Energy Levels of Light Nuclei
$A = 6$

D.R. Tilley [a,b], C.M. Cheves [a,c], J.L. Godwin [a,c], G.M. Hale [d],
H.M. Hofmann [e], J.H. Kelley [a,b], C.G. Sheu [a,c] and H.R. Weller [a,c]

[a]*Triangle Universities Nuclear Laboratory, Durham, NC 27708-0308*
[b]*Department of Physics, North Carolina State University, Raleigh, NC 27695-8202*
[c]*Department of Physics, Duke University, Durham, NC 27708-0305*
[d]*Los Alamos National Laboratory, Los Alamos, NM 87545*
[e]*Universität Erlangen-Nürnberg, Erlangen, Germany*

Abstract: An evaluation of $A = 5$–7 was published in *Nuclear Physics A*708 (2002), p. 3. This version of $A = 6$ differs from the published version in that we have corrected some errors discovered after the article went to press. The introduction and introductory tables have been omitted from this manuscript. Reference key numbers are in the NNDC/TUNL format.

(References closed August 23, 2001)

This work is supported by the US Department of Energy, Office of High Energy and Nuclear Physics, under: Contract No. DEFG02-97-ER41042 (North Carolina State University); Contract No. DEFG02-97-ER41033 (Duke University).

Table of Contents for $A = 6$

Below is a list of links for items found within the PDF document. The introductory Table 3 *is available on this website via the link.*

$\mathbf{A = 6}$

GENERAL: References to articles on general properties of $A = 6$ nuclei published since the previous review (1988AJ01) are grouped into categories and listed, along with brief descriptions of each item, in the General Tables for $A = 6$ located on our website at (*www.tunl.duke.edu/NuclData/General_Tables/06.shtml*).

^{6}n
(Not illustrated)

^{6}n has not been observed. See (1979AJ01, 1988AJ01) and references cited there. More recently (1990AL40) reports a search for ^{6}n in a ^{14}C(^{7}Li, ^{6}n) activation experiment at $E(^7\text{Li}) = 82$ MeV. No evidence for ^{6}n was obtained.

The method of angular potential functions was used by (1989GO18) in a calculation of the properties of multi-neutron systems which indicated that these systems have no bound states. The ground state energy of a six-neutron drop has been computed with variational and Green's function Monte Carlo methods (1997SM07).

^{6}H
(Fig. 7)

^{6}H was reported in the ^{7}Li(^{7}Li, ^{8}B)^{6}H reaction at $E(^7\text{Li}) = 82$ MeV (1984AL08, 1985AL1G) [$\sigma(\theta) \approx 60$ nb/sr at $\theta = 10°$] and in the ^{9}Be(^{11}B, ^{14}O)^{6}H reaction at $E(^{11}\text{B}) = 88$ MeV (1986BE35) [$\sigma(\theta) \approx 16$ nb/sr at $\theta \approx 8°$]. ^{6}H is unstable with respect to breakup into $^3\text{H} + 3\text{n}$ by 2.7 ± 0.4 MeV, $\Gamma = 1.8 \pm 0.5$ MeV (1984AL08), 2.6 ± 0.5 MeV, $\Gamma = 1.3 \pm 0.5$ MeV (1986BE35). The value adopted in the previous review (1988AJ01) is 2.7 ± 0.3 MeV, $\Gamma = 1.6 \pm 0.4$ MeV. See also (1987BO40). The atomic mass excess of ^{6}H using the (1995AU04) masses for ^{3}H and n, is then 41.9 ± 0.3 MeV. There is no evidence for the formation of ^{6}H in the ^{6}Li(π^-, π^+) reaction at $E_{\pi^-} = 220$ MeV as reported in (1990PA25). (1991SE06) shows that the continuum missing mass spectra can be explained in terms of the presence of dineutrons in the breakup products. An analysis of the proton spectra for the ^{7}Li(π^-, p) reaction (1990AM04) showed no evidence for ^{6}H.

The ground state of ^{6}H is calculated to have $J^\pi = 2^-$. Excited states are predicted at 1.78, 2.80 and 4.79 MeV with $J^\pi = 1^-$, 0^- and 1^+ [$(0 + 1)\hbar\omega$ model space] (1985PO10) [see also for $(0 + 2)\hbar\omega$ calculations]. See also the additional references cited in (1988AJ01).

^{6}He

(Figs. 4 and 7)

GENERAL: References to articles on general properties of ^{6}He published since the previous review (1988AJ01) are grouped into categories and listed, along with brief descriptions of each item, in the General Tables for ^{6}He located on our website at (*www.tunl.duke.edu/NuclData/General_Tables/6he.shtml*).

Ground State Properties:

The interaction radius of ^{6}He, obtained from measurements of the total interaction cross section, is 2.18 ± 0.02 fm (1985TA13, 1985TA18). These authors have also derived nuclear matter, charge and neutron r.m.s. radii.

^{6}He is considered to be a neutron-halo nucleus because its interaction radius, which is deduced from the total interaction cross section in (1985TA13, 1985TA18), is appreciably larger than that of ^{6}Li. A Glauber calculation using proton and neutron densities from an alpha-core valence-neutron model leads to the conclusion that the matter radius is much larger than the charge radius, as predicted by theoretical models of the ^{6}He ground-state wave function. These theoretical models include three-body models (1993ZH1J, 1995HI15), cluster-orbital shell models (1991SU03, 1994FU04), no-core microscopic shell models (1996NA24), and microscopic cluster models for various effective nucleon-nucleon interactions (1993CS04, 1997WU01). See also (1992TA18). The point proton and point neutron radii are often compared in order to enhance the effect, and are found to differ by 0.4–0.8 fm. For other typical properties of halo nuclei see (1995HA56).

1. ^{6}He(β^-)^{6}Li $\qquad Q_{\rm m} = 3.508$

The half-life is 806.7 ± 1.5 ms (1984AJ01). The decay to the ground state of ^{6}Li $(J^\pi = 1^+)$ is via a super-allowed Gamow-Teller transition; $\log ft = 2.910 \pm 0.002$ (1984AJ01, 1988AJ01). A second beta-decay branch leading to an unbound final state consisting of a deuteron and an α particle was reported (1990RI01) based on the observation of beta-delayed deuterons. The branching ratio for $E_{\rm d} > 350$ keV was measured (1993BO24, 1993RIZY) to be $(7.6 \pm 0.6) \times 10^{-6}$. Calculations are presented which consider alternative decay routes. (One considers a decay to an unbound state of ^{6}Li which then decays into $\alpha + $d. In the other route ^{6}He breaks up into an alpha particle plus a di-neutron which β decays to a deuteron). The calculation of (1994BA11) successfully reproduces the deuteron spectrum shape and branching ratios. References to theoretical work on the ^{6}He(β^-)^{6}Li decay are presented in Table 6.2.

2. ^{1}H(^{6}He, ^{6}He)^{1}H $\qquad E_{\rm b} = 9.975$

Angular distributions for elastic scattering and for 1n and 2n transfer were measured at 25 MeV/A, and spectroscopic amplitudes were extracted by (1999WO13). An analysis of elastic

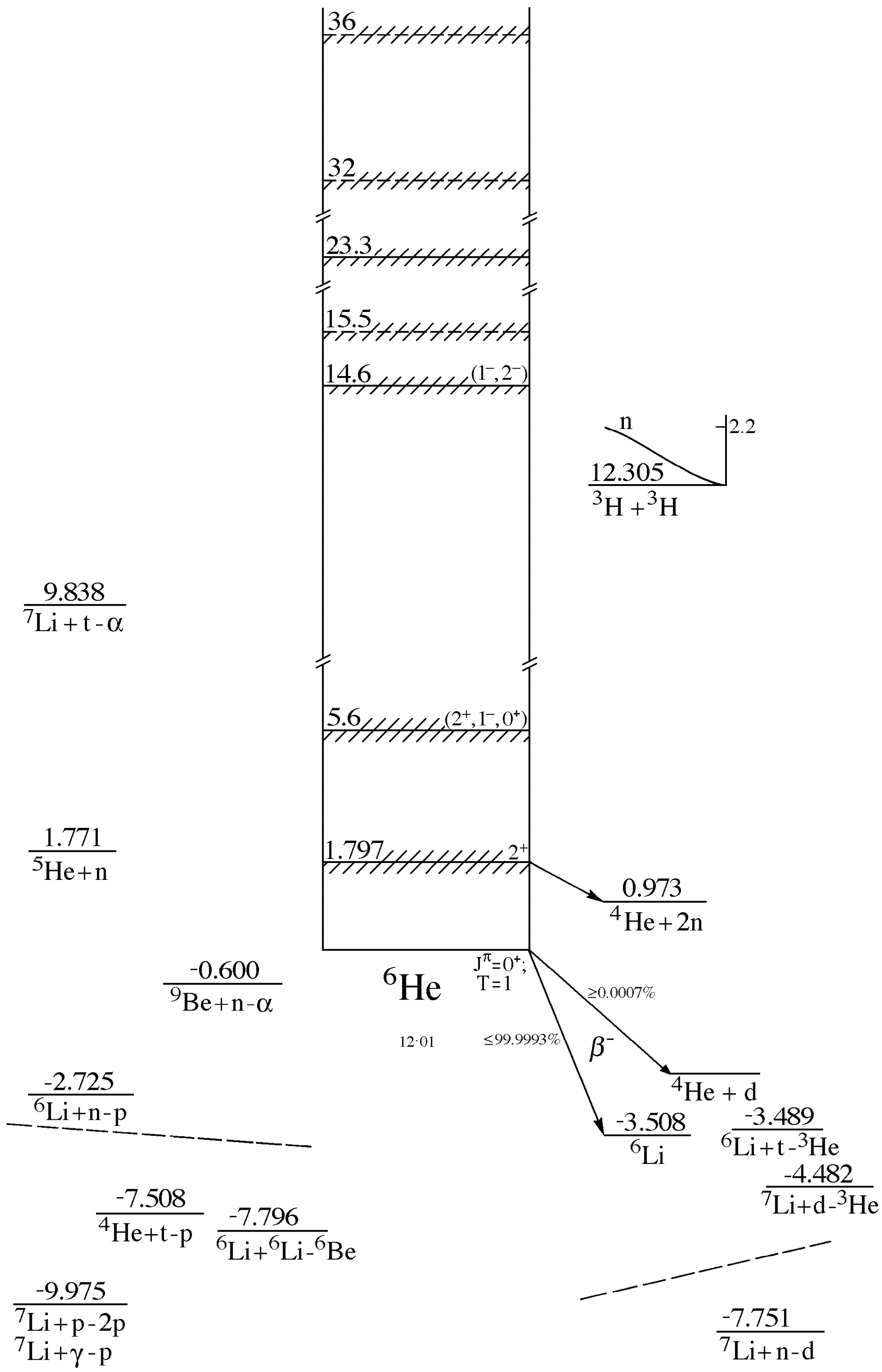


Figure 4: Energy levels of ^{6}He. For notation see Fig. 5.

Table 6.1: Energy levels of ^{6}He

E_x (MeV ± keV)	$J^\pi; T$	$\tau_{1/2}$ or Γ_{cm}	Decay	Reactions
g.s.	$0^+; 1$	$\tau_{1/2} = 806.7 \pm 1.5$ ms	β^-	1, 5, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 30, 31
1.797 ± 25	$2^+; 1$ [a]	$\Gamma = 113 \pm 20$ keV	n, α	5, 9, 10, 11, 12, 13, 15, 16, 19, 20, 21, 22, 23, 24, 26, 31
5.6 ± 300 [a]	$(2^+, 1^-, 0^+); 1$ [a]	12.1 ± 1.1 MeV [a]		15
14.6 ± 0.7 [a]	$(1^-, 2^-); 1$ [a]	7.4 ± 1.0 MeV [a]		9, 15, 19, 22, 24
(15.5 ± 500)		4 ± 2 MeV		10, 11, 16, 19, 23, 24
23.3 ± 1.0 [a]		14.8 ± 2.3 MeV [a]		11, 15, 19
(32)		≤ 2 MeV		23
(36)		≤ 2 MeV		23

[a] Newly adopted in this evaluation or revised from the previous evaluation (1988AJ01).

scattering data at 700 MeV/A is described in (1998AL05). See also the analysis (2000DE43) of data at $E = 25$, 40 MeV and that of (2000GU19) at $E = 25$–70 MeV. The reaction cross section was measured for 36 MeV/A ^{6}He on hydrogen, and a value of $\sigma_R = 409 \pm 22$ mb was obtained (2001DE19). Analysis within a microscopic model allowed the ^{6}He density distribution to be explored.

The use of elastic and inelastic scattering with secondary beams to probe ground-state transition densities of halo nuclei has been explored in a theoretical study (1995BE26). Cross sections for $E = 151$ MeV were calculated by (2000AV02), and density-distribution features were deduced. See also the discussion of (1999EG02).

3. (a) ^{3}H(t, n)^{5}He $\qquad Q_m = 10.534 \qquad E_b = 12.305$
   (b) ^{3}H(t, 2n)^{4}He $\qquad Q_m = 11.332$
   (c) ^{3}H(t, t)^{3}H

The cross section for reaction (b) was measured for $E_t = 30$ to 115 keV by (1986BR20, 1985JA16) who also calculated the astrophysical S-factors [the extrapolated $S(0) \approx 180$ keV·b] and discussed the earlier measurements. See also (1974AJ01, 1979AJ01) and (1986JA1E). Calculations have also been made within the framework of the two-channel resonating group method

Table 6.2: ^{6}He(β^-)^{6}Li – Theoretical work

Reference	Description
1989DO1B	Meson exchange corrections to the ^{6}He$_{\rm g.s.}$–^{6}Li$_{\rm g.s.}$ beta decay
1989SA20	Polarization effects of second-class currents in the direct and inverse decay of nuclei
1989TE04	Neutral current effect in nuclear β-decays
1990DA1H	Two body phase space in alpha-deuteron breakup at 40 MeV
1990DAZR	Beta-decay of the ground state of ^{6}He in three-particle $\alpha + 2$n model
1990DO04	Particle-hole symmetry and meson exchange corrections to the ^{6}He beta decay amplitude
1990HA29	A review of recent results on nuclear structure at the drip lines
1991DA24	Decay of the ground state of the ^{6}He nucleus in the three-particle $\alpha + 2$n model
1992DAZV	Static electromagnetic characteristics and beta-decay of ^{6}He
1992DE12	Beta-delayed deuteron emission of ^{6}He in a potential model
1993CH06	Gamow-Teller beta-decay rates for $A \leq 18$ nuclei, a comprehensive analysis
1993ZH09	^{6}He beta decay to the $\alpha +$ d channel in a three-body model
1994BA11	Deuteron emission following ^{6}He beta decay
1994BB03	Evidence for halo in quenching of ^{6}He β-decay into alpha and deuteron
1994CS01	Microscopic description of the beta delayed deuteron emission from ^{6}He
1994SK01	Improved limits on time-reversal-violating, tensor weak couplings in ^{6}He
1994SU02	Glauber theory microscopic analysis of fragmentation and beta-delayed particle emission
1995SU13	Study of halo structure in light nuclei with a multicluster model
1998GL01	Order-α radiative correction to ^{6}He β-decay recoil spectrum
1999ER02	Antisymmetrization in multicluster model & nucleon exchange effects

(1989VA20), the microscopic multichannel resonating group method (1991TY01) and the generator coordinate method (1990FU1H). For muon-catalyzed fusion see (1988MA1V, 1989BR23, 1989CH2F, 1990HA46). For earlier work see (1988AJ01).

4. ^{4}He(2n, γ)^{6}He $\qquad Q_{\rm m} = 0.973$

A mechanism for this reaction in astrophysical processes is suggested, and a reaction rate is calculated (1996EF02).

5. ^{4}He(t, p)^{6}He $\qquad Q_{\rm m} = -7.508$

Angular distributions of the protons to ^{6}He*(0, 1.80) have been measured at $E_{\rm t} = 22$ and 23 MeV. [No L-values were assigned.] No other states are observed with $E_{\rm x} \leq 4.2$ MeV: see (1979AJ01). Cross sections and angular distributions for the reaction products of the ^{3}H(α, p)^{6}He reaction were measured at $E_\alpha = 27.2$ MeV (1992GO21). A potential description of ^{3}H + ^{4}He elastic scattering is discussed in (1993DU09).

6. ^{4}He(α, 2p)^{6}He $\qquad Q_m = -27.322$

Total cross sections for the production of ^{6}He have been measured (2001AU06) at $E_\alpha = 159$, 280 and 620 MeV in a study of cosmic ray nucleosynthesis. The resulting cross sections decrease rapidly with energy.

7. ^{4}He(^{6}He, ^{6}He)^{4}He $\qquad E_b = 7.412$

Differential cross sections were measured at E(^{6}He) $= 151$ MeV. DWBA analysis suggests a spectroscopic factor of ≈ 1 for the di-neutron cluster. (1998TE1D, 1998TE03). Measurements at $E_{cm} = 11.6$ and 15.9 MeV (1999RA15) also show evidence for the 2n transfer process in the elastic scattering. However, a couple-discretized-continuum channel analysis discussed in (2000RU03) suggests a smaller 2n transfer process than commonly assumed (2001TE03). See also the analyses and calculations of (1998GO1J, 1999OG06, 1999OG09). A microscopic multicluster model description of the elastic scattering process is discussed in (1999FU03).

8. ^{6}He(p, p)^{6}He $\qquad E_b = 9.975$

See reaction 2 for experimental information on the ^{6}He + ^{1}H system.

Calculations of the elastic scattering of protons from ^{6}He at $E_p \geq 100$ MeV are described in (1992GA27). A folding model with target densities which reproduce the r.m.s. radii and a range of electroweak data was used.

A calculation of the expansion of the Glauber amplitude described in (1999AB37) found that a ^{6}He matter radius constant with the analysis is 2.51 fm. Finite-range coupled channel calculations have been performed below the ^{6}He three-body breakup threshold (2000TI02). A theoretical study (2000WE03) with four differential nuclear structure models concluded that elastic scattering at < 100 MeV/A does not provide good constraints on the structure of the ^{6}He ground state. First order optical potentials were studied for 20–40 MeV scattering by (2000DE43). A microscopic multicluster calculation of $\sigma(\theta)$ and σ(E) for $E_{cm} = 0$–5 MeV is reported in (2001AR05).

9. ^{6}Li(e, π^+)^{6}He $\qquad Q_m = -143.078$

(1986SH14) report breaks in (e, π^+) spectra at $E_e = 202$ MeV corresponding to $E_x = 7$, 9, 12, 13.6, 17.7 and 24.0 MeV. Using the shape of the virtual photon spectrum results in groups with angular distributions that suggest that the states at 13.6, 17.7 and 24.0 MeV are spin-dipole isovector states [$J^\pi = 1^-, 2^-$]. See also (1990SH1I). For the earlier work see (1984AJ01). [Note: The states reported here at 7, 9 and 12 MeV are inconsistent with the work reported in reactions 12, 13, 22 and 23, and with the work on the analog region in ^{6}Be].

10. (a) ^{6}Li(π^-, γ)^{6}He $\qquad Q_m = 136.062$

(b) ^{6}Li(π^-, π^0)^{6}He $\qquad Q_m = 1.086$

The excitation of ^{6}He*(0, 1.8) and possibly of (broad) states at $E_x = 15.6 \pm 0.5$, 23.2 ± 0.7 and 29.7 ± 1.3 MeV has been reported: see (1979AJ01). A study of capture branching ratios to ^{6}He*(0, 1.8) was reported in (1986PE05). For reaction (b) see (1984AJ01).

11. ^{6}Li(n, p)^{6}He $\qquad Q_m = -2.725$

Angular distributions of the ground state proton group, p_0 have been reported at $E_n = 4.7$ to 6.8 MeV, at 14 MeV and at 59.6 MeV [see (1979AJ01, 1984AJ01)] and at 118 MeV (1987PO18, 1988HA2C, 1988WA24). At $E_n = 59.6$ MeV broad structures in the spectra are ascribed to states at $E_x = 15.5 \pm 0.5$ and 25 ± 1 MeV with $\Gamma = 4 \pm 1.5$ and 8 ± 2 MeV (1983BR32, 1984BR03) [see for discussions of the GDR strength]. The ground state reaction has also been studied at $E_n = 198$ MeV (1988JA01). Proton spectra were measured at $E_n = 118$ MeV by (1998HA24).

An angular distribution of the proton group corresponding to population of the $E_x = 1.8$ MeV $J^\pi = 2^+$ state in ^{6}He was also reported (1988WA24). See also (1989WA1F). Angular distributions were measured for p_0 at $E_n = 280$ MeV in tests of isospin symmetry in (n, p), (p, p′) and (p, n) reactions populating the $T = 1$ isospin triads in $A = 6$ nuclei (1990MI10). Cross sections for $\theta_{lab} = 1°$–$10°$ for $E_n = 60$–260 MeV were measured to obtain the energy dependence of the Gamow-Teller strength (1991SOZZ, 1992SO02).

Several theoretical studies have been reported since the previous review. A dynamical multi-cluster model was used to generate transition densities for ^{6}He and ^{6}Li (1991DA08). A microscopic calculation in the framework of the $\alpha + 2$N model (1993SH1G) reproduced energy spectra and cross sections reliably. Predictions for the structure of a second $2^{(+)}$ resonance in the ^{6}He continuum were made with a $\alpha +$ N $+$ N cluster model (1997DA01). Halo excitation of ^{6}He in ^{6}Li(n, p)^{6}He was studied using four-body distorted wave theory (1997ER05); see also (1997VA06). The status of experimental and theoretical research on nuclei featuring a two-particle halo is reviewed in (1996DA31).

12. ^{6}Li(d, 2p)^{6}He $\qquad Q_m = -4.950$

The previous review (1988AJ01) notes that at $E_{\rm d} = 55$ MeV, ^{6}He*(0, 1.8) [the latter weak] are populated: no other states are observed with $E_{\rm x} \leq 25$ MeV [see (1984AJ01)]. More recently cross sections at 0° were measured at $E_{\rm d} = 260$ MeV (1993OH01) and at $E_{\rm d} = 125.2$ MeV (1995XU02). In both studies the cross section for (d, ^{2}He) showed a linear relationship with Gamow-Teller strength from β decay or (p, n) reactions.

13. ^{6}Li(t, ^{3}He)^{6}He $\qquad Q_{\rm m} = -3.489$

The ground-state angular distribution has been studied at $E_{\rm t} = 17$ MeV. At $E_{\rm t} = 22$ MeV only ^{6}He*(0, 1.8) are populated for $E_{\rm x} \leq 8.5$ MeV: see (1979AJ01). Differential cross sections for the transition to ^{6}He*(1.8) are reported at $E(^6{\rm Li}) = 65$ MeV (1987AL23). In a more recent experiment at $E_{\rm t} = 336$ MeV reported in (2000NA35), the ^{6}He ground and 1.8 MeV states were populated. In addition, a broad asymmetric structure around $E_{\rm x} \approx 5$ MeV was observed with an angular distribution which exhibited $\Delta L = 1$ dominance. Another structure at $E_{\rm x} \approx 14.6$ MeV was observed with the angular distribution indicating $\Delta L = 1$.

14. ^{6}Li(^{6}Li, ^{6}Be)^{6}He $\qquad Q_{\rm m} = -7.796$

Angular distributions have been studied for $E(^6{\rm Li}) = 32$ and 36 MeV for the transitions to $^6{\rm He}_{\rm g.s.}$, $^6{\rm Be}_{\rm g.s.}$ and, in inelastic scattering of ^{6}Li [see ^{6}Li], to the analog state ^{6}Li*(3.56): for a discussion of these see the references quoted in (1979AJ01).

15. ^{6}Li(^{7}Li, ^{7}Be)^{6}He $\qquad Q_{\rm m} = -4.370$

Measurements of differential cross sections at $E(^7{\rm Li}) = 82$ MeV are reported in (1992GLZX, 1993GLZZ, 1994SAZZ) and at $E(^7{\rm Li}) = 78$ MeV in (1993SA35, 1994RUZZ). The ^{6}He levels at $E_{\rm x} = 0$ $J^\pi = 0^+$ and $E_{\rm x} = 1.80$ $J^\pi = 2^+$ were identified. A maximum at $E_{\rm x} \approx 6$ MeV is interpreted as consistent with a soft-dipole response expected in neutron-halo nuclei. A study (1996JA11, 1999AN13) at $E(^7{\rm Li}) = 350$ MeV utilized magnetic analysis to observe transitions to the $J^\pi = 0^+$ ground state, and the $J^\pi = 2^+$ state at $E_{\rm x} = 1.8$ MeV, as well as pronounced resonances at ≈ 5.6 MeV, ≈ 14.6 MeV and ≈ 23.3 MeV (1996JA11). See Table 6.3. In experiments at $E = 65$ MeV/A with this reaction, isovector spin-flip and spin non-flip resonances were deduced (1998NAZP, 1998NAZR). See also the more recent measurements described in (2000NA22) and (2001NA18).

A theoretical study of ^{6}He structure with an extended microscopic three-cluster model is described in (1999AR08).

Table 6.3: Levels in ^{6}He from ^{6}Li(^{7}Li, ^{7}Be)^{6}He [a]

E_x (MeV)	J^π	Γ (MeV)	$d\sigma/d\Omega$ [b] (mb/sr)	G [c]
g.s.	0^+		0.72 ± 0.08	0.46 ± 0.05
1.92 ± 0.17	2^+		0.25 ± 0.04	0.40 ± 0.10
5.6 ± 0.3	$(2^+, 1^-, 0^+)$ [d]	12.1 ± 1.1	4.56 ± 0.48	0.39 ± 0.04
14.6 ± 0.7	$(1,\ 2)^-$	7.4 ± 1.0	2.11 ± 0.23	0.43 ± 0.06
23.3 ± 1.0		14.8 ± 2.3	1.75 ± 0.19	0.47 ± 0.07

[a] (1996JA11). $E(^7\text{Li}) = 350$ MeV.
[b] $\theta_{\text{cm}} = 4.5°$.
[c] Averaged spin-flip signatures $G = Y_{\text{coinc}}/Y_{\text{singles}}$.
[d] (1999AN13) and J. Jänecke, private communication.

16. (a) ^{7}Li(γ, p)^{6}He $\quad Q_m = -9.975$
(b) ^{7}Li(e, ep)^{6}He $\quad Q_m = -9.975$

At $E_\gamma = 60$ MeV, the proton spectrum shows two prominent peaks attributed to ^{6}He*($0 + 1.8$, 18 ± 3): see (1979AJ01). Reactions (a) and (b) have been studied by (1985SE17). See also ^{7}Li, (1984AJ01) and (1986BA2G). An analysis of the available experimental data on ^{7}Li photodisintegration at energies up to $E_\gamma = 50$ MeV is presented in (1990VAZM, 1990VA16). See also the discussion of reactions involving scattering of polarized electrons from polarized targets (1993CA11). In more recent work a broad excited state was observed (2001BO38) in ^{6}He with energy $E_x = 5 \pm 1$ MeV and width $\Gamma = 3 \pm 1$ MeV. In experiments with reaction (b) momentum distributions from transitions to the ^{6}He ground and first excited states were measured by (1999LA13, 2000LA17). The deduced spectroscopic factor for both reactions is 0.58 ± 0.05 in agreement with variational Monte Carlo calculations.

17. ^{7}Li(π^-, ^{6}He)n $\quad Q_m = 128.812$

The results of measurements of inclusive spectra made with π^- mesons with momentum 90 MeV/c are presented in (1993AM09). The yield of one-neutron emission was found to be $Y = (1.1 \pm 0.2) \times 10^{-3}$ per stopped π^-.

18. ^{7}Li(π^-, π^-p)^{6}He $\quad Q_m = -9.975$

Pion and proton spectra were measured at 0.7, 0.9, 1.25 GeV/c by (2000AB25). Fermi-momentum distributions were deduced.

19. ^{7}Li(n, d)^{6}He $Q_m = -7.751$

At $E_n = 60$ MeV, the deuteron spectrum shows two prominent peaks attributed to states centered at $E_x = 13.6$, 15.4 and 17.7 MeV (± 0.5 MeV) and a possible state or states (populated with an l_p transfer ≥ 2) at $E_x = 23.7$ MeV. DWBA analyses of the d_0 and d_1 groups are consistent with $l_p = 1$ and $S(1p_{3/2}) = 0.62$ for $^6He_{g.s.}$ and to $S(1_{p_{3/2}}) = 0.37$, $S(1_{p_{1/2}}) = 0.32$ for ^{6}He*(1.8) (1977BR17): see (1979AJ01). Measurements of the cross section as a function of energy for $E_x = 10$–30 MeV were reported in (1989CO22). See also the measurements at $E_n = 14.1$ MeV (1989SHZS).

20. ^{7}Li(p, 2p)^{6}He $Q_m = -9.975$

From measurements at $E_p = 1$ GeV (1985BE30, 1985DO16), the separation energy between 6–7 MeV broad $1p_{3/2}$ and $1s_{1/2}$ peaks is reported to be 14.1 ± 0.7 MeV. See also (1983GO06) and (1979AJ01). Differential cross section measurements at $E_p = 70$ MeV are reported in (1988PA26, 1998SH33, 2001SH03). Contributions from 1p and 1s nucleons in ^{7}Li were distinguished. Proton spectra measurements for $E_p = 1$ GeV were reported by (2000MI17, 2001MI07). Effective proton polarizations were deduced. See also the review of experimental and theoretical nucleon and cluster knockout reactions in light nuclei presented in (1987VD1A).

21. ^{7}Li(d, ^{3}He)^{6}He $Q_m = -4.482$

As summarized in the previous review (1988AJ01), angular distributions of the ^{3}He ions to ^{6}He*(0, 1.8) have been measured at $E_d = 14.4$ and 22 MeV: they have an $l_p = 1$ character and therefore these two states have $J^\pi = (0\text{–}3)^+$. There is no evidence for any other states of ^{6}He with $E_x < 10.7$ MeV: see (1979AJ01). (1987BO39) [$E_d = 30.7$ MeV] deduce that the branching ratio of ^{6}He*(1.8) into a dineutron [n^2: $T = 1$, $S = 0$] and an α-particle is 0.75 ± 0.10. See also (1985BO55) and (1987DA31). More recently, the energy spectrum of neutrons from the ^{6}He excited state at $E_x = 1.8$ MeV populated in this reaction was measured at $E_d = 23$ MeV (1994BO46).

22. ^{7}Li(t, α)^{6}He $Q_m = 9.838$

As summarized in (1988AJ01), the energy of the first-excited state is 1.797 ± 0.025 MeV, $\Gamma = 113 \pm 20$ keV. ^{6}He*(1.80) decays into ^{4}He + 2n. The branching ratio $\Gamma_{\gamma}/\Gamma_{\alpha} \leq 2 \times 10^{-6}$: for $\Gamma_{\rm cm} = 113 \pm 20$ keV, $\Gamma_{\gamma} \leq 0.23$ eV. Angular distributions of the α_0 and α_1 groups have been measured at $E_{\rm t} = 13$ and 22 MeV. No other α-groups are reported corresponding to ^{6}He states with $E_{\rm x} < 24$ MeV (region between $E_{\rm x} \approx 13$ and 16 MeV was obscured by the presence of breakup α-particles): see (1979AJ01). Angular distributions were reported at $E_{\rm t} = 0.151$ and 0.272 MeV (1987AB09; α_0, α_1) and at $E(^{7}\text{Li}) = 31$ MeV (1987AL23; to ^{6}He*(0, 1.8, 13.6)).

In more recent work, differential cross sections were measured at $E_{\rm t} = 38$ MeV (1992CL04). DWBA calculations are presented and spectroscopic factors are deduced.

The resonance theory of threshold phenomena was used to analyze differential cross sections for ^{7}Li(t, α)^{6}He*(1.8) for $\theta < 90°$ at $E_{\rm t} = 80$–500 keV in a study of ^{10}Be levels (1991LA1D).

23. ^{7}Li(^{3}He, p^{3}He)^{6}He $\qquad Q_{\rm m} = -9.975$

At $E(^{3}\text{He}) = 120$ MeV the missing mass spectra show ^{6}He*(0, 1.8) and a strong, broad peak corresponding to ^{6}He*(16) [possibly due to unresolved states]. There is no indication of a state near 23.7 MeV but there is some evidence of structures at $E_{\rm x} = 32.0$ and 35.7 MeV, with $\Gamma \leq 2$ MeV (1985FR01).

24. (a) ^{7}Li(^{6}Li, ^{7}Be)^{6}He $\qquad Q_{\rm m} = -4.370$

(b) ^{7}Li(^{7}Li, ^{8}Be)^{6}He $\qquad Q_{\rm m} = 7.280$

In reaction (a) at $E(^{6}\text{Li}) = 93$ MeV a broad peak ($\Gamma = 5.5$ MeV) was reported at $E_{\rm x} = 14$ MeV. A second structure may also be present at 15.5 MeV (1987GLZW, 1988BUZH). ^{6}He*(0, 1.8) are also populated (1988BUZH). For reaction (b) see ^{8}Be in (1988AJ01). See also ^{7}Be, (1984AJ01) and (1988BU1Q, 1984BA53), and see (1996SO17) which involves ^{10}Be excited states. Measurements of differential cross sections at $E(^{7}\text{Li}) = 22$ MeV were reported in (1988BO18).

25. ^{9}Be(γ, ^{3}He)^{6}He $\qquad Q_{\rm m} = -21.178$

Measurements of ground-state cross sections and angular distributions are reported in (1999SH05). See (1999ZHZN) for a compilation and evaluation of cross section data for $E_{\alpha} \leq 30$ MeV.

26. ^{9}Be(n, α)^{6}He $\qquad Q_{\rm m} = -0.600$

Angular distributions have been reported for $E_\mathrm{n} = 12.2$ to 18.0 MeV (α_0, α_1). No other states are observed with $E_\mathrm{x} \leq 7$ MeV: see (1979AJ01). For a study of possible dineutron breakup of ^{6}He*(1.8) see (1983OT02). An analysis of the alpha and neutron spectra observed in this reaction for $E_\mathrm{n} \approx 14$ MeV is presented in (1988FE06). See also ^{10}Be in (1988AJ01) and (1983SH1J).

27. ^{9}Be(^{6}He, ^{6}He)^{9}Be $E_\mathrm{b} = 19.069$

Elastic scattering measurements for $E(^6\mathrm{He}) = 8.8$–9.3 MeV were reported in (1991SM01). The data are well reproduced with calculations using ^{6}Li or ^{7}Li optical model parameters. See also ^{9}Be in (1988AJ01).

28. ^{9}Be(^{6}Li, ^{9}B)^{6}He $Q_\mathrm{m} = -4.576$

Differential cross sections were measured at $E(^6\mathrm{Li}) = 34$, 62 MeV, and spectroscopic factors were deduced (1985CO09). Vector and tensor analyzing powers were measured for detection of the ^{6}He nuclei at $\theta_\mathrm{cm} = 14°$–$80°$ at $E(^6\mathrm{Li}) = 32$ MeV (1993RE04). See ^{9}B in (1988AJ01).

29. ^{9}Be(^{7}Li, ^{6}He)^{10}B $Q_\mathrm{m} = -3.390$

This reaction has been used as a source of ^{6}He beams for elastic scattering experiments at $E(^6\mathrm{He}) = 8.8$–9.3 MeV (1991SM01) and at $E(^6\mathrm{He}) = 10.2$ MeV (1995WA01).

30. ^{9}Be(^{9}Be, ^{6}He)^{12}C $Q_\mathrm{m} = 5.101$

Angular distributions were measured at $E(^9\mathrm{Be}) = 40$ MeV (1992CO05). See ^{9}Be in (1988AJ01) and ^{12}C in (1990AJ01).

31. ^{11}B(^{7}Li, ^{12}C)^{6}He $Q_\mathrm{m} = 5.982$

At $E(^{11}\mathrm{B}) = 88$ MeV the population of the ground state and the first-excited state at $E_\mathrm{x} = 1.8 \pm 0.3$ MeV ($\Gamma \leq 0.2$ MeV) is reported (1987BEYI). See also (1988BEYJ).

32. ^{12}C(μ^+, ^{6}He)X

Measurements of the energy dependence at $E = 100$, 190 GeV were reported by (2000HA33).

33. ^{12}C(^{6}He, n)X

Peripheral fragmentation of ^{6}He at 240 MeV/A was studied (1997CH24, 1997CH47, 1998AL10) in a kinematically complete experiment. It was found that one-neutron stripping to ^{5}He is the dominant mechanism. A continuation of the analysis described in (2000AL04) indicates excitation of the ^{6}He first 2^{+} state and associates it with E1 dipole oscillation. See also (1993FE02). Model calculations are discussed in (1998BE09, 1998GA37).

34. ^{12}C(^{6}He, α)X

Measurements at 240 MeV/A are described in (1998AL10, 1998AN02, 1999AU01, 2000AL04). Fragmentation cross sections of ^{6}He were analyzed in the Glauber theory to investigate the importance of neutron correlation (1994SU02). Fragmentation reaction data and beta-delayed particle emission data are reproduced successfully. Detailed structure is described with a multicluster model and halo-like structure is discussed in (1995SU13). See also (1998BE09, 1998GA37).

35. ^{12}C(^{6}He, ^{6}He)^{12}C $E_{\rm b} = 18.376$

Elastic and quasielastic scattering of ^{6}He on ^{12}C was studied at $E(^{6}\text{He}) = 10.2$ MeV (1995WA01). See also (1995PE1D). Measurements of cross sections were made at 41.6 MeV/A (1996AL11). The results were successfully analyzed within a 4-body ($\alpha + \text{n} + \text{n} + {}^{12}$C) eikonal scattering model.

Potential parameters were deduced and differential cross sections were calculated for ^{6}He scattering at 50 and 100 MeV/A (1993GO06). The possibility of studying the structure of the neutron halo in ^{6}He elastic rainbow scattering is discussed. See also (1989SI02, 1992CL04, 1993FE02, 1995GA24). Calculations of cross sections at $E = 20$–60 MeV/A were reported in (2000BO45). Proton, neutron and matter r.m.s. distributions were also calculated.

