_m = -10.438$

Table 7.6: The branching ratio of ${}^7\text{Be}(\epsilon){}^7\text{Li}$ to ${}^7\text{Li}^*(0.48)$ ^a

Branching ratio (%)	Reference
10.32 ± 0.16	(1962TA11)
10.42 ± 0.18	(1973PO10)
10.35 ± 0.08	(1974GO26)
10.10 ± 0.45	(1983BA15)
10.61 ± 0.23	(1983DA14)
10.6 ± 0.5	(1983DO1M) ^c
10.7 ± 0.3	(1983FIZV)
10.7 ± 0.2	(1983MA34)
9.8 ± 0.5	(1983NO03) ^c
10.39 ± 0.06	weighted mean ^b

^a See also (1983DO1L, 1983KNZZ, 1983TAZY), (1983WAIM; theor.) and the text of reaction 28.

^b Not including the preliminary value of (1983FIZV).

^c And private communication.

Angular distributions of the t_0 and t_1 groups are reported at $E_n = 13.99$ MeV: see (1979AJ01). See also (1978DR03) and ${}^{10}\text{Be}$.

$$31. {}^9\text{Be}(p, {}^3\text{He}){}^7\text{Li} \quad Q_m = -11.201$$

At $E_p = 43.7$ MeV angular distributions have been obtained for the ${}^3\text{He}$ particles corresponding to ${}^7\text{Li}^*(0, 0.48, 4.63, 7.46)$. The 7.46 MeV state is strongly excited while the mirror state in ${}^7\text{Be}$ is not appreciably populated in the mirror reaction (see reaction 15 in ${}^7\text{Be}$). The angular distribution indicates that the transition to ${}^7\text{Li}^*(7.46)$ involves both $L = 0$ and 2, with a somewhat dominant $L = 0$ character. The $J^\pi = \frac{3}{2}^-$, $T = \frac{3}{2}$ state is located at $E_x = 11.28 \pm 0.04$ MeV, $\Gamma = 260 \pm 50$ keV: see (1979AJ01) for references. See also (1981DE1X).

$$32. (a) {}^9\text{Be}(d, \alpha){}^7\text{Li} \quad Q_m = 7.152$$

$$(b) {}^9\text{Be}(d, t){}^4\text{He}{}^4\text{He} \quad Q_m = 4.6836$$

Angular distributions have been measured for $E_d = 0.4$ to 27.5 MeV: see (1966LA04, 1974AJ01, 1979AJ01). A study at 11 MeV finds $\Gamma_{c.m.} = 93 \pm 25$ and 80 ± 20 keV, respectively, for ${}^7\text{Li}^*(4.63,$

7.46). No evidence is found for the $T = \frac{3}{2}$ state ${}^7\text{Li}^*(11.25)$. In a kinematically complete study of reaction (b) at $E_d = 26.3$ MeV, ${}^7\text{Li}^*(4.6, 6.5 + 7.5, 9.4)$ are strongly excited. No sharp α -decaying states of ${}^7\text{Li}$ are observed with $10 < E_x < 25$ MeV. Parameters for ${}^7\text{Li}^*(9.7)$ are $E_x = 9.36 \pm 0.05$ MeV, $\Gamma = 0.8 \pm 0.2$ MeV: see (1979AJ01). See also ${}^8\text{Be}$, ${}^{11}\text{B}$ in (1980AJ01, 1985AJ01) and (1980DE42, 1980DE43, 1980NE11, 1982LA09).

$$33. {}^9\text{Be}({}^6\text{Li}, {}^8\text{Be}){}^7\text{Li} \quad Q_m = 5.585$$

Angular distributions to ${}^7\text{Li}^*(0, 0.48)$ have been studied at $E({}^6\text{Li}) = 5.5$ and 6.5 MeV: see (1979AJ01).

$$34. {}^{10}\text{B}(n, \alpha){}^7\text{Li} \quad Q_m = 2.790$$

Angular distributions of α_0 , α_1 and of α_2 at the higher energies have been measured at $E_n = 0.2$ to 14.4 MeV [see (1979AJ01)] and at 2 and 24 keV (1979ST03; α_0 , α_1). See also ${}^{11}\text{B}$ in (1980AJ01), (1978LI32) and (1980MUID; applied).

$$35. {}^{10}\text{B}(d, {}^5\text{Li}){}^7\text{Li} \quad Q_m = -1.40$$

See (1982DO1E; $E_d = 13.6$ MeV).

$$36. {}^{10}\text{B}(\alpha, {}^7\text{Be}){}^7\text{Li} \quad Q_m = -16.200$$

See reaction 20 in ${}^7\text{Be}$.

$$37. {}^{11}\text{Be}(\beta^-){}^{11}\text{B}^* \rightarrow {}^7\text{Li} + \alpha \quad Q_m = 2.844$$

Delayed α -particles have been observed in the β^- decay of ${}^{11}\text{Be}$: they are due to the decay of ${}^{11}\text{B}^*(9.88)$ [$J^\pi = \frac{3}{2}^+$]. This state decays by α -emission $87.4 \pm 1.2\%$ to the ground state of ${}^7\text{Li}$ and $12.6 \pm 1.2\%$ to ${}^7\text{Li}^*(0.48)$ (1981AL03). See also ${}^{11}\text{Be}$, ${}^{11}\text{B}$ in (1985AJ01).

$$38. {}^{11}\text{B}(d, {}^6\text{Li}){}^7\text{Li} \quad Q_m = -7.189$$

At $E_d = 13.6$ and 19.5 MeV angular distributions have been measured for the transitions to ${}^6\text{Li}_{\text{g.s.}}$ and ${}^7\text{Li}^*(0, 0.48)$: see ${}^6\text{Li}$.

39. ${}^{11}\text{B}(\alpha, {}^8\text{Be}){}^7\text{Li}$ $Q_m = -8.756$

Angular distributions have been measured at $E_\alpha = 27.2$ MeV ([1983DO1F](#); see ${}^8\text{Be}$) and at $E_\alpha = 28.4$ and 29.0 MeV (to ${}^7\text{Li}^*(0, 0.48)$ and ${}^8\text{Be}^*(0, 2.9)$) and at 65 MeV (to ${}^7\text{Li}^*(0, 4.63)$). At $E_\alpha = 65$ and 72.5 MeV, ${}^7\text{Li}^*(0, 4.63)$ are very strongly populated while ${}^7\text{Li}^*(0.48, 6.68, 7.46)$ are weakly excited. See ([1979AJ01](#)) for references.

40. (a) ${}^{12}\text{C}(\gamma, p\alpha){}^7\text{Li}$ $Q_m = -24.6206$
 (b) ${}^{12}\text{C}(p, 2p\alpha){}^7\text{Li}$ $Q_m = -24.6206$

For reaction (a) see ([1979KI04](#)). For reaction (b) see ([1981AU1D](#); astrophysics) and ([1982ZH02](#); theor.).

41. ${}^{12}\text{C}(d, {}^7\text{Be}){}^7\text{Li}$ $Q_m = -17.539$

At $E_d = 39.8$ MeV, angular distributions have been measured for the transitions to ${}^7\text{Li}(0) + {}^7\text{Be}(0)$, ${}^7\text{Li}^*(0.48) + {}^7\text{Be}(0)$, ${}^7\text{Li}(0) + {}^7\text{Be}^*(0.43)$, and ${}^7\text{Li}^*(0.48) + {}^7\text{Be}(0.43)$. Assymetries exceeding 20% are observed in the ratio of the cross sections to ${}^7\text{Li}(0)$ and ${}^7\text{Be}(0)$: see ([1979AJ01](#)).

42. ${}^{12}\text{C}(\alpha, {}^9\text{B}){}^7\text{Li}$ $Q_m = -24.897$

At $E_\alpha = 65$ MeV this reaction proceeds via ${}^7\text{Li}^*(4.63)$ ([1978SA26](#)).

43. ${}^{12}\text{C}({}^6\text{Li}, {}^{11}\text{C}){}^7\text{Li}$ $Q_m = -11.471$

Angular distributions have been obtained at $E({}^6\text{Li}) = 36$ MeV for the transitions to ${}^7\text{Li}^*(0, 0.48)$: see ([1979AJ01](#)).

44. ${}^{13}\text{C}(p, {}^7\text{Be}){}^7\text{Li}$ $Q_m = -20.261$

An angular distribution involving ${}^7\text{Li}_{\text{g.s.}} + {}^7\text{Be}_{\text{g.s.}}$ has been measured at $E_p = 45.0$ MeV: see (1974AJ01).

$$45. {}^{13}\text{C}(\text{d}, {}^8\text{Be}){}^7\text{Li} \quad Q_m = -3.5875$$

At $E_d = 14.6$ MeV angular distributions are reported for the transitions to ${}^7\text{Li}^*(0, 0.48)$ and ${}^8\text{Be}_{\text{g.s.}}$: see (1979AJ01). See also (1982DO1E) and ${}^8\text{Be}$.

$$46. {}^{13}\text{C}({}^6\text{Li}, {}^{12}\text{C}){}^7\text{Li} \quad Q_m = 2.304$$

At $E({}^6\text{Li}) = 34$ MeV angular distributions have been measured for the transitions involving ${}^7\text{Li}_{\text{g.s.}} + {}^{12}\text{C}_{\text{g.s.}}$, ${}^7\text{Li}_{0.48}^* + {}^{12}\text{C}_{\text{g.s.}}$, ${}^7\text{Li}_{\text{g.s.}} + {}^{12}\text{C}_{4.4}^*$, and ${}^7\text{Li}_{0.48}^* + {}^{12}\text{C}_{4.4}^*$: see (1979AJ01).

$$47. {}^{14}\text{N}(\text{n}, 2\alpha){}^7\text{Li} \quad Q_m = -8.8217$$

At $E_n = 14.1$ MeV, ${}^7\text{Li}^*(0, 0.48)$ are approximately equally populated. At $E_n = 18.2$ MeV, ${}^7\text{Li}^*(4.63)$ may be involved: see (1979AJ01).

$$48. \text{(a) } {}^{17}\text{O}(\text{d}, {}^{12}\text{C}){}^7\text{Li} \quad Q_m = -2.580$$

$$\text{(b) } {}^{18}\text{O}(\text{d}, {}^{13}\text{C}){}^7\text{Li} \quad Q_m = -5.678$$

$$\text{(c) } {}^{19}\text{F}(\text{d}, {}^{14}\text{N}){}^7\text{Li} \quad Q_m = -6.122$$

At $E_d = 14.6$ to 15.0 MeV, angular distributions have been measured for the transitions to ${}^{12}\text{C}(0) + {}^7\text{Li}^*(0, 0.48)$ [reaction (a)], ${}^{13}\text{C}(0) + {}^7\text{Li}^*(0, 0.48)$ [reaction (b)] and ${}^{14}\text{N}(0) + {}^7\text{Li}^*(0, 0.48)$ [reaction (c)]: see (1979AJ01). Angular distributions involving ${}^7\text{Li}^*(0, 0.48)$ are also reported at $E_d = 13.6$ MeV (reaction (b)) (1980GA1K).

⁷Be
(Figs. 9 and 10)

GENERAL: (See also (1979AJ01).)

Nuclear models: (1978RE1A, 1979WI1B, 1980HA1M, 1981KU13, 1982FI13, 1983WA1M).

Astrophysical questions: (1978BU1B, 1979MO04, 1979RA20, 1979RA1C, 1980CA1C, 1980LA1G, 1980WI1M, 1983LI01).

Applied work: (1979LA1E, 1982HA1D, 1983HA1W).

Complex reactions involving ⁷Be: (1978DI1A, 1978DU1B, 1978HA40, 1978HE1C, 1979BO22, 1979KA07, 1979LO11, 1979PO10, 1979RA20, 1979SC1D, 1979VI05, 1980GR10, 1980MI01, 1980WI1K, 1980WI1L, 1980WO05, 1981CI03, 1981GR08, 1981ME13, 1981MO20, 1981TA22, 1982BO1J, 1982BO1N, 1982BO35, 1982FU04, 1982GL01, 1982GR09, 1982GU1H, 1982HA1V, 1982HI12, 1982LU01, 1982LY1A, 1982MO1N, 1983PU01, 1983SA06).

Reactions involving pions and kaons: (1978WA1B, 1979AL1J, 1979BO23, 1979SI16, 1980BA27, 1980LE02, 1981OS04, 1981SI09, 1982AL31, 1982DO02, 1982LEZY, 1983IRZZ, 1983PIZW).

Hypernuclei: (1978PO1A, 1978SO1A, 1981WA1J).

Other topics: (1979BE1H, 1982NG01).

Ground state of ⁷Be: (1982FI13, 1982NG01).

1. ⁷Be(ϵ)⁷Li $Q_m = 0.862$

The decay is complex: see ⁷Li.

2. ⁴He(³He, γ)⁷Be $Q_m = 1.5876$

The capture cross section has been measured for $E_\alpha = 0.38$ to 5.80 MeV [see (1974AJ01)], 0.250 to 2.954 MeV (1982KR05), 0.385 to 2.730 MeV (1982OS02), at $E_{c.m.} = 0.897$ MeV (1983RO1C) and for $E(^3\text{He}) = 19$ to 26 MeV (1983WA05; γ_{0+1} excitation function at 90°).

The branching ratios $\text{DC} \rightarrow 429/\text{DC} \rightarrow 0$ and the cross section for the $\text{DC} \rightarrow 429$ branch have been measured for $E_{c.m.} = 107$ to 1266 keV: the branching ratio is approximately constant at 0.43 ± 0.02 over that energy range; the cross section is 0.117 ± 0.016 nb at 107 keV. It increases to 421 ± 39 nb at $E_{c.m.} = 1266$ keV (1982KR05). These data lead to a value of $S(0) = 0.56 \pm 0.03$ keV · b (using microscopic DC model calculations, and a branching ratio, $10.42 \pm 0.06\%$, for the ⁷Be decay to ⁷Li*(0.48)) [see reaction 28 in ⁷Li] (1983VO01).