36. ^{208}Pb(^{6}He, 2nα)X

Measurements and analyses of a three-body breakup experiment at 240 MeV/A are described in (1999AU01, 2000AL04). Two-neutron interferometry measurements at 50 MeV/A are discussed in (2000MA12).

^{6}Li

(Figs. 5 and 7)

GENERAL: References to articles on general properties of ^{6}Li published since the previous review (1988AJ01) are grouped into categories and listed, along with brief descriptions of each item, in the General Tables for ^{6}Li located on our website at (*www.tunl.duke.edu/NuclData/General_Tables/6li.shtml*).

Ground State Properties:

$$\mu = +0.8220473(6)\ \text{nm}, +0.8220567(3)\ \text{nm: see (1989RA17)},$$
$$Q = -0.818(17)\ \text{mb (1998CE04)}.$$

The interaction nuclear radius of ^{6}Li is 2.09 ± 0.02 fm (1985TA18). These authors have also derived nuclear matter, charge and neutron r.m.s. radii.

Quadrupole moment: The tiny quadrupole moment of ^{6}Li poses a difficult task for theoretical calculations. Except for a phenomenological (1985ME02), a microscopic cluster (1986ME13), and a Greens-Function Monte-Carlo (1997PU03) calculation, the models fail even to predict the sign. See the discussion of three-body models in (1993SC30). In (1991UN02), this failure of the three-body models is blamed on the missing antisymmetrization of the valence nucleons with the nucleons in the alpha-core. Another microscopic cluster calculation (1992CS04) considers the findings of (1986ME13) to be due to a fortuitous choice of the model space.

Asymptotic D/S ratio [1] : The ratio of the D- and S-state asymptotic normalization constants, referred to in the literature as η, has been used widely to quantify the properties of the D-state wave function. There is general agreement in the $A = 2$–4 systems between theoretical calculations and empirical determinations of the normalization constants. See (1988WE20, 1990EI01, 1990LE24). The S-state $\alpha + \mathrm{d}$ normalization constant for ^{6}Li appears to be well determined (1993BL09, 1999GE02), but both the magnitude and sign of η are uncertain.

In a two-body $\alpha + \mathrm{d}$ model it was found (1984NI01) that in order to reproduce the experimental quadrupole moment Q, the wave functions must have $\eta < 0$. However, three-body $(\alpha + \mathrm{n} + \mathrm{p})$ models consistently result in predictions of $\eta > 0$ (1990LE24, 1995KU08). Recent microscopic six-body calculations using realistic NN potentials predict $\eta = -0.07$ (1996FO04).

The asymptotic D/S ratio has been probed empirically by studying scattering processes, transfer reactions, and ^{6}Li breakup. These determinations usually rely on an underlying assumption as to the scattering or reaction mechanism. The S- and D-state asymptotic normalization constants were determined in a study of d-α scattering (1978BO43) from which η was found to be $+0.005 \pm 0.014$. Several $^6\vec{\mathrm{Li}} + {}^{58}$Ni elastic scattering studies (1984NI01, 1995DE06, 1995RU14) have described polarization observables with $\eta \approx -0.01$, while an investigation of the breakup of $^6\vec{\mathrm{Li}}$ on ^{1}H suggests $\eta > 0$ (1992PU03). A study of the ^{6}Li(d, α)^{4}He reaction (1990SA47) found that η

[1] We are very grateful to K.D. Veal and C.R. Brune for providing these comments on the asymptotic D/S ratio for ^{6}Li.

should lie in the range -0.010 to -0.015. Recently, a phase-shift analysis of $^6\vec{\mathrm{Li}} + {}^4$He scattering determined $\eta = -0.025 \pm 0.006 \pm 0.010$ (1999GE02) while an analysis of ($^6\vec{\mathrm{Li}}$, d) transfer reactions resulted in a near zero value of $\eta = +0.0003 \pm 0.0009$ (1998VE03).

Based on these theoretical and empirical results, we conclude that both the magnitude and sign of η for the $^6\mathrm{Li} \rightarrow \alpha + \mathrm{d}$ wave function are not well determined. See also (1998VE03, 1999GE02).

Isotopic abundance: (7.5 ± 0.2)% (1984DE53). See also (1987LA1J, 1988LA1C).

For estimates of the parity-violating α-decay width of ^{6}Li*(3.56) [0^+; $T = 1$] see (1983RO12, 1984BU01, 1986BU07).

1. ^{1}H(^{6}Li, ^{6}Li)^{1}H

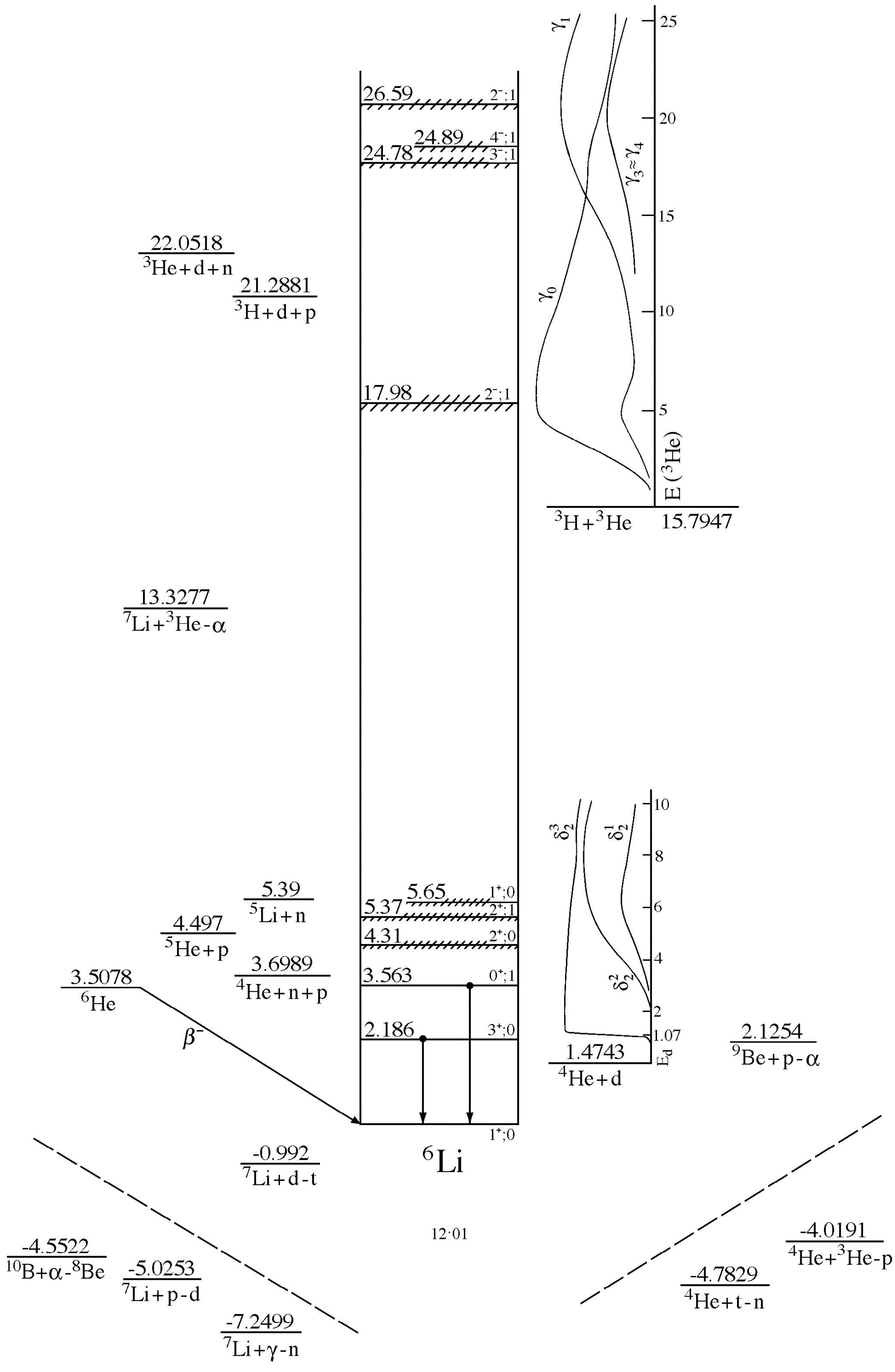
Differential cross sections were measured at $E = 0.7$ GeV/A by (2000DOZY, 2001EG02). Matter distribution radii and halo features of ^{6}Li*(3.56) were deduced.

2. ^{2}H(α, π^0)^{6}Li $\quad Q_\mathrm{m} = -133.503$

Measurements of cross sections at $E_\alpha = 418$, 420 MeV are reported by (2000AN15, 2000AN31). Halo features of ^{6}Li* were deduced.

3. (a) ^{3}He(^{3}H, γ)^{6}Li $\quad Q_\mathrm{m} = 15.7947$
(b) ^{3}He(^{3}H, n)^{5}Li $\quad Q_\mathrm{m} = 10.41 \quad E_\mathrm{b} = 15.80$
(c) ^{3}He(^{3}H, d)^{4}He $\quad Q_\mathrm{m} = 14.32037$
(d) ^{3}He(^{3}H, ^{3}H)^{3}He

Figure 5: Energy levels of ^{6}Li. In these diagrams, energy values are plotted vertically in MeV, based on the ground state as zero. Uncertain levels or transitions are indicated by dashed lines; levels which are known to be particularly broad are cross-hatched. Values of total angular momentum J, parity, and isobaric spin T which appear to be reasonably well established are indicated on the levels; less certain assignments are enclosed in parentheses. For reactions in which ^{6}Li is the compound nucleus, some typical thin-target excitation functions are shown schematically, with the yield plotted horizontally and the bombarding energy vertically. Bombarding energies are indicated in laboratory coordinates and plotted to scale in cm coordinates. Excited states of the residual nuclei involved in these reactions have generally not been shown; where transitions to such excited states are known to occur, a brace is sometimes used to suggest reference to another diagram. For reactions in which the present nucleus occurs as a residual product, excitation functions



26.59
2⁻;1
24.89
4⁻;1
24.78
3⁻;1
22.0518
3He+d+n
21.2881
3H+d+p
17.98
2⁻;1
γ1
γ3≈γ4
γ0
25
20
15
10
5
E (3He)
3H+3He
15.7947
13.3277
7Li+3He-α
δ2 3
δ2 1
δ2 2
10
8
6
4
2
1.07
Ed
5.39
5Li+n
5.65
1⁺;0
5.37
2⁺;1
4.497
5He+p
4.31
2⁺;0
3.6989
4He+n+p
3.563
0⁺;1
3.5078
6He
β⁻
2.186
3⁺;0
1.4743
4He+d
2.1254
9Be+p-α
1⁺;0
6Li
-0.992
7Li+d-t
12·01
-4.5522
10B+α-8Be
-5.0253
7Li+p-d
-7.2499
7Li+γ-n
-4.0191
4He+3He-p
-4.7829
4He+t-n

Table 6.4: Energy levels of ^{6}Li

E_x (MeV ± keV) [a]	$J^\pi; T$	Γ_{cm} (MeV) [a]	Decay	Reactions
g.s.	$1^+; 0$		stable	3, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 42, 43, 44, 45, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 59, 60, 61, 64, 67
2.186 ± 2	$3^+; 0$	0.024 ± 0.002	γ, d, α	3, 4, 5, 8, 9, 10, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 29, 30, 33, 34, 36, 37, 38, 39, 42, 44, 45, 46, 47, 48, 49, 55, 57
3.56288 ± 0.10	$0^+; 1$	$(8.2 \pm 0.2) \times 10^{-6}$	γ	3, 5, 12, 15, 17, 18, 20, 21, 22, 23, 25, 34, 37, 38, 39, 42, 44, 67
4.312 ± 22 [b]	$2^+; 0$	1.30 ± 0.10 [b]	γ, d, α	3, 8, 17, 18, 20, 21, 29, 37, 39, 42, 55
5.366 ± 15	$2^+; 1$	0.541 ± 0.020 [b]	γ, n, p, α	3, 17, 20, 37, 38, 39
5.65 ± 50	$1^+; 0$	1.5 ± 0.2	d, α	8, 20, 39, 42
17.985 ± 25 [b, c, e]	$2^-; 1$ [b]	3.012 ± 0.007 [b]	γ, t, ^{3}He	3
24.779 ± 54 [b, c, f]	$3^-; 1$ [b]	6.754 ± 0.110 [b]	γ, n, t, ^{3}He	3, 8
24.890 ± 55 [b, c]	$4^-; 1$ [b]	5.316 ± 0.112 [b]	γ, n, t, ^{3}He	3
26.590 ± 65 [b, c, g, d]	$2^-; 1$ [b, g]	8.684 ± 0.125 [b, g]	γ, n, d, t, ^{3}He	3,8

[a] See also Table 6.12.

[b] Newly adopted in this evaluation or revised from the previous evaluation (1988AJ01).

[c] See remarks under reaction 3, and see Table 6.5.

[d] For possible states at high E_x see reactions 8, 37, 39 and 45 and Table 6.9.

[e] $E_x = 17.985 \pm 25$ was previously reported in (1988AJ01) as $E_x = 21.0$ MeV.

[f] $E_x = 24.779 \pm 54$ MeV was previously reported as $E_x = 26.6 \pm 0.4$ MeV with $T = 0$ in (1988AJ01). See (1990MO10).

[g] (1990MO10).

have not been shown. Further information on the levels illustrated, including a listing of the reactions in which each has been observed, is contained in the master table, entitled "Energy levels of ^{6}Li".

In the previous review (1988AJ01), information on radiative capture of ^{3}H on ^{3}He was summarized as follows: "Capture γ-rays (reaction (a)) to the first three states of ^{6}Li [γ_0, γ_1, γ_2] have been observed for $E(^3\text{He}) = 0.5$ to 25.8 MeV, while the yields of γ_3 and γ_4 have been measured for $E(^3\text{He}) = 12.6$ to 25.8 MeV. The γ_2 excitation function does not show resonance structure. However, the γ_0, γ_1, γ_3 and γ_4 yields do show broad maxima at $E(^3\text{He}) = 5.0 \pm 0.4$ [γ_0, γ_1], 20.6 ± 0.4 [γ_1], ≈ 21 [γ_3] and 21.8 ± 0.8 [γ_4] MeV. The magnitude of the ground-state-capture cross section is well accounted for by a direct-capture model; that for the γ_1 capture indicates a non-direct contribution above $E(^3\text{He}) = 10$ MeV, interpreted as a resonance due to a state with $E_x = 25 \pm 1$ MeV, $\Gamma_{\text{cm}} = 4$ MeV, $T = 1$ (because the transition is E1, to a $T = 0$ final state) [the E1 radiative width $|\text{M}|^2 \geq 5.2/(2J + 1)$ W.u.], $J^\pi =(2, 3, 4)^-$, $\alpha + \text{p} + \text{n}$ parentage. The γ_4 resonance is interpreted as being due to a broad state at $E_x = 26.6$ MeV with $T = 0$. $J^\pi = 3^-$ is consistent with the measured angular distribution. The ground and first excited state reduced widths for ^{3}He + t parentage, $\theta_0^2 = 0.8 \pm 0.2$ and $\theta_1^2 = 0.6 \pm 0.3$: see (1974AJ01). See also (1985MOZZ, 1986MOZQ, 1987MO1I)."

Since the previous review (1988AJ01), a new resonance analysis (1988MO1I, 1990HE20, 1990MO10, 1992HE1E) has been applied to the $^3\text{He}+^3\text{H}$ elastic scattering in odd parity states and to the ^{3}He(^{3}H, γ) data. This analysis explains the shape of the capture cross sections and angular distributions in terms of very wide overlapping resonances. See Table 6.5. These correspond to ^{6}Li states at $E_x = 17.985 \pm 0.025$ MeV, $\Gamma_{\text{cm}} = 3.012 \pm 0.007$ MeV, $J^\pi = 2^-$; $E_x = 24.779 \pm 0.054$ MeV, $\Gamma_{\text{cm}} = 6.754 \pm 0.110$ MeV, $J^\pi = 3^-$; $E_x = 24.890 \pm 0.055$ MeV, $\Gamma_{\text{cm}} = 5.316 \pm 0.112$ MeV, $J^\pi = 4^-$; $E_x = 26.590 \pm 0.065$ MeV, $\Gamma_{\text{cm}} = 8.684 \pm 0.125$ MeV, $J^\pi = 2^-$ (all with $S = 1$, $T = 1$). The analysis is compatible with an almost pure ^{3}He–^{3}H cluster structure of the negative parity unbound ^{6}Li states with $S = 1, T = 1$. These results are supported by calculations described in (1995OH03) which utilize a complex-scaled ^{3}He + t resonating group method to calculate the energies and widths of the ^{6}Li ^{3}He + t states. Note, however, that the calculated scattering phase shifts rise only gradually with energy and stay well below $90°$. Consequently the stated precision on the extracted level parameters is a point of controversy between the authors of (1990MO10, 1990HE20) and one of the authors [H.M.H.] of this review. The radiative capture reaction as a source of ^{6}Li production in Big Bang nucleosynthesis is discussed in (1990FU1H, 1990MA1O, 1997NO04). See also (1995DU12).

The angular distribution and polarization of the neutrons in reaction (b) have been measured at $E(^3\text{He}) = 2.70$ and 3.55 MeV. The excitation function for $E(^3\text{He}) = 0.7$ to 3.8 MeV decreases monotonically with energy. The excitation function for n_0 has been measured for $E(^3\text{He}) = 2$ to 6 MeV and for $E(^3\text{He}) = 14$ to 26 MeV; evidence for a broad structure at $E(^3\text{He}) = 20.5 \pm 0.8$ MeV is reported [^{6}Li*(26.1)]: see (1979AJ01).

Angular distributions of deuterons (reaction (c)) have been measured for $E_t = 1.04$ to 3.27 MeV and at $E(^3\text{He}) = 0.29$ to 32 MeV. Polarization measurements are reported for $E_t = 9.02$ to 17.27 MeV [see (1979AJ01)], as well as at $E(^3\vec{\text{He}}) = 18.0$ and 33.0 MeV (1986RA1C). See also (1986KO1K) and (1985CA41). A microscopic calculation for reaction (c) and its inverse with special emphasis on isospin breaking in the analyzing power is described in (1990BR09). See also

Table 6.5: Levels of ^{6}Li from ^{3}He(^{3}H, ^{3}H)^{3}He and ^{3}He(^{3}H, γ_1)^{6}Li*(2.18) [a]

State	$J^\pi; T$	$E_{^3\mathrm{He}}$ (MeV)	E_x (MeV)	Γ_{cm} (MeV)
^{33}P$_2$	$2^-; 1$	2.190 ± 0.025	17.985 ± 0.025	3.012 ± 0.007
^{33}F$_3$	$3^-; 1$	8.984 ± 0.054	24.779 ± 0.054	6.754 ± 0.110
^{33}F$_4$	$4^-; 1$	9.095 ± 0.055	24.890 ± 0.055	5.316 ± 0.112
^{33}F$_2$	$2^-; 1$	10.795 ± 0.065	26.590 ± 0.065	8.684 ± 0.125

[a] From the analysis (1990HE20, 1990MO10) of data from (1968BL10, 1973VE09, 1977VL01).

the calculations of (1990BLZW, 1993DU02, 1993FI06).

Elastic scattering (reaction (d)) angular distributions were measured at $E(^3\mathrm{He}) = 5.00$ to 32.3 MeV and excitation functions were reported for $E(^3\mathrm{He}) = 4.3$ to 33.4 MeV see (1979AJ01). At the lower energies the elastic yield is structureless and decreases monotonically with energy. Polarization measurements were reported for $E_t = 9.02$ to 33.3 MeV. A strong change occurs in the analyzing power angular distributions at $E_t = 15$ MeV. See (1988AJ01) for a description of earlier analyses of these data. More recently a new resonance analysis (1990HE20, 1990MO10) of these same data along with ^{3}He(^{3}H, γ) data led to the ^{6}Li $S = 1$, $T = 1$ states discussed above under reaction 3(a). See Table 6.5. A coupled-channels variational model calculation of the ^{3}He(total) cross section for $E_t = 9$ MeV has been reported by (2001TH12).

For other channels see (1984AJ01). See also (1984KR1B). For thermonuclear reaction rates see (1988CA26).

4. (a) ^{3}H(α, n)^{6}Li $\quad Q_m = -4.7829$
   (b) ^{3}H(α, αd)n $\quad Q_m = -6.25725$
   (c) ^{3}H(α, t^{3}He)n $\quad Q_m = -20.57762$

^{6}Li*(0, 2.19) have been populated with reaction (a): see (1974AJ01). See also ^{7}Li (1983CO1E) and (1983FU11). Cross sections for $E_\alpha < 20$ MeV were calculated with a resonating group method by (1991FU02). A kinematically complete experiment on reaction (b) at $E_\alpha = 67.2$ MeV is described in (2000GO35). ^{6}Li excited states at $E_x = 14.5$ and 16.0 MeV with widths ≈ 1 MeV are reported. In a similar experiment (1999GO36) at $E_\alpha = 67.2$ MeV on reaction (c) a ^{6}Li level at $E_x \approx 20$–21 MeV was reported based on the energy of the final state between ^{3}H and ^{3}He.

5. ^{3}He(^{3}He, π^+)^{6}Li $\quad Q_m = -123.7941$

Differential cross sections were measured for the transitions to ^{6}Li*(0, 2.19) for $E(^3\text{He}) = 350$, 420, 500 and 600 MeV (1983LE26). See also (1984AJ01), (1983BR31, 1983JA13) and (1984GE05). Analyses of data for $E(^3\text{He}) = 295$–810 MeV and microscopic reaction model calculations are reported by (1991HA22). See also the calculations of (1999VO01).

6. ^{4}He(d, γ)^{6}Li $\qquad Q_\text{m} = 1.4743$

The previous review (1988AJ01) summarized the information on this reaction as follows: "No resonance has been observed corresponding to formation of ^{6}Li*(3.56) [0^+; $T = 1$]: the parity-forbidden $\Gamma_\alpha \leq 6 \times 10^{-7}$ eV (1984RO04)". See also (1984BU01, 1986BU07).

"The cross section for the capture cross section has been measured for $E_\alpha = 3$ to 25 MeV by detecting the recoiling ^{6}Li ions: the direct capture is overwhelmingly E2 with a small E1 contribution. The spectroscopic overlap between the $^6\text{Li}_\text{g.s.}$ and $\alpha+\text{d}$ is 0.85 ± 0.04: see (1984AJ01). See also (1982KI11), (1985CA41, 1986LA22, 1986LA27) and theoretical work presented in (1984AK01, 1985AK1B, 1986AK1C, 1986BA1R)."

Since the previous review (1988AJ01), measurements of the cross section at energies $E_\alpha \approx 2$ MeV corresponding to the 3^+ resonance at $E_\text{x} = 2.186$ MeV in ^{6}Li have been reported (1994MO17). Values extracted for the total width Γ and the radiative width Γ_γ confirm the adopted value (1988AJ01). An experimental search for the reaction at $E_\text{cm} \approx 53$ keV (1996CE02) gave an upper limit for the S factor of 2×20^{-7} MeV $\cdot$ b at the 90% confidence level. Implications for Big Bang nucleosynthesis of ^{6}Li are discussed. Thermonuclear reaction rates for this reaction calculated from evaluated data are presented in the compilation (1999AN35).

A considerable amount of theoretical work has been devoted to this reaction – much of it related to its importance in astrophysics. A list of references with brief descriptions is provided in Table 6.6.

7. (a) ^{4}He(d, np)^{4}He $\qquad Q_\text{m} = -2.224 \qquad E_\text{b} = 1.475$
(b) ^{4}He(d, t)^{3}He $\qquad Q_\text{m} = -14.320$

Reaction (a) has been studied to $E_\alpha = 165$ MeV and to $E_\text{d} = 21.0$ MeV: see (1979AJ01, 1984AJ01). Measurements are also reported at $E_\text{d} = 5.4$, 6.0 and 6.8 MeV (1985LU08), 6 to 11 MeV (1985OS02), 10.05 MeV (1983BR23) and 12.0 and 21.0 MeV (1983IS10) and at $E_\alpha = 11.3$ MeV (1987BR07). See also (1986DO1K).

More recently, measurements of the cross section and transverse tensor analyzing power at $E_\text{d} = 7$ MeV were made (1988GA14) with kinematic conditions chosen to correspond to production of the singlet deuteron. Coulomb and nuclear field effects in these reactions are discussed in (1987KO1X, 1988KA38). Cross sections and polarization observables from data at $E_\text{d} < 12$, 17 MeV are compared with three-body model predictions in (1988SU12).

Table 6.6: ^{4}He(d, γ)^{6}Li – Theoretical work

Reference	Description
1989CR01	D-state effects in the ^{4}He(d, γ)^{6}Li reaction
1989SC25	The reaction rate at $T = 300$ K for ^{2}H(α, γ)^{6}Li and other reactions
1990CR04	Tensor interaction effects in ^{4}He(d, γ)^{6}Li
1990KRZX	Polarization observables for ^{4}He(d, γ)^{6}Li and the D state of ^{6}Li
1990SC22	The extended elastic model II applied to ^{2}H(α, γ)^{6}Li
1991SC23	A simple expression for the cross-section factor in nuclear fusion
1991TY02	Low-energy ^{2}H(α, γ)^{6}Li and ^{208}Pb(^{6}Li, dα)^{208}Pb cross sections
1993JA02	Polarizability and E1 radiation in ^{4}He(d, γ)^{6}Li
1993MU12	Calculation of the ^{6}Li $\rightarrow \alpha + \mathrm{d}$ vertex constant
1994MO17	Direct capture in the 3^+ resonance of ^{2}H(α, γ)^{6}Li
1995DU12	Cluster model descriptions of ^{6}Li photodisintegration
1995IG06	Analysis of the nuclear astrophysical reaction ^{4}He(d, γ)^{6}Li
1995MU21	Astrophysical factor for ^{4}He(d, γ)^{6}Li
1995MU1J	Peripheral astrophysical radiative capture processes, a survey
1995RY01	^{4}He(d, γ)^{6}Li capture and the isoscalar E1 multipole
1997NO04	Nuclear reaction rates and primordial ^{6}Li
1998KH06	Microscopic study of ^{2}H(α, γ)^{6}Li in a multicluster model
2000IG03	Coulomb breakup & astrophys. S-factor of ^{2}H(α, α) at extremely low energies
2001NO01	Six-body calculation of the ^{2}H(α, γ)^{6}Li cross section

For reaction (b), measurements of vector and tensor analyzing power at $E_{\mathrm{d}} = 35$, 45 MeV have been reported (1986BR1N, 1986VA23, 1986VUZZ, 1987VU1A). Cross sections and polarization observables were measured at $E_{\mathrm{d}} = 32.1$, 35.15, 39.6, 49.7 MeV to investigate ^{3}H and ^{3}He asymptotic normalization constants (1987VU1B) and charge symmetry breaking (1988VU01). Cross sections and polarization observables measured at $E_{\mathrm{cm}} = 14$–33 MeV (1989BR23) were compared with microscopic-model predictions in a study of isospin violation. See also (1990BR09). The role of tensor force was explored in (1988BR18).

For earlier work and other breakup channels, see (1988AJ01).

8. ^{4}He(d, d)^{4}He $\qquad E_{\mathrm{b}} = 1.4743$

Elastic differential cross-section and polarization measurements have been carried out up to $E_\alpha = 166$ MeV and $E_{\mathrm{d}} = 45$ MeV: see (1974AJ01, 1979AJ01, 1984AJ01). Measurements were also reported at $E_{\mathrm{d}} = 0.87$ to 1.43 MeV (1984BA19, 1985BAYZ), at $E_{\mathrm{d}} = 11.9$ MeV (1988EL01), 21 MeV (1986MI1E), 24.0 and 38.2 MeV (1986GR1D), 31.8 to 39.0 MeV (1986KO1M), 40 MeV (1989DE1A), 56 MeV (1985NI01) and at $E_\alpha = 7.0$ GeV/c (1984SA39). A compilation of data

Table 6.7: Levels of ^{6}Li from ^{4}He(d, d)^{4}He [a]

E_d (MeV)	$J^\pi; T$	E_x (MeV)	Γ_{cm} (MeV)	Γ_d/Γ [b]	γ^2_d [c]
1.070 ± 0.003	$3^+; 0$	2.187			0.27
4.34 ± 0.04	$2^+; 0$	4.36	1.32 ± 0.04	0.967	0.511
5.7 ± 0.1 [d]	$1^+; 0$	5.3	1.9 ± 0.1	0.74	0.34
(19.3 ± 1.3)	$3^+; 0$	(14.3)	26.7 ± 1.0	0.34	1.69
(21.6 ± 1.1)	$3^+; 0$	(15.8)	17.8 ± 0.8	0.76	0.77
33 ± 2	4^+	23	12 ± 2	0.15	0.14
34 ± 5	3^-	24	16 ± 3	0.30	0.24
39^{+3}_{-9}	2^-	27	22 ± 7	0.43	0.42

[a] The data in this table are mostly from the S-matrix analysis of (1983JE03). The results are unique up to $E_d = 15$ MeV. See also Table 6.4 in (1974AJ01), and Tables 6.3 in (1979AJ01) and (1984AJ01).

[b] The errors in Γ_d/Γ are typically 0.03.

[c] In units of the Wigner limit $\gamma^2_w = 2.93$ MeV for a radius of 4.0 fm. See (1988AJ01).

[d] 6.26 MeV (R-matrix analysis): $E_x = 5.65$ MeV.

for energies $E_d = 1$–56 MeV is presented in (1987GR08). For a study of the inclusive inelastic scattering at $E_\alpha = 7.0$ GeV/c see (1987BA13).

Phase-shift analyses, particularly that by (1983JE03) which uses all available differential cross section, vector and tensor analyzing power measurements and $L \leq 5$, in the range $E_d = 3$ to 43 MeV lead to the results displayed in Table 6.7. It is found that the d-wave shifts are split and exhibit resonances at $E_x = 2.19$ (^{3}D$_3$), 4.7 (^{3}D$_2$) and 5.65 MeV (^{3}D$_1$). (1983JE03) suggest very broad G$_3$ and G$_4$ resonances at $E_d = (19.3)$ and 33 MeV, a D$_3$ resonance at 22 MeV and F$_3$ and F$_2$ resonances at ≈ 34 and ≈ 39 MeV, corresponding to states which are primarily of $(\mathrm{d} + \alpha)$ parentage.

(1985JE04) have investigated the points where $A_{yy} = 1$ and report four such points at $E_d = 4.30$ $[\theta_{cm} = 120.7°]$, 4.57 (58.0°), 11.88 (55.1°) and 36.0 ± 1.0 MeV ($150.1 \pm 0.3°$). [For the latter see also (1986KO1M)]. The correspondence of these polarization maxima to ^{6}Li states is discussed by (1985JE04). For a discussion of the M-matrix see (1988EL01). For work on $(\alpha + \mathrm{d})$ correlations involving ^{6}Li*(0, 2.19, $4.31 + 5.65$) see (1987CH08, 1987CH33, 1987PO03) and (1987FO08).

For additional references to early work see references cited in (1988AJ01).

A considerable body of theoretical work on the ^{4}He + d channel has been done since the previous review (1988AJ01). A list of references with brief descriptions is provided in Table 6.8.

9. (a) ^{4}He(^{3}He, p)^{6}Li $\qquad Q_m = -4.0192$

Table 6.8: ^{4}He(d, d)^{4}He – Theoretical work

Reference	Description
1988BE58	Polarization phenomena in ^{4}He(d, d) at intermediate energies
1988KA25	Convergence features in the pseudostate theory of the d $+ \alpha$ system
1988WE20	Manifestations of the D-state in light nuclei
1989ET05	Description of diffraction scattering on nuclei
1989FI1E	Microscopic theory of collective resonances of light nuclei
1989KR08	Pade approximation technique for processing scattering data
1990BL13	Analysis of higher partial waves in ^{4}He(d, d)in 3-body framework
1990DA1H	Two body phase space in α-d breakup at 40 MeV
1990GU23	D-wave effect in α-d elastic scattering at intermediate energies
1990HO1R	Microscopic study of clustering phenomena
1990HU09	A geometric model for nucleus-nucleus scattering at high energies
1990KU06	Reconstruction of interaction potential from scattering data
1990KU16	Padé-approximation techniques for processing scattering data
1990LI11	Further study of α elastic scattering on light nuclei
1991BL04	Manifestation of Pauli-forbidden states in ^{4}He(d, d) at low energies
1991KR02	Energy-dependent phase-shift analysis of ^{4}He(d, d) at low energies
1991KU09	d-α scattering in a three-body model
1991KU27	Recovering $\alpha +$ d potential from Faddeev and measured phase shifts
1992ES04	α-d resonances and the low-lying states of ^{6}Li
1992FU10	Reaction mechanisms in $A = 6$ with the multiconfiguration RGM
1992KU16	Supersymmetric potentials and the Pauli Principle in ^{4}He(d, d)
1992KU1G	Deuteron size effects in d-α scattering
1993BL09	Determination of ^{6}Li $\rightarrow \alpha +$ d vertex constant for d-α phase-shifts
1993FI06	Study of continuous spectrum of ^{6}Li in RGM
1994CS01	Microscopic description of beta-delayed deuteron emission in ^{6}He
1995DU12	Cluster model description of photonuclear processes in ^{6}Li
1997DU15	Electromagnetic effects in light nuclei and the cluster potential
1997KU14	Reconstruction of analytic S matrix from experimental d-α data
1998DU03	Potential cluster model description of the d-α interaction
1999CO11	An S-matrix inversion technique applied to α-d scattering

(b) ^{4}He(^{3}He, pd)^{4}He $\quad Q_{\rm m} = -5.49349$

Angular distributions have been measured at $E(^3{\rm He}) = 8$ to 18 MeV and $E_\alpha = 42$, 71.7 and 81.4 MeV: see (1974AJ01). More recently, proton polarization was measured as a function of angle at $E_{\rm cm} = 12.6$ MeV (1989GR02). At $E_\alpha = 28$, 63.7, 71.7 and 81.4 MeV the α-spectra show that the sequential decay (reaction (b)) involves ^{6}Li*(2.19) and possibly ^{5}Li: see (1979AJ01). See also the recent theoretical work of (1993GO16) and the multiconfiguration RGM calculations of (1995FU16).

10. (a) ^{4}He(α, d)^{6}Li $\quad Q_{\rm m} = -22.3722$

(b) ^{4}He(α, pn)^{6}Li $\quad Q_{\rm m} = -24.5968$

(c) ^{4}He(α, αd)^{2}H $\quad Q_{\rm m} = -23.84653$

Reactions (a) and (b) have been studied to $E_\alpha = 158.2$ MeV [see (1979AJ01, 1984AJ01)] and at 198.4 MeV (1985WO11). The dependence of the cross section on energy shows that the $\alpha + \alpha$ process does not contribute significantly to ^{6}Li (and ^{7}Li) synthesis above $E_\alpha = 250$ MeV (1985WO11) [and see for additional comments on astrophysical problems]. A more recent measurement of the cross section for reaction (b) (2001AU06, 2001ME13) at $E_\alpha = 159.3$, 279.6 and 619.8 MeV found cross sections which differ significantly from tabulated values commonly used in cosmic-ray production calculations and lead to lower predicted production of ^{6}Li. For reaction (c) [and excited states of ^{4}He] see (1984AJ01): ^{6}Li*(2.19) is involved in the process.

11. ^{6}He(β^-)^{6}Li $\quad Q_{\rm m} = 3.508$

See ^{6}He, reaction 1.

12. (a) ^{6}He(p, n)^{6}Li $\quad Q_{\rm m} = 2.7254$

(b) ^{6}He(p, p)^{6}He

The (p, n) reaction has been studied in inverse kinematics by ^{1}H(^{6}He, ^{6}Li)n experiments with secondary ^{6}He beams. An experiment utilizing a secondary ^{6}He beam with $E(^6{\rm He}) = 42$ MeV/A was reported by (1995CO05, 1998CO1M, 1998CO19, 1998CO28). The ^{6}Li ground state and $E_{\rm x} = 3.56$ MeV state were observed. Angular distributions were reported and the ratio of the cross section for the Gamow-Teller transition to the ground state and the Fermi transition to the isobaric analog state was measured. The reaction was also studied at $E/A = 93$ MeV (1996BR30). The 0° ground state cross section was measured to be $\frac{d\sigma}{d\Omega} = 43 \pm 16$ mb/sr. The ratio of Gamow-Teller to Fermi strength was found to be (87 ± 6)% of that expected from p, n systematics and beta decay. Differential cross sections at $E/A = 41.6$–68 MeV were measured by (1997CO04) to study the effects of halo structure. Measurements on reactions (a) and (b) utilizing a secondary ^{6}He beam at 36 MeV/A are reported by (2001DE19).

The status of theoretical and experimental research on nuclei featuring a two-particle halo was reviewed in (1996DA31).

13. ^{6}Li*(0^{+}; 1) $\rightarrow \alpha +$ d $\qquad Q_{\mathrm{m}} = 2.0886$

A theoretical study in a microscopic three-cluster model of the parity-violating $\alpha +$ d decay of the lowest 0^{+} state in ^{6}Li ($E_{\mathrm{x}} = 3.5629$ MeV) is described in (1996CS03). A phase shift analysis of ^{4}He + d was used in a determination of the vertex constant for the ^{6}Li(1^{+}; 0)$_{\mathrm{g.s.}} \rightarrow \alpha +$ d virtual decay by (1992BLZX, 1993BL09, 1997KU14). See also (1990RY07, 1991KR02, 1993BO38).