Table 7.7: Energy levels of ${}^7\text{Be}$

E_x (MeV \pm keV)	$J^\pi; T$	τ or $\Gamma_{\text{c.m.}}$	Decay	Reactions
g.s.	$\frac{3}{2}^-; \frac{1}{2}$	$\tau_{1/2} = 53.29 \pm 0.07$ d	ϵ	1, 2, 5, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30
0.42908 ± 0.10	$\frac{1}{2}^-; \frac{1}{2}$	$\tau_m = 192 \pm 25$ fsec	γ	2, 5, 9, 10, 11, 12, 13, 14, 15, 17, 19, 22, 23, 24, 25, 27, 28, 29, 30
4.57 ± 50	$\frac{7}{2}^-; \frac{1}{2}$	$\Gamma = 175 \pm 7$ keV	${}^3\text{He}, \alpha$	3, 10, 13, 14, 15
6.73 ± 100	$\frac{5}{2}^-; \frac{1}{2}$	1.2 MeV	${}^3\text{He}, \alpha$	3, 8, 9, 13, 15
7.21 ± 60	$\frac{5}{2}^-; \frac{1}{2}$	≤ 0.5 MeV	p, ${}^3\text{He}, \alpha$	3, 6, 8, 9, 13
9.27 ± 100	$\frac{7}{2}^-; \frac{1}{2}$		p, ${}^3\text{He}, \alpha$	3
9.9	$\frac{3}{2}^-; \frac{1}{2}$	≈ 1.8 MeV	p, ${}^3\text{He}, \alpha$	3, 6
11.01 ± 30	$\frac{3}{2}^-; \frac{3}{2}$	320 ± 30	p, ${}^3\text{He}, \alpha$	3, 6, 13, 15
17	$\frac{1}{2}^-; \frac{1}{2}$	≈ 6.5 MeV	${}^3\text{He}$	3, 13

(1982OS02) obtain $S(0) = 0.52 \pm 0.03$ keV \cdot b and (1983RO1C) find 0.63 ± 0.04 keV \cdot b. See also (1974AJ01) and (1981WI04; theor.). (1983RO1C) suggest, prior to (1983VO01), that $S(0) = 0.56 \pm 0.07$ keV \cdot b should be adopted. $C^2S = 1.0$ for ${}^7\text{Be}^*(0, 0.43)$ (1982KR05). See also (1980BA1P, 1980BA2M, 1980PE1N, 1981BA2F, 1981RO1W, 1982BA80; astrophysics) and (1981KI01, 1981LI01, 1982TA1G, 1983WA1M; theor.).

3. (a) ${}^4\text{He}({}^3\text{He}, {}^3\text{He}){}^4\text{He}$

$$E_b = 1.5876$$

(b) ${}^4\text{He}({}^3\text{He}, \text{p}){}^6\text{Li}$

$$Q_m = -4.0182$$

Elastic scattering studies have been reported for $E = 1.72$ to 140 MeV [see (1974AJ01, 1979AJ01)] and at $E_\alpha = 0.25$ to 2.95 MeV (1982KR05) and 140 MeV (1980RO03) and at $E({}^3\text{He}) = 18$ to 70 MeV (1978BA75) and 198.4 MeV (1980RO03). Polarization measurements have been carried out at $E = 4.3$ to 98 MeV: see (1979AJ01).

For $l \leq 4$, only f-wave phase shifts show resonance structure for $E({}^3\text{He}) < 18$ MeV, corresponding to ${}^7\text{Be}^*(4.57, 6.73, 9.27)$: see Table 7.7. No structure corresponding to ${}^7\text{Be}^*(7.21)$ ($J^\pi = \frac{5}{2}^-$) is seen in the elastic data. The s-wave phase shift is somewhat greater than hard-sphere. The decay of ${}^7\text{Be}^*(9.27)$ ($J^\pi = \frac{7}{2}^-$) to ${}^6\text{Li}(0)$ requires f-shell configuration admixture. An estimate of the yield of ground-state protons relative to those corresponding to ${}^6\text{Li}^*(2.19)$ yields $\gamma^2(\text{p}_0)/\gamma^2(\text{p}_1) = (16_{-10}^{+5})\%$. A phase-shift analysis (single-level R -matrix) has been carried out for

Table 7.8: ${}^7\text{Be}$ levels from ${}^3\text{He} + {}^4\text{He}$ ^a

E_x (MeV \pm keV)	J^π	l_α	LS term	θ_α^2 ^b	θ_p^2
4.57 ± 50	$\frac{7}{2}^-$	3	${}^2\text{F}_{7/2}$	0.70 ± 0.04	
6.73 ± 100	$\frac{5}{2}^-$	3	${}^2\text{F}_{5/2}$	1.36 ± 0.13	0.000 ± 0.002
7.21 ± 60	$\frac{5}{2}^-$	3	${}^4\text{P}_{5/2}$	0.010 ± 0.001	0.26 ± 0.02
9.27 ± 100	$\frac{7}{2}^-$	3	${}^4\text{D}_{7/2}$	0.70 ± 0.26	$0.29^{+0.09}_{-0.18}$ ^f
10.0 ^c	$\frac{3}{2}^-$	1	$({}^4\text{P}_{3/2})$		
≈ 10.0 ^d	$\frac{1}{2}^-$		$({}^4\text{P}_{1/2})$		
11.00 ± 50 ^e	$\frac{3}{2}^-$	1	$({}^2\text{P}_{3/2}, {}^2\text{D}_{3/2})$		0.13 ± 0.02 ^g

^a See also Table 7.10 in (1966LA04). For references see Table 7.7 in (1979AJ01).

^b $\gamma^2/(\frac{3}{2}\hbar^2/\mu a^2)$. $R = 4.0$ fm.

^c $\Gamma = 1.8$ MeV.

^d Broad.

^e $\Gamma = 0.4 \pm 0.05$ MeV; $T = \frac{3}{2}$.

^f $\theta_{p1}^2 = 1.8 \pm 0.5$

^g θ_{p2}^2 .

$E({}^3\text{He}) = 18$ to 32 MeV: the p-wave phase shifts indicate a $\frac{1}{2}^-$ state at $E_x \approx 16.7$ MeV ($E_r = 26.4$ MeV), with $\Gamma = 6.5$ MeV (1978LU05). The work of (1978BA75) is consistent with the results of (1978LU05) and, in addition, suggests broad $l = 4$ and 5 states at $E({}^3\text{He}) > 30$ MeV [$E_x > 19$ MeV].

The differential cross section for reaction (b) has been determined for $E({}^3\text{He}) = 8$ to 28 MeV [see (1979AJ01)] and at $E_\alpha = 22.2$ to 26.5 MeV (1980NE08; p_0). Resonances are observed corresponding to ${}^7\text{Be}^*(7.21, 9.27)$ in the p_0 yield, to ${}^7\text{Be}^*(9.27)$ in the p_1 yield and to states at $E_x \approx 10$ MeV ($T = \frac{1}{2}$) and 11.0 MeV ($T = \frac{3}{2}$) in the yield of 3.56 MeV γ -rays. The evidence for the latter derives mainly through interference arguments. There is also some evidence for an extremely broad $J^\pi = \frac{1}{2}^-$ structure at $E_x \geq 10$ MeV [see also ${}^6\text{Li}(p, p)$]: see Table 7.8 and (1974AJ01). See also (1980NE08). See also (1981BA1Q), (1978BR1A, 1979KA1G, 1982YA1A) and (1978DU1D, 1978TA1A, 1979KOZV, 1979LE11, 1979WI1B, 1981FI1B, 1981SH07, 1982AZ01, 1982FU01, 1982KA11, 1982LE23, 1983HO1F, 1983SA1G; theor.).

$$4. {}^4\text{He}(\alpha, n){}^7\text{Be} \quad Q_m = -18.9902$$

See (1978GL03, 1979AL1F), (1979AJ01) and ${}^8\text{Be}$.

$$5. {}^6\text{Li}(p, \gamma){}^7\text{Be} \quad Q_m = 5.606$$

Gamma transitions are observed to the ground (γ_0) and to the 0.43 MeV (γ_1) states. The yield shows no evidence of resonance for $E_p = 0.2$ to 1.0 MeV and the branching ratio remains approximately constant at $(62 \pm 5)\%$ to the ground state, 38% to ${}^7\text{Be}^*(0.43)$, $< 4\%$ to ${}^7\text{Be}^*(4.57)$: see (1974AJ01). The total cross section for $E_p = 0.2$ to 1.2 MeV has been obtained by (1979SW02): at $E_p = 0.8$ MeV it is $3.1 \pm 0.4 \mu\text{b}$, in good agreement with previous values. The branching ratio to ${}^7\text{Be}^*(0.43)$ is $(41 \pm 3)\%$ (1979SW02). The weighted mean of this and previous measurements is $(39 \pm 2)\%$ (1979SW02). See also (1980BA34).

6. (a) ${}^6\text{Li}(p, p){}^6\text{Li}$ $E_b = 5.606$
 (b) ${}^6\text{Li}(p, 2p){}^5\text{He}$ $Q_m = -4.59$
 (c) ${}^6\text{Li}(p, p\alpha){}^2\text{H}$ $Q_m = -1.4753$

Measurements of elastic angular distributions have been reported for $E_p = 0.5$ to 600 MeV: see (1966LA04, 1974AJ01) and ${}^6\text{Li}$. Two resonances are reported at $E_p = 1.84$ and 5 MeV in the elastic yield [${}^7\text{Be}^*(7.21, 9.9)$]. The parameters of the lower resonance are shown in Table 7.4. The 5 MeV resonance has $\Gamma \approx 1.8$ MeV and appears to also be formed by p-waves: γ_p^2 is then 3 ± 2 MeV · fm. A weak rise near $E_p = 8$ to 9 MeV may indicate a further level, ${}^7\text{Be}^* \approx 13$ MeV. A broad resonance at $E_p = 14$ MeV has also been suggested. Polarization measurements have been carried out for $E_p = 1.2$ to 155 MeV [see (1974AJ01, 1979AJ01)] and at $E_{\bar{p}} = 25$ and 35 MeV (1982ROZT; $0_0, p_1$) and 800 MeV (1979GLIC; p_2). A phase shift analysis for $E_p = 0.5$ to 5.6 MeV shows that only ${}^2\text{S}$, ${}^4\text{S}$ and ${}^4\text{P}$ are involved. The ${}^4\text{P}_{5/2}$ phase resonates at $E_p = 1.8$ MeV, and the broad resonance at 5 MeV can be reproduced equally well by either ${}^4\text{P}_{3/2}$ or ${}^4\text{P}_{1/2}$: tensor polarization measurements are necessary to distinguish between the two: see (1974AJ01).

The reaction cross section for formation of ${}^6\text{Li}^*(2.19)$ has been measured for $E_p = 3.6$ to 9.40 MeV: a broad resonance indicates the presence of a state with $E_x \approx 10$ MeV, $\Gamma = 1.8$ MeV, $J^\pi = (\frac{3}{2}, \frac{5}{2})^-$, $T = \frac{1}{2}$. The cross section and angular distributions of p_2 (${}^6\text{Li}^*(3.56)$) for $E_p = 4.26$ to 9.40 MeV is analyzed in terms of two $J^\pi = \frac{3}{2}^-$ states at $E_x \approx 10$ and 11 MeV: see reaction 3. The total cross section for formation of ${}^6\text{Li}^*(3.56)$ decreases slowly with energy for $E_p = 24.3$ to 46.4 MeV. The reaction cross section has been measured for $E_p = 25.0$ to 48 MeV: see (1979AJ01).

For reaction (b) see ${}^5\text{He}$, (1978NA18; $E_{\bar{p}} = 635$ MeV) and (1979AJ01). For reaction (c) see ${}^6\text{Li}$ and (1979AJ01). Studies of inclusive cross sections are reported at 640 MeV (1981ER07) and 400 GeV (1979BA28, 1979FR12, 1980NI09). For pion and kaon production see (1980NI09; 400 GeV). See also (1982AB1D) and (1981FR1R, 1981FR1T, 1981KR15, 1982ST15; theor.).

7. ${}^6\text{Li}(p, n){}^6\text{Be}$ $Q_m = -5.070$ $E_b = 5.606$

The yield of neutrons increases approximately monotonically from threshold to $E_p = 14.3$ MeV. Polarization measurements are reported at $E_p = 30$ and 50 MeV: see (1974AJ01). See also ${}^6\text{Be}$.

8. ${}^6\text{Li}(p, \alpha){}^3\text{He}$

$$Q_m = 4.0182$$

$$E_b = 5.606$$

$$Q_0 = 4018.2 \pm 1.1 \text{ keV: see (1981RO02)}$$

Over the range $E_p = 25$ to 50 keV, the cross section rises from 0.8 to $72 \mu\text{b}$: in the formula $\sigma \approx E^{-1} e^{-B/\sqrt{E}}$, $B = 90 \pm 6 \text{ keV}^{1/2}$. Cross-section measurements for $E_p = 62$ to 188 keV show deviation from an s-wave Gamow plot above ≈ 130 keV (1966GE11). Using cross-section measurements at $E_p = 136 \rightarrow 297$ keV, as well as the (1966GE11) results, (1979EL10) calculate $S(0) = 3.145 \text{ MeV} \cdot \text{b}$ [$E_{\text{c.m.}} = 1 \text{ keV} \rightarrow 500 \text{ keV}$]. Thermonuclear reaction rates are also derived (1979EL10). See also (1979SH14; $125 \rightarrow 700$ keV; $S(0) = 3 \text{ MeV} \cdot \text{b}$) and (1979AJ01).

At higher energies the cross section exhibits a broad, low maximum near $E_p = 1 \text{ MeV}$ and a pronounced resonance at $E_p = 1.85 \text{ MeV}$ ($\Gamma < 0.5 \text{ MeV}$). No other structure is reported up to $E_p = 5.6 \text{ MeV}$. Measurements between $E_p = 0.4$ and 3.4 MeV show that the polarizations are generally large and positive. The $E_p = 1.9 \text{ MeV}$ resonance appears in A_1 and A_2 : see (1974AJ01).

Angular distributions have been reported for $E_p = 0.15$ to 45 MeV [see (1974AJ01, 1979AJ01)] and at $E_p = 125$ to 700 keV (1979SH14), 136 to 297 keV (1979EL10) and 47.8 , 53.5 , 58.5 and 62.5 MeV (1982BA1V). See also (1979DE1E, 1979HA1C, 1980HA1Y, 1981JA1F; applied), (1981HO1E) and (1978PL1A; theor.).

9. ${}^6\text{Li}(d, n){}^7\text{Be}$

$$Q_m = 3.381$$

Angular distributions of the n_0 and n_1 groups have been measured at $E_d = 0.20$ to 15.25 MeV : see (1974AJ01, 1979AJ01). The $n\text{-}\gamma$ correlations are isotropic, indicating $J^\pi = \frac{1}{2}^-$ for ${}^7\text{Be}^*(0.43)$. Broad maxima are observed in the ratio of low-energy to high-energy neutrons at $E_d = 4.2$ and 5.1 MeV [${}^7\text{Be}^*(6.5, 7.2)$, $\Gamma_{\text{c.m.}} = 1.2$ and 0.5 MeV , respectively]: see (1966LA04). See also (1979HO04, 1980GU26) in ${}^8\text{Be}$.

10. ${}^6\text{Li}({}^3\text{He}, d){}^7\text{Be}$

$$Q_m = 0.112$$

Angular distributions of the d_0 and d_1 groups to ${}^7\text{Be}^*(0, 0.43)$ have been measured at $E({}^3\text{He}) = 8, 10, 14$ and 18 MeV : all the distributions show an $l = 1$ maximum at small angles: see (1974AJ01). At $E({}^3\text{He}) = 33.3 \text{ MeV}$ angular distributions and A_y measurements to ${}^7\text{Be}^*(0, 0.43)$ have been analyzed using coupled channels and DWBA. ${}^7\text{Be}^*(4.57)$ is also populated (1981BA38).