14. (a) ^{6}Li(γ, n)^{5}Li $\qquad Q_{\mathrm{m}} = -5.389$
(b) ^{6}Li(γ, p)^{5}He $\qquad Q_{\mathrm{m}} = -4.497$
(c) ^{6}Li(γ, d)^{4}He $\qquad Q_{\mathrm{m}} = -1.4743$
(d) ^{6}Li(γ, np)^{4}He $\qquad Q_{\mathrm{m}} = -3.6989$
(e) ^{6}Li(γ, t)^{3}He $\qquad Q_{\mathrm{m}} = -15.7947$

The previous review (1988AJ01) summarizes the information on these reactions as follows: "The (γ, n) and (γ, Xn) cross sections increase from threshold to a maximum at $E_{\gamma} \approx 12$ MeV then decrease to $E_{\gamma} = 32$ MeV: see (1984AJ01) and (1988DI02). (1984DY01) also report a broad peak at 16 MeV. The cross section for photoproton production (reaction (b)) is generally flat up to 90 MeV. [The previously reported hump at $E_{\gamma} \approx 16$ MeV is almost certainly due to oxygen contamination: see (1984AJ01).] See also (1988CA11) and ^{5}He. The cross section for reaction (c) is ≤ 5 μb in the range $E_{\gamma} = 2.6$ to 17 MeV consistent with the expected inhibition of dipole absorption by isospin selection rules: see (1966LA04). The onset of quasideuteron photodisintegration between 25 and 65 MeV is suggested by the study of (1984WA18; $E_{\gamma}(\mathrm{bremsstrahlung}) = 67$ MeV). The 90° differential cross section for reaction (e) decreases monotonically for $E_{\gamma} = 18$ to 70 MeV: reaction (e) contributes $\approx \frac{1}{3}$ of the total cross section for ^{6}Li + γ, consistent with a ^{3}H + ^{3}He cluster description of ^{6}Li$_{\mathrm{g.s.}}$ with $\theta^{2} \approx 0.68$. The agreement with the inverse reaction, ^{3}H(^{3}He, γ) [see reaction 3] is good: see (1984AJ01). See also (1986LI1F)."

"The absorption cross section has been studied in the range $E_{\gamma} \approx 100$ to 340 MeV; it shows a broad bump centered at ≈ 125 MeV and a fairly smooth increase to a maximum at ≈ 320 MeV: see (1984AJ01). For spallation studies see (1974AJ01, 1984AJ01). For pion production see (1986GL07, 1987GL01) and (1984AJ01)."

Since the previous review (1988AJ01) tagged photons were used to study ^{6}Li(γ, p) at $\theta_{\mathrm{p}} = 0^{\circ}$ for $E_{\gamma} \approx 59$ and 75 MeV. Strong evidence for the photo-deuteron mechanism was found.

Table 6.9: ^{6}Li(γ, X) – Theoretical work

Reference	Description
1988DU04	Calculation of the ^{6}Li(γ, dγ') cross section at $E_\gamma = 2.23$ MeV
1989AR02	Quark degrees of freedom and nuclear photoabsorption
1990BU29	Possibility (?) of observing an isoscalar E1 multipole in ^{6}Li(γ, d)
1990VA16	Cluster effects in ^{6}Li photodisintegration
1990ZH19	Manifestations of cluster structure in ^{6}Li(γ, d)
1991BE05	^{6}Li $\rightarrow \alpha +$ d break-up — astrophysical significance
1995DU12	Description of photonuclear processes in ^{6}Li

Measurements made for angles between 30° and 150° (1995DI01) showed most of the strength occurring in three-body breakup channels. Studies at these same energies of the (γ, d) and (γ, t) reaction were reported in (1997DI01). See also (1994RY01). Measurements of ^{6}Li(γ, d) at $E_\gamma \approx 60$ MeV indicated strict non-violation of the isospin selection rule for E1 absorption.

The (γ, pn) reaction was also studied at $E_\gamma = 55$–100 MeV with bremsstrahlung photons and with linearly polarized tagged photons for $E_\gamma = 0.3$–0.9 GeV. See also (1990RIZX).

Linearly polarized photons were used to measure the cross section asymmetry in ^{6}Li(γ, t)^{3}He up to $E_\gamma \approx 70$ MeV (1989BU10) and differential cross sections up to $E_\gamma \approx 90$ MeV (1993DE07, 1995BU08). Results of a measurement of the absolute total photoabsorption cross section for $E_\gamma = 300$–1200 MeV are presented in (1994BI06).

A list of theoretical references relating to ^{6}Li photonuclear reactions with brief descriptions is provided in Table 6.9.

15. ^{6}Li(γ, γ)^{6}Li

The width, Γ_γ, of ^{6}Li*(3.56) $= 8.1 \pm 0.5$ eV: see (1974AJ01) and Table 6.4 in (1979AJ01); $E_{\rm x} = 3562.88 \pm 0.10$ keV: see (1984AJ01). See also (1987PI06). The results of an absolute measurement of the total photoabsorption cross section are described in (1994BI06). Photon absorption and photon scattering for light elements is discussed in terms of a collective resonance phenomenon in (1990ZI03).

16. (a) ^{6}Li(γ, π^0)^{6}Li $\qquad Q_{\rm m} = -134.97660$

(b) ^{6}Li(γ, π^+)^{6}He $\qquad Q_{\rm m} = -143.0780$

(c) ^{6}Li(γ, π^-)^{6}Be $\qquad Q_{\rm m} = -143.8579$

Measurements of neutral-pion photoproduction yield (reaction (a)) for $E < 10$ MeV above threshold were reported in (1989NA23). The total cross section was measured in the energy region from the reaction threshold to $E_\gamma \approx 146.5$ MeV (1989GL07) and analyzed in the impulse approximation. The cross section increases monotonically to $\sigma = 6.50 \pm 0.96$ μb at $E_\gamma = 146.5$ MeV. See also (1986GL07, 1987GL01) and (1984AJ01). An analysis (1991TR1C) of early measurements suggests that anomalously large measured values of the cross section are due to target impurities. The differential cross section at small angles at energies $E \approx 300$–450 MeV has been measured by (1991BE16). Total and differential cross sections were measured within 23 MeV of threshold with tagged photons by (1999BE14). Differential cross sections for reaction (b) leading to the ^{6}He ground state have been measured at $E_\gamma = 200$ MeV (1991SH02) and analyzed by DWBA. See also the measurements of (1991GA26). The energy distributions of electroproduced π^+ at $E_e \approx 200$ MeV were measured and (γ, π^+) cross sections were deduced (1994SH38). For reaction (c) see (1988KA41, 1991GA26).

Theoretical studies of pion photoproduction include: an impulse-approximation calculation for (γ, π^0) at $E_\gamma = 300$ MeV (1989TR09); an impulse approximation and shell model study of inelastic photoproduction of pions (1991TR02); a DWIA Feynman-diagram production-operator-based calculation of (γ, π^+) at $E_\gamma = 200$ MeV (1990BE49); and multicluster dynamic-model calculation of π^+ photoproduction off ^{6}Li (1995ER1B); and an exclusive (γ, π^+) production calculation for $E_\gamma = 200$ MeV (1995DO24).

17. (a) ^{6}Li(e, e)^{6}Li

(b) ^{6}Li(e, ep)^{5}He	$Q_m = -4.497$
(c) ^{6}Li(e, ed)^{4}He	$Q_m = -1.4743$
(d) ^{6}Li(e, et)^{3}He	$Q_m = -15.7947$

The previous review (1988AJ01) summarized the information then available on electron scattering as follows: "The elastic scattering has been studied for $E_e = 85$ to 600 MeV: see (1974AJ01, 1979AJ01, 1984AJ01). The results appear to require that the ground state be viewed as an α-d cluster in which the deuteron cluster is deformed and aligned. The ground-state M1 current density has also been calculated (1982BE11). A model-independent analysis of the elastic scattering yields $r_{\rm r.m.s.} = 2.51 \pm 0.10$ fm. See also the discussion in (1984DO20)."

"Table 6.10 summarizes the results obtained in the inelastic scattering of electrons. Form factors have been measured for ^{6}Li*(2.19, 3.56, 5.37) as well as for the t+^{3}He continuum up to 4 MeV above threshold [no narrow structures corresponding to ^{6}Li states are observed]: see (1984AJ01)". In more recent work, nucleon spin structure functions were extracted from measurements of deep inelastic scattering on polarized targets by (1999RO13).

For reaction (b) see ^{5}He and (1987VA08) and (1987VA1N). Angular distributions for the d_0 group in the (e, d_0) reaction have been measured for $E_x = 10$ to 28 MeV. The deduced E1 and E2 components of the (γ, d_0) cross section show no structure. The E1 strength implies non-negligible isospin mixing in this energy region (1986TA06). Triple differential cross sections were measured for $E_x = 27$–49 MeV in a search for GDR evidence (1999HO02). At $E_e = 480$ MeV (reaction (c)) the α-d momentum distribution in the ground state of ^{6}Li has been studied. The results are well

Table 6.10: Levels of ^{6}Li from ^{6}Li(e, e′) and ^{6}Li(γ, γ') [a]

E_x (MeV)	$J^\pi; T$	$\Gamma_{\gamma 0}$ (eV)	Multipolarity
2.183 ± 0.009	$3^+; 0$	$(4.40 \pm 0.34) \times 10^{-4}$ [b]	E2
3.56288 ± 0.00010 c	$0^+; 1$	8.19 ± 0.17 [d]	M1
4.27 ± 0.04	$2^+; 0$	$(5.4 \pm 2.8) \times 10^{-3}$	E2
5.379 ± 17 [d, e]	$2^+; 1$	0.27 ± 0.05	M1

[a] See Tables 6.4 in (1979AJ01, 1984AJ01) for references and for the earlier work.
[b] (1969EI06), B(E2)↑$= 25.6 \pm 2.0\ e^2 \cdot \mathrm{fm}^4$. The value given in (1988AJ01) was incorrect. We are grateful to Dr. John Millener for pointing out this error.
[c] (1981RO02).
[d] Weighted mean of values shown in Table 6.4 in (1979AJ01).
[e] $\Gamma = 540 \pm 20$ keV.

accounted for by an αNN model. The α-d probability in the ground state of ^{6}Li is 0.73 [estimated ± 0.1]. The data are consistent with the expected $2S$ character of the α-d relative wave function (1986EN05). See also (1986EV1A). π^0 production involving ^{6}Li*(2.19, 3.56, 5.37) is reported at $E_e = 500$ MeV (1987NA1I).

For the earlier work see (1979AJ01, 1984AJ01) and the references cited in (1988AJ01).

Since the previous review (1988AJ01), experimental results on quasielastic response have been reviewed (1988LO1E). Measurements of the quasielastic scattering cross section for electrons on ^{6}Li are reported at momentum transfer 0.85–2.3 fm^{-1} (1988BU25). See also the measurements at $E_e = 80$–680 MeV by (1989LI09). Cross sections for ^{6}Li(e, ep) were measured in the missing energy region $0 \leq E_m \leq 30$ MeV and in the range $-100 \leq p_m \leq 200$ MeV/c of missing momentum (1989LA22). The ^{6}Li $\rightarrow$ p + (nα) spectral function was measured (1989LA13). The ratio of transverse and longitudinal response function was investigated in (1990LA06). See also the review (1990DE16) of proton spectral functions and momentum distributions in (e, e′p) experiments and see the report (1990GH1E) on nuclear density dependence of electron proton coupling in ^{6}Li(e, e′p).

Reaction (c) was used (1990JO1D) in a study of correlation functions in ^{6}Li. A measurement in parallel kinematics to study the mechanism of the ^{6}Li(e, e′α)^{2}H reaction is reported in (1991MI19, 1994EN04). Cross sections for ^{6}Li(e, e′t)^{3}He (reaction (d)) at $E_e = 523$ MeV and the momentum-transfer dependence of the ^{3}H and ^{3}He knockout reaction was measured by (1998CO06).

A list of references to theoretical work related to electron scattering on ^{6}Li is provided, along with brief descriptions, in Table 6.11.

18. (a) ^{6}Li($\pi^\pm$, $\pi^\pm$)^{6}Li

(b) ^{6}Li(π^+, π^-)

Table 6.11: ^{6}Li(e, e)^{6}Li – Theoretical work

Reference	Description
1987KR07	EM properties of ^{6}Li in cluster model
1987LE1N	Coincidence reactions and the 3-body structure of ^{6}Li
1988AL1J	Second Born approximation correction to ^{6}Li electron scattering
1988ES01	Elastic electromagnetic form factors of ^{6}Li from 3-body models
1989ER07	Exchange and correlation effects in EM structure of ^{6}Li
1989ES05	Inelastic $(1^{+} \rightarrow 0^{+})$ EM form factor of ^{6}Li with 3-body models
1989KU21	Correlation and exchange effects in EM form factors
1990BE54	Analysis of ^{6}Li(e, e′)^{6}Li transitions to the low-lying ^{6}Li levels
1990DE1V	NN correlations, evidence from ^{6}Li(e, e′p)^{5}He
1990KU12	Detailed study of EM structure of ^{6}Li from 3-body model
1990LO14	Cluster-model interpretation of ^{6}Li(e, e′p)^{5}He
1990LU06	Calculation of the magnetic form factor of ^{6}Li
1990RE1I	Parity-invariance violation in ^{6}Li(e, e′d)^{4}He
1990WA1J	Occupation probabilities of shell-model orbitals
1991LU07	Magnetic form factor of ^{6}Li
1991UN02	^{6}Li elastic form factors and antisymmetrization
1992JO02	Two-body correlations in ^{6}Li through the (e, e′d) reaction
1992LO09	Multiquark configuration effect on nuclear charge form factor
1992LOZX	Short-range correlation in the 6-body ^{6}Li wave function
1992RYZY	EM properties of ^{6}Li in multicluster dynamic model
1992ZH18	Calculation of ^{6}Li(e, ed) cross section in α2N model
1993KU27	Prohibition and suppression of multicluster states by Pauli principle
1993RY01	^{6}Li properties — multicluster dynamic model
1993SC30	Nucleon polarization in 3-body models of polarized Li
1994BO04	Shell model calculation of magnetic electron scattering
1994WE10	^{6}Li inelastic form factors in a cluster model
1995AR10	Halo structure in ^{6}Li $E_{\mathrm{x}} = 3.563\ 0^{+}$ state
1995DO23	Phenomenological transition amplitudes in selected p-shell nuclei
1995KU08	Cluster structure of ^{6}Li low-lying states
1995MA59	Finite-size effects in quasi-elastic scattering — Fermi gas model
1998WI10	Quantum Monte Carlo calculations for light nuclei
1998WI28	Microscopic calcalculation of ^{6}Li elastic & transition form factors
1999GN01	Multicluster calculation of ^{6}Li(e, e′) asymmetric & polarization ratios

(c) ^{6}Li(π^-, π^+)^{6}H $\quad Q_{\rm m} = -27.77$
(d) ^{6}Li(π^+, π^+p)^{5}He $\quad Q_{\rm m} = -4.497$
(e) ^{6}Li(π^+, p)^{5}Li $\quad Q_{\rm m} = 134.96$
(f) ^{6}Li(π^-, p)^{5}H $\quad Q_{\rm m} = 114.2$
(g) ^{6}Li(π^+, 2p)^{4}He $\quad Q_{\rm m} = 136.6536$
(h) ^{6}Li(π^-, 2p)4n $\quad Q_{\rm m} = 106.7933$
(i) ^{6}Li(π^+, π^+d)^{4}He $\quad Q_{\rm m} = -1.4743$
(j) ^{6}Li(π^+, pd)^{3}He $\quad Q_{\rm m} = 118.3006$
(k) ^{6}Li(π^+, ^{3}He)^{3}He $\quad Q_{\rm m} = 123.7941$
(l) ^{6}Li(π^-, ^{3}He)3n $\quad Q_{\rm m} = 114.5113$

Elastic angular distributions have been measured at $E_{\pi^+} \approx 50$ MeV [see (1984AJ01)] and at $E_{\pi^\pm} = 100$, 180 and 240 MeV (1986AN04; also to ^{6}Li*(2.19)). Differential cross sections are also reported for $E_{\pi^+} = 100$ to 260 MeV to ^{6}Li*(0, 2.19, 3.56, 4.25). The excitation function for the unnatural-parity transition to ^{6}Li*(3.56) has an anomalous energy dependence (1984KI16).

A number of experimental studies with polarized targets have been reported for elastic and inelastic ($E_{\rm x}$(^{6}Li) $= 2.19$ MeV, $J^{\pi} = 3^{+}$) scattering. Measurements of polarization observables are reported at $E_{\pi^+} = 134$, 164 MeV (1989TA21, 1990TA1L, 1991BO1R), $E_{\pi^+} = 160$–219 MeV (1991RI01, 1994RI06). Comparison of these data with a coupled channels model is discussed in (1995BO1H). See also the Δ-hole model analysis of (1992JU1B) and the multicluster dynamic model analysis by (1995RY1C). Calculations of cross sections and polarization observables at $E_{\pi^+} = 80$–260 MeV are presented in (1988ER06, 1988NA06). A theoretical study in terms of a strong absorption model is described in (1998AH06). Quantum Monte-Carlo calculations of cross sections for $E_{\pi} = 100$–240 MeV are reported in (2001LE01). Transition densities and B(E2) transition strengths were also calculated.

Measurements of pion double-charge exchange cross section (reactions (b) and (c)) at incident pion energies $E_{\pi} = 180$, 240 MeV are reported in (1989GR06, 1995FO1J). In (1991SE06) it is shown that continuum missing mass spectra from reaction (c) can be explained in terms of the presence of dineutrons in the products of the breakup.

Cross section measurements for reaction (d) at $E_{\pi^+} = 130$, 150 MeV are reported in (1987HU02). For a study of reaction (i) at $E_{\pi^+} = 130$ MeV, see (1987HU13).

Pion absorption followed by nucleon emission (reactions (e), (f), (g), (h), (j), (k), (l)) has been studied in a number of experiments. For reaction (k) see (1983BA26, 1983LO10, 1985MC05, 1986MC11). Measurements have been reported for cross sections for reaction (g) at $E_{\pi^+} = 30$, 50, 80, 115 MeV (1989ROZY); reactions (g) and (h) angular distributions at $E_{\pi} = 70$, 130, 165 MeV (1989YO05); reactions (g) and (h) angular correlations at $E_{\pi} = 165$ MeV (1989YO07); cross sections for reaction (g) at $E_{\pi^+} = 115$, 140, 165, 190, 220 MeV (1989ZHZZ); angular distributions for reaction (h) at $E_{\pi} = 70$, 130, 165 MeV (1989YO03); two-particle coincidences for reactions (g) and (h) at low energies (1991YO1C); cross sections at $E_{\pi} = 50$, 100, 150, 200

MeV (1990RA05, 1990RA20, 1992RA01, 1992RA11); differential and total cross sections for reaction (g) at $E_{\pi^+} = 100$, 165 MeV (1995PA22, 1996LO04); inclusive spectra of ^{3}He produced in reaction (l) (1992AM1H, 1993AM09); total reaction cross sections for (π^+, X), (π^-, X) at $E_\pi = 42$–65 MeV (1996SA08). See also the earlier work on reaction (g) at $E_{\pi^+} = 59.4$ MeV (1986RI01), and see the compilation and review of (1992BA57, 1993IN01).

Analysis of particle emission following π^+ absorption on ^{6}Li (1990RA20) has produced evidence for a three-nucleon absorption model. Distorted-wave impulse approximation calculations of cross sections and analyzing powers have been made (1992KH04) for two-nucleon pion absorption on polarized ^{6}Li targets. A model based solely on isospin was used (1993MA14) in a calculation of ratios of pion absorption on three nucleons and agreement with experiment suggest a one-step process.

19. (a) ^{6}Li(n, n)^{6}Li

(b) ^{6}Li(n, nd)^{4}He	$Q_m = -1.4743$
(c) ^{6}Li(n, p)^{6}He	$Q_m = -2.7254$
(d) ^{6}Li(n, d)^{5}He	$Q_m = -2.272$
(e) ^{6}Li(n, t)^{4}He	$Q_m = 4.7829$
(f) ^{6}Li(n, α)^{3}H	$Q_m = 4.7829$

Angular distributions involving the groups to ^{6}Li*(0, 2.19) have been reported at $E_n = 1.0$ to 14.6 MeV [see (1984AJ01)], 4.2, 5.4 and 14.2 MeV (1985CH37; n_0, n_1), 7.5 to 14 MeV (1983DA22; n_0), 8.9 MeV (1984FE1A; n_0), 8.0 and 24 MeV (1986HAZR; n_0, n_1), $E_n = 5$ to 17 MeV (1986PF1A; n_0), 11.5, 14.1 and 18 MeV (1998CH33; n_0, n_1), and at 11.5 and 18.0 MeV (1998IB02; n_0, n_1).

An analysis (1988HA25) of (n, n) and (n, n′) data at $E_n = 24$ MeV indicated that neutron and proton transition densities were approximately equal ($\rho_n \approx \rho_p$) in ^{6}Li. Cross sections and analyzing powers for $E_n = 8$–40 MeV were analyzed (1989HAZV) with microscopic optical model potentials. Secondary neutron spectra induced by 14.2 MeV neutrons on ^{6}Li were measured by (1993XI04).

An analysis of (n, n′) data at $E_n = 7.45$–14 MeV is discussed in (1990BE54). See also the calculation for elastic coherent and incoherent scattering of thermal neutrons on ^{6}Li (1990GO26) and the multi-cluster dynamic model calculation for ^{6}Li(n, n) at $E_n = 12$ MeV (1992KA06).

Theoretical studies of ^{6}Li(n, n) include multiconfiguration resonating group calculations (1988FU09, 1991FU02), folding model descriptions for $E_n = 25$–50 MeV (1993PE13), study of antisymmetry in NN potentials (1995CO18), study of optical model potentials for intermediate energies (1996CH33).

For reaction (b) see (1984AJ01, 1985CH37, 1993XI04, 1994EL08).

A number of experiments on the (n, p) charge exchange (reaction (c)) have been reported. They include: measurements of $\sigma(E_p)$ and $\sigma(\theta)$ at $E_n \approx 198$ MeV (1987HE22); $\sigma(\theta,\ E_p)$ at $E_n \approx 118$ MeV (1987PO18, 1988HA12, 1998HA24); $\sigma(\theta)$ at $E_n = 198$ MeV (1988JA01); $\sigma(\theta)$ to explore the Gamow-Teller sum rule (1988WA24); $\sigma(\theta)$, $\sigma(E_{\rm p})$ at $E_{\rm n} = 280$ MeV for an isospin symmetry test (1990MI10); $\sigma(\theta,\ E)$ at $E_{\rm n} = 60$–260 MeV (1992SO02); and polarization observables at $E_{\rm n} = 0.88$ GeV (1996BB23).

For reaction (e), measurements were reported at thermal neutron energies (1994IT04) and at $E_{\rm n} < 10$ MeV (1994DR11). For reaction (f), measurements of parity violation with cold polarized neutrons are described in (1990VE16, 1993VE1A, 1996VE02). A discussion of nuclear reaction rates and primordial ^{6}Li is presented in (1997NO04). See also the application-related calculation of (1993FA01).

Theoretical work related to reactions (b), (c), (d), (e), (f) includes: dynamical cluster-model calculation (1991DA08); microscopic calculation in a 3-particle $\alpha + 2$N model (1993SH1G); supermultiplet-symmetry-approximation calculation at $E_{\rm n} = 6.77$ MeV (1993DU09); multiconfiguration RGM calculation (1995FU16); and three-body cluster model calculations of ^{6}Li(n, p) at $E_{\rm n} = 50$ MeV (1997DA01, 1997ER05).

20. (a) ^{6}Li(p, p)^{6}Li

(b) ^{6}Li(p, 2p)^{5}He	$Q_{\rm m} = -4.497$
(c) ^{6}Li(p, pd)^{4}He	$Q_{\rm m} = -1.4743$
(d) ^{6}Li(p, p^{3}H)^{3}He	$Q_{\rm m} = -15.7947$
(e) ^{6}Li(p, pn)^{5}Li	$Q_{\rm m} = -5.39$

Proton angular distributions have been measured for $E_{\rm p} = 0.5$ to 800 MeV [$\rm p_0$, $\rm p_1$, $\rm p_2$, $\rm p_3$] [see (1966LA04, 1974AJ01, 1984AJ01)] and at $E_{\rm p} = 5$ to 17 MeV (1986PF1A; $\rm p_0$).

Double-differential cross sections for the continuum yield [$E_{\rm x} = 1.5$–3.5 MeV] are reported at $E_{\rm p} = 65$ MeV (1987TO06). See also (1983GLZZ, 1983PO1B, 1983POZX). More recently differential cross sections and/or polarization observables have been measured at $E_{\rm p} = 6$–10 MeV (1989HA17) [optical model analysis]; $E_{\rm p} = 1.6$–10 MeV (1989HA18) [phase shift analysis]; $E_{\rm p} = 65$, 80 MeV (1989TO04) [DWIA analysis]; $E_{\rm p} = 200$ MeV (1990GL04); $E_{\rm p} = 65$ MeV (1992NA02) [microscopic DWBA analysis]; $E_{\rm p} = 72$ MeV (1994HE11) [depolarization parameters]; $E_{\rm p} < 2.2$ MeV (1995SK01) [deduced resonance parameters]; $E_{\rm p} = 0.88$ GeV (1996BB23) [polarized target]; $E_{\rm p} = 250$–460 keV (1997BR37), $E_{\rm p} = 280$ MeV (1990MI10) [deduced isospin symmetry test]; $E_{\rm p} = 14$ MeV [optical model, coupled channels]; $E(^{6}{\rm Li}) = 62$, 72, 75 MeV/A, ^{1}H(^{6}Li, p) [neutron halo states] (1996KUZU); $E_{\rm p} = 1.6$–2.4 GeV (1999BB21, 1999DE47). For a summary of the results on excited states see Table 6.12.

Reaction (b) was studied at 70 MeV (1983GO06), at 50–100 MeV (1984PA1B, 1985PA1B) and 1 GeV (1985BE30, 1988BE2B, 2000MI17): see ^{5}He and (1984AJ01) for the earlier work. Reaction (c) has been studied at $E_{\rm p} = 9$ MeV to 1 GeV [see (1974AJ01, 1979AJ01, 1984AJ01)] and at 20 and 42 MeV (1983CA13) [report involvement of ^{6}Li*(4.31, 5.65)], at 70 MeV (1983GO06, 1985PAZL, 1985PA04) and at 119.6 and 200.2 MeV (1984WA09, 1985WA25). In the latter experiments the spectroscopic factors for $^{6}{\rm Li}_{\rm g.s.}$ are deduced to be 0.76 [at 119.6 MeV] and 0.84

[at 200.2 MeV] using DWIA and a bound-state Woods-Saxon $2S$ wave function (1984WA09, 1985WA25).

Work on reaction (d) has suggested that the ^{3}He + t parentage of ^{6}Li is comparable with the $\alpha + \mathrm{d}$ parentage: see (1984AJ01). See also (1985PAZL). Reaction (e) was studied at $E_\mathrm{p} = 70$ MeV (1988PA27). See also ^{5}Li, ^{6}Be and (1985BE30, 1993ST06). The (p, 3p) reaction has been studied by (1984NA17). The spectral function for pn pairs in ^{6}Li was obtained in a study of the ^{6}Li(p, pα)pn reaction at $E_\mathrm{p} = 200$ MeV (1990WA17). A measurement of tensor analyzing powers in ^{1}H(^{6}Li, d or α or t)X with 4.5 GeV polarized ^{6}Li deuterons provided information on the ^{6}Li D state (1992PU03). Systematic studies of electron screening effects on low energy reactions including $^{6}\mathrm{Li} + \mathrm{p}$ are reported in (1992EN01, 1992EN04, 1995RO37). For antiproton studies see (1987AS06). See also (1984AJ01, 1988AJ01) for the earlier work.

Theoretical work on these reactions reported since the previous review (1988AJ01) is listed in Table 6.13 along with brief descriptions.

21. (a) ^{6}Li(d, d)^{6}Li

(b) ^{6}Li(d, pn)^{6}Li	$Q_\mathrm{m} = -2.2246$
(c) ^{6}Li(d, 2d)^{4}He	$Q_\mathrm{m} = -1.4743$
(d) ^{6}Li(d, αp)^{3}H	$Q_\mathrm{m} = 2.5583$
(e) ^{6}Li(d, αn)^{3}He	$Q_\mathrm{m} = 1.7946$

Angular distributions of deuterons have been measured at $E_\mathrm{d} = 4.5$ to 19.6 MeV [see (1979AJ01)] and at 50 MeV (1988KO1C, 1996RU10). The 0^+, $T = 1$ state, ^{6}Li*(3.56) is not appreciably populated. For a summary of the results on excited states see Table 6.12. Gaussian potentials were derived for the description of $^{6}\mathrm{Li} + \mathrm{d}$ elastic scattering by (1992DU07).

At $E_\mathrm{d} = 21$ MeV reaction (b) shows spectral peaking (characteristic of ^{1}S$_0$ for the pn system [$T = 1$]) when ^{6}Li*(3.56) is formed, in contrast with the much broader shape (characteristic of ^{3}S$_1$) seen when ^{6}Li*(0, 2.19) are populated. A study of reaction (c) at $E_\mathrm{d} = 52$ MeV shows that the α-clustering probability, $N_\mathrm{eff} = 0.12^{+0.12}_{-0.06}$ if a Hankel function is used. The α-particle and the deuteron clusters in ^{6}Li have essentially a relative orbital momentum of $l = 0$. The D-state probability of the ground state of ^{6}Li is $\approx 5\%$ of the S-state. Quasi-free scattering is an important process even for $E_\mathrm{d} = 6$ to 11 MeV. Interference effects are evident in reaction (c) proceeding through ^{6}Li*(2.19, 4.31): this is due to the experiment being unable to determine whether the detected particle was emitted first or second in the sequential decay. Reactions (c) and (d) studied at $E_\mathrm{d} = 7.5$ to 10.5 MeV indicate that the three-body breakup of ^{6}Li at these low energies is dominated by sequential decay processes (1979AJ01, 1990YA11). Differential cross sections for cluster pickup by 20 MeV/A deuterons on ^{6}Li were measured by (1995MA57).

Calculation of Maxwellian rate parameters for reaction (d) and (e) are described in (2000VO08). See also ^{8}Be and references cited in (1988AJ01).

22. ^{6}Li(t, t)^{6}Li

Table 6.12: Parameters of levels of ^{6}Li [a]

E_x (MeV ± keV)	Γ_{cm} (keV)	Reactions
2.185 ± 3	20.0 ± 2.8	^{4}He(d, d)^{4}He
2.187 ± 3		^{4}He(d, d)^{4}He
2.188 ± 6	24 ± 2 [b]	^{6}Li(p, p′), (d, d′), ^{7}Li(d, t)^{6}Li
2.203 ± 6		^{9}Be(p, α)^{6}Li
2.186 ± 2	24 ± 2	“best” value
3.56288 ± 0.10 [c]	$(8.2 \pm 0.2) \times 10^{-3}$ [c]	^{6}Li(γ, γ')^{6}Li
4.36 ± 40	1320 ± 40	^{4}He(d, d)^{4}He
4.27 ± 40		^{6}Li(e, e′)^{6}Li
	1044 ± 58 [d]	^{6}Li(e, e′)^{6}Li
4.40 ± 120	1490 ± 150	^{6}Li(p, p′)^{6}Li
4.32 ± 40	1820 ± 110	^{6}Li(d, d′)^{6}Li
4.3 ± 100	600 ± 100	^{7}Li(^{3}He, α)^{6}Li
4.3 ± 200	1600 ± 300	^{7}Li(^{3}He, αd)^{4}He
4.3	1600 ± 120 [e]	^{7}Li(^{3}He, αd)^{4}He
4.30 ± 10	850 ± 50, 480 ± 80	^{9}Be(p, α)^{6}Li
4.312 ± 22	1300 ± 100 [f]	“best” value
5.379 ± 17 [g]	540 ± 20 [g]	^{6}Li(e, e′)^{6}Li
	546 ± 36 [d]	^{6}Li(e, e′)^{6}Li
5.33 ± 80	560^{+340}_{-100}	^{6}Li(p, p′)^{6}Li
5.34 ± 20	560 ± 40 [b]	^{7}Li(^{3}He, α)^{6}Li
5.325 ± 5	270 ± 12	^{9}Be(p, α)^{6}Li
5.366 ± 15	541 ± 20 [h]	“best” value
5.65 ± 50 [i]	1900 ± 100	^{4}He(d, d)^{4}He
5.7	1000^{+600}_{-400} [j]	^{6}Li(p, p′)^{6}Li
5.65 ± 200	1650 ± 300	^{7}Li(^{3}He, αd)^{4}He
5.65 ± 40	900 ± 60, 1260 ± 120	^{9}Be(p, α)^{6}Li
5.65 ± 50	1500 ± 200	“best” value

[a] For references and other values see Tables 6.5 in (1979AJ01, 1984AJ01, 1988AJ01).
[b] See (1988AJ01).
[c] (1981RO02).
[d] (1979BE38).
[e] Average of measurements for $E(^3\text{He}) = 4$, 5, 6 MeV (1995AR14).
[f] Weighted average of "best" values from (1988AJ01) and values of 1320 ± 40 keV (Table 6.7), 1044 ± 58 keV (1979BE38), and 1600 ± 120 keV from (1995AR14).
[g] See Table 6.4 in (1979AJ01).
[h] Weighted average of "best" values from (1988AJ01) and 546 ± 36 keV from (1979BE38).
[i] See Table 6.3 in (1979AJ01).
[j] See references (c) and (d) in Table 6.5 in (1979AJ01).

At $E_t = 17$ MeV angular distributions have been measured for the tritons to ^{6}Li*(0, 3.56): see (1979AJ01).

23. (a) $^6\text{Li}(^3\text{He}, ^3\text{He})^6\text{Li}$
(b) $^6\text{Li}(^3\text{He}, \text{p}\alpha)^4\text{He}$ $\quad Q_m = 16.878$

Angular distributions have been measured at $E(^3\text{He}) = 8$ to 217 MeV [see (1979AJ01, 1984AJ01)] and at 34, 50, 60 and 72 MeV (1986BR31; elastic).

More recently, differential cross sections were measured for elastic scattering at $E(^3\text{He}) = 93$ MeV (1994DO32), and at $E(^3\text{He}) = 60$ MeV (1995MA57), and for inelastic scattering to ^{6}Li*($E_x = 2.185$ MeV, $J^\pi = 3^+$) at $E(^3\text{He}) = 50$, 60, 72 MeV (1995BU20). A microscopic-potential analysis of data at $E(^3\text{He}) = 34$, 50, 60, 72 MeV is described in (1993SI06). Differential cross section and energy spectra were compiled and analyzed by (1995MI16). For reaction (b), cross sections have been measured at $E(^3\text{He}) = 11$, 13, 14 MeV (1989ARZR, 1989AR08); $E(^3\text{He}) = 2.5$ MeV (1989AR20); $E(^3\text{He}) = 1.6$ MeV (1991AR25); $E(^3\text{He}) = 1.6$–9 MeV (1992AR20); $E(^3\text{He}) = 8$–14 MeV (1995KO51); $E(^3\text{He}) = 2.0$, 22 MeV (1992DA1K); $E(^3\text{He}) = 7$, 9 MeV (1993AR12). A calculation of near-threshold two-fragment resonance amplitudes and widths for this reaction at $E(^3\text{He}) = 8$–14 MeV was reported in (1995KO51). See also ^{5}Li (1984AR17, 1987ZA07) and see ^{9}B in (1988AJ01).

24. (a) $^6\text{Li}(\alpha, \alpha)^6\text{Li}$
(b) $^6\text{Li}(\alpha, 2\alpha)^2\text{H}$ $\quad Q_m = -1.4743$

Angular distributions (reaction (a)) have been measured at $E_\alpha = 1.39$ to 166 MeV [see (1974AJ01, 1979AJ01, 1984AJ01)] and at $E_\alpha = 36.6$ and 50.5 MeV (1986BR31). See also (1986ROZK, 1987BU27). See also ^{10}B in (1988AJ01).

More recent measurements at $E_\alpha = 50.5$ MeV of elastic and inelastic ^{6}Li*($E_x = 2.185$ MeV, $J^\pi = 3^+$) were reported by (1994BUZY, 1996BU06). Tensor polarization for inelastic scattering to ^{6}Li*(2.185, 3^+) has been measured at $E_\alpha = 80$ MeV (1992KO19, 1993KO33). Angular distributions for (α, α') in the continuum region were studied at $E_\alpha = 50$ MeV (1992SA01) and at $E_\alpha = 40$ MeV (1994SA32), at $E_\alpha = 10$ MeV/A (1996SI13) and at $E_\alpha = 119$ MeV (1993OK1A). Cross sections and analyzing powers for elastic scattering of polarized ^{6}Li by ^{4}He are reported for $E(^6\text{Li}) = 50$ MeV (1995KE10) and $E_{\text{cm}} = 11.1$ MeV (1996GR08).

Studies of continuum coupling effects in inelastic scattering are described in (1995KA1Y, 1995KA43, 1997RU06, 2000RU03). Folding-model potential analyses of elastic scattering are reported in (1993SI09, 1995SA12). Multiconfiguration resonating group methods applied to the ^{6}Li$+\alpha$ system are discussed in (1994FU17, 1995FU11). Other recent theoretical studies include: a potential model description (1999MA02); analysis of density distribution influence (1998GO1J); a phase-shift-analysis determination of the asymptotic D- to S-state ratio (1999GE02); a calculation for $E_\alpha = 16.3$ and 48 MeV with a modified Volkov-potential (2000KO52); and a calculation of the nuclear potential and polarization tensor for $E_\alpha = 27.2$ MeV (2000KO67). See also (1988KO32, 1989LE07, 1999OG09).

Reaction (b) has been studied at $E_\alpha = 6.6$ to 700 MeV: see (1974AJ01, 1979AJ01, 1984AJ01). At the latter energy and using a width parameter of 60.6 MeV/c the effective number of α + d clusters for $^6\text{Li}_{\text{g.s.}}$, $n_{\text{eff}} = 0.98 \pm 0.05$. The results are very model dependent: see (1984AJ01). At $E_\alpha = 27.2$ MeV ^{6}Li*(2.19) is very strongly populated (1985KO29). See also references cited in (1988AJ01).

In more recent work, two dimensional coincidence spectra of charged particles were measured at $E_\alpha \approx 100$ MeV (1992GA18). Quasi-free scattering processes were studied at $E_\alpha = 77$–119 MeV (1992OK01), $E_\alpha = 118$ MeV (1993OK1B), and $E_\alpha = 118.4$ MeV (1997OK01). The four-body ^{6}Li(α, 2α)pn breakup reaction was measured at $E_\alpha = 77$–119 MeV (1992WA18, breakup cross sections); $E_\alpha = 118$ MeV (1988WA29, 1989WA26; spectral functions of pn pair).

25. (a) ^{6}Li(^{6}Li, ^{6}Li)^{6}Li
(b) ^{6}Li(^{6}Li, 2d)^{4}He^{4}He $\qquad Q_m = -2.9487$
(c) ^{6}Li(^{6}Li, α)^{4}He^{4}He $\qquad Q_m = 20.8979$

Angular distributions of ^{6}Li ions have been studied for $E(^6\text{Li}) = 3.2$ to 36 MeV [see (1974AJ01, 1979AJ01, 1984AJ01)] and at $E(^6\text{Li}) = 2.0$ to 5.5 MeV (1983NO08) and 156 MeV (1985SA36; ^{6}Li*(0, 2.19)), (1985MI05; elastic; ^{6}Li*(2.19, 3.56) are also populated), (1987EY01; several states in ^{12}C). Reaction (b) has been studied for $E(^6\text{Li}) = 36$ to 47 MeV: enhancements in yield, due to double spectator poles, have been observed in d-d and α-α but not in α-d double coincidence spectra. The widths of the peaks are smaller than those predicted from the momentum distribution of $\alpha + \text{d}$ clusters in ^{6}Li. ^{6}Li*(2.19) was also populated. See references in (1984AJ01). Other work on reaction (b) is reported by (1984LA19: 2.4 and 4.2 MeV) and by (1985NO1A).

For reaction (c), the energy dependence of quasi-free effects were investigated in the range $E(^6\text{Li}) = 2.4$–6.7 MeV (1987LA25, 1988LA11). An analysis (1996CH1C) used quasi-free data

Table 6.13: ^{6}Li(p, p)^{6}Li – Theoretical work

Reference	Description
1988HA25	^{6}Li proton and neutron transition densities from elastic scattering
1990ZH1R	Quasi resonating group method analysis of ^{6}Li(p, p)^{6}Li
1992GA27	Folding-model study of elastic scattering in halo nuclei
1993DU09	Potential description of N + ^{6}Li elastic scattering
1993KO44	Description of ^{6}Li(p, p)^{6}Li with microscopic effective interaction
1993PE13	Folding model description of ^{6}Li(p, p)^{6}Li at 25–50 MeV
1993SA10	DWBA analysis of ^{6}Li(p, p)^{6}Li near the α-d breakup threshold
1994ZH28	Elastic and inelastic proton scattering on ^{6}Li nucleus at intermediate energies
1994ZH34	Glauber-Sitenko diffraction theory calculation of ^{6}Li(p, p)^{6}Li
1995GA24	Analysis of properties of exotic nuclei in elastic scattering
1995KA03	Folding-model analysis of ^{6}Li(p, p$'$)^{6}Li at $E_{\rm p}$ = 10–136 MeV
1995KA07	Continuum-continuum coupling in ^{6}Li(p, p)^{6}Li at $E_{\rm p}$ = 65 MeV
1995KA43	Folding-model analysis of ^{6}Li(p, p$'$)^{6}Li at $E_{\rm p}$ = 10–136 MeV
1997DO01	Fully microscopic model analyses of ^{6}Li(p, p$'$)^{6}Li at $E_{\rm p}$ = 200 MeV
1997KA24	Shell model structures of ^{6}Li states excited in ^{6}Li(p, p$'$)^{6}Li
1998DO16	Microscopic analysis of ^{6}Li(p, p) at $E_{\rm p}$ = 65 MeV
1998FUZP	Microscopic optical model calculation for $E_{\rm p}$ = 60–70 MeV
2000TI02	Finite-range coupled channels calculation for ^{6}He + p rxn
2000DE61	Microscopic model analysis of ^{6}Li(p, p)^{6}Li for $E_{\rm p}$ = 25, 30, 40 MeV
2000LA40	Resonance optical model analysis for ^{6}Li(p, p)^{6}Li for $E_{\rm p}$ = 1–10 MeV
2000ZH40	Glauber-Sitenko diffraction theory calculation for $E_{\rm p}$ = 0.16–1.04 GeV
2001AR05	Microscopic multicluster calculation for ^{6}He + p at $E_{\rm cm}$ = 0–5 MeV

from reaction (c) to extract the ^{6}Li(d, α)^{4}He excitation function at astrophysical energies. See also ^{12}C in (1985AJ01) and references cited in (1988AJ01).

More recently, elastic scattering angular distributions were measured for $E(^6{\rm Li}) = 5$–40 MeV (1997PO03; optical model analysis). Eikonal-approximation calculations of differential cross sections and phase shifts for $E(^6{\rm Li}) = 156$ MeV were reported in (1992EL1A).

26. ^{6}Li(^{7}Li, ^{7}Li)^{6}Li

Angular distributions have been measured at $E(^7{\rm Li}) = 78$ MeV to ^{6}Li*(0, 2.19) (1986GLZU), and at $E(^7{\rm Li}) = 9$–40 MeV (1998PO03).

27. ^{6}Li(^{9}Be, ^{9}Be)^{6}Li

The elastic scattering has been studied in inverse kinematics at $E(^6\text{Li}) = 4.0$, 6.0 and 24 MeV [see (1979AJ01)], at 32 MeV (1985CO09) and at 50 MeV (1988TRZY; also inelastic). Recently angular distributions for elastic and inelastic scattering to ^{6}Li*(2.186, 3^+) were measured (1995MU01) at E_{cm} = 7, 10, 12 MeV. Excitation functions for $E_{\text{cm}} \approx 4$–12 were also reported. See also ^{9}Be in (1988AJ01). For the interaction cross section at $E(^6\text{Li}) = 790$ MeV/A see (1985TA18).

28. ^{6}Li(^{10}B, ^{10}B)^{6}Li

The elastic scattering has been studied at $E(^6\text{Li}) = 5.8$ and 30 MeV: see (1979AJ01).

29. (a) ^{6}Li(^{12}C, ^{12}C)^{6}Li
(b) ^{6}Li(^{13}C, ^{13}C)^{6}Li
(c) ^{6}Li(^{14}C, ^{14}C)^{6}Li

The elastic and inelastic scattering (reaction (a)) has been studied at $E(^6\text{Li}) = 4.5$ to 156 MeV [see (1984AJ01)] and at $E(^6\text{Li}) = 19.2$ MeV (1983RU09), 36 and 45 MeV [and $E(^{12}\text{C}) = 72$ and 90 MeV] (1984VI02, 1985VI03; also to ^{6}Li*(2.19, 4.31) and to various states of ^{12}C), at $E(^{12}\text{C}) = 58.4$ MeV (1987PA12), 90 MeV (1987DE02; also to various states of ^{12}C), 123.5 and 168.6 MeV (1988KA09; and to various states of ^{12}C), 150 MeV (1987TA21, 1988TA08), 156 MeV (1987EY01; and to various states in ^{12}C) and at 210 MeV (1988NA02). See also (1986SHZP, 1987PA12). More recently, measurements of cross sections and/or analyzing power observables have been reported at $E(^6\text{Li}) = 93$ MeV (1989DE34); at $E_{\text{cm}} = 13.3$ MeV ((1989HN1A, 1995CA26) and to ^{6}Li*(3^+, 2.186) and ^{12}C*(2^+, 4.44)); at $E(^6\text{Li}) = 210$ MeV (1989NA11, to ^{12}C*(2^+, 4.44)); at $E(^6\text{Li}) = 30$ MeV (1989VA04, to ^{12}C*(2^+, 4.44)); at 50 MeV (1990TR02, to ^{12}C*(2^+, 4.44; 0^+, 7.65; 3^-, 9.64)); at $E(^6\text{Li}) = 30$ MeV (1994RE01); at $E(^6\text{Li}) = 30, 60$ MeV (1996KE09, to ^{12}C*(2^+, 4.44; 0^+, 7.65; 3^-, 9.64)); at $E_{\text{cm}} = 20$ MeV (1996GA29, to ^{6}Li*(3^+, 2.18) and ^{12}C*(2^+, 4.44)); at $E(^6\text{Li}) = 318$ MeV (1993NA01); at $E(^6\text{Li}) = 30$ MeV (1994RE15, to ^{12}C*(2^+, 4.44; 3^-, 9.64)); and at $E(^6\text{Li}) = 50$ MeV (1995KE10). At $E(^6\text{Li}) = 34$ MeV the d-α angular correlations involve ^{6}Li*(0, 2.19) (1985CU04). See also (1988SE07), and see ^{12}C in (1985AJ01, 1990AJ01). An experimental study of the $\alpha + \text{d}$ breakup in $^6\text{Li} + {}^{12}\text{C}$ collision at $E(^6\text{Li}) = 156$ MeV is reported in (1989JE01). For pion production see (1984CH16). For the interaction cross section at $E(^6\text{Li}) = 790$ MeV/A see (1985TA18). For VAP measurements at $E(^6\text{Li}) = 30$ MeV see (1988VAZY). Fusion cross sections for $E(^6\text{Li}) = 3.11$–12.07 MeV are reported by (1998MU12).

The elastic scattering (reaction (b)) has been studied for $E(^6\text{Li}) = 5.8$ to 40 MeV: see (1984AJ01). Measurements of differential cross sections for $E_{\text{cm}} = 26$ MeV and observations of a nuclear quasi rainbow were reported by (1994DE43). See also (1987CA30, 1988WO10). The elastic scattering (reaction (c)) has been measured for $E(^6\text{Li}) = 93$ MeV (1987DE02). See also ^{18}F and ^{19}F in (1987AJ02) and references cited in (1988AJ01).

Several theoretical studies relating to ^{6}Li + ^{12}C have been reported. The role of the Pauli Principle in heavy ion scattering has been studied (1988GR32). The dispersive contribution to the ^{6}Li + ^{12}C real potential was estimated (1990KA14). Elastic cross sections for $E(^6\text{Li}) = 30$ MeV were analyzed (1990SA05). A semimicroscopic analysis of inelastic scattering at $E(^6\text{Li}) = 156$ MeV is described in (1992GA17). Folding model analysis of ^{6}Li + ^{12}C scattering is discussed in (1994NA03, 1994SA10, 1995KH03). Differential cross sections were analyzed with an S-matrix approach by (1998PI02).

Other theoretical descriptions of ^{6}Li + ^{12}C scattering are discussed in (1994SA33; strong absorption model), (1995IS1F; multiple diffraction interaction), and (1996CA01; microscopic description).

30. ^{6}Li(^{16}O, ^{16}O)^{6}Li

Elastic angular distributions have been reported at $E(^6\text{Li}) = 4.5$ to 50.6 MeV [see (1984AJ01)], at $E(^6\text{Li}) = 35.3$ and $E(^{16}\text{O}) = 94.2$ MeV (1984VI02) and at 50 MeV (1988TRZY; also inelastic). At $E(^6\text{Li}) = 25.7$ and $E(^{16}\text{O}) = 68.6$ MeV (1984VI01, 1985VI03) report some $\sigma(\theta)$ to ^{6}Li*(2.19) [and to ^{16}O*(6.13)]. See also (1987PA12). See (1985VI03, 1986SC28) for studies of the breakup. Polarization observables have has been measured at $E(^6\text{Li}) = 25.7$ MeV, and also using ^{16}O ions (1987VAZY, 1989VA04). Measurements of $E(^6\text{Li}) = 50$ MeV for elastic scattering and inelastic scattering to ^{16}O*(2^+, 6.05; 3^-, 6.13; 2^+, 6.92; 1^-, 7.12) were reported (1990TR02). For fusion cross sections see (1986MA19). See also ^{16}O in (1986AJ04), (1986MO1E, 1987PA12) and references cited in (1988AJ01). Theoretical work on this scattering reaction includes: $E(^6\text{Li}) = 29.8$ MeV, optical model description (1990SA05); $E(^6\text{Li}) = 29.8$–30.6 MeV, Pauli Principle rule (1988GR32); $E(^6\text{Li}) = 30.6$, optical model analysis (1990SA05); projectile effects (1991BO48); $E(^6\text{Li}) = 154$ MeV, 3-body cluster model (1991HI07); $E(^6\text{Li}) = 22.8$ MeV, nonresonant breakup states (1991HI11); and $E(^6\text{Li}) = 30$ MeV, double-folding model, role of Pauli Principle (1991SA26).

31. (a) ^{6}Li(^{24}Mg, ^{24}Mg)^{6}Li
(b) ^{6}Li(^{25}Mg, ^{25}Mg)^{6}Li
(c) ^{6}Li(^{26}Mg, ^{26}Mg)^{6}Li
(d) ^{6}Li(^{27}Al, ^{27}Al)^{6}Li

Elastic scattering for reaction (a) was studied at $E(^6\text{Li}) = 156$ MeV (1995DE53). Reaction (c) has been studied at $E(^6\text{Li}) = 88$ MeV and 36 MeV (1984AJ01) and at 44 MeV (1989RU05; polarization observables), and $E(^6\text{Li}) = 60$ MeV (1994WA20; polarization observables). Reaction (d) was studied at $E(^6\text{Li}) = 156$ MeV by (1987NI04; particles and gammas from inelastic scattering). See also the measurements at $E(^6\text{Li}) = 790$ MeV/A (1985TA18).

Theoretical studies for these reactions include: analyzed non-Rutherford cross sections (1991BO48); effects of nonresonant breakup states (1991HI11); strong absorption model analysis (1994SA33); cluster folding interaction (1991HI07); coupled channels study (1992HI02); and cluster-folding analysis (1994RU11).

32. (a) ^{6}Li(^{28}Si, ^{28}Si)^{6}Li
(b) ^{6}Li(^{30}Si, ^{30}Si)^{6}Li

The elastic scattering has been studied at $E(^{6}\text{Li}) = 13$ to 154 MeV [see (1984AJ01)], at 27 and 34 MeV (1983VI03) and at 210 MeV (1988NAZX). For a study of the decay see (1987NI04). See also references cited in (1988AJ01).

More recent measurements have been reported at $E(^{6}\text{Li}) = 210$ MeV (inelastic $\sigma(\theta)$ to ^{28}Si*(first 2^{+} state) (1989NA11); elastic $\sigma(\theta)$, optical parameters (1989NA02); and $E(^{6}\text{Li}) = 318$ MeV ($\sigma(\theta)$, folding model potentials (1990NAZZ, 1993NA01)). Related analyses and other theoretical studies include: Pauli Principle role (1988GR32, 1991SA26); scattering matrix approach (1990KU23); deduced model parameters (1990SA05); non-Rutherford cross section thresholds (1991BO48); cluster-folding interactions (1991HI07); energy dependence, dispersion relation (1991TI04); strong absorption model (1994SA33); $E(^{6}\text{Li}) = 210$, 318 MeV, energy approximation (1995EM03); microscopic description (1996CA01); microscopic potentials, density matrix formalism (1996KN02); $E(^{6}\text{Li}) = 35$, 53 MeV/A, breakup effect (1997SA57); and $E(^{6}\text{Li}) = 210$, 315 MeV, S-matrix approach (1998PI02).

For reaction (b) see (1987AR13).

33. (a) ^{6}Li(^{39}K, ^{39}K)^{6}Li
(b) ^{6}Li(^{40}Ca, ^{40}Ca)^{6}Li
(c) ^{6}Li(^{44}Ca, ^{44}Ca)^{6}Li
(d) ^{6}Li(^{48}Ca, ^{48}Ca)^{6}Li

Elastic scattering has been studied for $E(^{6}\text{Li}) = 26$ to 99 MeV: see (1984AJ01, 1988AJ01), and at $E(^{6}\text{Li}) = 34$ MeV (reaction (b)) by (1987VA31) and at 210 MeV (1988NAZX, 1989NA02; reaction (b)). ^{6}Li*(2.19) has been studied at $E(^{40}\text{Ca}) = 227$ MeV (1987VA31). Reaction (d) was studied at $E(^{6}\text{Li}) = 150$ MeV (1990KAZH). For fusion measurements (reaction (b)) see (1984BR04). For breakup measurements (reaction (b)) see (1984GR20, 1990YA09, 1992YAZW, 1993GU10, 1995AR15, 1996YA01).

For theoretical studies related to these reactions see: energy and target dependence of projectile breakup (1987SA21); sequential breakup cross sections (1987VA31); role of Pauli Principle (1988GR32); exchange effects (1988KH08, 1990DA23); imaginary part of channel-coupling potentials (1990TA1I); $E(^{6}\text{Li}) = 30$ MeV, deduced optical model parameters (1990SA05); cluster folding interactions (1991HI07); strong absorption model (1994SA33); S-matrix approach

(1995BE60, 1998PI02); and microscopic potentials (1996KN02). For earlier work see references cited in (1988AJ01).

34. (a) ^{7}Li(γ, n)^{6}Li $\quad Q_m = -7.249$
(b) ^{7}Li(γ, pπ^-)^{6}Li $\quad Q_m = -146.038$

Transitions to ^{6}Li*(0, 2.19, 3.56) have been observed in reaction (a): see (1979AJ01, 1984AJ01). Differential cross sections are reported for $E_{\rm brem} = 60$ to 120 MeV for the $n_0 + n_2$ groups (1985SE17). Bremsstrahlung yield for (γ, n_0) was measured for E_γ = 7–9 MeV (1989KA30). Reaction (b) at 0.9 GeV involves ^{6}Li*(2.19) (1985RE1A). See also the measurements of $E_\gamma = 350$ MeV reported by (1991GA26), and see ^{7}Li, (1985ST1A, 1986BA2G, 1986GO1M).

An analysis of ^{7}Li(γ, n) data in the giant resonance energy region is described in (1987VA05). Cluster effects were explored in (1992VA12). Calculation with a potential two cluster model are reported in (1997DU02).

35. ^{7}Li(π^-, π^-p)^{6}He $\quad Q_m = -9.9754$

Quasielastic pion-proton backward scattering was measured at $E_\pi = 0.7$, 0.9, 1.25 GeV (2000AB25). Fermi momentum distributions for ^{6}Li were deduced.

36. ^{7}Li(π^+, p)^{6}Li $\quad Q_m = 133.1026$

Differential cross sections have been measured at $E_{\pi^+} = 75$ and 175 MeV for the transitions to ^{6}Li*(0, 2.19): see (1984AJ01). Proton spectra measured at momentum exchange 660 MeV/c (1989LIZO) provided evidence for an η-meson nuclear bound state.

37. (a) ^{7}Li(p, d)^{6}Li $\quad Q_m = -5.0254$
(b) ^{7}Li(p, pn)^{6}Li $\quad Q_m = -7.2499$

Angular distributions of deuterons (reaction (a)) have been studied for $E_p = 167$ to 800 MeV [see (1979AJ01, 1984AJ01)] and at 18.6 MeV (1986GO23, 1987GO27; d_0, d_1, d_2; see for spectroscopic factors), 200 and 400 MeV (1985KR13; d_0, d_1; d_2 is weakly populated at 200 MeV) and at 800 MeV (1984SM04; d_0, d_1). The ratio of the intensities of the groups to ^{6}Li*(2.19) and ^{6}Li$_{\rm g.s.}$ increases with energy. It is suggested that this can be understood in terms of a small admixture of 1f orbital in these states (1985KR13). A DWBA analysis of $E_p = 185$ MeV data leads to $C^2S = 0.87$, 0.67, 0.24, (0.05), 0.14, respectively for ^{6}Li*(0, 2.19, 3.56, 4.31, 5.37). No other states were seen below $E_x \approx 20$ MeV: see (1979AJ01). The tensor analyzing power T_{20} was measured for the ^{1}H(^{7}Li, d)^{6}Li reaction at $E(^7\text{Li}) = 70$ MeV to ^{6}Li*(0, 2.186) (1991DA07). Data at $E_p = 33.6$ MeV were analyzed by (1991AB04) in a test for Cohen-Kurath wave functions. See also the analysis of data at $E_p = 698$ MeV by (1993AL05; η production). In reaction (b) at $E_p = 1$ GeV the separation energy between ≈6.5 MeV broad $1p_{3/2}$ and $1s_{1/2}$ groups is reported to be 18.0 ± 0.8 MeV (1985BE30, 1985DO16). See also (1983LY04, 1988BE1I, 1988GUZW). Differential cross sections were measured at $E_p = 70$ MeV (1988PA26) and at $E_p = 2.7$–3.8 MeV (1988BO37; application). See also the measurements for nuclear microprobe utilization (1995RI14).

38. ^{7}Li(d, t)^{6}Li $\qquad Q_m = -0.9927$

A study at $E_d = 23.6$ MeV of the relative cross sections of the analog reactions ^{7}Li(d, t)^{6}Li (to the first two $T = 1$ states at 3.56 and 5.37 MeV) and ^{7}Li(d, ^{3}He)^{6}He (to the ground and 1.80 MeV excited states) shows that ^{6}Li*(3.56, 5.37) have high isospin purity ($\alpha^2 < 0.008$): this is explained in terms of antisymmetrization effects which prevent mixing with nearby $T = 0$ states: see (1979AJ01). (1987BO39) [$E_d = 30.7$ MeV] deduce that the branching ratio of ^{6}Li*(4.31) [2^+] into a dinucleon [$T = 1$, $S = 0$] is (85 ± 10)%: see also reactions 21 in ^{6}He and 4 in ^{6}Be. See also (1987GUZZ; $E_d = 18$ MeV; angular distributions to ^{6}Li*(0, 2.19, 3.56)) and (1984BL21, 1986AV01, 1988GUZW). See also the analysis method discussed in (1995GU22; DWBA and dispersive theory).

39. (a) ^{7}Li(^{3}He, α)^{6}Li $\qquad Q_m = 13.3277$
(b) ^{7}Li(^{3}He, dα)^{4}He $\qquad Q_m = 11.8534$

Angular distributions have been reported at $E(^3\text{He}) = 5.1$ to 33.3 MeV [see (1974AJ01, 1984AJ01): the lower energy work has not been published] and more recently at $E(^3\text{He}) = 60$ MeV (1994BUZX). Excited states observed in this reaction are displayed in Table 6.12. See also (1968CO07) which reported observation of ^{6}Li states at 0.0, 2.17 ± 0.02, 3.55 ± 0.02 and 5.34 ± 0.02 MeV. (1986AN04) have analyzed unpublished data which suggest the involvement of several broad highly excited states of ^{6}Li. See also (1987AL23).

Several attempts have been made to observe the isospin-forbidden decay of ^{6}Li*(5.37) [2^+; 1] via ^{7}Li(^{3}He, α)^{6}Li*→ d+α: the branching is < 1%. $\Gamma_p/\Gamma = 0.35 \pm 0.10$ and $\Gamma_{p+n}/\Gamma = 0.65 \pm 0.10$ for ^{6}Li*(5.37): see (1979AJ01). ^{4}He + d spectra suggest the excitation of ^{6}Li*(4.3) [$E_x = 4.3 \pm 0.2$ MeV, $\Gamma = 1.6 \pm 0.3$ MeV] and ^{6}Li*(5.7) [$E_x = 5.65 \pm 0.2$ MeV, $\Gamma = 1.65 \pm 0.3$ MeV]: see (1984AJ01). See also (1985DA29, 1988BO1Y). A more recent measurement at $E(^3\text{He}) = 4$, 5, 6 MeV (1995AR14) gave values for the width of of ^{6}Li*(4.31) in agreement with the adopted value $\Gamma = 1700 \pm 200$ keV and found no dependence on incident energy. Measurements of d-α coincidence spectra at $E(^3\text{He}) = 11.5$ MeV (1988AR20) and 5.0 MeV (1991AR19) gave spectroscopic parameters for ^{6}Li*(5.65) in agreement with adopted values (1988AJ01). At $E(^3\text{He}) = 120$ MeV the missing mass spectra for (^{3}He, 2d) and (^{3}He, pt) reflect the population of ^{6}Li*(0, 2.19) and suggest broad structures at $E_x = 28.5$ and 32.9 MeV (1985FR01). See also ^{10}B in (1988AJ01) and (1983KU17, 1988BO1J).

40. (a) ^{7}Li(^{6}Li, ^{7}Li)^{6}Li
(b) ^{7}Li(^{7}Li, ^{8}Li)^{6}Li $\qquad Q_m = -5.2171$

At $E(^6\text{Li}) = 93$ MeV a broad group ($\Gamma \approx 11$ MeV) centered at $E_x = 20$ MeV is reported in addition to other peaks at $E_x = 17.1 \pm 0.3$, 18.9 ± 0.3 and 21.2 ± 0.3 MeV (1987GLZW). See (1984KO25) for reaction (b).

41. ^{9}Be(γ, t)^{6}Li $\qquad Q_m = -17.6885$

Cross section measurements were made with virtual photons using electrons at 21.0–39.0 MeV (1999SH05). A compilation and evaluation of cross section data for $E_\gamma < 30$ MeV has been done by (1999ZHZN).

42. (a) ^{9}Be(p, α)^{6}Li $\qquad Q_m = 2.1254$
(b) ^{9}Be(p, 2α)^{2}H $\qquad Q_m = 0.6510$
(c) ^{9}Be(p, pt)^{6}Li $\qquad Q_m = -17.6885$

Angular distributions of α-particles (reaction (a)) have been measured at $E_p = 0.11$ to 45 MeV. [see (1974AJ01, 1979AJ01)] and at $E_p = 22.5$, 31 and 41 MeV (1986HA27; α_0, α_1, α_2; see for spectroscopic factors). See also Table 6.12 and (1984AJ01). Recent measurements of angular distributions and analyzing power at $E_p = 77$–321 keV are reported by (1998BR10). Measurements at $E_x = 1$ GeV are reported in (2000ANZX). Calculations of the cross section and polarization observables for $E_p = 40$ MeV are reported in (2000GA49, 2000GA59). A study of possible reasons for non-observation of certain ^{6}Li excited states in the reaction is discussed in (1999TI07). ^{6}Li*(3.56) decays by γ-emission consistent with M1; $\Gamma_\alpha/\Gamma < 0.025$ [forbidden by spin and parity conservation]: see (1984AJ01). An analysis of the ^{9}Be(p, α) cross section at $E_p = 16$–700 keV is described in (2001BA47). Astrophysical S-factor, analyzing powers and R-matrix parameters were deduced. At $E_p = 9$ MeV the yield of reaction (b) is dominated by FSI through ^{8}Be*(0, 2.9) and ^{6}Li*(2.19) with little or no yield from direct three-body decay: see (1979AJ01). More recent measurements of cross sections and/or polarization observables have been reported at $E_p = 50$ MeV (1989GU05), $E_p = 25$, 30 MeV (1992PE12; determined spectroscopic strengths), $E_p = 40$ MeV (1997FA17) [see also (1989FA1B)], $E_p = 2$–5 MeV (1988ABZW), $E_p = 16$–390 keV [deduced $S(E)$] (1997ZA06), $E_p = 77$–321 keV [deduced stellar reaction rates] (1998BR10), $E_p = 30$–300 keV (2000ISZZ). See also application-related experiments (1990RE09, 1995RI14). Analyses of data for this reaction have been reported for $E_p = 45$–50 MeV [DWBA] (1996YA09, 1997YAZV) and $E_p < 2$ MeV [analyzed reaction rates, primordial ^{6}Li] (1997NO04). Reactions (b) and (c) at $E_p = 58$ MeV involve ^{6}Li*(0, 2.19) (1985DE17). See also ^{10}B in (1988AJ01) and (1985MAZG, 1986AN26, 1986KA26).

43. ^{9}Be(d, ^{5}He)^{6}Li $\qquad Q_m = -0.897$

See ^{5}He.

44. ^{9}Be(t, ^{6}He)^{6}Li $\qquad Q_m = -5.3830$

Angular distributions of $^6He_{g.s.} + {}^6Li_{g.s.}$ and $^6He_{g.s.} + {}^6$Li*(3.56) [both ions listed were detected] have been measured at $E_t = 21.5$ and 23.5 MeV. In the latter case the final state is composed of two isobaric analog states: angular distributions are symmetric about $90°$ cm, within the overall experimental errors. In the reaction leading to the ground states of ^{6}He and ^{6}Li differences from symmetry of as much as 40% are observed at forward angles. Angular distributions involving $^6He_{g.s.} +$ ^{6}Li*(2.19) and $^6Li_{g.s.} + {}^6$He*(1.8) have also been measured. This reaction appears to proceed predominantly by means of the direct pickup of a triton or ^{3}He from ^{9}Be. Differential cross sections are also reported at $E_t = 17$ MeV: see (1984AJ01) for references.

45. ^{9}Be(^{3}He, ^{6}Li)^{6}Li $\qquad Q_m = -1.8938$

Angular distributions of ^{6}Li ions have been obtained at $E(^3\text{He}) = 6$ to 10 MeV: see (1974AJ01). A study of the continuum suggests the population of ^{6}Li states at $E_x = 8$–12, ≈ 21 and 21.5 MeV: see (1984AJ01). More recently, measurements at $E(^3\text{He}) = 60$ MeV of differential cross sections have been reported (1990MA1O, 1990MAZG, 1995MA57). Spectroscopic factors were deduced. Angular distributions at $E(^3\text{He}) = 60$ MeV for transition to the ^{6}Li ground state and to ^{6}Li*(3^+, 2.185; 2^+, 5.37; 1^+, 5.65) were measured (1996RU13) and analyzed by coupled-channels methods.

46. ^{10}B(n, ^{5}He)^{6}Li $\qquad Q_m = -5.258$

Differential cross sections are reported at $E_n = 14.4$ MeV involving ^{6}Li*(2.19) and $^5He_{g.s.}$ (1984TU02).

47. ^{10}B(d, ^{6}Li)^{6}Li $\qquad Q_{\rm m} = -2.9861$

Angular distributions involving ^{6}Li*(0, 2.19) have been studied at $E_{\rm d} = 13.6$ MeV (1983DO10) and at 19.5 MeV [see (1974AJ01)]. See also (1984SHZJ).

48. ^{10}B(^{3}He, ^{7}Be)^{6}Li $\qquad Q_{\rm m} = -2.8738$

Angular distributions involving ^{6}Li*(0, 2.19) have been measured at $E(^{3}{\rm He}) = 30$ MeV: see (1974AJ01).

49. ^{10}B(α, ^{8}Be)^{6}Li $\qquad Q_{\rm m} = -4.5522$

At $E_{\alpha} = 72.5$ MeV only ^{6}Li*(0, 2.19) are observed: the latter is excited much more strongly than is the ground state [S_{α} for the ground state is 0.4 that for ^{6}Li*(2.19)]. The angular distributions for both transitions are flat: see (1979AJ01). See also (1984AJ01). A more recent measurement of differential cross sections at $E_{\alpha} = 27.2$ MeV is reported in (1995FA21). Spectroscopic factors were deduced.

50. ^{11}B(d, ^{7}Li)^{6}Li $\qquad Q_{\rm m} = -7.1903$

See (1984AJ01).

51. ^{11}B(^{3}He, ^{8}Be)^{6}Li $\qquad Q_{\rm m} = 4.5712$

Angular distributions are reported at $E(^{3}{\rm He}) = 71.8$ MeV involving several states in ^{8}Be (1986JA02, 1986JA14).

52. ^{12}C(p, ^{7}Be)^{6}Li $\qquad Q_{\rm m} = -22.5668$

Angular distributions involving ^{7}Be*(0, 0.43) have been measured at $E_{\rm p} = 40.3$ MeV (1985DE05). For the earlier work at $E_{\rm p} = 30.6$ to 56.8 MeV see (1974AJ01, 1979AJ01). See also references cited in (1988AJ01).

53. ^{12}C(d, ^{8}Be)^{6}Li $\qquad Q_{\rm m} = -5.8922$

Angular distributions involving states in ^{8}Be have been studied at $E_{\rm d} = 19.5$ and 51.8 MeV [see (1974AJ01)] and at 50 MeV (1985GO1G, 1989GO07, 1989GO26), 54.2 MeV (1984UM04) and 78 MeV (1986JA14), as well as at $E_{\rm d} = 18$ and 22 MeV (1987TA07) and 51.7 MeV (1986YA12). See also (1984NE1A, 1987GO1S) and the DWBA calculations at $E_{\rm d} = 50$ MeV (1988KA46) and $E_{\rm d} = 15$ MeV (1988RA27).

54. ^{12}C(^{3}He, ^{9}B)^{6}Li $\qquad Q_{\rm m} = -11.5708$

Angular distributions have been obtained at $E(^{3}{\rm He}) = 28$ to 40.7 MeV [see (1974AJ01)] and at $E(^{3}{\rm He}) = 33$ MeV (1989SI02), $E(^{3}{\rm He}) = 33.4$ MeV (1986CL1B; also $A_{\rm y}$), $E(^{3}{\rm He}) = 60$ MeV (1990MAZG, 1993MA48), $E(^{3}{\rm He}) = 30$–60 MeV (1995MA57). See also (1989GL1D) and see ^{9}B in (1988AJ01).

55. (a) ^{12}C(α, ^{10}B)^{6}Li $\qquad Q_{\rm m} = -23.7122$

(b) ^{12}C(α, dα)^{10}B $\qquad Q_{\rm m} = -25.1865$

Angular distributions (reaction (a)) at $E_{\alpha} = 42$ MeV involve ^{6}Li*(0, 2.19): see (1974AJ01). Differential cross sections were measured at $E_{\alpha} = 90$ MeV and cluster spectroscopic amplitudes were deduced (1991GL03). At $E_{\alpha} = 65$ MeV reaction (b) goes via ^{6}Li*(2.19, 4.31): see (1984AJ01). See also ^{10}B in (1988AJ01) and (1987GA20).

56. (a) ^{12}C(^{6}Li, α)^{14}N $\qquad Q_{\rm m} = 8.7980$

(b) ^{12}C(^{6}Li, αd)^{12}C $\qquad Q_{\rm m} = -1.4743$

An analysis involving excited states of ^{6}Li and ^{14}N was applied to cross section and analyzing power data at $E(^{6}{\rm Li}) = 33$ MeV by (2000MA43).

Measurements of triple differential cross sections for elastic breakup of 156 MeV ^{6}Li (reaction (b)) were reported in (1989HE28, 1989HE17, 1989RE1G). A diffraction dissociation model analysis was used. See also reaction 70. Partial cross sections for the $^{6}{\rm Li} + {}^{12}{\rm C}$ reaction were measured for $E(^{6}{\rm Li}) = 3.11$–12.07 MeV by (1998MU12).

57. ^{12}C(^{10}B, ^{16}O)^{6}Li $\qquad Q_{\rm m} = 2.7015$

See ^{16}O in (1986AJ04).

58. ^{12}C(^{11}B, ^{6}Li)^{17}O $Q_{\rm m} = -4.609$

Measurements of angular distributions at $E(^{11}\text{B}) = 25$, 35, 40 MeV have been reported by (1996JA12). Transfer mechanisms were studied.

59. ^{12}C(^{12}C, ^{12}C)^{6}Li^{6}Li $Q_{\rm m} = -28.1726$

The fragmentation of ^{12}C into two ^{6}Li ions has been observed at $E(^{12}\text{C}) = 2.1$ GeV/A (1986LIZP).

60. ^{12}C(^{14}N, ^{20}Ne)^{6}Li $Q_{\rm m} = -4.1810$

Angular distributions of reaction products were measured for $E(^{14}\text{N}) = 50$ MeV, and multi-nucleon transfer mechanisms were studied (1992ARZX). See also the analysis for $E(^{14}\text{N}) = 54$ MeV (1987GO12), and see ^{20}Ne in (1987AJ02, 1998TI06).

61. ^{13}C(p, ^{8}Be)^{6}Li $Q_{\rm m} = -8.6140$

See (1974AJ01).

62. ^{13}C(t, ^{6}Li)^{10}Be $Q_{\rm m} = -8.6181$

Measurements of differential cross sections and analyzing powers were reported by (1989SI02). Spectroscopic factors were extracted.

63. ^{13}C(^{3}He, ^{6}Li)^{10}B $Q_{\rm m} = -8.0809$

Differential cross sections at $E(^{3}\text{He}) = 60$ MeV have been reported (1990MAZG, 1995MA57). Cluster pick-up mechanisms were studied.

64. ^{16}O(d, ^{12}C)^{6}Li $Q_{\rm m} = -5.6876$

Angular distributions and polarization observables involving ^{6}Li ions and several ^{12}C states are reported at $E_{\rm d} = 22$ MeV (1987TA07) and 51.7 MeV (1986YA12) and at $E_{\rm d} = 54.2$ MeV (1984UM04). See also (1984NE1A), and ^{12}C in (1990AJ01) for polarization studies.

65. ^{16}O(^{3}He, ^{6}Li)^{13}N $Q_{\rm m} = -9.2376$

Measurements and analyses of differential cross sections at $E(^{3}{\rm He}) = 30$–60 MeV have been reported (1995MA57).

66. ^{19}F(d, ^{6}Li)^{15}N $Q_{\rm m} = -2.5394$

Differential cross sections at $E_{\rm d} = 50$ MeV were reported (1990GO14).

67. ^{19}F(^{3}He, ^{16}O)^{6}Li $Q_{\rm m} = 4.0945$

Angular distributions have been measured at $E(^{3}{\rm He}) = 11$ to 40.7 MeV involving ^{6}Li*(0, 3.56) and various states of ^{16}O: see (1974AJ01, 1977AJ02). Differential cross sections have been reported for $E(^{3}{\rm He}) = 66$ MeV (1991MA56).