11. ${}^6\text{Li}(\alpha, t){}^7\text{Be}$

$$Q_m = -14.208$$

See (1979AJ01).

12. (a) ${}^7\text{Li}(\gamma, \pi^-){}^7\text{Be}$ $Q_m = -140.429$
 (b) ${}^7\text{Li}(\pi^+, \pi^0){}^7\text{Be}$ $Q_m = 3.742$

For reaction (a) see (1979BO23). Forward-angle differential cross sections to ${}^7\text{Be}_{\text{g.s.}}$ have been measured at $E_{\pi^+} = 48$ MeV (1982LEZY), and $70 \rightarrow 180$ MeV (1980BA27, 1982DO02). See also (1982AL35).

13. ${}^7\text{Li}(\text{p}, \text{n}){}^7\text{Be}$ $Q_m = -1.644$

The excitation energy of ${}^7\text{Be}^*(0.43)$ is 429.20 ± 0.10 keV, $\tau_m = 192 \pm 25$ fsec: see (1979AJ01). Angular distributions of n_0 and n_1 are reported at $E_p = 1.9$ to 50 MeV [see (1974AJ01, 1979AJ01)] and at 119.8 MeV (1979GO16, 1980GO07; n_{0+1}). The population of ${}^7\text{Be}^*(4.55, 6.51, 7.19, 10.79)$ has also been observed: see (1974AJ01, 1979AJ01). The ratios σ_1/σ_0 (${}^7\text{Be}^*(0.43)/{}^7\text{Be}_{\text{g.s.}}$) have been measured at $24.8, 35$ and 45 MeV: an analysis of these yields the ratio of spin-flip to spin-nonflip strength $|V_{\sigma\tau}/V_\tau|^2$ (1980AU02). (1983TAZY) report cross-section measurements at $E_p = 60$ to 200 MeV. See also (1981SH1F, 1982KI1F, 1982TAZQ), (1979CH1B, 1980SE1D, 1982SA1M; applied), (1982GO1C, 1982PE06, 1982TA03), (1982GU1D, 1983GU1G; theor.) and ${}^8\text{Be}$.

14. ${}^7\text{Li}({}^3\text{He}, \text{t}){}^7\text{Be}$ $Q_m = -0.881$

Angular distributions of t_0 and t_1 have been measured at $E({}^3\text{He}) = 3.0$ to 4.0 MeV [see (1974AJ01)] and at $E({}^3\vec{\text{He}}) = 33.3$ MeV (1981BA37). The width of ${}^7\text{Be}^*(4.57)$, $\Gamma_{\text{c.m.}} = 175 \pm 7$ keV: see (1974AJ01). See also ${}^{10}\text{B}$.

15. ${}^9\text{Be}(\text{p}, \text{t}){}^7\text{Be}$ $Q_m = -12.082$

Angular distributions of tritons have been measured at $E_p = 43.7$ MeV (${}^7\text{Be}^*(0, 0.43, 4.57, 6.51, 11.01)$) and 46 MeV (${}^7\text{Be}^*(0 + 0.43, 4.57, 6.51, 10.69)$), and at $E_p = 50$ and 72 MeV (1982ZA1B; t_0, t_1). The 11 MeV state has $E_x = 11.01 \pm 0.04$ MeV, $\Gamma = 298 \pm 25$ keV, $J^\pi = \frac{3}{2}^-$, $T = \frac{3}{2}$ [the J^π ; T assignments are based on the similarity of the angular distribution to that in the (p, ${}^3\text{He}$) reaction to ${}^7\text{Li}^*(11.13)$]: see (1979AJ01).

16. ${}^9\text{Be}({}^3\text{He}, {}^5\text{He}){}^7\text{Be}$ $Q_m = -0.88$

See reaction 23 in ${}^5\text{He}$.

$$17. {}^{10}\text{B}(\text{p}, \alpha){}^7\text{Be} \quad Q_{\text{m}} = 1.146$$

Angular distributions have been measured for $E_{\text{p}} = 2.8$ to 7.0 MeV: see (1974AJ01). $E_{\text{x}} = 428.89 \pm 0.13$ keV (1979RI12). See also ${}^{11}\text{C}$ in (1980AJ01, 1985AJ01).

$$18. {}^{10}\text{B}(\text{d}, {}^5\text{He}){}^7\text{Be} \quad Q_{\text{m}} = -1.97$$

See (1982DO1E).

$$19. {}^{10}\text{B}({}^3\text{He}, {}^6\text{Li}){}^7\text{Be} \quad Q_{\text{m}} = -2.873$$

See ${}^6\text{Li}$.

$$20. {}^{10}\text{B}(\alpha, {}^7\text{Li}){}^7\text{Be} \quad Q_{\text{m}} = -16.200$$

At $E_{\alpha} = 45.6$ MeV the angular distributions of the ${}^7\text{Li}$ and of the ${}^7\text{Be}$ ions, corresponding to the ground-state transitions, have been measured. At a given angle the intensities of the two ions are the same, implying that the wave functions of the ground states of ${}^7\text{Li}$ and ${}^7\text{Be}$ are very similar: see (1974AJ01).

$$21. {}^{12}\text{C}(\gamma, \text{n}\alpha){}^7\text{Be} \quad Q_{\text{m}} = -26.265$$

See (1979KI04).

$$22. {}^{12}\text{C}(\text{p}, {}^6\text{Li}){}^7\text{Be} \quad Q_{\text{m}} = -22.565$$

See ${}^6\text{Li}$.

$$23. {}^{12}\text{C}(\text{d}, {}^7\text{Li}){}^7\text{Be} \quad Q_{\text{m}} = -17.539$$

See ${}^7\text{Li}$.

$$24. {}^{12}\text{C}({}^3\text{He}, {}^8\text{Be}){}^7\text{Be} \quad Q_m = -5.779$$

Angular distributions are reported at $E({}^3\text{He}) = 25.5$ to 30 MeV involving ${}^7\text{Be}^*(0, 0.43)$ [see (1979AJ01)] and at 41 MeV (1981LE01) and ${}^{15}\text{O}$ in (1981AJ01).

$$25. {}^{12}\text{C}(\alpha, {}^9\text{Be}){}^7\text{Be} \quad Q_m = -24.691$$

At $E_\alpha = 42$ MeV, angular distributions have been measured involving ${}^7\text{Be}^*(0, 0.43)$ and ${}^9\text{Be}_{\text{g.s.}}$: see (1974AJ01).

$$26. {}^{13}\text{C}(\text{p}, {}^7\text{Li}){}^7\text{Be} \quad Q_m = -20.261$$

See ${}^7\text{Li}$.

$$27. {}^{16}\text{O}({}^3\text{He}, {}^{12}\text{C}){}^7\text{Be} \quad Q_m = -5.5744$$

Angular distributions are reported at $E({}^3\text{He}) = 25.5, 30$ and 70 MeV to ${}^7\text{Be}^*(0, 0.43)$ and various states of ${}^{12}\text{C}$ [see ${}^{12}\text{C}$ in (1980AJ01)] and at 41 MeV (1981LE01).

$$28. {}^{16}\text{O}(\alpha, {}^{13}\text{C}){}^7\text{Be} \quad Q_m = -21.2058$$

See ${}^{13}\text{C}$ in (1981AJ01).

$$29. {}^{19}\text{F}(\text{d}, {}^{14}\text{C}){}^7\text{Be} \quad Q_m = -7.140$$

The angular distributions to ${}^7\text{Be}^*(0, 0.43) + {}^{14}\text{C}_{\text{g.s.}}$ has been measured at $E_d = 14.9$ MeV: see (1974AJ01).

$$30. \text{(a) } {}^{19}\text{F}({}^3\text{He}, {}^{15}\text{N}){}^7\text{Be} \quad Q_m = -2.426$$

$$\text{(b) } {}^{20}\text{Ne}({}^3\text{He}, {}^{16}\text{O}){}^7\text{Be} \quad Q_m = -3.146$$

See ^{15}N in (1981AJ01) and ^{16}O in (1982AJ01).

^7B

(Fig. 10)

GENERAL: (See also (1979AJ01).)

See (1979BE1H, 1982NG01).

Mass of ^7B : This nucleus has been studied in the $^7\text{Li}(\pi^+, \pi^-)^7\text{B}$ and $^{10}\text{B}(^3\text{He}, ^6\text{He})^7\text{B}$ reactions. In the (π^+, π^-) work (1981SE1B; preliminary) find the mass excess to be 27.80 ± 0.10 MeV and Γ for the ground state is 1.2 ± 0.2 MeV. In the earlier ($^3\text{He}, ^6\text{He}$) work [see (1974AJ01)] $M - A$ was reported to be 27.94 ± 0.10 MeV, $\Gamma = 1.4 \pm 0.2$ MeV. We adopt 27.87 ± 0.10 MeV, $\Gamma = 1.3 \pm 0.2$ MeV. The isobaric quartet mass law would predict $M - A = 27.76 \pm 0.17$ MeV. ^7B is unbound with respect to $^6\text{Be} + \text{p}$ ($Q = 2.21$), $^5\text{Li} + 2\text{p}$ ($Q = 1.61$), $^4\text{He} + 3\text{p}$ ($Q = 3.58$). The expected single-particle width is $\Gamma = 0.64$ MeV: it is suggested that the two-proton and three-proton decays make an appreciable contribution to the width: see (1974AJ01).

^7C

(Not illustrated)

Not observed: see (1982NG01; theor.).

References

(Closed 1 June 1983)

References are arranged and designated by the year of publication followed by the first two letters of the first-mentioned author's name and then by two additional characters. Most of the references appear in the National Nuclear Data Center files (Nuclear Science References Database) and have NNDC key numbers. Otherwise, TUNL key numbers were assigned with the last two characters of the form 1A, 1B, etc. In response to many requests for more informative citations, we have, when possible, included up to ten authors per paper and added the authors' initials.

- 1952AJ38 F. Ajzenberg and T. Lauritsen, *Revs. Mod. Phys.* 24 (1952) 321
- 1962TA11 J.G.V. Taylor and J.S. Merritt, *Can. J. Phys.* 40 (1962) 926
- 1966GE11 W. Gemeinhardt, D. Kamke and C. Von Rhoneck, *Z. Phys.* 197 (1966) 58
- 1966LA04 T. Lauritsen and F. Ajzenberg-Selove, *Nucl. Phys.* 78 (1966) 1
- 1973HA47 O. Hausser, A.B. McDonald, T.K. Alexander, A.J. Ferguson and R.E. Warner, *Nucl. Phys.* A212 (1973) 613
- 1973PO10 W.P. Poenitz and A. Devolpi, *Int. J. Appl. Radiat. Isotop.* 24 (1973) 471
- 1974AJ01 F. Ajzenberg-Selove and T. Lauritsen, *Nucl. Phys.* A227 (1974) 1
- 1974GO26 I.W. Goodier, J.L. Makepeace and A. Williams, *Int. J. Appl. Radiat. Isotop.* 25 (1974) 373
- 1975AJ02 F. Ajzenberg-Selove, *Nucl. Phys.* A248 (1975) 1
- 1975HO01 R.J. Holt, F.W.K. Firk, G.T. Hickey and R. Nath, *Nucl. Phys.* A237 (1975) 111
- 1975ZI1A Zimmerman, Fowler and Caughlan, OAP-399 (1975)
- 1976GAYV D.I. Garber and R.R. Kinsey, BNL 325, Vol. 2 (1976)
- 1976GO12 G.-H. Goritz and U. Mosel, *Z. Phys.* A277 (1976) 243
- 1976HA17 R.A. Hardekopf, G.G. Ohlsen, R.V. Poore and N. Jarmie, *Phys. Rev.* C13 (1976) 2127
- 1977BA37 T. Bauer, R. Beurtey, A. Boudard, G. Bruge, A. Chaumeaux, P. Couvert, H.H. Duhm, D. Garreta, M. Matoba, Y. Terrien et al., *Phys. Lett.* B69 (1977) 433
- 1977BA51 B. Bassalleck, W.-D. Klotz, F. Takeutchi, H. Ullrich and M. Furic, *Phys. Rev.* C16 (1977) 1526
- 1977BI12 N.S. Biryukov, B.V. Zhuravlev, N.V. Kornilov, V.I. Popov, A.P. Rudenko, O.A. Salnikov and V.I. Trykova, *At. Eneq.* 43 (1977) 176; *Sov. At. Energy* 43 (1977) 804
- 1977BR21 R.E. Brown, G.G. Ohlsen, R.F. Haglund, Jr. and N. Jarmie, *Phys. Rev.* C16 (1977) 513
- 1977CU02 R.I. Cutler, M.J. Nadworny and K.W. Kemper, *Phys. Rev.* C15 (1977) 1318; Erratum *Phys. Rev.* C16 (1977) 1692

- 1977DE1C Derrien and Edvardson, Proc. Int. Specialists Symp. on Neutron Stand. and Applic., 1977 (Nat. Bur. Standards, Wash., D.C., 1977) 14
- 1977GA1A Gayther, Ann. Nucl. Energy 4 (1977) 515; Phys. Abs. 70516 (1978)
- 1977GR1C Grechukhin and Soldatov, Zh. Eksp. Teor. Fiz. 72 (1977) 390
- 1977HA1E Hale, Proc. Int. Specialists Symp. on Neutron Standards and Applicaitons, 1977 (Nat. Bur. Standards, Wash., DC, 1977) p. 30
- 1977HA1H Hale, NBS Spec. Pub. 493 (1977) 30
- 1977HA1J Harvey and Schroder, Proc. Int. Spec. Symp. on Neutron Stand. and Applic., 1977 (Nat. Bur. Stand., Wash., D.C. 1977) 10
- 1977KA06 M. Karim and J.C. Overley, Phys. Rev. C15 (1977) 467
- 1977KE09 K.W. Kemper, G.E. Moore, R.J. Puigh and R.L. White, Phys. Rev. C15 (1977) 1726
- 1977KN1A Knitter, Proc. Int. Specialists Symp. on Neutron Standards and Applicaitons, 1977 (Nat. Bur. Standards, Wash., DC, 1977) p. 3
- 1977RO02 P.G. Roos, N.S. Chant, A.A. Cowley, D.A. Goldberg, H.D. Holmgren and R. Woody, III, Phys. Rev. C15 (1977) 69
- 1977WE03 R.B. Weisenmiller, N.A. Jelley, D. Ashery, K.H. Wilcox, G.J. Wozniak, M.S. Zisman and J. Cerny, Nucl. Phys. A280 (1977) 217
- 1978BA1C Balashov, in Clustering, Winnipeg 1978, AIP Conf. Proc. 47 (1978) 252
- 1978BA1E Bahcall, Rev. Mod. Phys. 50 (1978) 881
- 1978BA54 G. Bardin, J. Duclos, J. Joseph, A. Magnon, J. Martino and E. Zavattini, Phys. Lett. B79 (1978) 52
- 1978BA75 A.D. Bacher, H.E. Conzett, R. de Swiniarski, F.G. Resmini and T.A. Tombrello, Helv. Phys. Acta 51 (1978) 680
- 1978BH03 R.K. Bhowmik, E.C. Pollacco, N.E. Sanderson, J.B.A. England and G.C. Morrison, Phys. Lett. B80 (1978) 41
- 1978BR1A Brown, in Clustering, Winnipeg 1978, AIP Conf. Proc. 47 (1978) 90
- 1978BR1C Brewer and Crowe, Ann. Rev. Nucl. Part. Sci. 28 (1978) 239
- 1978BR34 L. Brown, R.S. Rajan, R.B. Roberts, F. Tera and D.J. Whitford, Nucl. Instrum. Meth. 156 (1978) 541
- 1978BU1B Buffington, Orth and Mast, Astrophys. J. 226 (1978) 355
- 1978CA1C Canal, Isern and Sanahuja, Astrophys. 220 (1978) 606
- 1978CH1E Cherkasov, Yad. Fiz. 28 (1978) 639
- 1978DA1A Dalitz and Gal, Ann. Phys. 116 (1978) 167
- 1978DE13 V.P. Denisov and I.Y. Chubukov, Yad. Fiz. 27 (1978) 882