68. ^{58}Ni(^{6}Li, d)X

Measurement of the tensor analyzing power made at $E(^{6}{\rm Li}) = 34$ MeV (1978VE03) were analyzed to obtain the D- and S-state ratio for the $< {\rm d}\alpha|^{6}{\rm Li}|$ bound state overlap.

69. ^{138}Ba(^{6}Li, ^{9}Li)

Angular distributions measured for $E(^{6}{\rm Li}) = 21$–32 MeV are reported by (1999MA16).

70. (a) ^{208}Pb(^{6}Li, ^{6}Li)^{208}Pb
(b) ^{208}Pb(^{6}Li, αd)^{208}Pb $Q_{\rm m} = -1.4743$

For reaction (a) differential cross sections were measured at $E(^6\mathrm{Li}) = 25$–60 MeV and analyzed by the optical model (1994KE08, 1998KE03).

For reaction (b) measurements of triple differential cross sections for elastic breakup of 156 MeV ^{6}Li were reported in (1989HE28, 1989HE17, 1989RE1G). Data were analyzed on the basis of a diffractive disintegration approach. Breakup measurements at $E(^6\mathrm{Li}) = 60$ MeV were reported in (1988HE16). See also reaction 56, and see the theoretical study of angular correlation of breakup fragments in (1989BA25).

^{6}Be

(Figs. 6 and 7)

GENERAL: References to articles on general properties of ^{6}Be published since the previous review (1988AJ01) are grouped into categories and listed, along with brief descriptions of each item, in the General Tables for ^{6}Be located on our website at (*www.tunl.duke.edu/NuclData/General_Tables/6be.shtml*).

1. (a) $^3\mathrm{He}(^3\mathrm{He}, \gamma)^6\mathrm{Be}$ $\quad Q_\mathrm{m} = 11.4884$
   (b) $^3\mathrm{He}(^3\mathrm{He}, \mathrm{p})^5\mathrm{Li}$ $\quad Q_\mathrm{m} = 11.17$ $\quad E_\mathrm{b} = 11.49$
   (c) $^3\mathrm{He}(^3\mathrm{He}, 2\mathrm{p})^4\mathrm{He}$ $\quad Q_\mathrm{m} = 12.8596$
   (d) $^3\mathrm{He}(^3\mathrm{He}, ^3\mathrm{He})^3\mathrm{He}$
   (e) $^3\mathrm{He}(^3\mathrm{He}, \mathrm{pd})^3\mathrm{He}$ $\quad Q_\mathrm{m} = -5.4935$

The yield of γ-rays to ^{6}Be*(1.7) (reaction (a)) increases smoothly from 0.4 to 9.3 μb (assuming isotropy) for $0.86 < E(^3\mathrm{He}) < 11.8$ MeV (90°). No transitions are observed to $^6\mathrm{Be}_\mathrm{g.s.}$

Table 6.14: Energy levels of ^{6}Be

E_x (MeV ± keV)	$J^\pi; T$	Γ_cm	Decay	Reactions
g.s.	$0^+; 1$	92 ± 6 keV	p, α	2, 3, 4
1.67 ± 50 [a]	$(2)^+; 1$	1.16 ± 0.06 MeV	p, α	1, 2, 3, 4
23	4^-	broad	γ, ^{3}He	1, 3
26	2^-	broad	^{3}He	1, 3
27	3^-	broad	^{3}He	1

[a] See Table 6.8 in (1974AJ01).

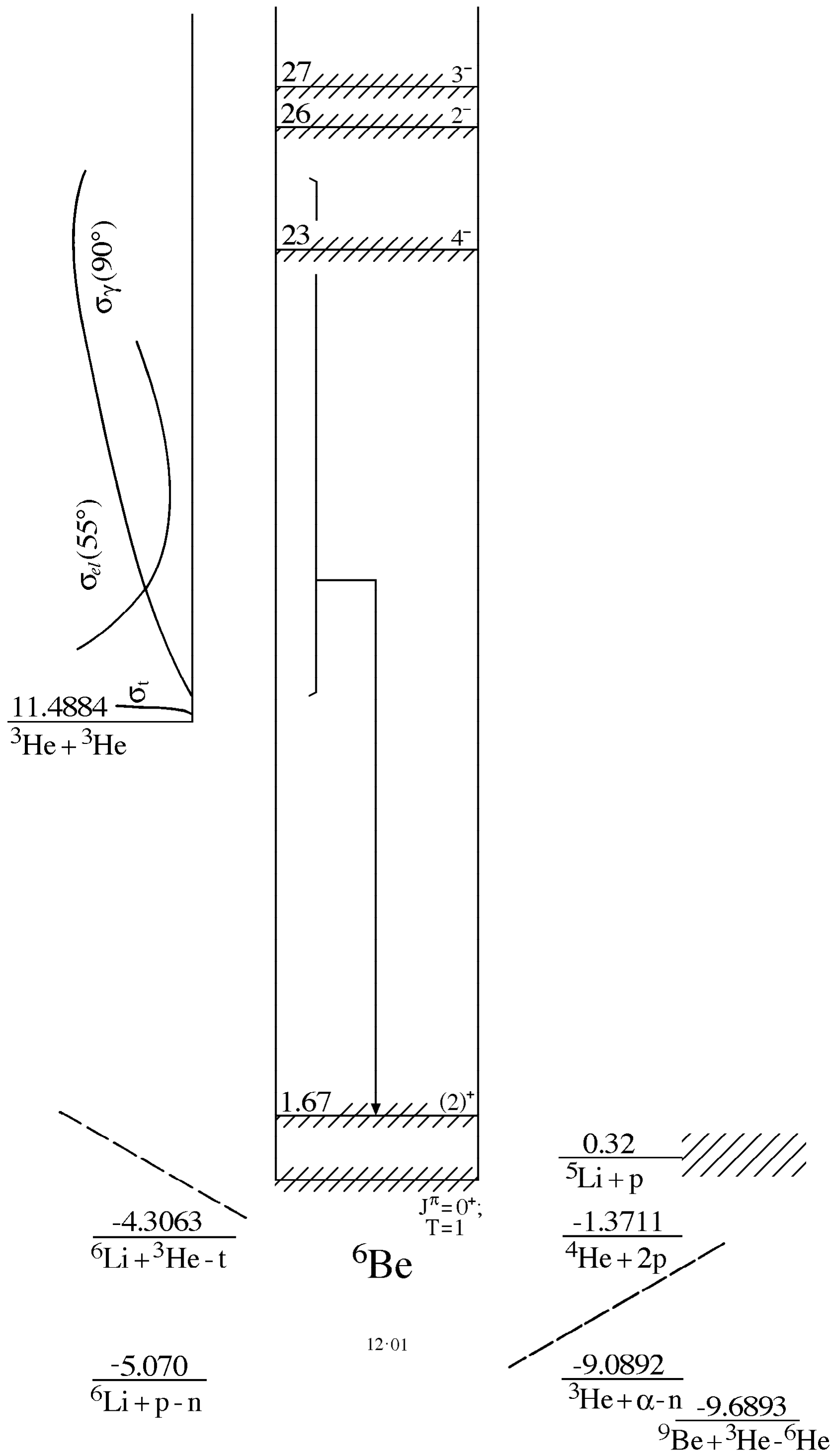


Figure 6: Energy levels of ^{6}Be. For notation see Fig. 5.

[$\sigma < 0.01$ μb at $E(^3\text{He}) = 1.4$ MeV]. This is understood in terms of a direct capture of ^{3}He by ^{3}He in the singlet spin state and with zero angular momentum: the $0^+ \rightarrow 0^+$ γ-transition is forbidden. Reaction (a) is thus of negligible astrophysical importance compared to reaction (c): see (1979AJ01). The capture cross section from $E(^3\text{He}) = 12$ MeV to 27 MeV continues to increase smoothly with energy at first and then shows a broad structure centered at $E(^3\text{He}) = 23 \pm 1$ MeV [$E_x = 23.0 \pm 0.5$ MeV], $\Gamma_{cm} \approx 5$ MeV. This appears to be a ^{33}F cluster resonance which decays by an E1 transition to ^{6}Be*(1.7). The γ-ray angular distributions are consistent with $J^\pi = 3^-$: see (1979AJ01). See also (1989IS1B). Thermonuclear reaction rates for this reaction calculated from evaluated data are presented in the compilation (1999AN35).

A_y has been measured for $E(^3\text{He}) = 14$ to 30 MeV [reaction (b)] by (1983KI10) using a polarized target. See also ^{5}Li.

Measurements of the total cross section for reaction (c) have been carried out for $E(^3\text{He}) = 60$ keV to 2.2 MeV [see (1979AJ01)] and for 36 to 685 keV (1987KR09). The measurements are consistent with a non-resonant reaction mechanism, at least down to $E_{cm} = 24.5$ keV. Upper limits for $\omega\gamma$ for a resonance below that energy (and with E_R (cm) as low as 16.2 keV) [which might help explain the low observed flux of solar neutrinos], are given in (1987KR09). [It should be noted that a corresponding mirror state in ^{6}He has not been observed.] The best fit to the data is given by $S(0) = 5.57 \pm 0.31$ MeV $\cdot$ b (1987KR09). See (1979AJ01) for the earlier work. See also (1966LA04, 1974AJ01). For work on astrophysical considerations see references cited in (1988AJ01), and see also the following work: thermonuclear reaction rates calculated from evaluated data (1988CA26, 1999AN35); dynamic screening (1988CA1J); neutrino astrophysics (1989BA2P); reaction rates (1989SC25); plasma fusion (1988PO1J); S factors, RGM (1989VA20); cross sections, extended elastic model (1990SC15); cross sections, microscopic study (1991TY01); phase shifts, generator coordinate method (1990KR12); astrophysical S-factor, potential model (1992WI09); cross sections, microscopic analysis (1994DE27); S factor, electron screening effects (1989BE08); and nucleosynthesis around black holes (1989JI1A). (1985SI12) report α-d correlation measurements at $E(^3\text{He}) = 13.6$ MeV, which suggest the breakup of the diproton (^{2}He) into $^2\text{H} + \text{e}^+ + \nu$.

The elastic scattering (reaction (d)) has been studied for $E(^3\text{He}) = 3$ to 32 MeV and at 120 MeV. The excitation function shows a smooth monotonic behavior except for an anomaly at $E(^3\text{He}) = 25$ MeV in the $L = 3$ partial wave corresponding to a broad state in ^{6}Be at $E_x \approx 24$ MeV. Polarization measurements have been carried out at $E(^3\vec{\text{He}}) = 17.9$ to 32.9 MeV. A two level R-matrix analysis of the phase shifts ($L \leq 5$) suggests three broad F-wave states at $E_x \approx 23.4$, 26.2 and 26.7 MeV [$J^\pi = 4^-$, 2^- and 3^-, respectively], in disagreement with the capture γ-ray results described above: see (1979AJ01). Calculations using the generator coordinate method have been reported for phase shifts ($E(^3\text{He}) < 5$ MeV) (1990KR12), and for differential cross sections and astrophysical S factors ($E(^3\text{He}) = 2$–6 MeV) (1994DE27). See also (1984AJ01) and (1986FO04).

A kinematically complete experiment (reaction (e)) has been performed at $E(^3\text{He}) = 120$ MeV: large peaks were observed which appear to correspond to ^{3}He-d quasi-free scattering followed by p-d FSI: see (1984AJ01).

The total reaction cross sections $\sigma_R = 156.7 \pm 3.8$, 250 ± 14 and 296 ± 12 mb at $E(^3\text{He}) = 17.9$, 21.7 and 24.0 MeV (1987BR02) [see also for partial cross sections for the breakup reactions and for unpublished results for σ_R for $E(^3\text{He}) = 3.0$ to 17.9 MeV]. See also (1984AJ01) and references cited in (1988AJ01).

2. ^{4}He(^{3}He, n)^{6}Be $\qquad Q_m = -9.0892$

Neutron groups to ^{6}Be*(0, 1.7) have been observed at $E(^3\text{He}) = 19.4$ to 38.61 MeV: see Table 6.8 in (1974AJ01) for the parameters of the first-excited state. There is no evidence for other states of ^{6}Be with $E_x \leq 5$ MeV, nor for a state near the ^{3}He threshold at 11.5 MeV: see (1979AJ01).

3. (a) ^{6}Li(p, n)^{6}Be $\qquad Q_m = -5.070$

(b) ^{6}Li(p, pn)^{5}Li $\qquad Q_m = -5.39$

Neutron groups have been observed to ^{6}Be*(0, 1.7) as has the ground-state threshold. The width of the ground state is 95 ± 28 keV. The parameters of ^{6}Be*(1.7) are displayed in Table 6.8 of (1974AJ01). Angular distributions have been reported at $E_p = 8.3$ to 144 MeV [see (1979AJ01, 1984AJ01)] and at 800 MeV (1986KI12). The transverse spin transfer coefficient, D_{NN} $(0°)$, at $E_p = 160$ MeV for the ground-state transition is -0.37 ± 0.04 in agreement with results in other light nuclei (1984TA07). See also ^{7}Be and references cited in (1988AJ01).

In more recent work, evidence for a proportionality between $\sigma_{pn}(0°)$ and Gamow-Teller transition strengths were examined (1987TA13). See also (1989RA1G). Measurements are reported at: $E_p = 60$–200 MeV [$D_{NN}(0°)$ (1990RA08)]; $E_p = 256$, 800 MeV [double differential cross sections (1993ST06)]; $E_p = 186$ MeV [polarization observables (1993WAZX, 1993YAZZ, 1994RA23), quasi-free excitations (1994WA22, 1999WAZV), dipole excitations (1995YA12)]; $E_p = 392$ MeV [$\sigma(\theta)$, $A_y(\theta)$ (1994TO08)]; $E_p = 300$, 400 MeV [quasi-free excitations, $D_{NN}(0°)$ (1994SA43)]; $E_p = 295$ MeV [spin-flip strength, $D_{NN}(0°)$ (1995WA16)]; $E_p = 200$ MeV [$A_y(\theta)$ (1995WAZW)]; $E_p = 35$ MeV [$\sigma(\theta)$ (1996ORZZ, 1998OR1B)]; and $E_p = 280$ MeV [$\sigma(\theta)$, isospin-symmetry test (1990MI10)]. For recent applications see (1998HA24, 1998WA12). Calculations with a dynamical multicluster model are discussed in (1991DA08, 1993SH1G). See also the review of two-particle neutron halo nuclei in (1996DA31).

In reaction (b) some evidence has been reported at $E_p = 47$ MeV for sequential decay via ^{6}Be*(15.5 ± 2, 24 ± 2): see (1979AJ01). See also (1988MIZX).

4. ^{6}Li(^{3}He, t)^{6}Be $\qquad Q_m = -4.3063$

Triton groups have been observed to ^{6}Be*(0, 1.7). The width of the ground state is 89 ± 6 keV. The parameters of the excited state are displayed in Table 6.8 of (1974AJ01). No other excited states have been seen with $E_x < 13$ MeV. There is no evidence for a state near 11.5 MeV: see (1979AJ01). (1987BO39) have studied the decay of ^{6}Be*(1.7) at $E(^3\text{He}) = 38.7$ MeV: they report that the branching ratio for decay via the emission of ^{2}He [$T = 1$, $S = 0$] is 0.60 ± 0.15: see also reactions 21 in ^{6}He and 38 in ^{6}Li and (1984BO49, 1985BO56, 1988BO1J). See also (1984AJ01), (1987DA31; theor.) and ^{9}B in (1988AJ01).

In more recent work, kinematically complete experiments for ^{6}Li(^{3}He, t)^{6}Be*(0, 1.7) $\rightarrow \alpha + \text{p} + \text{p}$ were reported in (1988BO38, 1989BO1N, 1989BO25, 1989BO42) and in (1992BO25, 1993BO38 [studied decay mechanism]). Measurements of differential cross sections at $E(^3\text{He}) = 93$ MeV are described in (1994DOZW).

^{6}B, ^{6}C
(Not illustrated)

Not observed: see (1979AJ01, 1984AJ01, 1989GR06 [^{6}Li(π^+, π^-) at $E_{\pi^+} = 180$, 240 MeV], 93PO11 [properties of exotic light nuclei]) (1998SU18).

Table 6.15: Isospin triplet components $(T = 1)$ in $A = 6$ nuclei [a]

^{6}He		^{6}Li			^{6}Be		
E_x (MeV)	J^π	E_x (MeV)	J^π; T	ΔE_x [b] (MeV)	E_x (MeV)	J^π	ΔE_x [c] (MeV)
0	0^+	3.56	0^+; 1		0	0^+	
1.80	2^+	5.37	2^+; 1	+0.01	1.67	(2)$^+$	−0.13
5.6	$(2^+, 1^-, 0^+)$						
14.6	$(1^-, 2^-)$	17.99	2^-; 1	−0.17	26	2^-	11.4
		24.78	3^-; 1		27	3^-	
		24.89	4^-; 1		23	4^-	
		26.59	2^-; 1				

[a] As taken from Tables 6.1, 6.4 and 6.14.

[b] Defined as $E_x(^7\text{Li}) - E_x(^6\text{He}) - 3.56$ MeV.

[c] Defined as $E_x(^6\text{Be}) - E_x(^6\text{He})$.

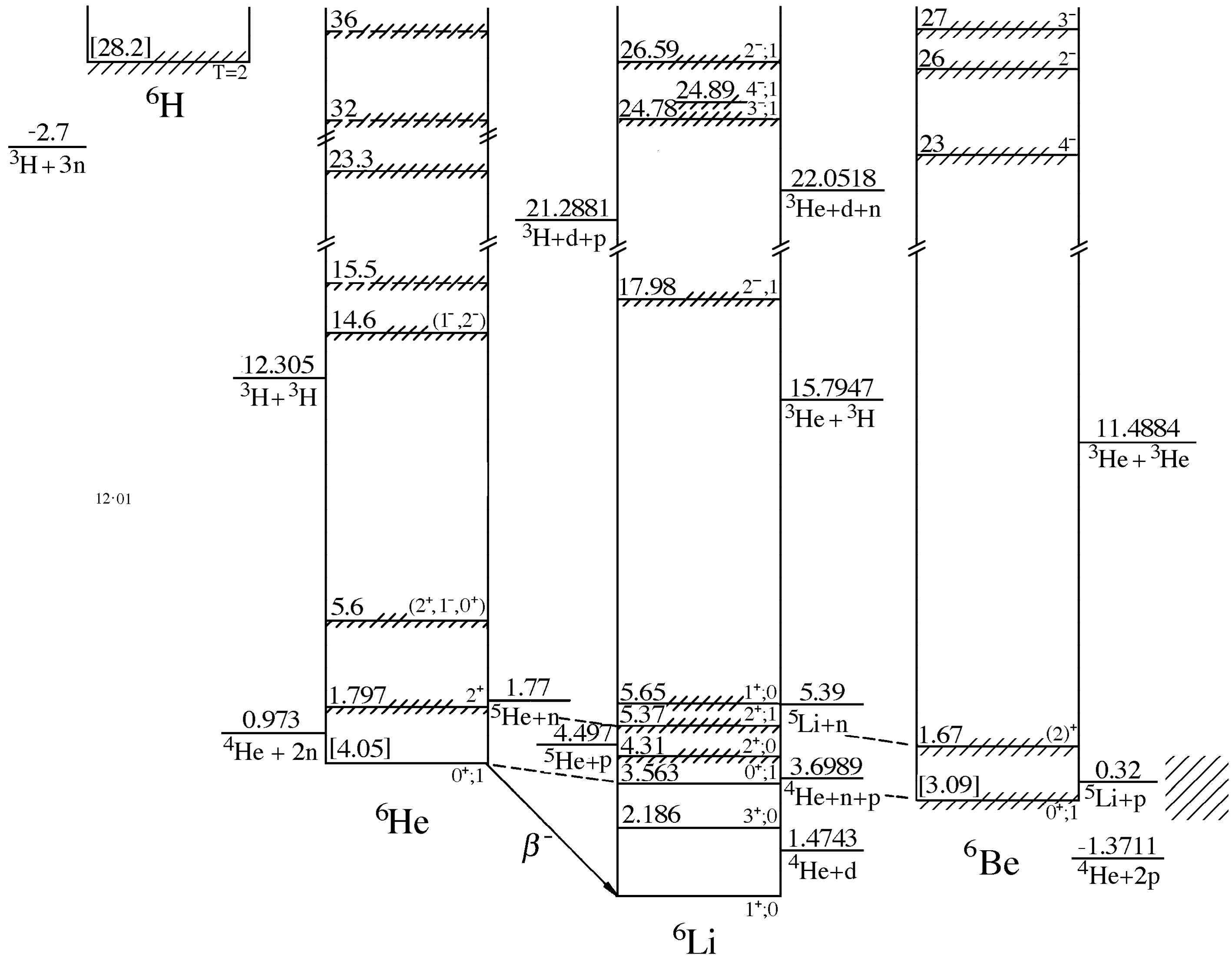


Figure 7: Isobar diagram, $A = 6$. For notation see Fig. 3.

References

(Closed 23 August 2001)

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.

1966LA04 T. Lauritsen and F. Ajzenberg-Selove, Nucl. Phys. 78 (1966) 1

1968BL10 S.L. Blatt, A.M. Young, S.C. Ling, K.J. Moon and C.D. Porterfield, Phys. Rev. 176 (1968) 1147

1968CO07 C.L. Cocke, Nucl. Phys. A110 (1968) 321

1969EI06 F. Eigenbrod, Z. Phys. 228 (1969) 337

1973VE09 E. Ventura, J.R. Calarco, W.E. Meyerhof and A.M. Young, Phys. Lett. B46 (1973) 364

1974AJ01 F. Ajzenberg-Selove and T. Lauritsen, Nucl. Phys. A227 (1974) 1

1977AJ02 F. Ajzenberg-Selove, Nucl. Phys. A281 (1977) 1

1977BR17 F.P. Brady, N.S.P. King, B.E. Bonner, M.W. McNaughton, J.C. Wang and W.W. True, Phys. Rev. C16 (1977) 31

1977VL01 R. Vlastou, J.B.A. England, O. Karban and S. Baird, Nucl. Phys. A292 (1977) 29

1978BO43 M.P. Bornand, G.R. Plattner, R.D. Viollier and K. Alder, Nucl. Phys. A294 (1978) 492

1978VE03 M.N. Vergnes, G. Rotbard, F. Guilbaut, D. Ardouin, C. Lebrun, E.R. Flynn, O.L. Hanson and S.D. Orbesen, Phys. Lett. B72 (1978) 447

1979AJ01 F. Ajzenberg-Selove, Nucl. Phys. A320 (1979) 1

1979BE38 J.C. Bergstrom, U. Deutschmann and R. Neuhausen, Nucl. Phys. A327 (1979) 439

1981RO02 R.G.H. Robertson, J.A. Nolen, Jr., T. Chapuran and R. Vodhanel, Phys. Rev. C23 (1981) 973

1982BE11 J.C. Bergstrom, S.B. Kowalski and R. Neuhausen, Phys. Rev. C25 (1982) 1156

1982KI11 J.C. Kim, J. Korean Phys. Soc. 15 (1982) 101

1983BA26 P.D. Barnes, B. Bassalleck, R.A. Eisenstein, G. Franklin, R. Grace, C. Maher, P. Pile, R. Rieder, J. Szymanski, W.R. Wharton et al., Nucl. Phys. A402 (1983) 397

1983BR23 M. Bruno, F. Cannata, M. D'Agostino, B. Jenny, W. Gruebler, V. Konig, P.A. Schmelzbach and P. Doleschall, Nucl. Phys. A407 (1983) 29

1983BR31 D.A. Bromley, Nucl. Phys. A400 (1983) 3c.

1983BR32 F. Brady, G.A. Needham, J.L. Romero, C.M. Castaneda, T.D. Ford, J.L. Ullmann and M.L. Webb, Phys. Rev. Lett. 51 (1983) 1320

1983CA13 G. Calvi, M. Lattuada, F. Riggi, C. Spitaleri, D. Vinciguerra and D. Miljanic, Lett. Nuovo Cim. 37 (1983) 279

1983CO1E H. Conde, T. Andersson, L. Nilsson and C. Nordborg, in Antwerp (1983) 447; Phys. Abs. (1984) 43476

1983DA22 J.H. Dave and C.R. Gould, Phys. Rev. C28 (1983) 2212

1983DO10 V.N. Dobrikov, O.F. Nemets, A.S. Gass and A.A. Shvedov, Izv. Akad. Nauk. SSSR, Ser. Fiz. 47 (1983) 943; Bull. Acad. Sci. USSR Phys. Ser. 47 (1983) 114

1983FU11 Y. Fujiwara and Y.C. Tang, Phys. Rev. C28 (1983) 1869

1983GLZZ C.W. Glover, C.C. Foster, P. Schwandt, J.R. Comfort, J. Rapaport, T.N. Taddeucci, D. Wong, J. Seubert and G. Wagner, Bull. Amer. Phys. Soc. 28 (1983) 996, EC3

1983GO06 O.K. Gorpinich, E.P. Kadkin, S.N. Kondratev, Yu.N. Lobach, M.V. Pasechnik, L.S. Saltykov and V.V. Tokarevsky, Izv. Akad. Nauk. SSSR Ser. Fiz. 47 (1983) 185; Bull. Acad. Sci. USSR Phys. Ser. 47 (1983) 179

1983IS10 M. Ishikawa, S. Seki, K. Furuno, Y. Tagishi, M. Sawada, T. Sugiyama, K. Matsuda, T. Murayama, N.X. Dai, J. Sanada et al., Phys. Rev. C28 (1983) 1884

1983JA13 B. Jakobsson, Phys. Scr. T5 (1983) 207

1983JE03 B. Jenny, W. Gruebler, V. Konig, P.A. Schmelzbach and C. Schweizer, Nucl. Phys. A397 (1983) 61

1983KI10 U. Kirchner, R. Beckmann, U. Holm and H.-G. Korber, Nucl. Phys. A405 (1983) 159

1983KU17 N. Kumar, Nucl. Phys. A410 (1983) 50

1983LE26 Y. Le Bornec, F. Hibou, L. Bimbot, T. Hennino, J.C. Jourdain, F. Reide, B. Tatischeff, N. Willis, E. Aslanides, G. Bergdolt et al., Phys. Lett. B133 (1983) 149

1983LO10 G.J. Lolos, R.R. Johnson, P. Couvert, J. McKenna, R. Myers, I. Spadinger and P. Lorrain, Phys. Lett. B126 (1983) 20

1983LY04 E.B. Levshin, K.G. Sailer and A.D. Foursat, Yad. Fiz. 38 (1983) 633; Sov. J. Nucl. Phys. 38 (1983) 377

1983NO08 E. Norbeck, P.T. Wu, C.R. Chen and R.R. Carlson, Phys. Rev. C28 (1983) 1140

1983OT02 K. Otozai, T. Sekine, R. Arakawa, K. Hata, T. Saito and H. Baba, Z. Phys. A311 (1983) 303

1983PO1B Poppe et al., AIP Conf. Proc. 97 (1983) 226

1983POZX C.H. Poppe, D. Rowley and F.S. Dietrich, Bull. Amer. Phys. Soc. 28 (1983) 969, AD8

1983RO12 R.G.H. Robertson and B.A. Brown, Phys. Rev. C28 (1983) 443

1983RU09 K. Rusek, Z. Moroz, R. Caplar, P. Egelhof, K.-H. Mobius, E. Steffens, I. Koenig, A. Weller and D. Fick, Nucl. Phys. A407 (1983) 208

1983SH1J K. Shibata and S. Shirato, J. Phys. Soc. Jpn. 52 (1983) 3748

1983VI03 M.F. Vineyard, J. Cook and K.W. Kemper, Nucl. Phys. A405 (1983) 429

1984AJ01 F. Ajzenberg-Selove, Nucl. Phys. A413 (1984) 1

1984AK01 A.I. Akhiezer and M.P. Rekalo, Dokl. Akad. Nauk. SSSR 274 (1984) 1079; Sov. Phys. Dokl. 24 (1984) 121

1984AL08 D.V. Aleksandrov, E.A. Ganza, Yu.A. Glukhov, B.G. Novatsky, A.A. Ogloblin and D.N. Stepanov, Yad. Fiz. 39 (1984) 513; Sov. J. Nucl. Phys. 39 (1984) 323

1984AR17 N. Arena, S. Cavallaro, A.S. Figuera, P. D'Agostino, G. Fazio, G. Giardina and F. Mezzanares, Lett. Nuovo Cim. 41 (1984) 59

1984BA19 I.Ya. Barit, L.S. Dulkova, E.V. Kuznetsova and N.M. Sobolevsky, Izv. Akad. Nauk. SSSR Ser. Fiz. 48 (1984) 380; Bull. Acad. Sci. USSR Phys. Ser. 48 (1984) 159

1984BA53 J. Bang, F.A. Gareev, S.A. Goncharov and G.S. Kazacha, Nucl. Phys. A429 (1984) 330.

1984BL21 L.D. Blokhintsev, A.M. Mukjamedzhanov and A.N. Safronov, Fiz. Elem. Chastits At. Yadra 15 (1984) 1296; Sov. J. Part. Nucl 15 (1984) 580

1984BO49 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, A.A. Ogloblin, L.V. Chulkov and G.B. Yankov, Pisma Zh. Eksp. Teor. Fiz. 40 (1984) 204; JETP Lett. (USSR) 40 (1984) 969

1984BR03 F.P. Brady, G.A. Needham, J.L. Ullmann, C.M. Castaneda, T.D. Ford, N.S.P. King, J.L. Romero, M.L. Webb, V.R. Brown and C.H. Poppe, J. Phys. G10 (1984) 363.

1984BR04 J. Brzychczyk, L. Freindl, K. Grotowski, Z. Majka, S. Micek, R. Planeta, M. Albinska, J. Buschmann, H. Klewe-Nebenius, H.J. Gils et al., Nucl. Phys. A417 (1984) 174

1984BU01 V.V. Burov, V.M. Dubovik, S.G. Kadmensky, Yu.M. Tchuvilsky and L.A. Tosunyan, J. Phys. G10 (1984) L21

1984CH16 E. Chiavassa, S. Costa, G. Dellacasa, N. De Marco, M. Gallio, A. Musso, E. Aslanides, P. Fassnacht, F. Hibou, T. Bressani et al., Nucl. Phys. A422 (1984) 621

1984DE53 P. De Bievre, M. Gallet, N.E. Holden and I.L. Barnes, J. Phys. Chem. Ref. Data 13 (1984) 809

1984DO20 T.W. Donnelly and I. Sick, Rev. Mod. Phys. 56 (1984) 461

1984DY01 N. Dytlewski, S.A. Siddiqui and H.H. Thies, Nucl. Phys. A430 (1984) 214

1984FE1A Ferch et al., INDC (CCP)-221/L (1984) 18

1984GE05 J.-F. Germond and C. Wilkin, J. Phys. G10 (1984) 745

1984GR20 K. Grotowski, Z. Majka, R. Planeta, M. Szczodrak, Y. Chan, G. Guarino, L.G. Moretto, D.J. Morrissey, L.G. Sobotka, R.G. Stokstad, I. Tserruya et al., Phys. Rev. C30 (1984) 1214

1984KI16 R.R. Kiziah, M.D. Brown, C.J. Harvey, D.S. Oakley, D.P. Saunders, P.A. Seidl, C.F. Moore, W.B. Cottingame, R.W. Garnett, S.J. Greene et al., Phys. Rev. C30 (1984) 1643.

1984KO25 I. Koenig, D. Fick, S. Kossionides, P. Egelhof, K.-H. Mobius and E. Steffens, Z. Phys. A318 (1984) 135

1984KR1B A.V. Kravtsov, N.P. Popov and G.E. Solvakin, Pisma Zh. Eksp. Teor. Fiz. 40 (9184) 124; JETP Lett. (USSR) 40 (1984) 875

1984LA19 M. Lattuada, F. Riggi, C. Spitaleri, D. Vinciguerra, G. Vourvopoulos, X. Aslanoglou and D. Miljanic, Phys. Rev. C30 (1984) 531

1984NA17 V.S. Nadezhdin, N.I. Petrov, V.I. Satarov and A.M. Rozanova, Yad. Fiz. 40 (1984) 27; Sov. J. Nucl. Phys. 40 (1984) 17

1984NE1A Nemets, Rudchik and Chuvilski, in Alma Ata (1984) 334

1984NI01 H. Nishioka, J.A. Tostevin, R.C. Johnson and K.-I. Kubo, Nucl. Phys. A415 (1984) 230

1984PA1B Pasechnik et al., in Alma Ata (1984) 288

1984RO04 R.G.H. Robertson, P. Dyer, R.C. Melin, T.J. Bowles, A.B. McDonald, G.C. Ball, W.G. Davies and E.D. Earle, Phys. Rev. C29 (1984) 755

1984SA39 L. Satta, J. Duflo, F. Plouin, P. Picozza, L. Goldzahl, J. Banaigs, R. Frascaria, F.L. Fabbri, A. Codino, J. Berge et al., Phys. Lett. B139 (1984) 263

1984SHZJ A.A. Shvedov, V.N. Dobrikov and O.F. Nemets, in Alma-Ata (1984) 332

1984SM04 G.R. Smith, J.R. Shepard, R.L. Boudrie, R.J. Peterson, G.S. Adams, T.S. Bauer, G.J. Igo, G. Pauletta, C.A. Whitten, Jr., A. Wriekat et al., Phys. Rev. C30 (1984) 593.

1984TA07 T.N. Taddeucci, T.A. Carey, C. Gaarde, J. Larsen, C.D. Goodman, D.J. Horen, T. Masterson, J. Rapaport, T.P. Welch and E. Sugarbaker, Phys. Rev. Lett. 52 (1984) 1960

1984TU02 M. Turk and B. Antolkovic, Nucl. Phys. A431 (1984) 381

1984UM04 K. Umeda, T. Yamaya, T. Suehiro, K. Takimoto, R. Wada, E. Takada, S. Shimoura, A. Sakaguchi, S. Murakami, M. Fukada et al., Nucl. Phys. A429 (1984) 88

1984VI01 M.F. Vineyard, K.W. Kemper and J. Cook, Phys. Lett. B142 (1984) 249

1984VI02 M.F. Vineyard, J. Cook, K.W. Kemper and M.N. Stephens, Phys. Rev. C30 (1984) 916

1984WA09 R.E. Warner, R.S. Wakeland, J.-Q. Yang, D.L. Friesel, P. Schwandt, G. Caskey, A. Galonsky, B. Remington and A. Nadasen, Nucl. Phys. A422 (1984) 205

1984WA18 M.W. Wade, M.K. Brussel, L.J. Koester, Jr. and J.H. Smith, Phys. Rev. Lett. 53 (1984) 2540

1985AJ01 F. Ajzenberg-Selove, Nucl. Phys. A433 (1985) 1; Erratum Nucl. Phys. A449 (1986) 155.

1985AK1B I. Akhiezer and M.P. Rekalo, Dokl. Akad. Nauk. SSSR 280 (1985) 83; Sov. Phys. Dokl. (USA) 30 (1985) 45

1985AL1G Aleksandrov et al., Questions in At. Phys. and in Tech., USSR (1985) 3

1985BAYZ I.Ya. Barit, Yu.G. Balashko, L.S. Dulkova and S.V. Zuev, Program and Theses, Proc. 35th Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Leningrad (1985) p. 307

1985BE30 S.L. Belostotsky, S.S. Volkov, A.A. Vorobyev, Yu.V. Dotsenko, L.G. Kudin, N.P. Kuropatkin, O.V. Miklukho, V.N. Nikulin and O.E. Prokofyev, Yad. Fiz. 41 (1985) 1425; Sov. J. Nucl. Phys. 41 (1985) 903

1985BO55 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, A.A. Ogloblin, L.V. Chulkov and G.B. Yankov, Pisma Zh. Eksp. Teor. Fiz. 42 (1985) 303; JETP Lett. (USSR) 42 (1985) 374

1985BO56 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, A.A. Ogloblin, L.V. Chulkov and G.B. Yankov, Pisma Zh. Eksp. Teor. Fiz. 42 (1985) 305; JETP Lett. (USSR) 42 (1985) 377

1985CA41 G.R. Caughlan, W. A. Fowler, M.J. Harris and B.A. Zimmerman, At. Data Nucl. Data Tables 32 (1985) 197

1985CH37 S. Chiba, M. Baba, H. Nakashima, M. Ono, N. Yabuta, S. Yukinori and N. Hirakawa, J. Nucl. Sci. Tech. (Tokyo) 22 (1985) 771

1985CO09 J. Cook and K.W. Kemper, Phys. Rev. C31 (1985) 1745

1985CU04 A. Cunsolo, A. Foti, G. Imme, G. Pappalardo, G. Raciti, F. Rizzo and N. Saunier, Nuovo Cim. A85 (1985) 343.

1985DA29 V. D'Amico, G. Fazio, S. Femino, G. Giardina, A. Italiano and F. Mezzanares, Can. J. Phys. 63 (1985) 1438

1985DE05 G. D'Erasmo, V. Variale and A. Pantaleo, Phys. Rev. C31 (1985) 656

1985DE17 E. Descroix, M. Bedjidian, J.Y. Grossiord, A. Guichard, M. Gusakow, M. Jacquin, J.R. Pizzi and G. Bagieu, Nucl. Phys. A438 (1985) 112.

1985DO16 Yu.V. Dotsenko and V.E. Starodubsky, Yad. Fiz. 42 (1985) 107; Sov. J. Nucl. Phys. 42 (1985) 66.