- 1978DI1A Di Napoli et al., *J. Inorg. Nucl. Chem.* 40 (1978) 1973
- 1978DR03 D.M. Drake, E.D. Arthur and M.G. Silbert, *Nucl. Sci. Eng.* 65 (1978) 49
- 1978DU1B Dubna-Warsaw-Leningrad Collaboration, *Yad. Fiz.* 27 (1978) 1246
- 1978DU1C Dubovoi, *Izv. Akad. Nauk SSSR Ser. Fiz.* 43 (1979) 2111
- 1978DU1D Dumbrajs, *Lett. Nuovo Cim.* 23 (1978) 48
- 1978DW1A Dwek, *Astrophys. J.* 225 (1978) L149
- 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. C* 18 (1978) 2316
- 1978ER1A Ericson, *Prog. Part. Nucl. Phys.* 1 (1978) 67
- 1978FI10 D.J.S. Findlay, D.J. Gibson, R.O. Owens and J.L. Matthews, *Phys. Lett.* B79 (1978) 356
- 1978FU09 S. Furui, *Nucl. Phys.* A312 (1978) 311
- 1978FU13 A.V. Fursaev, V.K. Tartakovskij and A.A. Pasichny, *Ukr. Fiz. Zh.* 23 (1978) 827
- 1978GL03 B.G. Glagola, G.J. Mathews, H.F. Breuer, V.E. Viola, Jr., P.G. Roos, A. Nadasen and S.M. Austin, *Phys. Rev. Lett.* 41 (1978) 1698
- 1978GU16 I.S. Gurbanovich and N.S. Zelenskaya, *Yad. Fiz.* 27 (1978) 1513; *Sov. J. Nucl. Phys.* 27 (1978) 798
- 1978HA1E Hartoog, *Publ. Astron. Soc. Pac.* 90 (1978) 167
- 1978HA40 P.E. Haustein and T.J. Ruth, *Phys. Rev. C* 18 (1978) 2241
- 1978HE1C Hendrie, in *Clustering, Winnipeg 1978*, AIP Conf. Proc. 47 (1978) 402
- 1978HE1D Heitzmann, *Atomkernenergie* 31 (1978) 262
- 1978HE21 R.G. Helmer, R.C. Greenwood and R.J. Gehrke, *Nucl. Instrum. Meth. Phys. Res.* 155 (1978) 189
- 1978KI13 H.R. Kissener, G.E. Dogotar, R.A. Eramzhyan and R.A. Sakaev, *Nucl. Phys.* A312 (1978) 394
- 1978KN1C Knoll, Jufner and Bouyssy, *Nucl. Sci. Eng.* 69 (1979) 223
- 1978KO12 S.-i. Komoda and S.-i. Igarasi, *J. Nucl. Sci. Tech.* 15 (1978) 79
- 1978KU06 E.L. Kuplennikov, V.A. Goldshtein and N.G. Afanasev, *Sov. J. Nucl. Phys.* 27 (1978) 313
- 1978LA11 G. Landaud, A. Devaux, P. Delpierre, J. Kahane, R. Sene, J. Yonnet and R. Anne, *Phys. Rev. C* 18 (1978) 1776
- 1978LA23 G.P. Lamaze, R.A. Schrack and O.A. Wasson, *Nucl. Sci. Eng.* 68 (1978) 183

- 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. (John Wiley and Sons, Inc., New York, 1978)
- 1978LI32 H. Liskien and E. Wattecamps, Nucl. Sci. Eng. 68 (1978) 132
- 1978LU05 Y.-W. Lui, O. Karban, A.K. Basak, C.O. Blyth, J.M. Nelson and S. Roman, Nucl. Phys. A297 (1978) 189
- 1978MI13 M.V. Mihailovic and M. Poljsak, Nucl. Phys. A311 (1978) 377
- 1978NA05 K. Nakamura, S. Hiramatsu, T. Kamae, H. Muramatsu, N. Izutsu and Y. Watase, Nucl. Phys. A296 (1978) 431
- 1978NA18 V.S. Nadezhdin, N.I. Petrov and V.I. Satarov, Yad. Fiz. 27 (1978) 1164; Sov. J. Nucl. Phys. 27 (1978) 617
- 1978OR1A Orth, Buffington, Smoot and Mast, Astrophys. J. 226 (1978) 1147
- 1978PL1A Plattner, in Few Body Syst. and Nucl. Forces, Graz 1978, Springer Lect. Notes 87 (1978) 376
- 1978PO1A B. Povh, Ann. Rev. Nucl. Part. Sci. 28 (1978) 1
- 1978RA2A S. Raman, C.A. Houser, T.A. Walkiewicz and I.S. Towner, At. Data Nucl. Data Tables 21 (1978) 567; Erratum At. Data Nucl. Data Tables 22 (1978) 369
- 1978RE1A Redish, in Few Body Syst. and Nucl. Forces, Graz 1978, Springer Lect. Notes 87 (1978) 427
- 1978RE1B Renner et al., Bull. Amer. Phys. Soc. 23 (1978) 526
- 1978RO17 D. Robson, Nucl. Phys. A308 (1978) 381
- 1978SA1B Sanjeeviah and Sanjeevaiah, Indian J. Phys. A52 (1978) 114
- 1978SA26 A. Saha, R. Kamermans, J. van Driel and H.P. Morsch, Phys. Lett. B79 (1978) 363
- 1978SI1D R.R. Silbar, J.N. Ginocchio and M.M. Sternheim, Phys. Rev. C18 (1978) 2785
- 1978SO1A Sokol, Izv. Akad. Nauk SSSR Ser. Fiz. 42 (1978) 1829
- 1978ST1C Starrfield, Truran and Sparks, Astrophys. J. 226 (1978) 186
- 1978ST1D Starrfield, Truran, Sparks and Arnould, Astrophys. J. 222 (1978) 600
- 1978TA1A Tang, Lemere and Thompson, Phys. Rept. 47 (1978) 167
- 1978TH1A Thompson, in Clustering, Winnipeg 1978, AIP Conf. Proc. 47 (1978) 69
- 1978VO03 Y.M. Volkov, G.A. Kolomenskii, E.F. Lakovichev, E.D. Makhnovskii, A.V. Nadtochii, V.V. Popov, V.P. Fominenko and V.P. Chizhov, Yad. Fiz. 27 (1978) 868; Sov. J. Nucl. Phys. 27 (1978) 461
- 1978WA1B Walter, in Clustering, Winnipeg 1978, AIP Conf. Proc. 47 (1978) 444
- 1978WO1A Woloshyn, in Clustering, Winnipeg 1978, AIP Conf. Proc. 47 (1978) 457

- 1979AF1A Afanasev et al., Int. Conf. Nucl. Phys. With Electromag. Interact., Mainz (1979) 3.1
- 1979AH1A Ahrens et al., 1978 RPI Symp., Photopion Nucl. Phys., (Plenum Press, New York, 1979) 385
- 1979AJ01 F. Ajzenberg-Selove, Nucl. Phys. A320 (1979) 1
- 1979AK02 V. Aksinenko, M. Anikina, A. Banasiuk, V. Buttsev, L. Chkaidze, N. Glagoleva, A. Golokhvastov, V. Ilina, S. Kadikova, N. Kaminsky et al., Nucl. Phys. A324 (1979) 266
- 1979AL1F Alard et al., Nucl. Instrum. Meth. Phys. Res. 160 (1979) 419
- 1979AL1J Alster and Warszawski, Phys. Rept. 52 (1979) 87
- 1979AL22 Y. Alhassid, R.D. Levine, J.S. Karp and S.G. Steadman, Phys. Rev. C20 (1979) 1789
- 1979AN1B L.W. Anderson and G.A. Nimmo, Phys. Rev. Lett. 42 (1979) 1520
- 1979BA17 B. Bassalleck, E.L. Haase, W.-D. Klotz, F. Takeutchi, H. Ullrich, M. Furic and Y. Sakamoto, Phys. Rev. C19 (1979) 1893
- 1979BA1M Bassalleck et al., in Conf. Proc. TRIUMF, Vancouver (1979) Paper 1E28
- 1979BA1P Bahcall, Bull. Amer. Phys. Soc. 24 (1979) 48
- 1979BA1R Baba et al., Bull. Amer. Phys. Soc. 24 (1979) 862
- 1979BA28 Y.D. Bayukov, V.I. Efremenko, S. Frankel, W. Frati, M. Gazzaly, G.A. Leksin, N.A. Nikiforov, C.F. Perdrisat, V.I. Tchistilin and Y.M. Zaitsev, Phys. Rev. C20 (1979) 764
- 1979BA37 C.M. Bartle, Nucl. Phys. A330 (1979) 1
- 1979BE1G J. Bernabeu and P. Pascual, Nucl. Phys. A324 (1979) 365
- 1979BE1H Benenson and Kashy, Rev. Mod. Phys. 51 (1979) 527
- 1979BO1E Borovikova et al., Pisma V Zh. Eksp. Teor. Fiz. 30 (1979) 527
- 1979BO1F Bolger et al., in Houston, AIP Conf. Proc. 54 (1979) 519
- 1979BO1G Bolger et al., in Conf. Proc. TRIUMF, Vancouver (1979) Paper 1C11
- 1979BO22 V.I. Bogatin, O.V. Lozhkin and Y.P. Yakovlev, Nucl. Phys. A326 (1979) 508
- 1979BO23 P.E. Bosted, K.I. Blomqvist and A.M. Bernstein, Phys. Rev. Lett. 43 (1979) 1473
- 1979BR03 H.S. Bradlow, W.D.M. Rae, P.S. Fisher, N.S. Godwin, G. Proudfoot and D. Sinclair, Nucl. Phys. A314 (1979) 171
- 1979BR04 H.S. Bradlow, W.D.M. Rae, P.S. Fisher, N.S. Godwin, G. Proudfoot and D. Sinclair, Nucl. Phys. A314 (1979) 207
- 1979BU14 A.V. Bursak, V.V. Verzhbitskii, A.M. Gorbатов, Y.N. Krylov and A.B. Solovei, Yad. Fiz. 30 (1979) 339; Sov. J. Nucl. Phys. 30 (1979) 175
- 1979BU1C Bunyatov et al., Yad. Fiz. 30 (1979) 1054
- 1979CH1B Chaudhri, Templer and Rouse, Int. J. Appl. Rad. Isotopes 30 (1979) 504

- 1979CO1C Cooper, in Houston, AIP Conf. Proc. 54 (1979) 222
- 1979CZ1A Czirr and Carlson, Bull. Amer. Phys. Soc. 24 (1979) 864
- 1979DA1C Dabbs, Bull. Amer. Phys. Soc. 24 (1979) 651
- 1979DA1D Davis, Evans and Cleveland, in Long Distance Neutrino Detection, 1978, AIP Conf. Proc. 52 (1979) 17
- 1979DE15 P. Desgrolard and P.A.M. Guichon, Z. Phys. A290 (179) 373
- 1979DE1E Deveaux, Gilligan and Miley, Bull. Amer. Phys. Soc. 24 (1979) 1112
- 1979DO17 G.E. Dogotar, R.A. Eramzhyan, M. Gmitro, H.R. Kissener and E. Tinkova, J. Phys. G5 (1979) L221
- 1979DO1E Donnelly and Peccei, Phys. Rept. 50 (1979) 1
- 1979DY01 P. Dyer, T.C. Awes, C.K. Gelbke, B.B. Back, A. Mignerey, K.L. Wolf, H. Breuer, V.E. Viola, Jr. and W.G. Meyer, Phys. Rev. Lett. 42 (1979) 560
- 1979EL10 A.J. Elwyn, R.E. Holland, C.N. Davids, L. Meyer-Schutzmeister, F.P. Mooring and W. Ray, Jr., Phys. Rev. C20 (1979) 1984
- 1979EN1C Engfer et al., in Houston, AIP Conf. Proc. 54 (1979) 176
- 1979FO1F Fou, Rasmussen, Swann and Van Patter, IEEE Trans. on Nucl. Sci. 26 (1979) 1378
- 1979FR12 S. Frankel, W. Frati, M. Gazzaly, Y.D. Bayukov, V.I. Efremenko, G.A. Leksin, N.A. Nikiforov, V.I. Tchistilin, Y.M. Zaitsev and C.F. Perdrisat, Phys. Rev. C20 (1979) 2257
- 1979FU1E Fujii et al., Isotopenpraxis 15 (1979) 203
- 1979GA04 J.A. Gaidos, L.J. Gutay, A.S. Hirsch, R. Mitchell, T.V. Ragland, R.P. Scharenberg, F. Turkot, R.B. Willmann and C.L. Wilson, Phys. Rev. Lett. 42 (1979) 82
- 1979GA1D Gal, in Houston, in AIP Conf. Proc. 54 (1979) 680
- 1979GA1E Gal, in NATO Inst. Vol. 45 (Plenum Press 1979) 485
- 1979GE1A Gelbke, in BNL-51115 (1979) 1
- 1979GL1C Glashausser et al., in Conf. Proc. TRIUMF, Vancouver (1979) Paper 4A2
- 1979GO07 R. Gorgen, F. Hinterberger, R. Jahn, P. von Rossen and B. Schuller, Nucl. Phys. A320 (1979) 296
- 1979GO11 J. Gomez del Campo, R.G. Stokstad, J.A. Biggerstaff, R.A. Dayras, A.H. Snell and P.H. Stelson, Phys. Rev. C19 (1979) 2170
- 1979GO16 C.A. Goulding, M.B. Greenfield, C.C. Foster, T.E. Ward, J. Rapaport, D.E. Bainum and C.D. Goodman, Nucl. Phys. A331 (1979) 29
- 1979GR1E Greenwood, in Proc. 3rd Symp. on Neutron Capture Gamma Rays, 1978 (Plenum Press, New York 1979) 441
- 1979HA1C Hale, Bull. Amer. Phys. Soc. 24 (1979) 881

- 1979HE19 R.G. Helmer, P.H.M. Van Assche and C. Van der Leun, *At. Data Nucl. Data Tables* 24 (1979) 39
- 1979HO04 R.E. Holland, A.J. Elwyn, C.N. Davids, F.J. Lynch, L. Meyer-Schutzmeister, J.E. Monahan, F.P. Mooring and W. Ray, Jr., *Phys. Rev. C* 19 (1979) 592
- 1979HO11 H.H. Hogue, P.L. von Behren, D.W. Glasgow, S.G. Glendinning, P.W. Lisowski, C.E. Nelson, F.O. Purser, W. Tornow, C.R. Gould and L.W. Seagondollar, *Nucl. Sci. Eng.* 69 (1979) 22
- 1979IN1A Ingram, in Houston, *AIP Conf. Proc.* 54 (1979) 455
- 1979JA1B Jassby, *Bull. Amer. Phys. Soc.* 24 (1979) 872
- 1979JU02 G. Junghans, K. Bangert, U.E.P. Berg, R. Stock and K. Wienhard, *Z. Phys.* A291 (1979) 353
- 1979KA07 S.B. Kaufman, M.W. Weisfield, E.P. Steinberg, B.D. Wilkins and D.J. Henderson, *Phys. Rev. C* 19 (1979) 962
- 1979KA1G Karban, *Microscopic Optical Potentials*. Hamburg, Germany (Springer-Verlag 1979) p. 264; *Phys. Abs.* 97712 (1979)
- 1979KI04 V.V. Kirichenko, A.F. Khodyachikh, P.I. Vatset, I.V. Dogyust and V.A. Zolenko, *Yad. Fiz.* 29 (1979) 572; *Sov. J. Nucl. Phys.* 29 (1979) 292
- 1979KI10 M. Kirchbach and H.-U. Jager, *Yad. Fiz.* 29 (1979) 1191; *Sov. J. Nucl. Phys.* 29 (1979) 614
- 1979KI1D Kissener and Eramzhyan, *Int. Conf. Nucl. Phys. With Electromag. Inter., MAINZ* (1979) L.20
- 1979KI1G Kim and Primakoff, in "Mesons in Nucl.", Eds. Rho and Wilkenson (North-Holland, Amsterdam, 1979) 69
- 1979KN01 H.D. Knox, R.M. White and R.O. Lane, *Nucl. Sci. Eng.* 69 (1979) 223
- 1979KOZV R.D. Koshel and P.J. Griffin, *Bull. Amer. Phys. Soc.* 24 (1979) 611, DL15
- 1979LA1D Lamaze, Schwartz and Kellie, *Bull. Amer. Phys. Soc.* 24 (1979) 862
- 1979LA1E Lal, Nijampurkar, Rajagopalan and Somayajulu, *Proc. Indian Acad. Sci.* A88 (1979) 29
- 1979LE11 M. LeMere, D.J. Stubeda, H. Horiuchi and Y.C. Tang, *Nucl. Phys.* A320 (1979) 449
- 1979LE1B M. LeMere and Y.C. Tang, *Phys. Rev. C* 19 (1979) 391
- 1979LO11 H. Lohner, B. Ludewigt, D. Frekers, G. Gaul and R. Santo, *Z. Phys.* A292 (1979) 35
- 1979MA02 W.M. MacDonald, E.T. Dressler and J.S. O'Connell, *Phys. Rev. C* 19 (1979) 455
- 1979MA11 V.N. Maksimenko and L.L. Chopovskii, *Yad. Fiz.* 29 (1979) 311; *Sov. J. Nucl. Phys.* 29 (1979) 154
- 1979MA1F Mathews and Viola, *Astrophys. J.* 228 (1979) 375

- 1979MA1G Mathews, Proc. MAINZ, 1979, Springer Lect. Notes 108 (1979) 369
- 1979MC1A McGuire, Von Rosenvinge and McDonald, Bull. Amer. Phys. Soc. 24 (1979) 693
- 1979ME07 G. Mechttersheimer, G. Buche, U. Klein, W. Kluge, H. Matthay, D. Munchmeyer and A. Moline, Nucl. Phys. A324 (1979) 379
- 1979ME2A D.F. Measday and G.A. Miller, Ann. Rev. Nucl. Part. Sci. 29 (1979) 121
- 1979MI1C Milder et al., 1978 RPI Symp. "Photopion Nucl. Phys.", (Plenum Press, New York, 1979) p. 245
- 1979MO04 R.A. Moyle, B.G. Glagola, G.J. Mathews and V.E. Viola, Jr., Phys. Rev. C19 (1979) 631
- 1979MO22 T.P. Morrison, G.D. Jones, L.P. Ekstrom, F. Kearns, A. Kogan, P.R.G. Lornie, O. Mustaffa, H.G. Price, D.N. Simister, P.J. Twin et al., J. Phys. G5 (1979) 1751
- 1979NA04 I. Navon, D. Ashery, G. Azuelos, H.J. Pfeiffer, H.K. Walter and F.W. Schlepütz, Phys. Rev. Lett. 42 (1979) 1465
- 1979PE1C Perroud, in 1978 RPI Symp. "Photopion Nucl. Phys.", (Plenum Press, New York, 1979) p. 69
- 1979PE1D Petrov and Shabelskii, Sov. J. Nucl. Phys. 30 (1979) 66
- 1979PO10 N.T. Porile, G.D. Cole and C.R. Rudy, Phys. Rev. C19 (1979) 2288
- 1979RA1C Ramaty, Kozlovsky and Lingenfelter, Astrophys. J. Suppl. Series 40 (1979) 487
- 1979RA20 J.R. Radin, E. Gradsztajn and A.R. Smith, Phys. Rev. C20 (1979) 787
- 1979RE1A Redwine, in Houston, AIP Conf. Proc. 54 (1979) 501
- 1979RE1B Renier and Martin, Bull. Amer. Phys. Soc. 24 (1979) 887
- 1979RI12 Y. Rihet, G. Costa, C. Gerardin and R. Seltz, Phys. Rev. C20 (1979) 1583
- 1979RO1A Robert, Merlivat and Javoy, Nature 282 (1979) 785
- 1979SC08 T.C. Schweizer, R.R. Doering, S.T. Thornton, L.C. Dennis, K.R. Cordell and R.L. Parks, Phys. Rev. C19 (1979) 1408
- 1979SC1D Scott, Prog. Nucl. Phys. 4 (1979) 5
- 1979SH14 T. Shinozuka, Y. Tanaka and K. Sugiyama, Nucl. Phys. A326 (1979) 47
- 1979SI16 M.K. Singham, G.N. Epstein and F. Tabakin, Phys. Rev. Lett. 43 (1979) 1476
- 1979SK05 D.M. Skopik, J. Asai, E.L. Tomusiak and J.J. Murphy II, Phys. Rev. C20 (1979) 2025
- 1979ST03 M.L. Stelts, R.E. Chrien, M. Goldhaber, M.J. Kenny and C.M. McCullagh, Phys. Rev. C19 (1979) 1159
- 1979ST1D Stanley, Glover and Petrovich, Bull. Amer. Phys. Soc. 24 (1979) 816
- 1979ST25 J.P. Stoquert, N. Bendjaballah, H. Beaumevieille, C. Gerardin and R. Seltz, J. Physique 40 (1979) 813

- 1979SU1F Suzuki and Kubo, in Tsukuba Symp. on Polarization Phenomena, Nov. 1979, Ed. K.Yagi, (1979) p. 211
- 1979SW02 Z.E. Switkowski, J.C.P. Heggie, D.L. Kennedy, D.G. Sargood, F.C. Barker and R.H. Spear, Nucl. Phys. A331 (1979) 50
- 1979TI1A Titov, Int. Conf. Nucl. Phys. with Electromagnetic Interact., Mainz (1979) 6.14
- 1979VA1B Van Bibber, in BNL-51115 (1979) 365
- 1979VE08 L. Vegh and J. Ero, J. Phys. G5 (1979) L227
- 1979VI05 A. Vidal-Quadras and M. Ortega, Nuovo Cim. A49 (1979) 235
- 1979WA1D Walecka, Proc. Mainz, 1979, Springer Lect. Notes 108 (1979) 484
- 1979WE03 H. Weigmann and P. Manakos, Z. Phys. A289 (1979) 383
- 1979WE06 J.P. Wefel and J.M. Kidd, Phys. Rev. C19 (1979) 1380
- 1979WI1B Wildermuth and Kanellopoulos, Rept. Prog. Phys. 42 (1979) 1719
- 1979WI1C Winter and Andra, Z. Phys. A291 (1979) 5
- 1979WI1D Willet, Ling, Mahoney and Jacobson, Astrophys. J. 234 (1979) 753
- 1979YA1C Yang, Schramm, Steigman and Rood, Astrophys. J. 227 (1979) 697
- 1979ZE01 A.F. Zeller, K.W. Kemper, D.C. Weisser, T.R. Ophel, D.F. Hebbard and A. Johnston, Nucl. Phys. A323 (1979) 477
- 1979ZI1A Ziegler, Proc. Mainz, 1979, Springer Lecture Notes 108 (1979) 148
- 1980AH1A J. Ahrens, Nucl. Phys. A335 (1980) 67
- 1980AJ01 F. Ajzenberg-Selove and C.L. Busch, Nucl. Phys. A336 (1980) 1
- 1980AS02 J. Asai, J.J. Murphy II and D.M. Skopik, Phys. Rev. C21 (1980) 469
- 1980AU02 S.M. Austin, L.E. Young, R.R. Doering, R. DeVito, R.K. Bhowmik and S.D. Schery, Phys. Rev. Lett. 44 (1980) 972; Erratum Phys. Rev. Lett. 44 (1980) 1711
- 1980AU1C N. Auerbach and N. Van Giai, Phys. Lett. B90 (1980) 354
- 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
- 1980BA34 F.C. Barker, Aust. J. Phys. 33 (1980) 159
- 1980BA39 C.M. Bartle, Nucl. Instrum. Meth. Phys. Res. 176 (1980) 503
- 1980BO03 J.D. Bowman, Nucl. Phys. A335 (1980) 375

- 1980BO1N Bohigas, Proc. Int. Conf. on Nucl. Phys. (Berkeley) (1980) 116
- 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
- 1980BR1L Bretscher and Smith, ANL/NDM-55 (1980)
- 1980CA1C Canal, Isern and Sanahuja, Astrophys. J. 235 (1980) 504
- 1980CH05 R.E. Chrien, T.J. Krieger, R.J. Sutter, M. May, H. Palevsky, R.L. Stearns, T. Kozlowski and T. Bauer, Phys. Rev. C21 (1980) 1014
- 1980CO11 J. Cook, J.M. Barnwell, N.M. Clarke and R.J. Griffiths, J. Phys. G6 (1980) 1251
- 1980CO1H Cochran and Hill, Bull. Amer. Phys. Soc. 25 (1980) 784
- 1980CO1R Cook, Stone and Vogl, Astrophys. J. 238 (1980) L97
- 1980CZ1A Czirr and Carlson, Proc. Int. Conf. on Nucl. Cross Sect. for Tech., Knoxville, TN 1979 (NBS 1980) 84; Phys. Abs. 7101 (1982)
- 1980DE42 A.S. Deineko, I.I. Zalyubovsky, I.Ya. Malakhov, V.D. Sarana and N.A. Shlyakhov, Izv. Akad. Nauk SSSR Ser. Fiz. 44 (1980) 957; Bull. Acad. Sci. USSR Phys. Ser. 44 (1980) 51
- 1980DE43 A.S. Deineko, Yu.V. Lyashko, I.Ya. Malakhov, V.D. Sarana, V.E. Storizhko and N.A. Shlyakhov, Izv. Akad. Nauk. SSSR Ser. Fiz. 44 (1980) 2375
- 1980DO1E Dover and Gal, Proc. Int. Conf. on Nucl. Phys. (Berkeley) (1980) 795
- 1980EG03 P. Egelhof, W. Dreves, K.-H. Mobius, E. Steffens, G. Tungate, P. Zupranski, D. Fick, R. Bottger and F. Roesel, Phys. Rev. Lett. 44 (1980) 1380
- 1980ER01 R.A. Eramzhyan, M. Gmitro and H.R. Kissener, Nucl. Phys. A338 (1980) 436
- 1980FR1G P.H. Frampton and S.L. Glashow, Phys. Rev. Lett. 44 (1980) 1481
- 1980GA1C A. Gal and C.B. Dover, Phys. Rev. Lett. 44 (1980) 379
- 1980GA1K Gass et al., Ukr. Fiz. Zh. 25 (1980) 1276, 1281
- 1980GA1P Gal, Nukelonika 25 (1980) 447
- 1980GO07 C.D. Goodman, C.A. Goulding, M.B. Greenfield, J. Rapaport, D.E. Bainum, C.C. Foster, W.G. Love and F. Petrovich, Phys. Rev. Lett. 44 (1980) 1755
- 1980GO1Q Gorbatov, Krylov and Solovei, Yad. Fiz. 32 (1980) 636
- 1980GR10 R.E.L. Green and R.G. Korteling, Phys. Rev. C22 (1980) 1594
- 1980GU1E Guet et al., Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) 471
- 1980GU26 B.Ya. Guzhovsky, S.N. Abramovich, A.G. Zvenigorodsky, V.P. Protopopov, G.N. Sleptsov and S.V. Trusillo, Izv. Akad. Nauk. SSSR Ser. Fiz. 44 (1980) 1983
- 1980HA1M Han, Lu, Zhuang and Zheng, Proc. Int. Conf. on Nucl. Phys. (Berkeley) (1980) 777