1985FR01 R. Franke, K. Kochskamper, B. Steinheuer, K. Wingender, W. Von Witsch and H. Machner, Nucl. Phys. A433 (1985) 351

1985GO1G Gorionov et al., in Leningrad (1985) 310

1985JA16 N. Jarmie and R.E. Brown, Nucl. Instrum. Meth. Phys. Res. B10-11 (1985) 405

1985JE04 B. Jenny, W. Gruebler, V. Konig and P.A. Schmelzbach, Nucl. Phys. A444 (1985) 93

1985KO29 Yu.E. Kozyr, V.I. Medvedev, Yu.N. Pavlenko and V.M. Pugach, Izv. Akad. Nauk. SSSR, Ser. Fiz. 49 (1985) 1026; Bull. Acad. Sci. USSR Phys. Ser. 49 (1985) 179

1985KR13 J.J. Kraushaar, P.D. Kunz, J.H. Mitchell, J.M. Cameron, D.A. Hutcheon, R.P. Liljestrand, W.J. McDonald, C.A. Miller, W.C. Olsen, J.R. Tinsley et al., Phys. Rev. C32 (1985) 1083

1985LU08 R.C. Luhn, S. Sen, N.O. Gaiser, S.E. Darden and Y. Koike, Phys. Rev. C32 (1985) 11

1985MAZG B.S. Mazitov and E.N. Rasulov, in Leningrad (1985) 298

1985MC05 B.J. McParland, E.G. Auld, P. Couvert, G.L. Giles, G. Jones, W. Ziegler, X. Aslanoglou, G.M. Huber, G.J. Lolos, S.I.H. Naqvi et al., Phys. Lett. B156 (1985) 47

1985ME02 A.C. Merchant and N. Rowley, Phys. Lett. B150 (1985) 35

1985MI05 S. Micek, Z. Majka, H. Rebel, H.J. Gils and H. Klewe-Nebenius, Nucl. Phys. A435 (1985) 621

1985MOZZ A. Mondragon and E. Hernandez, Bull. Amer. Phys. Soc. 30 (1985) 700, AE4

1985NI01 K. Nisimura, H. Shimizu, K. Imai, T. Ichihara, N. Matsuoka, K. Hatanaka, H. Sakai, T. Saito, K. Hosono, M. Kondo et al., Nucl. Phys. A432 (1985) 378

1985NO1A Norbeck and Lin, Bull. Amer. Phys. Soc. 30 (1985) 1248

1985OS02 H. Oswald, M. Buballa, J. Helten, M. Karus, B. Laumann, R. Melzer, P. Niessen, G. Rauprich, J. Schulte-Uebbing, H. Paetz gen. Schieck and Y. Koike, Nucl. Phys. A435 (1985) 77

1985PA04 M.V. Pasechnik, L.S. Saltykov, E.P. Kadkin, I.I. Loshchakov and A.I. Vdovin, Izv. Akad. Nauk. SSSR, Ser. Fiz. 49 (1985) 58; Bull. Acad. Sci. USSR Phys. Ser. 49 (1985) 61

1985PA1B Pasechnik, in Leningrad (1985) 265

1985PAZL M.V. Pasechnik, L.S. Saltykov, E.P. Kadkin, I.I. Loshchakov and A.I. Vdovin, in Leningrad (1985) 296

1985PO10 N.A.F.M. Poppelier, L.D. Wood and P.W.M. Glaudemans, Phys. Lett. B157 (1985) 120.

1985RE1A Repenko et al., in Leningrad (1985) 342

1985SA36 Y. Sakuragi, M. Kamimura, S. Micek, H. Rebel and H.J. Gils, Z. Phys. A322 (1985) 627

1985SE17 M.R. Sene, I. Anthony, D. Branford, A.G. Flowers, A.C. Shotter and C.H. Zimmerman, Nucl. Phys. A442 (1985) 215

1985SI12 B.K. Sinha, A.M. Nachabe, P. Bricault, J. Pouliot, L. Potvin, R. Roy and R.J. Slobodrian, Z. Phys. A321 (1985) 381

1985ST1A Stibunov, in Leningrad (1985) 341

1985TA13 I. Tanihata, H. Hamagaki, O. Hashimoto, S. Nagamiya, Y. Shida, N. Yoshikawa, O. Yamakawa, K. Sugimoto, T. Kobayashi, D.E. Greiner et al., Phys. Lett. B160 (1985) 380

1985TA18 I. Tanihata, H. Hamagaki, O. Hashimoto, Y. Shida, N. Yoshikawa, K. Sugimoto, O. Yamakawa, T. Kobayashi and N. Takahashi, Phys. Rev. Lett. 55 (1985) 2676

1985VI03 M.F. Vineyard, J. Cook and K.W. Kemper, Phys. Rev. C31 (1985) 879

1985WA25 R.E. Warner, J.-Q. Yang, D.L. Friesel, P. Schwandt, G. Caskey, A. Galonsky, B. Remington, A. Nadasen, N.S. Chant, F. Khazaie et al., Nucl. Phys. A443 (1985) 64

1985WO11 L.W. Woo, K. Kwiatkowski, S.H. Zhou and V.E. Viola, Phys. Rev. C32 (1985) 706

1986AJ04 F. Ajzenberg-Selove, Nucl. Phys. A460 (1986) 1

1986AK1C A.I. Akhiezer and M.P. Rekalo, Dokl. Akad. Nauk SSSR 287 (1986) 1365; Sov. Phys. Dokl. 31 (1986) 332

1986AN04 L.E. Antonuk, D. Bovet, E. Bovet, Y. De Coulon, J.-P. Egger, F. Goetz, P. Gretillat, C. Lunke, E. Schwarz, G.S. Adams et al., Nucl. Phys. A451 (1986) 741

1986AN26 B. Antolkovic, G. Paic and K. Kadija, Few-Body Syst. 1 (1986) 159

1986AV01 G.V. Avakov, L.D. Blokhintsev, A.M. Mukhamedzhanov and R. Yarmukhamedov, Yad. Fiz. 43 (1986) 824; Sov. J. Nucl. Phys. 43 (1986) 524

1986BA1R G. Baur, C.A. Bertulani and H. Rebel, in Heidelberg (1986) 980; Phys. Abs. 49378 (1987)

1986BA2G Barlamov, Ishkanov, Chernyaev and Eramzhian, in Kharkov (1986) 345

1986BE35 A.V. Belozyorov, C. Borcea, Z. Dlouhy, A.M. Kalinin, R. Kalpakchieva, Nguyen Hoai Chau, Yu.Ts. Oganessian and Yu.E. Penionzhkevich, Nucl. Phys. A460 (1986) 352

1986BR1N M. Bruno, F. Cannata, M.D. D'Agostino, M. Frisoni, H. Herman, B. Vuaridel, V. Konig, W. Gruebler, K. Elsener, P.A. Schemlzbach et al., Few-Body Syst. Suppl. 1 (1986) 211

1986BR20 R.E. Brown and N. Jarmie, Radiat. Eff. 92 (1986) 45

1986BR31 V.N. Bragin, N.T. Burtebaev, A.D. Dujsebaev, G.N. Ivanov, S.B. Sakuta, V.I. Chuev and L.V. Chulkov, Yad. Fiz. 44 (1986) 312; Sov. J. Nucl. Phys. 44 (1986) 198

1986BU07 V.V. Burov, V.M. Dubovik, S.G. Kadmensky, Yu.M. Tchuvilsky and L.A. Tosunyan, J. Phys. G12 (1986) 509

1986CL1B N.M. Clarke, P.J. Simmons, K.I. Pearce, S. Roman, A. Farooq and G. Rai, J. Phys. Soc. Jpn. Suppl. 55 (1986) 756

1986DO1K P. Doleschall, C. Chandler, M. Bruno, F. Cannata, M. D'Agostino and M.L. Fiandri, Few-Body Syst. Suppl. 1 (1986) 206

1986EN05 R. Ent, H.P. Blok, J.F.A. van Hienen, G. van der Steenhoven, J.F.J. van den Brand, J.W.A. den Herder, E. Jans, P.H.M. Keizer, L. Lapikas, E.N.M. Quint et al., Phys. Rev. Lett. 57 (1986) 2367

1986EV1A Evseev, Buki, Likhachev and Shevchenko, in Kharkov (1986) 350

1986FO04 D. Fox, D.A. Cebra, Z.M. Koenig, P. Ugorowski and G.D. Westfall, Phys. Rev. C33 (1986) 1540

1986GL07 I.V. Glavanakov, V.N. Eponeshnikov, Yu.F. Krechetov, G.M. Radutsky and V.A. Tryasuchev, Phys. Lett. B178 (1986) 155

1986GLZU Yu.A. Glukhov, E.I. Koshchy, N.S.Lutsay, Yu.G. Mashkarov, E.Yu. Nikolsky, A.T. Rudchik,S.B. Sakuta and K.F. Ustimenkov, in Kharkov (1986) 371

1986GO1M B.I. Goryachev, Sov. J. Nucl. Phys. 44 (1986) 252

1986GO23 S.A. Goncharov, Yu.I. Denisov, A.M. Mukhamedzhanov, E.A. Romanovsky, G.E. Valiev, I.R. Gulamov, T. Iskhakov, G. Ni, N.K. Timofeyuk, R. Yarmukhamedov et al., Yad. Fiz. 44 (1986) 303; Sov. J. Nucl. Phys. 44 (1986) 191

1986GR1D W. Gruebler, V. Konig, P.A. Schmelzbach, R.E. White, B. Vuaridel, C. Forstner, D. Singy, M. Bittcher and J. Ulbricht, J. Phys. Soc. Jpn. Suppl. 55 (1986) 884

1986HA27 H.J. Hauser, M. Walz, F. Weng, G. Staudt and P.K. Rath, Nucl. Phys. A456 (1986) 253

1986HAZR L.F. Hansen, J. Rapaport, X. Wang and F.A. Barrios, Bull. Amer. Phys. Soc. 31 (1986) 1237, ED3

1986JA02 L. Jarczyk, B. Kamys, Z. Rudy, A. Strzalkowski, B. Styczen, G.P.A. Berg, A. Magiera, J. Meissburger, W. Oelert, P. Von Rossen et al., Nucl. Phys. A448 (1986) 1

1986JA14 L. Jarczyk, B. Kamys, Z. Rudy, A. Strzalkowski, B. Styczen, G.P.A. Berg, A. Magiera, J. Meissburger, W. Oelert, P. von Rossen et al., Nucl. Phys. A459 (1986) 52

1986JA1E Jarime, Preprint LA-UR-86-3705 (1986)

1986KA26 K. Kadija and G. Paic, Phys. Rev. C34 (1986) 380

1986KI12 N.S.P. King, P.W. Lisowski, G.L. Morgan, P.N. Craig, R.G. Jeppesen, D.A. Lind, J.R. Shepard, J.L. Ullmann, C.D. Zafiratos, C.D. Goodman et al., Phys. Lett. B175 (1986) 279

1986KO1K H.-G. Korber, R. Beckmann, U. Holm and A. Lindner, J. Phys. Soc. Jpn. Suppl. 55 (1986) 632

1986KO1M V. Konig, P.A. Schmelzbach, W. Gruebler, Ch. Forstner, M. Bittcher, J. Ulbricht, B. Vuaridel and D. Singy, J. Phys. Soc. Jpn. Suppl. 55 (1986) 886

1986LA22 K. Langanke, Nucl. Phys. A457 (1986) 351

1986LA27 K. Langanke and C. Rolfs, Z. Phys. A325 (1986) 193

1986LI1F Likhachev et al., in Kharkov (1986) 349

1986LIZP P.J. Lindstrom, M.E. Baumgartner, E. Beleal, F. Bieser, M. Bronson, D.E. Greiner, C.P. McParland, D.L. Olson, H.J. Crawford, J. Engelage et al., Bull. Amer. Phys. Soc. 31 (1986) 888, KI5

1986MA19 J.F. Mateja, A.D. Frawley, L.C. Dennis and K. Sartor, Phys. Rev. C33 (1986) 1649

1986MC11 B.J. McParland, E.G. Auld, P. Couvert, G.L. Giles, G. Jones, W. Ziegler, X. Aslanoglou, G.M. Huber, G.J. Lolos, S.I.H. Naqvi et al., Nucl. Phys. A456 (1986) 629

1986ME13 T. Mertelmeier and H.M. Hofmann, Nucl. Phys. A459 (1986) 387

1986MI1E K. Miyagawa, Y. Koike, T. Ueda, T. Sawada and S. Takagi, J. Phys. Soc. Jpn. Suppl. 55 (1986) 890

1986MO1E Z. Moroz, J. Phys. Soc. Jpn. Suppl. 55 (1986) 221

1986MOZQ A. Mondragon and E. Hernandez, in Harrogate (1986) B10, 36

1986PE05 J.P. Perroud, A. Perrenoud, J.C. Alder, B. Gabioud, C. Joseph, J.F. Loude, N. Morel, M.T. Tran, E. Winkelmann, H. Von Fellenberg et al., Nucl. Phys. A453 (1986) 542

1986PF1A H.G. Pfutzner, A.L. Li, K. Murphy, C.R. Howell, M.L. Roberts, I. Slaus, R.L. Walter, M. Herman and H.M. Hofmann, J. Phys. Soc. Jpn. Suppl. 55 (1986) 556

1986RA1C C. Rai, C. Blyth and A. Farooq, J. Phys. Soc. Jpn. Suppl. 55 (1986) 1010

1986RI01 R. Rieder, P.D. Barnes, B. Bassalleck, R.A. Eisenstein, G. Franklin, R. Grace, C. Maher, P. Pile, J. Szymanski, W.R. Wharton et al., Phys. Rev. C33 (1986) 614

1986ROZK A. Roy, R.K. Bhowmik, C.V.K. Baba, M.G. Betigeri, R. Mythili and A.K. Jain, in Harrogate (1986) C225, 412

1986SC28 C.J.S. Scholz, L. Ricken and E. Kuhlmann, Z. Phys. A325 (1986) 203

1986SH14 K. Shoda, M. Torikoshi, O. Sasaki, S. Toyama, T. Kobayashi, A. Kagaya and H. Tsubota, Phys. Rev. C33 (1986) 2179

1986SHZP T. Shimoda, N. Ikeda, A. Nakamura, S. Shimoura, K. Katori, T. Fukuda and H. Ogata, in Harrogate (1986) C159, 346

1986TA06 H. Taneichi, H. Ueno, K. Shoda, Y. Kawazoe and T. Tsukamoto, Nucl. Phys. A448 (1986) 315

1986VA23 C.P.M. van Engelen, E.A. Bakkum, R.J. Meijer and R. Kamermans, Nucl. Phys. A457 (1986) 375.

1986VUZZ B. Vuaridel, W. Gruebler, V. Konig, P.A. Schmelzbach, K. Elsener, J. Ulbricht, D. Singy, Ch. Forstner, M. Bittcher, M. Bruno et al., in Harrogate (1986) 258, C71

1986YA12 T. Yamaya, J.I. Hirota, K. Takimoto, S. Shimoura, A. Sakaguchi, S. Kubono, M. Sugitani, S. Kato, T. Suehiro and M. Fukada, Phys. Rev. C34 (1986) 2369

1987AB09 S.N. Abramovich, L.A. Morkin, V.I. Serov and Yu.V. Strelnikov, Izv. Akad. Nauk SSSR Ser. Fiz. 51 (1987) 930; Bull. Acad. Sci. USSR Phys. Ser. 51 (1987) 92

1987AJ02 F. Ajzenberg-Selove, Nucl. Phys. A475 (1987) 1

1987AL23 D.V. Aleksandrov, Yu.A. Glukhov, B.G. Novatsky, E.Yu. Nikolsky, S.B. Sakuta and D.N. Stepanov, Yad. Fiz. 46 (1987) 385; Sov. J. Nucl. Phys. 46 (1987) 197

1987AR13 A.E. Aravantinos and A.C. Xenoulis, Phys. Rev. C35 (1987) 1746

1987AS06 E. Aslanides, D.M. Drake, J.C. Peng, D. Garreta, P. Birien, G. Bruge, H. Catz, A. Chaumeaux, S. Janouin, D. Legrand et al., Nucl. Phys. A470 (1987) 445

1987BA13 J. Banaigs, J. Berger, P. Berthet, G. Bizard, M. Boivin, M. De Sanctis, J. Duflo, F.L. Fabbri, R. Frascaria, L. Goldzahl et al., Phys. Rev. C35 (1987) 1416

1987BEYI A.V. Belozyorov, C. Borcea, Z. Dlouhy, A.M. Kalinin, N.H. Chau and Yu.E. Penionzhkevich, JINR-E15-87-733 (1987)

1987BO39 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, A.A. Ogloblin, L.V. Chulkov and G.B. Yankov, Yad. Fiz. 46 (1987) 12; Sov. J. Nucl. Phys. 46 (1987) 7

1987BO40 C. Borcea, A.V. Belozyorov, Z. Dlouhy, A.M. Kalinin, N.H. Chau and Yu.E. Penionzhkevich, Rev. Roum. Phys. 32 (1987) 497

1987BR02 R.E. Brown, F.D. Correll, P.M. Hegland, J.A. Koepke and C.H. Poppe, Phys. Rev. C35 (1987) 383

1987BR07 M. Bruno, F. Cannata, M. D'Agostino, M.L. Fiandri, M. Frisoni, H. Oswald, P. Niessen, J. Schulte-Uebbing, H. Paetz gen. Schieck, P. Doleschall et al., Phys. Rev. C35 (1987) 1563

1987BU27 N.T. Burtebaev, A.D. Duisebaev, V.S. Sadkovskii and G.A. Feofilov, Izv. Akad. Nauk SSSR Ser. Fiz. 51 (1987) 615; Bull. Acad. Sci. USSR Phys. Ser. 51 (1987) 191

1987CA30 G. Cardella, A. Cunsolo, A. Foti, G. Imme, G. Pappalardo, G. Raciti, F. Rizzo, N. Alamanos, B. Berthier and N. Saunier, Phys. Rev. C36 (1987) 2403

1987CH08 Z. Chen, C.K. Gelbke, J. Pochodzalla, C.B. Chitwood, D.J. Fields, W.G. Lynch and M.B. Tsang, Phys. Lett. B186 (1987) 280

1987CH33 Z. Chen, C.K. Gelbke, W.G. Gong, Y.D. Kim, W.G. Lynch, M.R. Maier, J. Pochodzalla, M.B. Tsang, F. Saint-Laurent, D. Ardouin et al., Phys. Rev. C36 (1987) 2297

1987DA31 B.V. Danilin, M.V. Zhukov, A.A. Korsheninnikov, L.V. Chulkov and V.D. Efros, Yad. Fiz. 46 (1987) 427; Sov. J. Nucl. Phys. 46 (1987) 225

1987DE02 A.C. Demiyanova, V.N. Bragin, A.A. Ogloblin, A.L. Lebedev, J.M. Bang, S.A. Goncharov, S.N. Ershov, F.A. Gareev and P.P. Korovin, Phys. Lett. B184 (1987) 129

1987EY01 W. Eyrich, A. Hofmann, A. Lehmann, B. Muhldorfer, H. Schlosser, H. Wirth, H.J. Gils, H. Rebel and S. Zagromski, Phys. Rev. C36 (1987) 416

1987FO08 D. Fox, D.A. Cebra, J. Karn, C. Parks, G.D. Westfall and W.K. Wilson, Phys. Rev. C36 (1987) 640

1987GA20 A.K. Ganguly, B. Chaudhuri and B.B. Baliga, Nuovo Cim. A97 (1987) 639

1987GL01 I.V. Glavanakov, A.L. Deynezhenko, V.N. Eponeshnikov, Yu.F. Krechetov, G.A. Pleshkov, G.M. Radutsky, G.A. Saruev, A.A. Sidorov, V.A. Tryasuchev and E.N. Shuvalov, Yad. Fiz. 45 (1987) 3; Sov. J. Nucl. Phys. 45 (1987) 1; Erratum Sov. J. Nucl. Phys. 46 (1987) 384

1987GLZW Yu.A. Glukhov, S.B. Sakuta and D.N. Stepanov, in Yurmala (1987) 383

1987GO12 M.S. Golovkov and V.Z. Goldberg, Izv. Akad. Nauk SSSR, Ser. Fiz. 51 (1987) 129; Bull. Acad. Sci. USSR, Phys. Ser. 51 (1987) 120

1987GO1S Goryunov et al., in Yurmala (1987) 474

1987GO27 S.A. Goncharov, A.M. Mukhamedzhanov, E.A. Romanovsky, G.E. Valiev, I.R. Gulamov, T. Iskhakov, G. Nie, N.K. Tomopheyuk, R. Yarmukhamedov, V. Kroha et al., Czech. J. Phys. B37 (1987) 168

1987GR08 W. Gruebler, Nucl. Phys. A463 (1987) 193c.

1987GUZZ I.R. Gulamov, T. Iskhakov, A.M. Mukhamedzhanov, Sh. Kayumov, A.A. Karakhodzhaev, G.K. Ni, E.A. Romanovsky and G.S. Valiev, in Yurmala (1987) 344

1987HE22 R. Helmer, Can. J. Phys. 65 (1987) 588

1987HU02 J.R. Hurd, J.S. Boswell, R.C. Minehart, L.B. Rees, Y. Tzeng, H.J. Ziock and K.O.H. Ziock, Nucl. Phys. A462 (1987) 605

1987HU13 J.R. Hurd, J.S. Boswell, R.C. Minehart, Y. Tzeng, H.J. Ziock, K.O.H. Ziock, L.C. Liu and E.R. Siciliano, Nucl. Phys. A475 (1987) 743

1987KO1X V.V. Komarov, A.M. Green, A.M. Popova and V.L. Shablov, Mod. Phys. Lett. A2 (1987) 81

1987KR07 A.T. Kruppa, R. Beck and F. Dickmann, Phys. Rev. C36 (1987) 327

1987KR09 A. Krauss, H.W. Becker, H.P. Trautvetter and C. Rolfs, Nucl. Phys. A467 (1987) 273

1987LA1J A. Lamberty, E. Michels and P. De Bievre, Int. J. Mass Spectrom. Ion Proc. 79 (1987) 311

1987LA25 M. Lattuada, F. Riggi, D. Vinciguerra, C. Spitaleri and D. Miljanic, Z. Phys. A328 (1987) 497

1987LE1N D.R. Lehman, AIP Conf. Proc. 162 (1987) 131

1987MO1I A. Mondragon and E. Hernandez, in Leuven (1988) 794

1987NA1I Naumenko et al., in Yurmala (1987) 370

1987NI04 W. Nitsche, G.J. Wagner, K.T. Knopfle, P. Grabmayr and Y. Kawazoe, Z. Phys. A326 (1987) 435

1987PA12 S.J. Padalino, K. Sartor, L.C. Dennis and K.W. Kemper, Phys. Rev. C35 (1987) 1692

1987PI06 I.M. Piskarev, Yad. Fiz. 45 (1987) 1222; Sov. J. Nucl. Phys. 45 (1987) 758

1987PO03 J. Pochodzalla, C.K. Gelbke, W.G. Lynch, M. Maier, D. Ardouin, H. Delagrange, H. Doubre, C. Gregoire, A. Kyanowski, W. Mittig et al., Phys. Rev. C35 (1987) 1695

1987PO18 D. Pocanic, K. Wang, C.J. Martoff, S.S. Hanna, R.C. Byrd, C.C. Foster, D.L. Friesel and J. Rapaport, Can. J. Phys. 65 (1987) 687

1987SA21 Y. Sakuragi, Phys. Rev. C35 (1987) 2161

1987TA07 Y. Tagishi, Y. Aoki, M. Kurokawa, T. Murayama, T. Sakai, M. Takei, M. Tomizawa and K. Yagi, Phys. Rev. C35 (1987) 1153

1987TA13 T.N. Taddeucci, C.A. Goulding, T.A. Carey, R.C. Byrd, C.D. Goodman, C. Gaarde, J. Larsen, D. Horen, J. Rapaport and E. Sugarbaker, Nucl. Phys. A469 (1993) 125

1987TA21 M. Tanaka, T. Yamagata, S. Nakayama, M. Inoue, Y. Sakuragi, M. Kamimura, K. Goto, K. Katori, M. Yanagi and H. Ogata, Phys. Rev. C36 (1987) 2146

1987TO06 M. Tosaki, M. Fujiwara, K. Hosono, T. Noro, H. Ito, T. Yamazaki and H. Ikegami, Nucl. Phys. A463 (1987) 429c.

1987VA05 V.V. Varlamov, B.S. Ishkhanov, V.V. Surgutanov, A.P. Chernyaev and R.A. Eramzhyan, Izv. Akad. Nauk SSSR Ser. Fiz. 51 (1987) 195; Bull. Acad. Sci. USSR Phys. Ser. 51 (1987) 179

1987VA08 G. van der Steenhoven, A.M. van den Berg, H.P. Blok, S. Boffi, J.F.J. van den Brand, R. Ent, T. de Forest, Jr., C. Giusti, J.W.A. den Herder, E. Jans et al., Phys. Rev. Lett. 58 (1987) 1727

1987VA1N Van Der Steenhoven et al., in Panic (1987) 618

1987VA31 S.P. Van Verst, D.P. Sanderson, K.W. Kemper, D. Shapira, R.L. Varner and B. Shivakumar, Phys. Rev. C36 (1987) 1865

1987VAZY S.P. van Verst, D.P. Sanderson, K.W. Kemper, D.E. Trcka, G.A. Hall, V. Hnizdo, K.R. Chapman and B.G. Schmidt, Bull. Amer. Phys. Soc. 32 (1987) 1547, AE10

1987VD1A A.I. Vdovin, A.V. Golovin and I.I. Loschakov, Sov. J. Part. Nucl. 18 (1987) 573

1987VU1A B. Vuaridel, W. Gruebler, V. Konig, P.A. Schmelzbach, K. Elsener, J. Ulbricht, D. Singy, Ch. Forstner, M. Bittcher, M. Bruno et al., Helv. Phys. Acta. 60 (1987) 326

1987VU1B B. Vuaridel, W. Gruebler, V. Konig, P.A. Schmelzbach, M. Bittcher, K. Elsener, Ch. Forstner, M. Bruno, F. Cannata, M. D'Agostino et al., Few-Body Syst. Suppl. 2 (1987) 504

1987ZA07 M. Zadro, D. Miljanic, M. Lattuada, F. Riggi and C. Spitaleri, Nucl. Phys. A474 (1987) 373

1988ABZW S.N. Abramovich, B.Ya. Guzhovsky and V.N. Protopopov, Program and Theses, Proc. 38th Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Baku, 1988, p. 299

1988AJ01 F. Ajzenberg-Selove, Nucl. Phys. A490 (1988) 1

1988AL1J I.M. Al-Khamiesi, B.K. Kerimov and M.Ya. Safin, Acta Phys. Pol. B19 (1988) 213

1988AR20 N. Arena, S. Cavallaro, G. Fazio, G. Giardina, A. Italiano and F. Mezzanares, J. Phys. Soc. Jpn. 57 (1988) 3773

1988BE1I Bekbaev et al., in Baku (1988) 442

1988BE2B S.L. Belostotsky, Yu.V. Dotsenko, N.P. Kuropatkin, O.V. Mikluho, V.N. Nikulin, O.E. Prokofiev, Yu.A. Scheglov, V.E. Starodubsky, A.Yu. Tsaregorodtsev, A.A. Vorobyov and M.B. Zhalov, in Novosibirsk (1988) 191

1988BE58 S.V. Berezovsky and A.P. Soznik, Ukr. Fiz. Zh. 33 (1988) 993

1988BEYJ A.V. Belozerov, K. Borcha, I. Vintsour, Z. Dlougy, N.K. Tyau and Yu.Eh. Penionzhkevich, in Baku (1988) 380.

1988BO18 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Yad. Fiz. 47 (1988) 616; Sov. J. Nucl. Phys. 47 (1988) 391

1988BO1J Bochkarev et al., in Baku (1988) 347

1988BO1Y F. Bonsignore, P. D'Agostino, G. Fazio, G. Giardina, S. Interdonato, A. Ltaliano, R. Palamara and A. Taccone, Report INFN/BE-88/5

1988BO37 C. Boni, E. Cereda, G.M. Braga Marcazzan and V. De Tomasi, Nucl. Instrum. Meth. Phys. Res. B35 (1988) 80

1988BO38 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Pisma Zh. Eksp. Teor. Fiz. 48 (1988) 124; JETP Lett. 48 (1988) 133

1988BR18 M. Bruno, F. Cannata, M. D'Aggostino, M.L. Fiandri, M. Herman, H.M. Hofmann, B. Vuaridel, V. Konig, W. Gruebler, P.A. Schmelzbach et al., Phys. Rev. C38 (1988) 521

1988BU1Q Buranov et al., in Baku (1988) 363

1988BU25 A.Yu. Buki, N.G. Shevchenko, V.N. Polishchuk, A.A. Khomich and B.V. Mazanko, Yad. Fiz. 48 (1988) 913

1988BUZH V.V. Buranov, N.I. Venikov, Yu.A. Glukhov, A.M. Dobychin, A.A. Ogloblin, S.B. Sakuta and V.N. Unezhev, in Baku (1988) 362

1988CA11 P.J. Carlos, Ph. Bourgeois, J. Fagot, J.L. Fallou, P. Garganne, J.M. Laget, A. Lepretre, A. de Miniac, A. Veyssiere, J. Jury et al., Phys. Lett. B203 (1988) 33

1988CA1J C. Carraro, A. Schafer and S.E. Koonin, Astrophys. J. 331 (1988) 565

1988CA26 G.R. Caughlan and W.A. Fowler, At. Data Nucl. Data Tables 40 (1988) 283

1988DI02 S.S. Dietrich and B.L. Berman, At. Data Nucl. Data Tables 38 (1988) 199

1988DU04 E.I. Dubovoy and G.I. Chitanava, Yad. Fiz. 47 (1988) 75; Sov. J. Nucl. Phys. 47 (1988) 48.

1988EL01 K. Elsener, W. Gruebler, F. Sperisen, K. Ghazi-Wakili, V. Konig, P.A. Schmelzbach, B. Vuaridel, M. Bittcher, D. Singy and J. Ulbricht, Nucl. Phys. A481 (1988) 227

1988ER06 R.A. Eramzhyan, M. Gmitro, T.D. Kaipov, S.S. Kamalov and R. Mach, J. Phys. (London) G14 (1988) 1511

1988ES01 A. Eskandarian, D.R. Lehman and W.C. Parke, Phys. Rev. C38 (1988) 2341; Erratum Phys. Rev. C39 (1989) 1188

1988FE06 D. Ferenc, B. Antolkovic and G. Paic, Fizika 20 (1988) 77

1988FU09 Y. Fujiwara, Q.K.K. Liu and Y.C. Tang, Phys. Rev. C38 (1988) 1531

1988GA14 N.O. Gaiser, S.E. Darden, R.C. Luhn, H. Paetz gen. Schieck and S. Sen, Phys. Rev. C38 (1988) 1119

1988GR32 K.A. Gridnev, V.B. Subbotin and S.N. Fadeev, Izv. Akad. Nauk SSSR Ser. Fiz. 52 (1988) 2262; Bull. Acad. Sci. USSR Phys. Ser. 52 (1988) 184

1988GUZW I.R. Gulamov, A.M. Mukhamedzhanov and G.K. Ni, in Baku (1988) 300

1988HA12 S.S. Hanna, J. Phys. (London) G14 (1988) S283

1988HA25 L.F. Hansen, J. Rapaport, X. Wang, F.A. Barrios, F. Petrovich, A.W. Carpenter and M.J. Threapleton, Phys. Rev. C38 (1988) 525

1988HA2C S.S. Hanna, in Novosibirsk (1988) 418

1988HE16 J. Hesselbarth, S. Khan, Th. Kihm and K.T. Knopfle, Z. Phys. A33 (1988) 365

1988JA01 K.P. Jackson, A. Celler, W.P. Alford, K. Raywood, R. Abegg, R.E. Azuma, C.K. Campbell, S. El-Kateb, D. Frekers, P.W. Green et al., Phys. Lett. B201 (1988) 25

1988KA09 K. Katori, T. Shimoda, T. Fukuda, S. Shimoura, A. Sakaguchi, M. Tanaka, T. Yamagata, N. Takahashi, H. Ogata, M. Kamimura et al., Nucl. Phys. A480 (1988) 323

1988KA25 H. Kanada, T. Kaneko and Y.C. Tang, Phys. Rev. C38 (1988) 2013

1988KA38 V.I. Karmanov, V.V. Komarov, A.M. Popova, N.A. Sotnikova and V.L. Shablov, Izv. Akad. Nauk SSSR Ser. Fiz. 52 (1988) 936; Bull. Acad. Sci. USSR Phys. Ser. 52 (1988) 99

1988KA41 V.L. Kashevarov and G.A. Sokol, Fiz. Elem. Chastits At. Yad. 19 (1988) 1299; Sov. J. Part. Nucl. 19 (1988) 560

1988KA46 V.G. Kadmensky, S.G. Kadmensky, P.A. Lukyanovich and A.T. Rudchik, Ukr. Fiz. Zh. 33 (1988) 1309

1988KH08 D.T. Khoa, Nucl. Phys. A484 (1988) 376

1988KO1C Kozchy, Mashkarov and Rudchik, in Baku (1988) 350

1988KO32 Yu.E. Kozyr and M.V. Sokolov , Izv. Akad. Nauk SSSR, Ser. Fiz. 52 (1988) 902; Bull. Acad. Sci. USSR, Phys. Ser. 52 (1988) 65

1988LA11 M. Lattuada, F. Riggi, D. Vinciguerra, C. Spitaleri, G. Vourvopoulos, D. Miljanic and E. Norbeck, Z. Phys. A330 (1988) 183

1988LA1C A. Lamberty and P. de Bievre, Int. J. Mass Spectrom. Ion Proc. 83 (1988) 135

1988LO1E R.W. Lourie, AIP Conf. Proc. 176 (1988) 103

1988MA1V V.E. Markushin, Muon Catal. Fusion 3 (1988) 395

1988MIZX J. Mildenberger, O. Hausser, R. Abegg, W.P. Alford, A. Celler, D. Frekers, R. Helmer, R. Henderson, K. Hicks, K.P. Jackson, R. Jeppesen et al., Bull. Amer. Phys. Soc. 33 (1988) 1180, AG5

1988MO1I A. Mondragón and E. Hernández, in Belgium (1988) 794

1988NA02 A. Nadasen, M. McMaster, G. Gunderson, A. Judd, S. Villanueva, P. Schwandt, J.S. Winfield, J. van der Plicht, R.E. Warner, F.D. Becchetti et al., Phys. Rev. C37 (1988) 132

1988NA06 R. Nagaoka and K. Ohta, Ann. Phys. 184 (1988) 148

1988NAZX A. Nadasen, A. McMaster, J. Tavormina, F.D. Becchetti, J.W. Janecke, P. Schwandt, J. Winfield and R.E. Warner, Bull. Amer. Phys. Soc. 33 (1988) 1101, KJ13

1988PA26 M.V. Pasechnik, V.B. Shostak, V.P. Badovsky, G.P. Palkin, S.B. Kumshaev and V.P. Likhachev, Izv. Akad. Nauk SSSR Ser. Fiz. 52 (1988) 928; Bull. Acad. Sci. USSR Phys. Ser. 52 (1988) 91

1988PA27 M.V. Pasechnik, V.B. Shostak, V.P. Badovsky, G.P. Palkin, P.G. Ofengenden, S.B. Kumshaev and V.P. Likhachev, Ukr. Fiz. Zh. 33 (1988) 976

1988PO1J C. Powell, J. Nering, B.C. Maglich and A. Wilmerding, Nucl. Instrum. Meth. Phys. Res. A271 (1988) 41

1988RA27 Md.A. Rahman, Nuovo Cim. A100 (1988) 419

1988SE07 V.M. Semjonov, K.M. Omar, K.A. Gridnev and E.F. Hefter, Phys. Rev. C38 (1988) 765

1988SU12 I. Supek, I. Slaus, Y. Koike, P.A. Treado and J.M. Lambert, Few-Body Syst. 4 (1988) 39

1988TA08 M. Tanaka, T. Yamagata, S. Nakayama, M. Inoue, K. Goto, K. Katori, M. Yanagi and H. Ogata, Nucl. Instrum. Meth. Phys. Res. A267 (1988) 139

1988TRZY D.E. Trcka, S.P. Van Verst, A.D. Frawley, K.W. Kemper, J.D. Fox, V. Hnizdo and E.G. Myers, Bull. Amer. Phys. Soc. 33 (1988) 1101, KJ12.

1988VAZY S.P. Van Verst, K.W. Kemper, D.E. Trcka, G.A. Hall, V. Hnizdo, K.R. Chapman and B.G. Schmidt, Bull. Amer. Phys. Soc. 33 (1988) 1101, KJ11.