- 1980HA1Y Hale and Dodder, Proc. Int. Conf. on Nucl. Cross Sect. for Tech., Knoxville, TN (1980) 650; Phys. Abs. 3987 (1982)
- 1980IS1E Ishkanov, Morkeev, Novikov and Piskarev, Yad. Fiz. 32 (1980) 11
- 1980IW1A Iwao, Lett. Nuovo Cim. 29 (1980) 40
- 1980JA1F Jarmie, Correll, Brown, Hardekopf and Ohlsen, LA-8492 (1980) 1
- 1980JO06 M.B. Johnson, Phys. Rev. C22 (1980) 192
- 1980JO1D Johnson and Siciliano, Bull. Amer. Phys. Soc. 25 (1980) 741
- 1980KA11 J. Kallne, J. Davis, P.C. Gugelot, J.S. McCarthy, G.R. Smith, R.L. Boudrie, B. Hoistad and C.L. Morris, Phys. Rev. C21 (1980) 2681
- 1980KA16 H. Kanada, Q.K.K. Liu and Y.C. Tang, Phys. Rev. C22 (1980) 813
- 1980KA1R Kanda and Hirakawa, J. Nucl. Sci. Tech. 17 (1980) 888, 899
- 1980KE1D Kehayias et al., Bull. Amer. Phys. Soc. 25 (1980) 724
- 1980KE1L Kellie, Lamaze and Schwartz, Proc. Int. Conf. on Nucl. Cross Sect. for Tech., Knoxville 1979 (NBS 1980) 48
- 1980KH09 S.A.E. Khallaf, Rev. Roum. Phys. 25 (1980) 741
- 1980KI1D King, Chen, Yao and Lui, Proc. Int. Conf. on Nucl. Phys. (Berkeley) (1980) 930
- 1980KO1V Koptev, Maev, Makarov and Khanzadeev, Yad. Fiz. 31 (1980) 1501
- 1980LA1G Lambert, Dominy and Sivertsen, Astrophys. J. 235 (1980) 114
- 1980LE02 T.-S.H. Lee and D. Kurath, Phys. Rev. C21 (1980) 293
- 1980ME1F Meyer, Proc. Int. Conf. on Nucl. Phys. (Berkeley) (1980) 683
- 1980MI01 T. Mikumo, M. Sasagase, M. Sato, T. Ooi, Y. Higashi, Y. Nagashima and M. Yamouchi, Phys. Rev. C21 (1980) 620
- 1980MI02 D. Miljanic, S. Blagus, V. Pecar and D. Rendic, Nucl. Phys. A334 (1980) 189
- 1980MO1M Molinari, Phys. Rept. 64 (1980) 283
- 1980MO28 G.C. Morrison, R.K. Bhowmik, E.C. Pollacco, J.B.A. England and N.E. Sanderson, J. Phys. (Paris) Colloq. C10 (1980) 243
- 1980MU1D Muller et al., Nucl. Instrum. Meth. Phys. Res. 170 (1980) 151
- 1980NE08 O.F. Nemets, V.V. Ostashko and A.M. Yasnogorodsky, Pisma Zh. Eksp. Teor. Fiz. 32 (1980) 451; JETP Lett. (USSR) 32 (1981) 427
- 1980NE11 O.F. Nemets, V.M. Pugach, V.A. Pilipchenko, Yu.N. Pavlenko and V.M. Stoika, Izv. Akad. Nauk SSSR Ser. Fiz. 44 (1980) 1093; Bull. Acad. Sci. USSR Phys. Ser. 44:5 (1980) 170
- 1980NI09 N.A. Nikiforov, Y.D. Bayukov, V.I. Efremenko, G.A. Leskin, V.I. Tchistilin, Y.M. Zaitsev, S. Frankel, W. Frati, M. Gazzaly and C.F. Perdrisat, Phys. Rev. C22 (1980) 700

- 1980PE1C R.J. Peterson, Nucl. Phys. A335 (1980) 365
- 1980PE1N Peak, Aust. J. Phys. 33 (1980) 821
- 1980RE1B Read et al., Bull. Amer. Phys. Soc. 25 (1980) 592
- 1980RO03 P.G. Roos, A. Nadasen, P.E. Frisbee, N.S. Chant, T.A. Carey, M.T. Collins, B.T. Lee-
mann, P.J. Griffin and R.D. Koshel, Phys. Rev. C21 (1980) 799
- 1980SA04 A.N. Saharia and R.M. Woloshyn, Phys. Rev. C21 (1980) 1111
- 1980SC1K Scalo and Miller, Astrophys. J. 239 (1980) 953
- 1980SC24 I. Schwanner, R. Abela, G. Backenstoss, W. Kowald, P. Pavlopoulos, L. Tauscher,
H.J. Weyer, P. Blum, M. Dorr, W. Fetscher et al., Phys. Lett. B96 (1980) 268
- 1980SE1D Seguin, CEA-N-2132 (June 1980)
- 1980SH1N K.V. Shiticova, Nucl. Phys. A331 (1979) 365
- 1980ST06 M.F. Steeden, J. Coopersmith, S.J. Cartwright, M.D. Cohler, N.M. Clarke and R.J.
Griffiths, J. Phys. G6 (1980) 501
- 1980SU04 S. Susila, Acta Phys. Pol. B11 (1980) 221
- 1980TA1D Tavares et al., Lett. Nuovo Cim. 27 (1980) 358
- 1980TI05 Yu.I. Titov, A.S. Esaulov, R.V. Akhmerov, N.G. Afanasev, A.S. Omelaenko and E.M.
Smelov, Yad. Fiz. 31 (1980) 1396; Sov. J. Nucl. Phys. 31 (1980) 724
- 1980UC1A Uchida et al., J. Nucl. Mater. 89 (1980) 92
- 1980VA1D van der Leun, Helmer and van Assche, Proc. Conf. in Atomic Masses and Fund.
Constants, Nolen and Benenson Eds., Plenum (1980) p. 499
- 1980WH1A C.A., Jr. Whitten, Nucl. Phys. A335 (1980) 419
- 1980WI1K L. Winsberg, E.P. Steinberg, D. Henderson and A. Chrapkowski, Phys. Rev. C22
(1980) 2108
- 1980WI1L L. Winsberg, Phys. Rev. C22 (1980) 2123
- 1980WI1M Wiedenbeck and Greiner, Astrophys. J. 239 (1980) L139
- 1980WO05 C.L. Woods, N.A. Jelley, A.A. Pilt and J.S. Winfield, J. Phys. G6 (1980) L187
- 1980ZE03 A.F. Zeller, Y.-W. Lui, R.E. Tribble and D.M. Tanner, Phys. Rev. C22 (1980) 1534
- 1980ZH1A Zhang et al., Proc. Int. Conf. on Nucl. Phys., Berkeley (1980) p. 920
- 1980ZU01 P. Zupranski, W. Dreves, P. Egelhof, K.-H. Mobius, E. Steffens, G. Tungate and D.
Fick, Phys. Lett. B91 (1980) 358
- 1981AB04 A.Kh. Abdurakhimov, M.Kh. Anikina, V.S. Buttsev, L.D. Chikovani, L.V. Chkhaidze,
E.A. Dementjev, L.L. Gabunia, M. Gazdzicki, N.S. Glagoleva, A.I. Golokhvastov et
al., Nucl. Phys. A362 (1981) 376
- 1981AJ01 F. Ajzenberg-Selove, Nucl. Phys. A360 (1981) 1.

- 1981AL03 D.E. Alburger, D.J. Millener and D.H. Wilkinson, Phys. Rev. C23 (1981) 473
- 1981AO02 K. Aoki and H. Horiuchi, Prog. Theor. Phys. 66 (1981) 1903
- 1981AS07 D. Ashery, I. Navon, G. Azuelos, H.K. Walter, H.J. Pfeiffer and F.W. Schleputz, Phys. Rev. C23 (1981) 2173
- 1981AU1D Audouze, Prog. Part. Nucl. Phys. 6 (1981) 125
- 1981AU1G Austin, Prog. Part. Nucl. Phys. 7 (1981) 1
- 1981AV02 I.K. Averyanov, A.I. Golubev and A.A. Sadovoy, Yad. Fiz. 33 (1981) 66
- 1981AV1A Avignone and Donnelly, Nucl. Instrum. Meth. 179 (1981) 163
- 1981BA1L Bahcall, IAS (1981) 1
- 1981BA1Q Banaigs et al., Proc. Versailles Conf. (1980) p. 568
- 1981BA20 O.L. Bartaya and J.V. Mebonia, Yad. Fiz. 33 (1981) 987
- 1981BA2F Barnes, Prog. Part. Nucl. Phys. 6 (1981) 235
- 1981BA2G Bahcall, Prog. Part. Nucl. Phys. 6 (1981) 111
- 1981BA37 A.K. Basak, O. Karban, S. Roman, G.C. Morrison, C.O. Blyth and J.M. Nelson, Nucl. Phys. A368 (1981) 74
- 1981BA38 A.K. Basak, O. Karban, S. Roman, G.C. Morrison, C.O. Blyth and J.M. Nelson, Nucl. Phys. A368 (1981) 93
- 1981BE01 R. Beck, M.V. Mihailovic and M. Poljsak, Nucl. Phys. A351 (1981) 295
- 1981BE13 B. Bellinghausen, A. Christ, H.J. Gassen, G. Goerigk, R. Muller, G. Noldeke, T. Reichelt, H. Stanek and P. Stipp, Nucl. Phys. A358 (1981) 373c
- 1981BE17 R. Bertini, O. Bing, P. Birien, K. Braune, W. Bruckner, H. Catz, A. Chaumeaux, M.A. Faessler, R.-W. Frey, D. Garreta et al., Nucl. Phys. A360 (1981) 315
- 1981BE27 R. Beck, R. Krivec and M.V. Mihailovic, Nucl. Phys. A363 (1981) 365
- 1981BE45 R. Bertini, O. Bing, P. Birien, K. Braune, W. Bruckner, A. Chaumeaux, M.A. Faessler, R.W. Frey, D. Garreta, T.J. Ketel et al., Nucl. Phys. A368 (1981) 365
- 1981BE63 V.B. Belyaev and O.P. Solovtsova, Yad. Fiz. 33 (1981) 699; Sov. J. Nucl. Phys. 33 (1981) 363
- 1981BH02 R.K. Bhowmik, E.C. Pollacco, J.B.A. England, G.C. Morrison and N.E. Sanderson, Nucl. Phys. A363 (1981) 516
- 1981BL1F Blum et al., Proc. Versailles Conf. (1981) p. 383
- 1981BL1G M. Blann and T.T. Komoto, Phys. Rev. C24 (1981) 426
- 1981BO03 A. Boudard, Y. Terrien, R. Beurtey, L. Bimbot, G. Burge, A. Chaumeaux, P. Couvert, J.M. Fontaine, M. Garcon, Y. Le Bornec et al., Phys. Rev. Lett. 46 (1981) 218; Phys. Rev. Lett. 47 (1981) 147

- 1981BO09 A. Bouyssy, Phys. Lett. B99 (1981) 373
- 1981BO1X Bogatin et al., Yad. Fiz. 34 (1981) 104
- 1981BO1Y Bouten and Bouten, Prog. Part. Nucl. Phys. 5 (1981) 55
- 1981BR1K Brady et al., Bull. Amer. Phys. Soc. 26 (1981) 1128
- 1981CE04 F.E. Cecil and R.F. Fahlsing, Phys. Rev. C24 (1981) 1769; Erratum Phys. Rev. C25 (1982) 2137
- 1981CH12 Y.H. Chiu and F.W.K. Firk, Nucl. Phys. A364 (1981) 43
- 1981CH18 E. Cheifetz, H.C. Britt and J.B. Wilhelmy, Phys. Rev. C24 (1981) 519
- 1981CI03 M.A. Cirit and F. Yazici, Phys. Rev. C23 (1981) 2627
- 1981CO05 J. Cook, N.M. Clarke and R.J. Griffiths, Nucl. Phys. A357 (1981) 246
- 1981DA1C R.H. Dalitz, Nucl. Phys. A354 (1981) 101
- 1981DA1K Dave et al., Bull. Amer. Phys. Soc. 26 (1981) 551
- 1981DE18 E.S. de Almeida and V. di Napoli, Lett. Nuovo Cim. 31 (1981) 311
- 1981DE1T Dementij, Fartushnyj and Afanas'ev, Proc. Versailles Conf. (1981) p.127
- 1981DE1X Delbar, IPC-N-8102 (1981)
- 1981DU1H Dumbrajs, Fortschr. Phys. 29 (1981) 487
- 1981EG1B Egelhof et al., Santa Fe 1980, AIP Conf. Proc. 69 (1981) 916
- 1981EG1E Egelhof et al., Naturwiss. 68 (1981) 385
- 1981EL06 Z. El-Itaoui, Y.C. Tang, H. Kanada and Q.K.K. Liu, Phys. Rev. C24 (1981) 2735
- 1981EN01 J.C. Engdahl, G.F. Knoll and J.C. Robertson, Nucl. Sci. Eng. 78 (1981) 44
- 1981ER07 J. Ero, Z. Fodor, P. Koncz, Z. Seres and M. Csatlos, Nucl. Phys. A367 (1981) 419
- 1981ER10 J. Ero, Z. Fodor, P. Koncz, Z. Seres, M. Csatlos, B.A. Khomenko, N.N. Khovanskij, Z.V. Krumstein, Yu.P. Merekov and V.I. Petrukhin, Nucl. Phys. A372 (1981) 317
- 1981EV01 V.S. Evseev, V.S. Kurbatov, V.M. Sidorov, V.B. Belyaev, J. Wrzecionko, M. Daum, R. Frosch, J. McCulloch and E. Steiner, Nucl. Phys. A352 (1981) 379
- 1981FI1A Filipov, Chopovskii and Maksimenko, Izv. Akad. Nauk SSSR Ser. Fiz. 45 (1981) 32
- 1981FI1B H.R. Fiebig and W. Timm, Nucl. Phys. A368 (1981) 164
- 1981FR1N Friedrich, Phys. Rept. 74 (1981) 209
- 1981FR1R S. Frankel and W. Frati, Phys. Rev. C24 (1981) 2739; IBID Phys. Rev. C24 (1981) 2157
- 1981FR1T Frankfurt and Strikman, Phys. Rept. 76 (1981) 215
- 1981GA1C Garcia-Munoz, Guzik, Simpson and Wefel, Bull. Amer. Phys. Soc. 26 (1981) 557