1988VU01 B. Vuaridel, W. Gruebler, V. Konig, K. Elsener, P.A. Schmelzbach, J. Ulbricht, Ch. Forstner, M. Bittcher, D. Singy, M. Bruno et al., Nucl. Phys. A484 (1988) 34

1988WA24 K. Wang, C.J. Martoff, D. Pocanic, W.J. Cummings, S.S. Hanna, R.C. Byrd and C.C. Foster, Phys. Rev. C38 (1988) 2478

1988WA29 R.E. Warner, A. Okihana, M. Fujiwara, N. Matsuoka, K. Tamura, M. Tosaki, T. Ohsawa, K. Fukunaga, P.A. Kimoto and N. Koori, Phys. Rev. C38 (1988) 2945

1988WE20 H.R. Weller and D.R. Lehman, Ann. Rev. Nucl. Part. Sci. 38 (1988) 563

1988WO10 C.L. Woods, F.C. Barker, W.N. Catford, L.K. Fifield and N.A. Orr, Aust. J. Phys. 41 (1988) 525

1989AR02 T. A. Arakelyan, L. S. Davtyan and S. G. Matinyan, Yad. Fiz. 49 (1989) 86

1989AR08 N. Arena, Seb. Cavallaro, A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano, M. Herman and M. Lombardi, Phys. Rev. C40 (1989) 1126

1989AR20 N. Arena, Seb. Cavallaro, P. D'Agostino, G. Fazio, G. Giardina, A. Italiano, F. Mezzanares, M. Herman and M. Lombardi, Nuovo Cim. A102 (1989) 1327

1989ARZR N. Arena, Seb. Cavallaro, A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano, M. Herman, G. Reffo and A. Taccone, in Vancouver (1989) C25; TRI-89-2 (1989)

1989BA25 A.D. Bates, R.P. Rassool, E.A. Milne, M.N. Thompson and K.G. McNeill, Phys. Rev. C40 (1989) 506

1989BA2P J.N. Bahcall, Neutrino Astrophys. (Publ. Cambridge Univ. Press 1989)

1989BE08 Gy. Bencze, Nucl. Phys. A492 (1989) 459

1989BO1N Bochkarev et al., in Tashkent (1989) 334

1989BO25 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Yad. Fiz. 49 (1989) 1521

1989BO42 O. V. Bochkarev, L. V. Chulkov, A. A. Korsheninnikov, E. A. Kuzmin, I. G. Mukha and G. B. Yankov, Nucl. Phys. A505 (1989) 215

1989BR23 M. Bruno, F. Cannata, M. D'Agostino, M. L. Fiandri, M. Herman, H. M. Hofmann, B. Vuaridel, W. Gruebler, V. Konig, P. A. Schmelzbach et al., Nucl. Phys. A501 (1989) 462

1989BU10 N.A. Burkova, Yu.V. Vladimirov, V.B. Ganenko, V.A. Gushchin, I.G. Evseev, Yu.V. Zhebrovskij, M.A. Zhusupov, L.Ya. Kolesnikov, V.P. Likhachev, S.A. Pashchuk et al., Phys. Lett. B223 (1989) 136

1989CH2F L. Chatterjee, Indian J. Pure Applied Phys. 27 (1989) 787

1989CO22 M.E. Colin, C. Friedli and P. Lerch, Radiochim. Acta. 46 (1989) 13

1989CR01 R. Crespo, A. M. Eiro and F. D. Santos, Phys. Rev. C39 (1989) 305

1989DE1A A. De, S. Karmakar, T. Roychaudhury, S.S. Dasgupta, S.N. Chintalapudi, M. Ismail, S.R. Banerjee and A.S. Divatia, Indian J. Phys. B63 (1989) 94

1989DE34 A.S. Demyanova, J.M. Bang, F.A. Gareev, S.A. Goncharov, S.N. Ershov, A.A. Ogloblin and P.P. Korovin, Nucl. Phys. A501 (1989) 336

1989DO1B B. Doyle, B. Goulard and N.C. Mukhopadhyay, in Wein 89 (1989) 673

1989ER07 R.A. Eramzhyan, G.G. Ryzhikh, V.I. Kukulin and Yu.M. Tchuvilsky, Phys. Lett. B228 (1989) 1

1989ES05 A. Eskandarian, D.R. Lehman and W.C. Parke, Phys. Rev. C39 (1989) 1685

1989ET05 E. Etim and L. Satta, Nuovo Cim. A101 (1989) 775

1989FA1B Falk et al., in Sao Paulo (1989) 297

1989FI1E G.F. Filippov, Riv. Nuovo Cim. 12 (1989) 1

1989GL07 I.V. Glavanakov, A.L. Deinezhenko, V.N. Eponeshnikov, P.P. Krasnonosenkikh, Yu.F. Krechetov, N.A. Lashuk, G.A. Pleshkov and E.N. Shuvalov, Yad. Fiz. 50 (1989) 1516

1989GL1D Glovatska et al., Tashkent (1989) 339

1989GO07 O.Yu. Goryunov, S.G. Kadmensky, E.I. Koshchy, P.A. Lukyanovich, Yu.G. Mashkarov, O.F. Nemets and A.T. Rudchik, Yad. Fiz. 49 (1989) 421

1989GO18 A.M. Gorbatov, P.V. Komarov, Yu.N. Krylov, A.V. Bursak, V.L. Skopich, P.Yu. Nikishov and E.A. Kolganova, Yad. Fiz. 50 (1989) 347; Sov. J. Nucl. Phys. 50 (1989) 218

1989GO26 O. Yu. Goryunov, I. I. Zalyubovsky, E. I. Koshchy, S. B. Kumshaev, Yu. G. Mashkarov, O. F. Nemets, A. T. Rudchik, V. K. Chernievsky, O. A. Ponkratenk and A. V. Shustov, Ukr. Fiz. Zh. 34 (1989) 1144

1989GR02 M. Grote, C. Hammerich, H. Klindt and U. Strohbusch, Nucl. Phys. A491 (1989) 173

1989GR06 P.A.M. Gram, S.A. Wood, E.R. Kinney, S. Hoibraten, P. Mansky, J.L. Matthews, T. Soos, G.A. Rebka, Jr. and D.A. Roberts, Phys. Rev. Lett. 62 (1989) 1837

1989GU05 G.S. Gurevich, V.M. Lebedev, O.F. Nemets, Yu.N. Pavlenko, V.M. Pugach, A.V. Spassky and I.B. Teplov, Yad. Fiz. 49 (1989) 3

1989HA17 M. Haller, M. Betz, W. Kretschmer, A. Rauscher, R. Schmitt and W. Schuster, Nucl. Phys. A496 (1989) 189

1989HA18 M. Haller, W. Kretschmer, A. Rauscher, R. Schmitt and W. Schuster, Nucl. Phys. A496 (1989) 205

1989HAZV L.F. Hansen, F.S. Dietrich and R.L. Walter, Bull. Amer. Phys. Soc. 34 (1989) 1809

1989HE17 N. Heide, D. K. Srivastava and H. Rebel, Phys. Rev. Lett. 63 (1989) 601

1989HE28 N. Heide, H. Rebel, V. Corcalciuc, H. J. Gils, H. Jelitto, J. Kiener, J. Wentz, S. Zagromski and D. K. Srivastava, Nucl. Phys. A504 (1989) 374

1989HN1A Hnizdo et al., Sao Paulo (1989) 327

1989IS1B B.S. Ishkhanov, I.M. Kapitonov, V.G. Neudachin, V.G. Shevchenko, R.A. Eramzhyan and N.P. Yudin, Vestn. Mosk. U. Fiz. Astron. SSSR 30 (1989) 3

1989JE01 H. Jelitto, J. Buschmann, V. Corcalciuc, H.J. Gils, N. Heide, J. Kiener, H. Rebel, C. Samanta and S. Zagromski, Z. Phys. A332 (1989) 317

1989JI1A L. Jin, W.D. Arnett and S.K. Chakrabarti, Astrophys. J. 336 (1989) 572

1989KA30 S. Karataglidis, D. Zubanov, P.D. Harty and M.N. Thompson, Nucl. Phys. A501 (1989) 108

1989KR08 V. M. Krasnopolsky, V. I. Kukulin and J. Horacek, Czech. J. Phys. B39 (1989) 593

1989KU21 V.I. Kukulin, G.G. Ryzhikh, Yu.M. Chuvilsky and R.A. Eramzhyan, Izv. Akad. Nauk SSSR Ser. Fiz. 53 (1989) 121; Bull. Acad. Sci. USSR Phys. Ser. 53 (1989) 118

1989LA13 J.B.J.M. Lanen, A.M. van den Berg, H.P. Blok, J.F.J. van den Brand, C.T. Christou, R. Ent, A.G.M. van Hees, E. Jans, G.J. Kramer, L. Lapikas et al., Phys. Rev. Lett. 62 (1989) 2925

1989LA22 J.B.J.M. Lanen, R.G. Lovas, A.T. Kruppa, H.P. Blok, J.F.J. van den Brand, R. Ent, E. Jans, G.J. Kramer, L. Lapikas, E.N.M. Quint, G. van der Steenhoven et al., Phys. Rev. Lett. 63 (1989) 2793

1989LE07 M. LeMere and Y.C. Tang, Phys. Rev. C39 (1989) 1696

1989LI09 J. Lichtenstadt, J. Alster, M.A. Moinester, J. Dubach, R.S. Hicks, G.A. Peterson and S. Kowalski, Phys. Lett. B219 (1989) 394

1989LIZO B.J. Lieb, H.O. Funsten, J. Mackenzie, C.F. Perdrisat, V. Punjabi, C. Lyndon, E. Cheung, P. Ulmer, R. Estep, L.C. Liu et al., Bull. Amer. Phys. Soc. 34 (1989) 1828

1989NA02 A. Nadasen, M. McMaster, M. Fingal, J. Tavormina, P. Schwandt, J. S. Winfield, M. F. Mohar, F. D. Becchetti, J. W. Janecke and R. E. Warner, Phys. Rev. C39 (1989) 536

1989NA11 A. Nadasen, M. McMaster, M. Fingal, J. Tavormina, J. S. Winfield, R. M. Ronningen, P. Schwandt, F. D. Becchetti, J. W. Janecke and R. E. Warner, Phys. Rev. C40 (1989) 1237

1989NA23 G.A. Naumenko, E.V. Repenko, V.N. Stibunov and V.A. Tryasuchev, Pisma Zh. Eksp. Teor. Fiz. 50 (1989) 226; JETP Lett. 50 (1989) 251

1989RA17 P. Raghavan, At. Data Nucl. Data Tables 42 (1989) 189.

1989RA1G J. Rapaport, Santa Fe 88 (1989) 186

1989RE1G H. Rebel, Calcutta (1989) 364

1989ROZY D. Rothenberger, B. G. Ritchie, J. R. Comfort, R. A. Giannelli, J. R. Tinsley, N. S. Chant, D. J. Mack, P. G. Roos, J. D. Silk, G. S. Kyle et al., Bull. Amer. Phys. Soc. 34 (1989) 1204

1989RU05 K. Rusek, J. Giroux, H. J. Jansch, H. Vogt, K. Becker, K. Blatt, A. Gerlach, W. Korsch, H. Leucker, W. Luck et al., Nucl. Phys. A503 (1989) 223

1989SA20 N.V. Samsonenko, C.L. Kathat, M.A. Ousmane and A. L. Samgin, J. Phys. G15 (1989) 1413

1989SC25 A. Scalia, Nuovo Cim. A102 (1989) 953

1989SHZS S. Shirato, S. Shibuya, K. Hata, Y. Ando and K. Shibata, JAERI-M 89-107 (Jpn. Atomic Energy Res.) (1989)

1989SI02 P.J. Simmonds, N.M. Clarke, K.I. Pearce, R.J. Griffiths, B. Stanley, S. Roman, A. Farooq, G. Rai, M.C. Mannion and C.A. Ogilvie, J. Phys. (London) G15 (1989) 353

1989TA21 R. Tacik, E.T. Boschitz, R. Meier, S. Ritt, M. Wessler, K. Junker, J.A. Konter, S. Mango, D. Renker, B. van den Brandt et al., Phys. Rev. Lett. 63 (1989) 1784

1989TE04 H. Terazawa, J. Phys. Soc. Jpn. 58 (1989) 767

1989TO04 M. Tosaki, M. Fujiwara, K. Hosono, T. Noro, H. Ito, T. Yamazaki and H. Ikegami, Nucl. Phys. A493 (1989) 1

1989TR09 V.A. Tryasuchev, Yad. Fiz. 49 (1989) 1056

1989VA04 S. P. Van Verst, D. P. Sanderson, D. E. Trcka, K. W. Kemper, V. Hnizdo, B. G. Schmidt and K. R. Chapman, Phys. Rev. C39 (1989) 853

1989VA20 V. S. Vasilevsky and I. Yu. Rybkin, Yad. Fiz. 50 (1989) 662; Sov. J. Nucl. Phys. 50 (1989) 411

1989WA1F J. W. Watson, Nucl. Instrum. Meth. Phys. Res. B40/41 (1989) 481

1989WA26 R. E. Warner, A. Okihana, M. Fujiwara, N. Matsuoka, K. Tamura, M. Tosaki, T. Ohsawa, K. Fukunaga, S. Kakigi, J. Kasagi et al., Nucl. Phys. A503 (1989) 161

1989YO03 H. Yokota, S. Igarashi, K. Hama, T. Mori, T. Katsumi, K. Nakayama, K. Ichimaru, R. Chiba, K. Nakai and J. Chiba, Phys. Rev. C39 (1989) 2090

1989YO05 H. Yokota, S. Igarashi, K. Hama, T. Mori, T. Katsumi, K. Ichimaru, K. Nakayama, R. Chiba, K. Nakai and J. Chiba, Phys. Rev. C40 (1989) 270

1989YO07 H. Yokota, S. Igarashi, K. Hama, T. Mori, T. Katsumi, K. Ichimaru, K. Nakayama, R. Chiba, K. Nakai and J. Chiba, Phys. Rev. C40 (1989) 1069.

1989ZHZZ D. Zhang, H. Breuer, N.S. Chant, B.S. Flanders, S.D. Hyman, D.J. Mack, P.G. Roos, J.D. Silk, K. Dhuga, G.S. Kyle et al., Bull. Amer. Phys. Soc. 34 (1989) 1205

1990AJ01 F. Ajzenberg-Selove, Nucl. Phys. A506 (1990) 1.

1990AL40 D.V. Aleksandrov, E.Yu. Nikol'skii and D.N. Stepanov, Yad. Fiz. 52 (1990) 933; Sov. J. Nucl. Phys. 52 (1990) 593

1990AM04 A.I. Amelin, M.G. Gornov, Yu.B. Gurov, A.I. Ilin, V.P. Koptev, P.V. Morokhov, K.O. Oganesyan, V.A. Pechkurov, V.I. Savelev, F.M. Sergeev et al., Pisma Zh. Eksp. Teor. Fiz. 51 (1990) 607; JETP Lett. (USSR) 51 (1990) 688

1990BE49 C. Bennhold, L. Tiator and L.E. Wright, Can. J. Phys. 68 (1990) 1270

1990BE54 S.M. Bekbaev, G. Kim and R. A. Eramzhyan, Izv. Akad. Nauk SSSR, Ser. Fiz. 54 (1990) 1014; Bull. Acad. Sci. USSR, Phys. Ser. 52, No.5 (1990) 198

1990BL13 L.D. Blokhintsev, V.I. Kukulin and D.A. Savin, Yad. Fiz. 51 (1990) 1289; Sov. J. Nucl. Phys. 51 (1990) 819

1990BLZW C. Blyth, J.B.A. England, G.M. Field, O. Karban, C.N. Pinder, N.M. Clarke, G. Rai, R. Vlastou, L. Zybert and G.C. Morrison, Bull. Amer. Phys. Soc. 35 (1990) 1668

1990BR09 M. Bruno, F. Cannata, M. D'Agostino, M.L. Fiandri, M. Herman and H.M. Hofmann, Phys. Rev. C41 (1990) 2435

1990BU29 N.A. Burkova, K.A. Zhaksibekova, M.A. Zhusupov and R.A. Eramzhyan, Phys. Lett. B248 (1990) 15

1990CR04 R. Crespo, A.M. Eiro and J.A. Tostevin, Phys. Rev. C42 (1990) 1646

1990DA1H Dasgupta and Mandal, Panic XII (1990) Paper II-41

1990DA23 T.K. Dao and O.M. Knyazkov, Fiz. Elem. Chastits At. Yad. 21 (1990) 1456; Sov. J. Part. Nucl. 21 (1990) 623

1990DAZR B.V. Danilin and N.B. Shulgina, in Leningrad 90 (1990) 227

1990DE16 P.K.A. de Witt Huberts, J. Phys. (London) G16 (1990) 507

1990DE1V P.K.A. de Witt Huberts, Prog. Part. Nucl. Phys. 24 (1990) 205

1990DO04 B. Doyle, B. Goulard and N.C. Mukhopadhya, Phys. Rev. C42 (1990) 1361

1990EI01 A.M. Eiro and F.D. Santos, J. Phys. (London) G16 (1990) 1139

1990FU1H C. Funck and K. Langanke, Int. J. Mod. Phys. A5 (1990) 195

1990GH1E Ghio et al., in Panic XII (1990) Paper I-77

1990GL04 C.W. Glover, C.C. Foster, P. Schwandt, J.R. Comfort, J. Rapaport, T.N. Taddeucci, D. Wang, G.J. Wagner, J. Seubert, A.W. Carpenter et al., Phys. Rev. C41 (1990) 2487

1990GO14 O.Yu. Goryunov, E.I. Koshchii, Yu.G. Mashkarov, A.T. Rudchik, V.K. Chernievskii and Yu.M. Chuvil'skii, Sov. J. Nucl. Phys. 51 (1990) 595

1990GO26 M. Goswami, F. Ahmed and L.S. Kothari, Ann. Nucl. Energy 17 (1990) 549

1990GU23 B. Guo, X. Li and K. Chen, Chin. J. Nucl. Phys. 12 (1990) 215

1990HA29 P.G. Hansen, Phys. Scr. T32 (1990) 21

1990HA46 D. Harley, B. Muller and J. Rafelski, J. Phys. G16 (1990) 281

1990HE20 E. Hernandez and A. Mondragon, J. Phys. G16 (1990) 1339

1990HO1R H. Horiuchi, in Santa Fe 90 (1990); Nucl. Phys. A522 (1991) 257c.

1990HU09 J. Hufner and V. Kitipova, Nucl. Phys. A517 (1990) 571

1990JO1D Jodice et al., Panic XII (1990) Paper I-76

1990KA14 S. Kailas, Phys. Rev. C41 (1990) 2943

1990KAZH S. Kato, N. Matsuoka, K. Hosono, T. Noro, M. Yosoi and K. Shrane, Osaka Univ. Lab. Nucl. Studies Ann. Rept. 1989 (1990) 39

1990KR12 R. Krivec and M.V. Mihailovic, Few-Body Syst. 8 (1990) 45

1990KRZX L.H. Kramer and H.R. Weller, Bull. Amer. Phys. Soc. 35 (1990) 1058

1990KU06 V.I. Kukulin and V.N. Pomerantsev, Yad. Fiz. 51 (1990) 376; Sov. J. Nucl. Phys. 51 (1990) 240

1990KU12 V.I. Kukulin, V.T. Voronchev, T.D. Kaipov and R.A. Eramzhyan, Nucl. Phys. A517 (1990) 221

1990KU16 V.I. Kukulin, V.M. Krasnopolsky, E.V. Kuznetsova and J. Horacek, Czech. J. Phys. B40 (1990) 945

1990KU23 A.V. Kuznichenko, A.S. Molev and G.M. Onishchenko, Izv. Akad. Nauk SSSR, Ser. Fiz. 54 (1990) 848; Bull. Acad. Sci. USSR, Phys. Ser. 54 (1990) 31

1990LA06 J.B.J.M. Lanen, H.P. Blok, E. Jans, L. Lapikas, G. van der Steenhoven and P.K.A. de Witt Huberts, Phys. Rev. Lett. 64 (1990) 2250

1990LE24 D.R. Lehman, J. Phys. (Paris) Colloq. C6 (1990) 47

1990LI11 Li Xun-Gui and Chen Ke-Zhong, Nuovo Cim. A103 (1990) 387

1990LO14 R.G. Lovas, A.T. Kruppa and J.B.J.M. Lanen, Nucl. Phys. A516 (1990) 325

1990LU06 P. Lu and B.P. Nigam, J. Phys. G16 (1990) L135

1990MA1O J. Madsen, Phys. Rev. D41 (1990) 2472

1990MAZG Yu.G. Mashkarov, E.I. Koshchy, N.T. Burtebaev, A.D. Duisebaev, G.N. Ivanov, V.I. Kanashevich, V.A. Khaimin and V.V. Adodin, in Leningrad 90 (1990) 318

1990MI10 J. Mildenberger, O. Hausser, R.G. Jeppesen, B. Larson, B. Pointon, A. Trudel, R. Henderson, K. Hicks, K.P. Jackson, A. Miller et al., Phys. Rev. C42 (1990) 732

1990MO10 A. Mondragon and E. Hernandez, Phys. Rev. C41 (1990) 1975

1990NAZZ A. Nadasen, B. Ashe, J. Brusoe, P. Schwandt, J. Winfield, G. Yoo, F.D. Becchetti, J. Brown, D. Hotz, J. Janecke et al., Bull. Amer. Phys. Soc. 35 (1990) 1667

1990PA25 B. Parker, K.K. Seth and R. Soundranayagam, Phys. Lett. B251 (1990) 483

1990RA05 R.D. Ransome, V.R. Cupps, S. Dawson, R.W. Fergerson, A. Green, C.L. Morris, J.A. McGill, J.R. Comfort, B.G. Ritchie, J. Tinsley et al., Phys. Rev. Lett. 64 (1990) 372

1990RA08 J. Rapaport, C.C. Foster, C.D. Goodman, C.A. Goulding, T.N. Taddeucci, D.J. Horen, E.R. Sugarbaker, C. Gaarde, J. Larsen, J.A. Carr et al., Phys. Rev. C41 (1990) 1920

1990RA20 R.D. Ransome, V.R. Cupps, S. Dawson, R.W. Fergerson, A. Green, C.L. Morris, J.A. McGill, J.R. Comfort, B.G. Ritchie, J.R. Tinsley et al., Phys. Rev. C42 (1990) 1500

1990RE09 R. Reichle, R. Behrisch and J. Roth, Nucl. Instrum. Meth. Phys. Res. B50 (1990) 68

1990RE1I M.P. Rekalo, Sov. Phys. J. 33 (1990) 409

1990RI01 K. Riisager, M.J.G. Borge, H. Gabelmann, P.G. Hansen, L. Johannsen, B. Jonson, W. Kurcewicz, G. Nyman, A. Richter, O. Tengblad et al., Phys. Lett. B235 (1990) 31

1990RIZX B.B. Ritchie, M.K. Brussel, N.R. Kolb and J.H. Smith, Bull. Amer. Phys. Soc. 35 (1990) 1679

1990RY07 G.G. Ryzhikh and Yu.M. Chuvilsky, Izv. Akad. Nauk 54 (1990) 2276; Bull. Acad. Sci. (1990) 188

1990SA05 S.S. Saad, N.Z. Darwish, F.M. El-Ashry and Kh.M. Omar, Appl. Radiat. Isot. 41 (1990) 211

1990SA47 F.D. Santos, I.J. Thompson and A.M. Eiro, J. Phys. (Paris) Colloq. C6 (1990) 443

1990SC15 A. Scalia, Nuovo Cim. A103 (1990) 85

1990SC22 A. Scalia, Nuovo Cim. A103 (1990) 927

1990SH1I Shaw et al., Panic XII (1990) Paper I-29

1990TA1I G. Tatara and T. Terasawa, Prog. Theor. Phys. 83 (1990) 552

1990TA1L Tacik et al., Panic XII (1990) Paper III-67

1990TR02 D.E. Trcka, A.D. Frawley, K.W. Kemper, D. Robson, J.D. Fox and E.G. Myers, Phys. Rev. C41 (1990) 2134

1990VA16 V.V. Varlamov, B.S. Ishkhanov and A.P. Chernyaev, Izv. Akad. Nauk SSSR, Ser. Fiz. 54 (1990) 561; Bull. Acad. Sci. USSR, Phys. Ser. 54 (1990) 181

1990VAZM V.V. Varlamov, B.S. Ishkhanov and A.P. Chernyaev, Program and Thesis, Proc. 40th Ann. Conf. Nucl. Spectrosc. Struct. At. Nucl., Leningrad (1990) 289

1990VE16 V.A. Vesna, I.S. Okunev, B.G. Peskov, E.V. Shulgina, A.D. Antonov, Yu. Andzheevsky, Yu.M. Gledenov, M.P. Mitrikov and Yu.P. Popov, Pisma Zh. Eksp. Teor. Fiz. 52 (1990) 550; JETP Lett. 52 (1990) 7

1990WA17 R.E. Warner, E. Cheung, C.F. Perdrisat, V. Punjabi, C.A. Davis, R. Helmer, A. Galonsky, L. Heilbronn, D. Krofcheck, S.E. Darden et al., Phys. Rev. C42 (1990) 2143

1990WA1J Wagner, Prog. Part. Nucl. Phys. 24 (1990) 17

1990YA09 T. Yamaya, S. Oh-ami, M. Fujiwara, T. Itahashi, K. Katori, M. Tosaki, S. Kato, S. Hatori and S. Ohkubo, Phys. Rev. C42 (1990) 1935

1990YA11 J. Yao, H. Sun, H. Lu, N. Dai and B. Qi, Nucl. Phys. A519 (1990) 602

1990ZH19 M.A. Zhusupov, Izv. Akad. Nauk 54 (1990) 2230; Bull. Acad. Sci. 54 (1990) 143

1990ZH1R X. Zhao, F. Zeng and Y. Ling, High Energy Phys. Nucl. Phys. 14 (1990) 85

1990ZI03 B. Ziegler, Phys. Lett. B237 (1990) 334

1991AB04 S. Abdel-Kariem, Czech. J. Phys. B41 (1991) 545

1991AR19 N. Ena, Seb. Cavallaro, P. D'Agostino, A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano, R. Palamara and A. Taccone, Few-Body Syst. 10 (1991) 187

1991AR25 N. Arena, Seb. Cavallaro, A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano, A. Taccone, V.D. Chesnokova, V.S. Olkhovsky and A.K. Zaichenko, Nuovo Cim. A104 (1991) 1809

1991BE05 C.A. Bertulani and M.S. Hussein, Nucl. Phys. A524 (1991) 306

1991BE16 A.S. Belousov, Ya.A. Vazdik, E.I. Malinovsky, S.V. Rusakov, P.A. Smirnov, Yu.V. Solovev, A.R. Terkulov, A.A. Tryasuchev, A.P. Usik and A.M. Fomenko, Yad. Fiz. 53 (1991) 609; Sov. J. Nucl. Phys. 53 (1991) 379

1991BL04 L.D. Blokhintsev, V.I. Kukulin, D.A. Savin and A.A. Sakharuk, Yad. Fiz. 53 (1991) 693; Sov. J. Nucl. Phys. 53 (1991) 433

1991BO1R E.T. Boschitz, Few-Body Syst. Suppl. 5 (1991) 191

1991BO48 M. Bozoian, Nucl. Instrum. Meth. Phys. Res. B56-57 (1991) 740

1991DA07 N.J. Davis, C.H. Shepherd-Themistocleous, A.C. Shotter, T. Davinson, E.W. Macdonald, D.G. Ireland, P.J. Sellin, P.J. Woods, O. Karban, G. Tungate et al., J. Phys. G17 (1991) L39

1991DA08 B.V. Danilin, M.V. Zhukov, S.N. Ershov, F.A. Gareev, R.S. Kurmanov, J.S. Vaagen and J.M. Bang, Phys. Rev. C43 (1991) 2835

1991DA24 B.V. Danilin and N.B. Shulgina Izv, Akad. Nauk. 55 (1991) 908; Bull. Acad. Sci. 55 (1991) 44.

1991FU02 Y. Fujiwara and Y.C. Tang, Nucl. Phys. A522 (1991) 459

1991GA26 V.B. Ganenko, V.A. Gushchin, Yu.V. Zhebrovsky, L.Ya. Kolesnikov, A.L. Rubashkin and P.V. Sorokin, Yad. Fiz. 54 (1991) 1495; Sov. J. Nucl. Phys. 54 (1991) 911

1991GL03 L. Glowacka, J. Turkiewicz, O.Yu. Goryunov, A.V. Mokhnach, O.A. Ponkratenko, A.T. Rudchik, V.K. Chernievsky, A.A. Shvedov, E.I. Koshchy and Yu.G. Mashkarov, Nucl. Phys. A534 (1991) 349

1991HA22 L. Harzheim, M.G. Huber and B.C. Metsch, Z. Phys. A340 (1991) 399

1991HI07 Y. Hirabayashi and Y. Sakuragi, Phys. Lett. B258 (1991) 11

1991HI11 Y. Hirabayashi, Phys. Rev. C44 (1991) 1581

1991KR02 V.M. Krasnopolsky, V.I. Kukulin, E.V. Kuznetsova, J. Horacek and N.M. Queen, Phys. Rev. C43 (1991) 822

1991KU09 Yu.A. Kuperin, D.M. Latypov, S.P. Merkurev, M. Bruno and F. Cannata, Yad. Fiz. 53 (1991) 942; Sov. J. Nucl. Phys. 53 (1991) 582

1991KU27 V.I. Kukulin, V.N. Pomerantsev, D.A. Savin and A.A. Sakharuk, Izv. Akad. Nauk 55 (1991) 81; Bull. Acad. Sci. 55 (1991) 76

1991LA1D L.M. Lazarev, Ukr. Fiz. Zh. 36 (1991) 661; Ukr. J. Phys. 36 (1991) 503

1991LU07 P. Lu and B.P. Nigam, Nuovo Cim. A104 (1991) 1313

1991MA56 Yu.G. Mashkarov, E.I. Koshchii, N.G. Burtebaev, A.D. Duisebaev, V.A. Adodin, Yu.M. Churil’skii, O.Yu. Goryunov and A.T. Rudchik, Yad. Fiz. 54 (1991) 629; Sov. J. Nucl. Phys. 54 91991) 382

1991MI19 J.H. Mitchell, H.P. Blok, B.L. Berman, W.J. Briscoe, M.A. Daman, R. Ent, E. Jans, L. Lapikas and J.J.M. Steijger, Phys. Rev. C44 (1991) 2002

1991RI01 S. Ritt, E.T. Boschitz, R. Meier, R. Tacik, M. Wessler, K. Junker, J.A. Konter, S. Mango, D. Renker, B. van den Brandt et al., Phys. Rev. C43 (1991) 745

1991SA26 S.S. Saad, Appl. Radiat. Isot. 42 (1991) 827

1991SC23 A. Scalia, Nuovo Cim. A104 (1991) 691

1991SE06 K.K. Seth and B. Parker, Phys. Rev. Lett. 66 (1991) 2448

1991SH02 J. Shaw, T. Kobayashi, W. Clayton, L. Ghedira, D. Myers, P. Stoler, P.K. Teng, E.J. Winhold and J.H.J. Distelbrink, Phys. Rev. C43 (1991) 1800

1991SM01 R.J. Smith, J.J. Kolata, K. Lamkin, A. Morsad, K. Ashktorab, F.D. Becchetti, J.A. Brown, J.W. Janecke, W.Z. Liu and D.A. Roberts, Phys. Rev. C43 (1991) 761

1991SOZZ D.S. Sorenson, X. Aslanoglou, F.P. Brady, J.R. Drummond, R.C. Haight, C.R. Howell, N.S.P. King, A. Ling, P.W. Lisowski, C.L. Morris et al., Bull. Amer. Phys. Soc. 36 (1991) 1350, J11 6

1991SU03 Y. Suzuki, Nucl. Phys. A528 (1991) 395

1991TI04 M.A. Tiede, D.E. Trcka and K.W. Kemper, Phys. Rev. C44 (1991) 1698

1991TR02 V.A. Tryasuchev and A.V. Kolchin, Yad. Fiz. 53 (1991) 703; Sov. J. Nucl. Phys. 53 (1991) 439

1991TR1C V.A. Tryasuchev and A.I. Fiks, Sov. Phys. J. 34 (1991) 1025; Izv. Vyssh. Uchebn. Zaved. Fiz. 34 (1991) 92

1991TY01 S. Typel, G. Bluge, K. Langanke and W.A. Fowler, Z. Phys. A339 (1991) 249

1991TY02 S. Typel, G. Blüge and K. Langanke, Z. Phys. A339 (1991) 335

1991UN02 M. Unkelbach and H.M. Hofmann, Few-Body Syst. 11 (1991) 143

1991YO1C H. Yokota, in Tokyo 90 (1991) 385

1992AM1H A.I. Amelin, B.A. Chernyshev, M.G. Gornov, Yu.B. Gurov, P.V. Morokhov, V.A. Pechkurov, V.I. Savel'ev, R.R. Shafigullin, A.V. Shishkov and V.P. Koptev, in Penyscola (1992) 516

1992AR20 N. Arena, Seb. Cavallaro, A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano and A. Taccone, J. Phys. G18 (1992) 2003

1992ARZX K.P. Artemov, V.Z. Goldverg, M.S. Golovkov, V.P. Rudakov, I.N. Serikov, V.A. Timofeev, R.W. Zurmuhle, D.R. Benton, Z. Liu, S.P. Barrow et al., in Dubna 92 (1992) 49

1992BA57 T.S. Bauer, Nucl. Phys. A546 (1992) 181c.

1992BLZX L.D. Blokhintsev, V.I. Kukulin, E.V. Kuznetsova, A.A. Sakharuk and D.A. Savin, in Adelaide (1992) 74.

1992BO25 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Sov. J. Nucl. Phys. 55 (1992) 955

1992CL04 N.M. Clarke, J. Phys. G18 (1992) 917

1992CO05 L.M. Comere, L. Reber, K.W. Kemper, D. Robson, J.D. Brown and T.L. Talley, Phys. Rev. C45 (1992) 1803

1992CS04 A. Csoto and R.G. Lovas, Phys. Rev. C46 (1992) 576

1992DA1K A. D'Arrigo, G. Fazio, G. Giardina, A. Italiano, M. Lombardi, V.S. Olkhovsky, A. Taccone, V.D. Tchesnokova and A.K. Zaichenko, Hadronic J. 15 (1992) 303

1992DAZV B.V. Danilin, M.V. Zhukov, J.M. Bang, I.J. Thompson and J. S. Vaagen, in Adelaide (1992) 46

1992DE12 P. Descouvemont and C. Leclercqwillain, J. Phys. G18 (1992) L99

1992DU07 S.B. Dubovichenko and A.V. Dzhazairov-Kakhramanov, Yad. Fiz. 55 (1992) 2918; Sov. J. Nucl. Phys. 55 (1992) 1632

1992EL1A M. El-Shabshiry and A.T. Matar, Indian J. Phys. B66 (1992) 89

1992EN01 S. Engstler, G. Raimann, C. Angulo, U. Greife, C. Rolfs, U. Schroder, E. Somorjai, B. Kirch and K. Langanke, Phys. Lett. B279 (1992) 20

1992EN04 S. Engstler, G. Raimann, C. Angulo, U. Greife, C. Rolfs, U. Schroder, E. Somorjai, B. Kirch and K. Langanke, Z. Phys. A342 (1992) 471

1992ES04 A. Eskandarian and I.R. Afnan, Phys. Rev. C46 (1992) 2344

1992FU10 Y. Fujiwara and Y.C. Tang, Few-Body Syst. 12 (1992) 21

1992GA17 B.S. Galakhmatova, E.A. Romanovsky and K.V. Shitikova, Bull. Russ. Acad. Sci. Phys. 56 (1992) 91; Izv. Ross. Akad. Nauk. Ser. Fiz. 56 (1992) 47

1992GA18 S.A. Gaidaenko, E.P. Kadkin S.N. Kondratyev, Mv.V Pasechnik, V.S. Propenko, L.S. Saltykov, V.D. Sklyarenko, V.V. Tokarevsky and A.D. Fursa, Bull. Russ. Acad. Sci. Phys. 56 (1992) 136; Izv. Ross. Akad. Nauk. Ser. Fiz. 56 (1992) 156

1992GA27 F.A. Gareev, S. N. Ershov, E.F. Svinareva, B.V. Danilin, S.A. Fayans, D.V. Fedorov, M.V. Zhukov, S.A. Goncharov and J.S. Vaagen, Europhys. Lett. 20 (1992) 487

1992GLZX Yu.A. Glukhov, A.A. Ogloblin, O.Ya. Osadchy, S.B. Sakuta, D.V. Aleksandrov, A.S. Demyanova, B.G. Novatsky and D.N. Stepanov, in Alma Ata 92 (1992) 302

1992GO21 O.K. Gorpinich, V.I. Konfederatenko, V.V. Ostashko, O.M. Povoroznik, A.T. Rudchik and B.G. Struzhko, Bull. Russ. Acad. Sci. Phys. 56 (1992) 439

1992HE1E E. Hernandez and A. Mondragon, Rev. Mex. Fis. 38 Suppl. 1 (1992) 67

1992HI02 Y. Hirabayashi and Y. Sakuragi, Nucl. Phys. A536 (1992) 375

1992JO02 M. Jodice, S. Frullani, F. Garibaldi, F. Ghio, G.P. Capitani, E. DeSanctis, M. Bernheim, A. Gerard, A. Magnon, C. Marchand et al., Phys. Lett. B282 (1992) 31

1992JU1B K. Junker, in Penyscola (1992) 199

1992KA06 M. Kamal, V.T. Voronchev, V.I. Kukulin, V.M. Krasnopolsky, Y. Nakao and K. Kudo, J. Phys. G18 (1992) 379

1992KH04 M.G. Khayat, N.S. Chant, P.G. Roos and T.-S.H. Lee, Phys. Rev. C46 (1992) 2415

1992KO19 Y.E. Kozyr, Bull. Russ. Acad. Sci. Phys. 56 (1992) 448

1992KU16 Yu.A. Kuperin, D.M. Latypov and S.P. Merkurev, Yad. Fiz. 55 (1992) 2057; Sov. J. Nucl. Phys. 55 (1992) 1141

1992KU1G K. Kumar and A.K. Jain, Pramana J. Phys. 39 (1992) 71

1992LO09 M.A.K. Lodhi, A.Y. Abokor and M. Yusof Sulaiman, Nuovo Cim. A105 (1992) 1257

1992LOZX M.A.K. Lodhi, P.M. Giancana and M.Y. Sulaiman, in Adelaide (1992) 100

1992NA02 Y. Nakai, M. Nakamura, H. Sakaguchi, H. Togawa, T. Nakano, S. Hirata, O. Kamigaito, M. Iwaki, H.M. Shimizu, H. Kaneko et al., Phys. Rev. C45 (1992) 451

1992OK01 A. Okihana, T. Konishi, R.E. Warner, D. Francis, M. Fujiwara, N. Matsuoka, K. Fukunaga, S. Kakigi, T. Hayashi, J. Kasagi et al., Nucl. Phys. A549 (1992) 1

1992PE12 F. Pellegrini, G.F. Segato, A. Barbadoro, L. Corradi, M. Morando, P. Pavan and I. Gabrielli, Phys. Rev. C46 (1992) 2354

1992PU03 V. Punjabic, F. Perdrisat, E. Cheung, J. Yonnet, M. Boivin, E. Tomasi-Gustafsson, R. Siebert, R. Frascaria, E. Warde, S. Belostotsky et al., Phys. Rev. C46 (1992) 984

1992RA01 R.D. Ransome, C.L. Morris, V.R. Cupps, R.W. Fergerson, J.A. McGill, D.L. Watson, J.D. Zumbro, B.G. Ritchie, J.R. Comfort, J.R. Tinsley et al., Phys. Rev. C45 (1992) R509

1992RA11 R.D. Ransome, C.L. Morris, M.K. Jones, B.G. Ritchie, D.L. Watson, J.A. McGill, K. Pujara, D.B. Clayton, I. Brown, P. Campbell and C.F. Moore, Phys. Rev. C46 (1992) 273

1992RYZY G.G. Ryzhikh, R.A. Eramzhyan, V.I. Kukulin and Yu.M. Tchuvilsky, in Adelaide (1992) 38

1992SA01 C. Samanta, S. Ghosh, M. Lahiri, S. Ray and S.R. Banerjee, Phys. Rev. C45 (1992) 1757

1992SO02 D.S. Sorenson, X. Aslanoglou, F.P. Brady, J.R. Drummond, R.C. Haight, C.R. Howell, N.S.P. King, A. Ling, P.W. Lisowski, B.K. Park et al., Phys. Rev. C45 (1992) R500.