- 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
- 1981GU1B Gurbanovich and Zelenskaya, Proc. Versailles Conf. (1981) p. 142
- 1981HA1N Harms and Haefele, Amer. Sci. 69 (1981) 310
- 1981HA1Y Han, Lu, Zhuang and Zheng, Phys. Energ. Fortis Phys. Nucl. 5 (1981) 489
- 1981HE1H Heusi, Proc. Versailles Conf. (1981) p. 331
- 1981HN02 V. Hnizdo, K.W. Kemper and J. Szymakowski, Phys. Rev. Lett. 46 (1981) 590
- 1981HO1E Holland et al., Nucl. Sci. 28 (1981) 1344
- 1981HU1C Ed V. Hungerford, Nucl. Phys. A353 (1981) 75
- 1981IN1B Int. Nucl. Data Comm. INDC-36/LN (1981)
- 1981IO01 D.B. Ion and R. Ion-Mihai, Nucl. Phys. A360 (1981) 400
- 1981IS06 B.S. Ishkhanov, Yu.A. Novikov and I.M. Piskarev, Yad. Fiz. 33 (1981) 28; Sov. J. Nucl. Phys. 33 (1981) 15
- 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
- 1981JA1C Jarmie, Correll, Brown, Hardekopf and Hale, Bull. Amer. Phys. Soc. 26 (1981) 565
- 1981JA1F Jarmie, Nucl. Sic. Eng. 78 (1981) 404
- 1981JA1G Jarmie et al., Santa Fe 1980, (1981) p. 1314
- 1981KH1E Kholnov et al., Proc. Samarkand Conf. (1981) p. 609
- 1981KI01 B.T. Kim, T. Izumoto and K. Nagatani, Phys. Rev. C23 (1981) 33
- 1981KO1D Koenig et al., Santa Fe 1980, AIP Conf. Proc. 69 (1981) 919
- 1981KR15 H. Krimm, A. Klar and H.J. Pirner, Nucl. Phys. A367 (1981) 333
- 1981KR1J Kramer, John and Schenzle, Clustering Phenomena in Nuclei 2 (1981)
- 1981KU13 V.I. Kukulkin, V.M. Krasnopolsky, M.A. Miselkhi and V.T. Voronchev, Yad. Fiz. 34 (1981) 21
- 1981LE01 P. Lezoch, H.J. Trost, Md.A. Rahman and U. Strohbush, Phys. Lett. B98 (1981) 158
- 1981LI01 Q.K.K. Liu, H. Kanada and Y.C. Tang, Phys. Rev. C23 (1981) 645
- 1981LI25 Q.K.K. Liu, H. Kanada and Y.C. Tang, Z. Phys. A303 (1981) 253
- 1981ME13 M.C. Mermaz, J. Barrette and H.E. Wegner, Phys. Rev. C24 (1981) 2148
- 1981MO08 K.-H. Mobius, R. Bottger, P. Egelhof, Z. Moroz, E. Steffens, G. Tungate, W. Dreves, I. Koenig and D. Fick, Phys. Rev. Lett. 46 (1981) 1064
- 1981MO20 J. Mougey, R. Ost, M. Buenerd, A.J. Cole, C. Guet, D. Lebrun, J.M. Loiseaux, P. Martin, M. Maurel, E. Monnard et al., Phys. Lett. B105 (1981) 25

- 1981MU10 D. Mukhopadhyay, G. Grawert, D. Fick and Z. Moroz, Phys. Lett. B104 (1981) 361
- 1981MU1H A.I. Muminov and F.S. Akilov, Sov. J. Nucl. Phys. 34 (1981) 7; Yad. Fiz. 34 (1981) 13
- 1981MUZQ S.F. Mughabghab, M. Divadeenam and N.E. Holden, Neutron Cross Sections Part A, Z=1-60 (Academic Press, New York, 1981)
- 1981NA1C Nann, Kamal, Seth, Iversen and Hoistad, Bull. Amer. Phys. Soc. 26 (1981) 581
- 1981OS04 E. Oset and D. Strottman, Nucl. Phys. A355 (1981) 437
- 1981PH1D Philpott, Petrovich and Carpenter, Bull. Amer. Phys. Soc. 26 (1981) 1135
- 1981PR1F Primakoff and Rosen, Ann. Rev. Nucl. Part. Sci. 31 (1981) 145
- 1981RA1M Rao, Sridhar and Susila, Phys. Scr. 24 (1981) 925
- 1981RO02 R.G.H. Robertson, J.A. Nolen, Jr., T. Chapuran and R. Vodhanel, Phys. Rev. C23 (1981) 973
- 1981RO1W Rolfs, in Nucl. Struct., NATO B67 (1981) 369
- 1981SA16 F.D. Santos and A.M. Goncalves, Phys. Lett. B101 (1981) 219
- 1981SA22 H. Sanjeeviah and B. Sanjeevaiah, Indian J. Pure Appl. Phys. 19 (1981) 44
- 1981SC1M Schatzman, CERN 81-11
- 1981SE11 U. Sennhauser, L. Felawka, T. Kozlowski, H.K. Walter, F.W. Schlepuetz, R. Engfer, E.A. Hermes, P. Heusi, H.P. Isaak, H.S. Pruys et al., Phys. Lett. B103 (1981) 409
- 1981SE1B Seth, in Helsingor, June 1981 Conf., CERN 81-09 (1981) 655
- 1981SE1H Sennhauser et al., Proc. Versailles Conf. (1981) 330
- 1981SE1J Seth et al., Proc. Versailles Conf. (1981) 537
- 1981SH01 A.C. Shotter, A.N. Bice, J.M. Wouters, W.D. Rae and J. Cerny, Phys. Rev. Lett. 46 (1981) 12
- 1981SH07 H.S. Sherif, Phys. Rev. C23 (1981) 2361
- 1981SH1F Shafroth, Gould, Dave and Wender, Bull. Amer. Phys. Soc. 26 (1981) 593
- 1981SI09 M.K. Singham and F. Tabakin, Ann. Phys. 135 (1981) 71
- 1981SI1D Singham and Tabakin, Proc. Versailles Conf. (1981) 129
- 1981SR01 K. Srinivasa Rao, R. Sridhar and S. Susila, Phys. Scr. 24 (1981) 925
- 1981TA22 S.L. Tabor, L.C. Dennis and K. Abdo, Phys. Rev. C24 (1981) 2552
- 1981WA1J Wang, Zhang, Li and Ruan, Proc. Versailles Conf. (1981) 374
- 1981WH01 W.R. Wharton and B.D. Keister, Phys. Rev. C23 (1981) 1141
- 1981WH1C Wharton et al., Bull. Amer. Phys. Soc. 26 (1981) 581
- 1981WH1D Wharton et al., Proc. Versailles Conf. (1981) 327

- 1981WI04 R.D. Williams and S.E. Koonin, Phys. Rev. C23 (1981) 2773
- 1981WI1F Willis et al., Proc. Versailles Conf. (1981) 189
- 1981YA1C Yavin, CEA-N-2211 (1981)
- 1981ZU1A Zupranski et al., Santa Fe 1980, AIP Conf. Proc. 69 (1981) 970
- 1981ZU1B Zupranski, Santa Fe 1980, AIP Conf. Proc. 69 (1981) 1080
- 1982AB1D Abramovich, Gushovskii and Protopopov, in Kiev (1982) 566
- 1982AJ01 F. Ajzenberg-Selove, Nucl. Phys. A375 (1982) 1
- 1982AL1H Aleksandrov et al., in Kiev (1982) 367
- 1982AL31 G.D. Alekseev, T.D. Blokhintseva, O.E. Gorchakov, A.V. Zhelamkov, V.V. Karpukhin, A.V. Kravtsov, V.V. Kruglov, A.V. Kuptsov, V.P. Kurochkin, L. Luchan et al., Yad. Fiz. 36 (1982) 322
- 1982AL35 V.P. Alfimenkov, S.B. Borzakov, Vo Van Tkhuon, L.B. Pikelner and E.I. Sharapov, Yad. Fiz. 36 (1982) 1089; Sov. J. Nucl. Phys. 36 (1982) 637
- 1982AP1A Apokin et al., Yad. Fiz. 35 (1982) 382
- 1982AW02 A.M. Awin and P.E. Shanley, Nucl. Phys. A386 (1982) 101
- 1982AZ01 A.A. Azzam and M.A. Fawzy, Indian J. Phys. A56 (1982) 1
- 1982BA1V Barit et al., in Kiev (1982) 305
- 1982BA1W Badalov and Filippov, in Kiev (1982) 196
- 1982BA2G B.F. Bayman, P.J. Ellis and Y.C. Tang, Phys. Rev. Lett. 49 (1982) 532
- 1982BA52 F.C. Barker, Aust. J. Phys. 35 (1982) 291
- 1982BA80 J.N. Bahcall, W.F. Huebner, S.H. Lubow, P.D. Parker and R.K. Ulrich, Rev. Mod. Phys. 54 (1982) 767
- 1982BI06 L. Bimbot, M.P. Combes, J.C. Jourdain, Y. Le Bornec, F. Reide, A. Willis, N. Willis, J.-F. Germond and C. Wilkin, Phys. Lett. B114 (1982) 311
- 1982BL1G Blin, Bohrmann and Knoll, Z. Phys. A306 (1982) 177
- 1982BO1G Bogdanov, Kerimov and Safin, in Kiev (1982) 400
- 1982BO1J D.H. Boal, Phys. Rev. C25 (1982) 3068
- 1982BO1N Boyd, Bull. Amer. Phys. Soc. 27 (1982) 761
- 1982BO1Q Bogatin et al., Sov. J. Nucl. Phys. 35 (1982) 49
- 1982BO1Y Bogatin et al., Yad. Fiz. 36 (1982) 33
- 1982BO35 C. Borcea, E. Gierlik, A.M. Kalinin, R. Kalpakchieva, Yu.Ts. Oganessian, T. Pawlat, Yu.E. Penionzhkevich and A.V. Rykhlyuk, Nucl. Phys. A391 (1982) 520
- 1982BU09 P.E. Burt, L.W. Fagg and H. Crannell, Phys. Rev. C26 (1982) 713

- 1982CO16 J. Cook, N.M. Clarke, J. Coopersmith and R.J. Griffiths, Nucl. Phys. A386 (1982) 346
- 1982CO18 J. Cook, Nucl. Phys. A388 (1982) 153
- 1982CO1D Cowan and Haxton, Science 216 (1982) 51
- 1982DE12 V.P. Denisov and I.Ya. Chubukov, Yad. Fiz. 35 (1982) 11; Sov. J. Nucl. Phys. 35 (1982) 6; Erratum Yad. Fiz. 37 (1983) 1072; Sov. J. Nucl. Phys. 37 (1983) 634
- 1982DE1Y de Saint Simon et al., in MSU (1982) 48
- 1982DE30 L.C. Dennis, K.M. Abdo, A.D. Frawley and K.W. Kemper, Phys. Rev. C26 (1982) 981
- 1982DE35 A. Dellafiore and E. Lipparini, Nucl. Phys. A388 (1982) 639
- 1982DEZQ M. Deutsch, J. Piekarczyk, R. Chrien, M. Le Vine, M. May, D. Maurizio, P. Pile, S. Bart, R. Hackenburg, E. Hungerford et al., Bull. Amer. Phys. Soc. 27 (1982) 721, DD9
- 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
- 1982DO1E Dobrikov, Nemets, Gass and Shvedov, in Kiev (1982) 318
- 1982DO1M Dover and Walker, Phys. Rept. 89 (1982) 1
- 1982DR06 L. Drigo and G. Tornielli, Nuovo Cim. A70 (1982) 402
- 1982EC01 J.S. Eck, T.R. Ophel, P.D. Clark, J. Nurzynski and D.C. Weissner, Phys. Rev. C25 (1982) 2391
- 1982ER06 J. Ero, Z. Fodor, P. Koncz, Z. Seres, M. Csatlos, B.A. Khomenko, N.N. Khovanskij, Z.V. Krumstein, Yu.P. Merekov, V.I. Petrukhin et al., Nucl. Phys. A386 (1982) 484
- 1982ER1B Eramzhyan et al., Czech. J. Phys. 32 (1982) 326
- 1982ER1E Eramzhyan, Fetisov, Majling and Zofka, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 91
- 1982FI13 G.F. Filippov, L.L. Chopovsky and V.S. Vasilevsky, Nucl. Phys. A388 (1982) 47
- 1982FIZY D. Fick, A. Weller and P. Egelhof, Bull. Amer. Phys. Soc. 27 (1982) 492, DXa7
- 1982FU01 R.D. Furber, R.E. Brown, G.L. Peterson, D.R. Thompson and Y.C. Tang, Phys. Rev. C25 (1982) 23
- 1982FU04 T. Fukuda, M. Ishihara, M. Tanaka, I. Miura, H. Ogata and H. Kamitsubo, Phys. Rev. C25 (1982) 2464
- 1982GE1C Germond and Wilkin, in "Pion Production and Absorption in Nuclei-Indiana 1981", AIP Conf. Proc. 79 (1982) 411
- 1982GI01 E.F. Gibson, J.J. Kraushaar, T.G. Masterson, R.J. Peterson, R.S. Raymond, R.A. Ristinen, R.L. Boudrie and N.S.P. King, Nucl. Phys. A377 (1982) 389

- 1982GL01 B.G. Glagola, V.E. Viola, Jr., H. Breuer, N.S. Chant, A. Nadasen, P.G. Roos, S.M. Austin and G.J. Mathews, Phys. Rev. C25 (1982) 34
- 1982GO1C C. Goodman, Nucl. Phys. A374 (1982) 241
- 1982GO1E Gogitidze et al., in Kiev (1982) 338
- 1982GO1H Gorpinitch et al., in Kiev (1982) 295
- 1982GR09 A. Grutter, Nucl. Phys. A383 (1982) 98
- 1982GU1D Guliamov, Kim and Bekbaev, in Kiev (1982) 394
- 1982GU1E Gurbanovich and Zelenskaia, in Kiev (1982) 390
- 1982GU1H H.H. Gutbrod, A.I. Warwick and H. Wieman, Nucl. Phys. A387 (1982) 177
- 1982HA1D Haight, Mathews and White, Bull. Amer. Phys. Soc. 27 (1982) 519
- 1982HA1V Haight, Bull. Amer. Phys. Soc. 27 (1982) 760
- 1982HA1X Hale, Stewart and Young, in ENDF-301, BNL-NCS-51619 (1982) 25
- 1982HI06 S.-I. Higuchi, K. Shibata, S. Shirato and H. Yamada, Nucl. Phys. A384 (1982) 51
- 1982HI12 K.H. Hicks, T.E. Ward, H. Bowman, J.G. Ingersoll, J.O. Rasmussen, J.P. Sullivan, M. Koike and J. Peter, Phys. Rev. C26 (1982) 2016
- 1982HN1A Hnizdo, Cook, Kemper and Vineyard, Bull. Amer. Phys. Soc. 27 (1982) 706
- 1982IS10 H.P. Isaak, P. Heusi, H.S. Pruys, R. Engfer, E.A. Hermes, T. Kozlowski, U. Sennhauser and H.K. Walter, Helv. Phys. Acta 55 (1982) 477
- 1982JA1C Jacak et al., in MSU (1982) 32; Bull. Amer. Phys. Soc. 27 (1982) 715
- 1982JO1C Johnstone and Thomas, J. Phys. G8 (1982) L105
- 1982KA11 H. Kanada, T. Kaneko and Y.C. Tang, Nucl. Phys. A380 (1982) 87
- 1982KI1F King et al., Bull. Amer. Phys. Soc. 27 (1982) 720
- 1982KIZW E.R. Kinney, G.S. Adams, J.L. Matthews and W.W. Sapp, Bull. Amer. Phys. Soc. 27 (1982) 708, BE5
- 1982KL1B Klingenbeck, Hupke and Huber, in MSU (1982) 5
- 1982KNZZ H.D. Knox, G. Randers-Pehrson, P. Koehler, D. Resler, R.O. Lane and B. Rodricks, Bull. Amer. Phys. Soc. 27 (1982) 723, DE12
- 1982KO11 N.N. Kolesnikov, D. Amarasingam and V.I. Tarasov, Yad. Fiz. 35 (1982) 32; Sov. J. Nucl. Phys. 35 (1982) 20
- 1982KO1U Komoda and Sekiya, Atomkernernerg. Kerntecyhy. 40 (1982) 119
- 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
- 1982KR1E Kravtsov, Popov and Solyakin, Sov. J. Nucl. Phys. 35 (1982) 876

- 1982LA09 M. Lattuada, F. Riggi, C. Spitaleri, D. Vinciguerra and C.M. Sutura, *Lett. Nuovo Cim.* 33 (1982) 433
- 1982LE10 M. LeMere, Y.C. Tang and H. Kanada, *Phys. Rev. C* 25 (1982) 2902
- 1982LE1L Le Bornec and Willis, in "Pion Production and Absorption in Nuclei-Indiana 1981", *AIP Conf. Proc.* 79 (1982) 155
- 1982LE23 M. LeMere, Y. Fujiwara, Y.C. Tang and Q.K.K. Liu, *Phys. Rev. C* 26 (1982) 1847
- 1982LEZY M. Leitch, H.W. Baer, R. Bolton, J.D. Bowman, M.D. Cooper, F. Cverna, N.S.P. King, J. Alster, A. Doron, A. Erell et al., *Bull. Amer. Phys. Soc.* 27 (1982) 467, BF3
- 1982LO1B Londergain, "Pion Production and Absorption in Nuclei-Indiana 1981", *AIP Conf. Proc.* 79 (1982) 339
- 1982LU01 B. Ludewigt, G. Gaul, R. Glasow, H. Lohner and R. Santo, *Phys. Lett.* B108 (1982) 15
- 1982LY1A U. Lynen, H. Ho, W. Kuhn, D. Pelte, U. Winkler, W. F.J. Muller, Y. -T. Chu, P. Doll, A. Gobbi, K. Hildenbrand et al., *Nucl. Phys.* A387 (1982) 129
- 1982MA1Y May, *Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982* (1982) 63
- 1982MC1D McNally, *Bull. Amer. Phys. Soc.* 27 (1982) 711
- 1982MO13 Z. Moroz, P. Zupranski, R. Bottger, P. Egelhof, K.-H. Mobius, G. Tungate, E. Steffens, W. Dreves, I. Koenig and D. Fick, *Nucl. Phys.* A381 (1982) 294
- 1982MO1N J. Mougey, *Nucl. Phys.* A387 (1982) 109
- 1982MO1Q Motoba, Ikeda and bando, *Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982* (1982) 129
- 1982MU10 D. Mukhopadhyay and G. Grawert, *Nucl. Phys.* A385 (1982) 133
- 1982NA14 M.A. Nagarajan, I.J. Thompson and R.C. Johnson, *Nucl. Phys.* A385 (1982) 525
- 1982NA1K Nann, in "Pion Production and Absorption in Nuclei-Indiana 1981", *AIP Conf. Proc.* 79 (1982) 219
- 1982NG01 Nguyen Tien Nguyen and I. Ulehla, *Czech. J. Phys.* B32 (1982) 1040
- 1982NI03 H. Nishioka, R.C. Johnson, J.A. Tostevin and K.-I. Kubo, *Phys. Rev. Lett.* 48 (1982) 1795
- 1982OH09 H. Ohnishi, M. Tanifuji, M. Kamimura and M. Yahiro, *Phys. Lett.* B118 (1982) 16
- 1982OS01 E. Oset and D. Strottman, *Nucl. Phys.* A377 (1982) 297
- 1982OS02 J.L. Osborne, C.A. Barnes, R.W. Kavanagh, R.M. Kremer, G.J. Mathews, J.L. Zyskind, P.D. Parker and A.J. Howard, *Phys. Rev. Lett.* 48 (1982) 1664
- 1982PA1G Pagel, *Phil. Trans. Royal Soc. London* 307 (1982) 19
- 1982PE06 F. Petrovich, R.H. Howell, C.H. Poppe, S.M. Austin and G.M. Crawley, *Nucl. Phys.* A383 (1982) 355

- 1982PI1J Piekarz, in Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 72
- 1982PO1C Povh, Czech. J. Phys. 32 (1982) 183
- 1982RA1L Rahman Khan, Conf. on Hypernucl. Kaon Phys., Heidelberg, June 1982 (1982) 115
- 1982RA1M Ramaty and Lingenfelter, Ann. Rev. Nucl. Part. Sci. 32 (1982) 235
- 1982RI1A Rieder et al., Bull. Amer. Phys. Soc. 27 (1982) 469
- 1982ROZS C. Rolfs, P. Schmalbrock, H.P. Trautvetter, R.E. Azuma, J.D. King and W.S. Rodney, McMaster Univ., Ann.Rept. (1982) p.3
- 1982ROZT D. Rowley, F.S. Dietrich, C.H. Poppe, H.E. Conzett, D. Eversheim and C. Rioux, Bull. Amer. Phys. Soc. 27 (1982) 700, AE5
- 1982SA1F Sadowski, Knox, Resler and Lane, Bull. Amer. Phys. Soc. 27 (1982) 624
- 1982SA1M Saha et al., Nucl. Instrum. Meth. Phys. Res. 201 (1982) 465
- 1982SE08 U. Sennhauser, H.-J. Pfeiffer, H.K. Walter, F.W. Schlegel, H.S. Pruys, R. Engfer, R. Hartmann, E.A. Hermes, P. Heusi, H.P. Isaak et al., Nucl. Phys. A386 (1982) 429
- 1982SH1K Sharabati, Hecker and Joneja, Nucl. Instrum. Meth. Phys. Res. 201 (1982) 445
- 1982SL01 R.J. Slobodrian and H.E. Conzett, Z. Phys. A308 (1982) 15
- 1982SM02 A.B. Smith, P.T. Guenther and J.F. Whalen, Nucl. Phys. A373 (1982) 305
- 1982SP1B Spite and Spite, Nature 297 (1982) 483
- 1982ST15 D.J. Stubeda, Y. Fujiwara and Y.C. Tang, Phys. Rev. C26 (1982) 2410
- 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
- 1982TA1G Tang, Bull. Amer. Phys. Soc. 27 (1982) 748
- 1982TA23 S.L. Tabor, L.C. Dennis and K. Abdo, Nucl. Phys. A391 (1982) 458
- 1982TAZQ T.N. Taddeucci, J. Rapaport, C.D. Goodman, C.C. Foster, A. Bacher, D.J. Horen, P. Koncz, E. Sugarbaker and J. Larsen, Bull. Amer. Phys. Soc. 27 (1982) 719, DD1
- 1982WA1G P.L. Walden, Nucl. Phys. A374 (1982) 277
- 1982WA23 C.W. Wang, G.C. Kiang, L.L. Kiang, G.C. Jon and E.K. Lin, J. Phys. Soc. Jpn. 51 (1982) 3093
- 1982WH1A Wharton, in "Pion Production and Absorption in Nucl. - Indiana 1981", AIP Conf. Proc. 79 (1982) 371
- 1982WO09 C.L. Woods, B.A. Brown and N.A. Jelley, J. Phys. G8 (1982) 1699
- 1982WU1B Wu et al., Chin. Phys. 2 (1982) 726
- 1982YA1A A.I. Yavin, Nucl. Phys. A374 (1982) 297
- 1982ZA1B Zaika et al., in Kiev (1982) p. 306
- 1982ZH02 M.A. Zhusupov and Yu.N. Uzikov, J. Phys. G8 (1982) L99

- 1983AJ01 F. Ajzenberg-Selove, Nucl. Phys. A392 (1983) 1; Erratum Nucl. Phys. A413 (1984) 168
- 1983AO03 K. Aoki and H. Horiuchi, Prog. Theor. Phys. (Kyoto) 69 (1983) 857
- 1983BA15 D.P. Balamuth, L. Brown, T.E. Chapuran, J. Klein, R. Middleton and R.W. Zurmuhle, Phys. Rev. C27 (1983) 1724
- 1983BA17 C.M. Bartle, D.W. Gebbie and C.L. Hollas, Nucl. Phys. A397 (1983) 21
- 1983BU1F Burkova and Zhusupov, in Moscow (1983) p. 348
- 1983CO05 J. Cook, M.F. Vineyard, K.W. Kemper and V. Hnizdo, Phys. Rev. C27 (1983) 1536
- 1983DA14 C.N. Davids, A.J. Elwyn, B.W. Filippone, S.B. Kaufman, K.E. Rehm and J.P. Schiffer, Phys. Rev. C28 (1983) 885
- 1983DO1F Dobrikov et al., in Moscow (1983) p. 328, 329
- 1983DO1L Donaghue et al., Bull. Amer. Phys. Soc. 28 (1983) 713
- 1983DO1M Donaghue et al., Unknown Source
- 1983DU1B Dubovitschenko and Zhusupov, in Moscow (1983) p. 184
- 1983FI1J Filippov, Vasilevski and Nesterov, in Moscow (1983) p. 158
- 1983FIZV S.A. Fisher and R.L. Hershberger, Bull. Amer. Phys. Soc. 28 (1983) 713, GE5
- 1983FU04 T. Fukuda, M. Ishihara, M. Tanaka, H. Ogata, I. Miura, M. Inoue, T. Shimoda, K. Katori and S. Nakayama, Phys. Rev. C27 (1983) 2029
- 1983FU06 Y. Fujiwara and Y.C. Tang, Phys. Rev. C27 (1983) 2457
- 1983GO1R Gontcharova, Kissener and Eramzhian, in Moscow (1983) 188
- 1983GU1G Guliamov, Kim, Bekbaev and Islomov, in Moscow (1983) p. 428
- 1983HA1W Haight et al., IEEE Trans. Nucl. Sci. 30 (1983) 1160
- 1983HO1F Horiuchi, Prog. Theor. Phys. 69 (1983) 886
- 1983HU02 M.G. Huber, K. Klingenberg and R. Hupke, Nucl. Phys. A396 (1983) 191c
- 1983IRZZ F. Irom, J. Comfort, H.W. Baer, J.D. Bowman, M.D. Cooper, E. Piasetzky, U. Sennhauser, H. Ziock, J. Alster, A. Errell et al., Bull. Amer. Phys. Soc. 28 (1983) 671, BG5
- 1983JO1E J.A. Johnstone and A.W. Thomas, Nucl. Phys. A392 (1983) 409
- 1983KA1K Kadmenski and Tschuvilski, in Moscow (1983) p. 181
- 1983KN1G Knox and Lane, Unknown Source
- 1983KNZZ D.A. Knapp, A.B. Mc Donald and C.L. Bennett, Bull. Amer. Phys. Soc. 28 (1983) 713, GE4
- 1983KU03 H. Kumahora, H. Inoue and Y. Yoshizawa, Nucl. Instrum. Meth. Phys. Res. 206 (1983) 489

- 1983KW01 K. Kwiatkowski, S.H. Zhou, T.E. Ward, V.E. Viola, Jr., H. Breuer, G.J. Mathews, A. Gokmen and A.C. Mignerey, Phys. Rev. Lett. 50 (1983) 1648
- 1983LI01 K.F. Liu and F. Gabbard, Phys. Rev. C27 (1983) 93
- 1983LI07 J. Lichtenstadt, J. Alster, M.A. Moinester, J. Dubach, R.S. Hicks, G.A. Peterson and S. Kowalski, Phys. Lett. B121 (1983) 377
- 1983MA34 G.J. Mathews, R.C. Haight, R.G. Lanier and R.M. White, Phys. Rev. C28 (1983) 879
- 1983MO03 K.-H. Mobius, Z. Phys. A310 (1983) 159
- 1983NO03 E.B. Norman, T.E. Chupp, K.T. Lesko, J.L. Osborne, P.J. Grant and G.L. Woodruff, Phys. Rev. C27 (1983) 1728; Erratum Phys. Rev. C28 (1983) 1409
- 1983PIZW E. Piasezky, U. Sennhauser, H.W. Baer, J.D. Bowman, M.D. Cooper, H. Ziock, F. Irom, J. Alster, A. Erell and M. Moinester, Bull. Amer. Phys. Soc. 28 (1983) 704, EG1
- 1983PU01 G.D. Putt, L.K. Fifield, M.A.C. Hotchkis, T.R. Ophel and D.C. Weisser, Nucl. Phys. A399 (1983) 190
- 1983RI1C Rieder et al., Bull. Amer. Phys. Soc. 28 (1983) 705
- 1983RO1C Robertson et al., Phys. Rev. C27 (1983) 11
- 1983SA06 M. Sato, M. Sasagase, Y. Nagashima, J. Schimizu, T. Nakagawa, Y. Fukuchi and T. Mikumo, Phys. Rev. C27 (1983) 2621
- 1983SA1G Safronov, in Moscow (1983) 451
- 1983SE07 M.R. Sene, I. Anthony, D. Branford, A.G. Flowers, A.C. Shotter, C.H. Zimmerman, J.C. McGeorge, R.O. Owens and P.J. Thorley, Phys. Rev. Lett. 50 (1983) 1831
- 1983SEZV U. Sennhauser, R. Engfer, P. Heusi, H.P. Isaak, H.S. Pruys and H.C. Walter, Bull. Amer. Phys. Soc. 28 (1983) 718
- 1983ST1J Stepanenko et al., in Moscow (1983) 388
- 1983TAZY T.N. Taddeucci, J. Rapaport, C.D. Goodman, C.C. Foster, C.A. Goulding, C. Gaarde, J. Larsen, D.J. Horen, T. Masterson, E. Sugarbaker et al., Bull. Amer. Phys. Soc. 28 (1983) 714, GE6
- 1983TH04 I.J. Thompson and M.A. Nagarajan, Phys. Rev. B123 (1983) 379
- 1983TR1F Trefil, Killy and Rood, Nature 302 (1983) 111
- 1983VO01 H. Volk, H. Krawinkel, R. Santo and L. Wallek, Z. Phys. A310 (1983) 91
- 1983WA05 C.E. Waltham, S.H. Chew, J. Lowe, J.M. Nelson and A.R. Barnett, Nucl. Phys. A395 (1983) 119
- 1983WA1M Wallister, Liu, Kanada and Tang, Unknown Source (1983)
- 1983ZH1D Zhivopistev and Slivoi, in Moscow (1983) 354
- 1985AJ01 F. Ajzenberg-Selove, Nucl. Phys. A433 (1985) 1; Erratum Nucl. Phys. A449 (1986) 155.