1992TA18 I. Tanihata, D. Hirata, T. Kobayashi, S. Shimoura, K. Sugimoto and H. Toki, Phys. Lett. B289 (1992) 261

1992VA12 V.V. Varamov, A.E. Kosikhin, A.J. Ugaste and A.P. Chernjaev, Bull. Russ. Acad. Sci. Phys. 56 (1992) 126; Izv. Ross. Akad. Nauk. Ser. Fiz. 56 (1992) 143

1992WA18 R.E. Warner, A. Okihana, M. Fujiwara, N. Matsuoka, S. Hayashi, S. Kakigi, K. Fukunaga, J. Kasagi, M. Tosaki and M.B. Greenfield, Phys. Rev. C46 (1992) 616

1992WI09 S. Winkler, H. Krauss, K. Grun, T. Rauscher, H. Oberhummer, H. Abele and G. Staudt, J. Phys. G18 (1992) L147

1992YAZW T. Yamaya, M. Saitoh, K. Ishigaki, M. Fujiwara, T. Suehiro, S. Kato, K. Katori, M. Tanaka, S. Kubono and V. Guimaraes, Inst. Nucl. Study, Univ. Tokyo Ann. Rept. 1991 (1992) 16

1992ZH18 M.A. Zhusupov and E.T. Ibraeva, Bull. Russ. Acad. Sci. Phys. 56 (1992) 140; Izv. Ross. Akad. Nauk. Ser. Fiz. 56 (1992) 166

1993AL05 J.S. Al-Khalili, M.B. Barbaro and C. Wilkin, J. Phys. G19 (1993) 403

1993AM09 A.I. Amelin, M.N. Ber, M.G. Gornov, Yu.B. Gurov, S.V. Lapushkin, P.V. Morokhov, V.A. Pechkurov, B.A. Chernyshev, R.R. Shafigullin, A.V. Shishkov et al., Phys. At. Nucl. 56 (1993) 1297

1993AR12 N. Arena, S. Cavallaro, A. D’Arrigo, G. Fazio, G. Giardina, A. Italiano, A. Taccone, D.Q. Hung and V.S. Olkhovsky, Nuovo Cim. A106 (1993) 1007

1993BL09 L.D. Blokhintsev, V.I. Kukulin, A.A. Sakharuk, D.A. Savin and E.V. Kuznetsova, Phys. Rev. C48 (1993) 2390

1993BO24 M.J.G. Borge, L. Johannsen, B. Jonson, T. Nilsson, G. Nyman, K. Riisager, O. Tengblad and K.W. Rolander, Nucl. Phys. A560 (1993) 664

1993BO38 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Izv. Akad. Nauk Ser. Fiz. 57 (1993) 183; Bull. Russ. Acad. Sci. 57 (1993) 932

1993CA11 J.A. Caballero, T.W. Donnelly and G.I. Poulis, Nucl. Phys. A555 (1993) 709

1993CH06 W.T. Chou, E.K. Warburton and B.A. Brown, Phys. Rev. C47 (1993) 163

1993CS04 A. Csoto, Phys. Rev. C48 (1993) 165

1993DE07 V.V. Denyak, I.G. Evseev, V.P. Likhachev, S.A. Pashchuk and V.M. Khvastunov, Yad. Fiz. 56 (1993) 26; Phys. At. Nucl. 56 (1993) 14.

1993DU02 S.B. Dubovichenko and A.V. Dzhazairov-Kakhramanov, Yad. Fiz. 56 (1993) 87; Phys. At. Nucl. 56 (1993) 195

1993DU09 S.B. Dubovichenko, A.V. Dzhazairov-Kakhramanov and A.A. Sakharuk, Phys. At. Nucl. 56 (1993) 1044

1993FA01 L.R. Fawcett, Jr., Nucl. Sci. Eng. 113 (1993) 173

1993FE02 J. Feng, W.Q. Shen, Y.G. Ma and Z.Y. Zhu, Phys. Lett. B305 (1993) 9

1993FI06 G.F. Filippov, L. Truhilio and I.Y. Rybkin, Phys. At. Nucl. 56 (1993) 470

1993GLZZ Yu.A. Glukhov, A.A. Ogloblin, O.Ya. Osadchy, S.b. Sakuta, F.A. Gareev and S.N. Ershov, in Dubna 93 (1993) 275

1993GO06 S.A. Goncharov and A.A. Oglobin, Phys. At. Nucl. 56 (1993) 309

1993GO16 O.K. Gorpinich, Yu.N. Pavlenko, O.M. Povoroznik and B.G. Struzhko, Izv. Akad. Nauk Ser. Fiz. 57 (1993) 121; Bull. Russ Acad Sci. 57 (1993) 112

1993GU10 P. Guazzoni, M. Jaskola, L. Zetta, C.-Y. Kim, T. Udagawa and G. Bohlen, Nucl. Phys. A564 (1993) 425

1993IN01 C.H.Q. Ingram, Nucl. Phys. A553 (1993) 573c.

1993JA02 S. Jang, Phys. Rev. C47 (1993) 286.

1993KO33 Yu.E. Kozyr, Bull. Russ. Acad. Sci. 57 (1993) 148

1993KO44 M. Kohno, Phys. Rev. C48 (1993) 3122

1993KU27 V.I. Kukulin, G.G. Ryzhikh, Yu.M. Chuvilsky and R.A. Eramzhyan, Bull. Russ. Acad. Sci. Phys. 57 (1993) 1696

1993MA14 A. Mateos and N. Simicevic, Phys. Rev. C47 (1993) R1842

1993MA48 Yu.G. Mashkarov, E.I. Koshchy, I.I. Zalyubovsky, N.t. Burtebaev, A.D. Duisebaev, V.V. Adodin and A.T. Rudchik, Izv. Akad. Nauk Ser. Fiz. 57 (1993) 137; Bull. Acad. Russ. Sci. 57 (1993) 889

1993MU12 A.M. Mukhamedzhanov, Kh.D. Razikov, N.K. Timofeyud and R. Yarmukhamedov, Yad. Fiz. 56 (1993) Phys. At. Nucl. 56 (1993) 937

1993NA01 A. Nadasen, T. Stevens, J. Farhat, J. Brusoe, P. Schwandt, J.S. Winfield, G. Yoo, N. Anantaraman, F.D. Becchetti, J. Brown et al., Phys. Rev. C47 (1993) 674

1993OH01 H. Ohnuma, K. Hatanaka, S.I. Hayakawa, M. Hosaka, T. Ichihara, S. Ishida, S. Kato, T. Niizeki, M. Ohura, H. Okamura et al., Phys. Rev. C47 (1993) 648.

1993OK1A A. Okihana, T. Konishi and S. Kakigi, Bull. Inst. Chem. Res. Kyoto Univ. 71 (1993) 62

1993OK1B A. Okihana, R.E. Warner, M. Fujiwara, N. Matsuoka, K. Fukunaga, S. Kakigi, N. Koori and M. Tosaki, Bull. Inst. Chem. Res. Kyoto Univ. 71 (1993) 62

1993PE13 F. Petrovich, S.K. Yoon, M.J. Threapleton, R.J. Philpott, J.A. Carr, F.S. Dietrich and L.F. Hansen, Nucl. Phys. A563 (1993) 387

1993RE04 E.L. Reber, K.W. Kemper, P.L. Kerr, A.J. Mendez, E.G. Myers, B.G. Schmidt and N.M. Clarke, Phys. Rev. C47 (1993) 2190

1993RIZY K. Riisager, M.J.G. Borge, P.G. Hansen, B. Jonson, P. Moller, T. Nilsson, G. Nyman, O. Tengblad and K. Wilhelmsen, in Germany (1993) 311

1993RY01 G.G. Ryzhikh, R.A. Eramzhyan, V.I. Kukulin and Yu.M. Tchuvilsky, Nucl. Phys. A563 (1993) 247

1993SA10 C. Samanta, M. Lahiri, S. Roy, S. Ray and S.R. Banerjee, Phys. Rev. C47 (1993) 1313

1993SA35 S.B. Sakuta, A.A. Ogloblin, O.Y. Osadchy, Y.A. Glukhov, S.N. Ershov, F.A. Gareev and J.S. Vaagen, Europhys. Lett. 22 (1993) 511

1993SC30 N.W. Schellingerhout, L.P. Kok, S.A. Coon and R.M. Adam, Phys. Rev. C48 (1993) 2714; Erratum Phys. Rev. C52 (1995) 439

1993SH1G N.B. Shul’gina and B.V. Danilin, in Wein 92 (1993) 603

1993SI06 T. Sinha, S. Roy and C. Samanta, Phys. Rev. C47 (1993) 2994

1993SI09 T. Sinha, S. Roy and C. Samanta, Phys. Rev. C48 (1993) 785

1993ST06 S. Stamer, W. Scobel, W.B. Amian, R.C. Byrd, R.C. Haight, J.L. Ullmann, R.W. Bauer, M. Blann, B.A. Pohl, J. Bisplinghoff et al., Phys. Rev. C47 (1993) 1647

1993VE1A V.A. Vesna, I.S. Okunev, E.V. Shulgina, Yu.M. Gledenov, S.S. Parzhitskii and Yu.P. Popov, in Wein 92 (1993) 419

1993WAZX L. Wang, X. Yang, J. Rapaport, S. DeLucia, B. Luther, D. Marchlenski, E. Sugarbaker, C. Foster, C.D. Goodman, A. Smith et al., Bull. Amer. Phys. Soc. 38 (1993) 982

1993XI04 H. Xia, G. Shen, H. Tang, Z. Zhou, B. Qi, Z. Ke, and C. Zhou, Chin. J. Nucl. Phys. 15 (1993) 367

1993YAZZ X. Yang, L. Wang, J. Rapaport, S. DeLucia, B. Luther, D. Marchlenski, E. Sugarbaker, C. Foster, C.D. Goodman, A. Smith et al., Bull. Amer. Phys. Soc. 38 (1993) 1051

1993ZH09 M.V. Zhukov, B.V. Danilin, L.V. Grigorenko and N.B. Shul'gina, Phys. Rev. C47 (1993) 2937

1993ZH1J M.V. Zhukov, B.V. Danilin, D.V. Fedorov, J.M. Bang, I.J. Thompson and J.S. Vaagen, Phys. Rep. 231 (1993) 151

1994BA11 F.C. Barker, Phys. Lett. B322 (1994) 17

1994BB03 D. Baye, Y. Suzuki and P. Descouvemont, Prog. Theor. Phys. 91 (1994) 271

1994BI06 N. Bianchi, V. Muccifora, E. Desanctis, A. Fantoni, P.L. Sandri, V. Lucherini, E. Polli, A.R. Reolon, P. Rossi, M. Anghinolfi et al., Phys. Lett. B325 (1994) 333

1994BO04 J.G.L. Booten and A.G.M. Van Hees, Nucl. Phys. A569 (1994) 510

1994BO46 O.V. Bochkarev, A.A. Korsheninnikov, E.A. Kuzmin, I.G. Mukha, L.V. Chulkov and G.B. Yankov, Phys. At. Nucl. 57 (1994) 1281

1994BUZX N. Burtebaev, A. Duisebaev, G.N. Ivanov and S.B. Sakuta, in Kharkov 94 (1994) 221

1994BUZY N. Burtebaev, A. Duisebaev, G.N. Ivanov and S.B. Sakuta, in Kharkov 94 (1994) 220

1994CS01 A. Csoto and D. Baye, Phys. Rev. C49 (1994) 818

1994DE27 P. Descouvemont, Phys. Rev. C50 (1994) 2635

1994DE43 A.S. Demyanova, A.A. Ogloblin and O.Ya. Osadchy, Yad. Fiz. 57 (1994) 2025; Phys. At. Nucl. 57 (1994) 1949

1994DO32 V.N. Domnikov, D.Sh. Eleukenov, E.P. Kadkin, S.N. Kondratiev, S.V. Nevsky, O.F. Nemets, L.S. Saltykov, V.D. Sklyarenko, L.I. Slyusarenko, V.V. Tokarevsky et al., Bull. Russ. Acad. Sci. Phys. 58 (1994) 1910; Izv. Ross. Akad. Nauk Ser. Fiz. 58 (1994) 178

1994DOZW V.N. Domnikov, D.Sh. Eleukenov, E.P. Kadkin, S.N. Kondratev, O.F. Nemetz, S.V. Nevsky, L.S. Saltykov, V.D. Sklyarenko, L.I. Slyusarenko, V.V. Tokarevsky et al., in Kharkov 94 (1994) 250

1994DR11 M. Drosg, D.M. Drake and J. Masarik, Nucl. Instrum. Meth. Phys. Res. B94 (1994) 319

1994EL08 S. El-Sharkawy, Phys. Scr. 50 (1994) 97

1994EN04 R. Ent, B.L. Berman, H.P. Blok, J.F.J. Vandenbrand, W.J. Briscoe, M.N. Harakeh, E. Jans, P.D. Kunz and L. Lapikas, Nucl. Phys. A578 (1994) 93

1994FU04 S. Funada, H. Kameyama and Y. Sakuragi, Nucl. Phys. A575 (1994) 93

1994FU17 Y. Fujiwara and Y.C. Tang, Few-Body Syst. 16 (1994) 91

1994HE11 R. Henneck, G. Masson, P.D. Eversheim, R. Gebel, F. Hinterberger, U. Lahr, H.W. Schmitt, J. Schleef and B.V. Przewoski, Nucl. Phys. A571 (1994) 541

1994IT04 N. Ito, M. Baba, S. Matsuyama, I. Matsuyama and N. Hirakawa, Nucl. Instrum. Meth. Phys. Res. A337 (1994) 474

1994KE08 N. Keeley, S.J. Bennett, N.M. Clarke, B.R. Fulton, G. Tungate, P.V. Drumm, M.A. Nagarajan and J.S. Lilley, Nucl. Phys. A571 (1994) 326

1994MO17 P. Mohr, V. Kolle, S. Wilmes, U. Atzrott, G. Staudt, J.W. Hammer, H. Krauss and H. Oberhummer, Phys. Rev. C50 (1994) 1543

1994NA03 A .Nadasen, J. Winfield, P. Schwandt, J. Farhat, L. Nieman, R.E. Warner, F.D. Becchetti, J.W. Jänecke and N. Anantaraman, Phys. Rev. C49 (1994) 2258

1994RA23 J. Rapaport, Nucl. Phys. A577 (1994) 83c.

1994RE01 E.L. Reber, K.W. Kemper, P.V. Green, P.L. Kerr, A.J. Mendez, E.G. Myers and B.G. Schmidt, Phys. Rev. C49 (1994) R1

1994RE15 E.L. Reber, K.W. Kemper, P.V. Green, P.L. Kerr, A.J. Mendez, E.G. Myers, B.G. Schmidt and V. Hnizdo, Phys. Rev. C50 (1994) 2917

1994RI06 S. Ritt, E. Boschitz, B. Brinkmöller, J. Bühler, R. Meier, M. Wessler, J.A. Konter, S. Mango, B. van den Brandt, S.S. Kamalov et al., Phys. Rev. C49 (1994) 3117

1994RU11 K. Rusek, N.M. Clarke and R.P. Ward, Phys. Rev. C50 (1994) 2010

1994RUZZ A.T. Rudchik, S.B. Sakuta and Yu.A. Glukhov, in Kharkov 94 (1994) 267

1994RY01 D. Ryckbosch, L. Van Hoorebeke, R. Van de Vyver, C. Van den Abeele, J. Dias, J.-O. Adler, K.I. Blomqvist, D. Nilsson, B. Schröder and K. Ziakas, Nucl. Phys. A568 (1994) 52

1994SA10 G.R. Satchler and W.G. Love, Phys. Rev. C49 (1994) 2254

1994SA32 C. Samanta, T. Sinha, S. Ghosh, S. Ray and S.R. Banerjee, Phys. Rev. C50 (1994) 1226

1994SA33 D.R. Sarker, M.A. Rahman, M. Rahman andn H.M.S. Gupta, Nuovo Cim. A107 (1994) 511

1994SA43 H. Sakai, M.B. Greenfield, K. Hatanaka, S. Ishida, N. Koori, H. Okamura, A. Okihana, H. Otsu, N. Sakamoto, Y. Satou et al., Nucl. Phys. A577 (1994) 111c.

1994SAZZ S.B. Sakuta, A.A. Ogloblin, O.Ya. Osadchy, Yu.A. Glukhov, S.N. Ershov and F.A. Gareev, in Kharkov 94 (1994) 268

1994SH38 K. Shoda, O. Sasaki, K. Takeshita, T. Taniuchi and H. Tsubota, J. Phys. Soc. Jpn. 63 (1994) 478

1994SK01 M. Skalsey, Phys. Rev. C49 (1994) R620

1994SU02 Y. Suzuki, T. Kido, Y. Ogawa, K. Yabana and D. Baye, Nucl. Phys. A567 (1994) 957

1994TO08 K. Tomizawa, I. Arai, H. Kitayama, N. Kato, Y. Nagasaka, M. Tanaka, K. Yagi, J. Chiba, T. Kobayashi, A. Manabe et al., Phys. Lett. B328 (1994) 264

1994WA20 R.P. Ward, N.M. Clarke, K.I. Pearce, C.N. Pinder, C.O. Blyth, H.D. Choi, P.R. Dee, S. Roman, G. Tungate and N.J. Davis, Phys. Rev. C50 (1994) 918

1994WA22 L. Wang, X. Yang, J. Rapaport, C.D. Goodman, C.C. Foster, Y. Wang, J. Piekarewicz, E. Sugarbaker, D. Marchlenski, S. Delucia et al., Phys. Rev. C50 (1994) 2438

1994WE10 S. Weber, M. Kachelriess, M. Unkelbach and H.M. Hofmann, Phys. Rev. C50 (1994) 1492

1994ZH28 M.A. Zhusupov, E.T. Ibraeva, V.I. Kukulin and V.V. Peresypkin, Yad. Fiz. 57 (1994) 2013; Phys. At. Nucl. 57 (1994) 1937

1994ZH34 M.A. Zhusupov, E.T. Ibraeva and V.V. Peresypkin, Izv. Akad. Nauk Ser. Fiz. 58 (1994) 71; Bull. Russ. Acad. Sci. Phys. 58 (1994) 770

1995AR10 K. Arai, Y. Suzuki and K. Varga, Phys. Rev. C51 (1995) 2488

1995AR14 N. Arena, Seb. Cavallaro, P. D'Agostino, A. D'Arrigo, N.V. Eremin, G. Fazio, G. Giardina, M. Lombardi, M. Sacchi, T.U. Klochko et al., Yad. Fiz. 58 (1995) 215; Phys. At. Nucl. 58 (1995) 173

1995AR15 K.P. Artemov, M.S. Golovkov, V.V. Pankratov and V.P. Rudakov, Yad. Fiz. 58 (1995) 219; Phys. At. Nucl. 58 (1995) 177

1995AU04 G. Audi and A.H. Wapstra, Nucl. Phys. A595 (1995) 409

1995BE26 C.A. Bertulani and H. Sagawa, Nucl. Phys. A588 (1995) 667

1995BE60 Yu.A. Berezhnoi and V.V. Pilipenko, Bull. Russ. Acad. Sci. Phys. 59 (1995) 528

1995BO1H E. Boschitz, B. Brinkmoller, J. Buhler, R. Meier, S. Ritt, M. Wessler, J.A. Konter, S. Mango and B. van den Brandt, in AIP Conf. Proc. 334 (1995) 534

1995BU08 N.A. Burkova, V.V. Denyak, R.A. Ehramzhyan, I.G. Evseev, V.M. Khvastunov, V.P. Likhachev, S.A. Pashchuk and M.A. Zhusupov, Nucl. Phys. A586 (1995) 293

1995BU20 N. Burtebaev, A.D. Duisebaev, G.N. Ivanov and S.B. Sakuta, Yad. Fiz. 58 (1995) 596; Phys. At. Nucl. 58 (1995) 540

1995CA26 J. Carter, Z.Z. Vilakazi, R.W. Fearick, V. Hnizdo, E. Muskat, K.W. Kemper, D.E. Trcka and S.P. Van Verst, Nucl. Phys. A591 (1995) 349

1995CO05 M.D. Cortina-Gil, P. Roussel-Chomaz, N. Alamanos, F. Auger, J. Barrette, Y. Blumenfeld, J.M. Casandjian, M. Chartier, V. Fekou-Youmbi, B. Fernandez et al., Nucl. Phys. A583 (1995) 787c.

1995CO18 S.G. Cooper and R.S. Mackintosh, Nucl. Phys. A592 (1995) 338

1995DE06 P.R. Dee, C.O. Blyth, H.D. Choi, N.M. Clarke, S.J. Hall, O. Karban, I. Martel-Bravo, S. Roman, G. Tungate, R.P. Ward et al., Phys. Rev. C51 (1995) 492

1995DE53 H. Dennert, E. Aschenauer, W. Eyrich, A. Lehmann, M. Moosburger, N. Scholz, H. Wirth, H.J. Gils, H. Rebel and S. Zagromski, Phys. Rev. C52 (1995) 3195

1995DI01 J.F. Dias, D. Ryckbosch, R. Vandevyver, C. Vandenabeele, G. Demeyer, L. Vanhoorebeke, J.O. Adler, K.I. Blomqvist, D. Nilsson, H. Ruijter et al., Nucl. Phys. A587 (1995) 434

1995DO23 B.C. Doyle and N.C. Mukhopadhyay, Phys. Rev. C52 (1995) 1947

1995DO24 B.C. Doyle, N.C. Mukhopadhyay and R.S. Wittmann, Phys. Rev. C52 (1995) 1957

1995DU12 S.B. Dubovichenko and A.V. Dzhazairov-Kakhramanov, Yad. Fiz. 58 (1995) 852; Phys. At. Nucl. 58 (1995) 788

1995EM03 A.V. Embulaev, V.K. Lukyanov and V.P. Permyakov, Bull. Russ. Acad. Sci. Phys. 59 (1995) 1876

1995ER1B R.A. Eramzhyan, G.G. Ryzhikh and S.S. Kamalov, in Dubna 94 (1995) 645

1995FA21 G. Fazio, G. Giardina, O.Yu. Goryunov, A.A. Shvedov and R. Palamara, J. Phys. Soc. Jpn. 64 (1995) 1141

1995FO1J W. Fong, J.L. Matthews, M.L. Dowell, E.R. Kinney, S.A. Wood, P.A.M. Gram, G.A. Rebka, Jr. and D.A. Roberts, Few-Body Syst. Suppl. (Austria) 9 (1995) 187

1995FU11 Y. Fujiwara and Y.C. Tang, Prog. Theor. Phys. 93 (1995) 357

1995FU16 Y. Fujiwara and Y.C. Tang, Prog. Theor. Phys. (Kyoto) 93 (1995) 711

1995GA24 F.A. Gareev, S.N. Ershov, G.S. Kazacha, S.Yu. Shmakov and V.V. Uzhinsky, Yad. Fiz. 58 (1995) 620; Phys. At. Nucl. 58 (1995) 564

1995GU22 I.R. Gulamov, A.M. Mukhamedzhanov and G.K. Nie, Phys. At. Nucl. 58 (1995) 1689; Yad. Fiz. 58 (1995) 1789

1995HA56 P. G. Hansen, A.S. Jensen and B. Jonson, Ann. Rev. Nucl. Part. Sci. 45 (1995) 591

1995HI15 E. Hiyama and M. Kamimura, Nucl. Phys. A588 (1995) 35c.

1995IG06 S.B. Igamov and R. Yarmukhamedov, Yad. Fiz. 58 (1995) 1400; Phys. At. Nucl. 58 (1995) 1317.

1995IS1F Ye.I. Ismatov, Sh.Kh. Djuraev, A.V. Khugaev and D.E. Mannanov, in St. Petersburg XV (1995) 451

1995KA03 R. Kanungo, C. Samanta, S. Roy and S.K. Samaddar, Nucl. Phys. A581 (1995) 294

1995KA07 R. Kanungo, M. Lahiri, C. Samanta and H. Rebel, Z. Phys. A351 (1995) 9

1995KA1Y R. Kanungo, M. Lahiri and C. Samanta, H. Rebel, Rept. FZKA 5565 (1995) 23

1995KA43 R. Kanungo, M. Lahiri and C. Samanta, Int. J. Mod. Phys. E4 (1995) 827

1995KE10 P.L. Kerr, K.W. Kemper, P.V. Green, K. Mohajeri, E.G. Myers, D. Robson and B.G. Schmidt, Phys. Rev. C52 (1995) 1924

1995KH03 D.T. Khoa, G.R. Satchler and W. von Oertzen, Phys. Rev. C51 (1995) 2069

1995KO51 V.V. Komarov, A.M. Popova, M. El-Tahavi, F.I. Karmanov and V.L. Shablov, Bull. Russ. Acad. Sci. Phys. 59 (1995) 745

1995KU08 V.I. Kukulin, V.N. Pomerantsev, K.D. Razikov, V.T. Voronchev and G.G. Ryzhikh, Nucl. Phys. A586 (1995) 151

1995MA57 Yu.G. Mashkarov, E.I. Koshchy and Yu.M. Chuvilsky, Bull. Russ. Acad. Sci. Phys. 59 (1995) 150

1995MA59 M. Marinus and H.G. Miller, Nuovo Cim. A108 (1995) 437

1995MI16 D. Miljanic, S. Blagus, M. Lattuada, N. Soic and C. Spitaleri, Phys. Rev. C52 (1995) 1140

1995MU01 E. Muskat, J. Carter, R.W. Fearick and V. Hnizdo, Nucl. Phys. A581 (1995) 42

1995MU1J A.M. Mukhamedzhanov and R.E. Tribble, Few-Body Syst. Suppl. 8 (1995) 335

1995MU21 A.M. Mukhamedzhanov, R.P. Schmitt, R.E. Tribble and A. Sattarov, Phys. Rev. C52 (1995) 3483

1995OH03 H. Ohkura, T. Yamada and K. Ikeda, Prog. Theor. Phys. (Kyoto) 94 (1995) 47

1995PA22 Z. Papandreou, G.M. Huber, G.J. Lolos, J.C. Cormier, E.L. Mathie, S.I.H. Naqvi, D.F. Ottewell, R. Tacik, P.L. Walden, G. Jones et al., Phys. Rev. C51 (1995) R2862

1995PE1D Yu.E. Penionzkevich, C. Borcea, F. Carstoiu, I. David, Z. Dlouhy, A.S. Fomichev, D. Guillemaud-Mueller, M. Lewitowicz, S.M. Lukyanov, A.C. Mueller et al., in St. Petersburg XV (1995) 107

1995RI14 S. Rio, N. Metrich, M. Mosbah and P. Massiot, Nucl. Instrum. Meth. Phys. Res. B100 (1995) 141

1995RO37 C. Rolfs and E. Somorjai, Nucl. Instrum. Meth. Phys. Res. B99 (1995) 297

1995RU14 K. Rusek, N.M. Clarke, G. Tungate and R.P. Ward, Phys. Rev. C52 (1995) 2614

1995RY01 G.G. Ryzhikh, R.A. Eramzhyan and S. Shlomo, Phys. Rev. C51 (1995) 3240; Erratum Phys. Rev. C53 (1996) 2560

1995RY1C G.G. Ryzhikh, R.A. Eramzhyan and S.S. Kamalov, in Dubna 94 (1995) 302

1995SA12 S.S. Saad, Appl. Radiat. Isot. 46 (1995) 23

1995SK01 M. Skill, R. Baumann, G. Keil, N. Kniest, E. Pfaff, M. Preiss, G. Reiter, G. Clausnitzer, M. Haller and W. Kretschmer, Nucl. Phys. A581 (1995) 93

1995SU13 Y. Suzuki, K. Arai, Y. Ohbayasi and K. Varga, Nucl. Phys. A588 (1995) 15c.

1995WA01 R.E. Warner, F.D. Becchetti, J.W. Janecke, D.A. Roberts, D. Butts, C.L. Carpenter, J.M. Fetter, A. Muthukrishnan, J.J. Kolata, K. Lamkin et al., Phys. Rev. C51 (1995) 178

1995WA16 T. Wakasa, H. Sakai, H. Okamura, H. Otsu, S. Ishida, N. Sakamoto, T. Uesaka, Y. Satou, M.B. Greenfield, N. Koori et al., Phys. Rev. C51 (1995) R2871

1995WAZW T. Wakasa, H. Sakai, H. Okamura, H. Otsu, S. Fujita, M.B. Greenfield, S. Ishida, N. Koori, A. Okihana, N. Sakamoto et al., RCNP (Osaka) Ann. Rept. 1994 (1995) 153

1995XU02 H.M. Xu, G.K. Ajupova, A.C. Betker, C.A. Gagliardi, B. Kokenge, Y.W. Lui and A.F. Zaruba, Phys. Rev. C52 (1995) R1161.

1995YA12 X. Yang, L. Wang, J. Rapaport, C.D. Goodman, C.C. Foster, Y. Wang, E. Sugarbaker, D. Marchlenski, S. Delucia, B. Luther et al., Phys. Rev. C52 (1995) 2535

1996AL11 J.S. Al-Khalili, M.D. Cortina-Gil, P. Roussel-Chomaz, N. Alamanos, J. Barrette, W. Mittig, F. Auger, Y. Blumenfeld, J.M. Casandjian, M. Chartier et al., Phys. Lett. B378 (1996) 45

1996BB23 J. Ball, M. Combet, J.-L. Sans, B. Benda, P. Chaumette, J. Deregel, G. Durand, A.P. Dzyubak, C. Gaudron, F. Lehar et al., Nucl. Instrum. Meth. Phys. Res. A381 (1996) 4

1996BR30 J.A. Brown, D. Bazin, W. Benenson, J. Caggiano, M. Fauerbach, M. Hellstrom, J.H. Kelley, R.A. Kryger, R. Pfaff, B.M. Sherrill et al., Phys. Rev. C54 (1996) R2105

1996BU06 N. Burtebaev, A.D. Duisebaev, G.N. Ivanov and S.B. Sakuta, Yad. Fiz. 59 (1996) 33; Phys. At. Nucl. 59 (1996) 29.

1996CA01 F. Carstoiu and M. Lassaut, Nucl. Phys. A597 (1996) 269

1996CE02 F.E. Cecil, J. Yan and C.S. Galovich, Phys. Rev. C53 (1996) 1967

1996CH1C S. Cherubini, V.N. Kondratyev, M. Lattuada, C. Spitaleri, D. Miljanic, M. Zadro and G. Baur, Astrophys. J. 457 (1996) 855

1996CH33 S. Chiba and M. Harada, J. Nucl. Sci. Technol. 33 (1996) 346

1996CS03 A. Csoto and K. Langanke, Nucl. Phys. A601 (1996) 131

1996DA31 B.V. Danilin, M.V. Zhukov, N.B. Shulgina, I.J. Thompson, J.M. Bang, F.A. Gareev and J.S. Vaagen, Bull. Russ. Acad. Sci. Phys. 60 (1996) 21; Izv. Ross. Akad. Nauk Ser. Fiz. 60 (1996) 28

1996EF02 V.D. Efros, W. Balogh, H. Herndl, R. Hofinger and H. Oberhummer, Z. Phys. A355 (1996) 101

1996FO04 J.L. Forest, V.R. Pandharipande, S.C. Pieper, R.B. Wiringa, R. Schiavilla and A. Arriaga, Phys. Rev. C54 (1996) 646

1996GA29 D.L. Gay, E.E. Bartosz, P.D. Cathers, D.D. Caussyn, T.L. Drummer, K.W. Kemper, P.L. Kerr and D. Robson, Phys. Rev. C54 (1996) 3273

1996GR08 P.V. Green, K.V. Kemper, P.L. Kerr, K. Mohajeri, E.G. Myers, D. Robson, K. Rusek and I.J. Thompson, Phys. Rev. C53 (1996) 2862

1996JA11 J. Janecke, T. Annakkage, G.P.A. Berg, B.A. Brown, J.A. Brown, G. Crawley, S. Danczik, M. Fujiwara, D.J. Mercer, K. Pham et al., Phys. Rev. C54 (1996) 1070

1996JA12 L. Jarczyk, B. Kamys, M. Kistryn, A. Magiera, Z. Rudy, A. Strzalkowski, R. Barna, V. D'Amico, D. De Pasquale, A. Italiano et al., Phys. Rev. C54 (1996) 1302

1996KE09 P.L. Kerr, K.W. Kemper, P.V. Green, K. Mohajeri, E.G. Myers, B.G. Schmidt and V. Hnizdo, Phys. Rev. C54 (1996) 1267

1996KN02 O.M. Knyazkov, A.A. Kolozhvari, I.N. Kukhtina and S.A. Fayans, Yad. Fiz. 59 (1996) 466; Phys. At. Nucl. 59 (1996) 439

1996KUZU A.V. Kulik, Yad. Fiz. 59 (1996) 217; Phys. At. Nucl. 59 (1996) 199

1996LO04 G.J. Lolos, G.M. Huber, E.L. Mathie, S.I.H. Naqvi, Z. Papandreou, D.F. Ottewell, P.L. Walden, G. Jones, X. Aslanoglou and J.L. Visschers, Phys. Rev. C54 (1996) 211

1996NA24 P. Navratil and B.R. Barrett, Phys. Rev. C54 (1996) 2986

1996ORZZ H. Orihara, A. Terakawa, C.C. Yun, K. Itoh, A. Yamamoto, Y. Teramoto, N. Matsumura, T. Nakagawa, K. Ishii and H. Ohnuma, Cyclotron Rad. Center, Tohoku Univ. Ann. Rept. 1995 (1996) 28

1996RU10 A.T. Rudchik, A. Budzanowski, E.I. Koshchy, L. Glowacka, Y.G. Mashkarov, M. Makowskarzeszutko, V.M. Pirnak, R. Siudak, A. Szczurek, J. Turkiewicz et al., Nucl. Phys. A602 (1996) 211

1996RU13 A.T. Rudchik, E.I. Koshchy, A. Budzanowski, R. Siudak, A. Szczurek, I. Skwirczynska, Yu.G. Mashkarov, L. Glowacka, J. Turkiewicz, I.I. Zalyubovsky et al., Nucl. Phys. A609 (1996) 147

1996SA08 A. Saunders, S. Hoibraten, J.J. Kraushaar, B.J. Kriss, R.J. Peterson, R.A. Ristinen, J.T. Brack, G. Hofman, E.F. Gibson and C.L. Morris, Phys. Rev. C53 (1996) 1745

1996SI13 T. Sinha, R. Kanungo, C. Samanta, S. Ghosh, P. Basu and H. Rebel, Z. Phys. A355 (1996) 397

1996SO17 N. Soic, S. Blagus, M. Bogovac, S. Fazinic, M. Lattuada, M. Milin, D. Miljanic, D. Rendic, C. Spitaleri, T. Tadic and M. Zadro, Europhys. Lett. 34 (1996) 7

1996VE02 V.A. Vesna, Y.M. Gledenov, I.S. Okunev, Y.P. Popov and E.V. Shulgina, Yad. Fiz. 59 (1996) 23; Phys. At. Nucl. 59 (1996) 19.

1996YA01 T. Yamaya, K. Ishigaki, H. Ishiyama, T. Suehiro, S. Kato, M. Fujiwara, K. Katori, M.H. Tanaka, S. Kubono, V. Guimaraes and S. Ohkubo, Phys. Rev. C53 (1996) 131

1996YA09 Y. Yamashita and Y. Kudo, Phys. Rev. C54 (1996) 2077

1997BR37 C.R. Brune, H.J. Karwowski and E.J. Ludwig, Nucl. Instrum. Meth. Phys. Res. A389 (1997) 421

1997CH24 L.V. Chulkov et al., Phys. Rev. Lett. 79 (1997) 201

1997CH47 L.V. Chulkov and G. Schrieder, Z. Phys. A359 (1997) 231

1997CO04 M.D. Cortina-Gil, P. Roussel-Chomaz, N. Alamanos, J. Barrette, W. Mittig, F. Auger, Y. Blumenfeld, J.M. Casandjian, M. Chartier, V. Fekou-Youmbi et al., Nucl. Phys. A616 (1997) 215c.

1997DA01 B.V. Danilin, T. Rogde, S.N. Ershov, H. Heiberg-Andersen, J.S. Vaagen, I.J. Thompson and M.V. Zhukov, Phys. Rev. C55 (1997) R577

1997DI01 J.F. Dias, D. Ryckbosch, R. Van de Vyver, C. Van den Abeele, G. De Meyer, L. Van Hoorebeke, J.-O. Adler, K.I. Blomqvist, D. Nilsson, H. Ruijter and B. Schroder, Phys. Rev. C55 (1997) 942

1997DO01 P.J. Dortmans, K. Amos and S. Karataglidis, J. Phys. G23 (1997) 183

1997DU02 S.B. Dubovichenko, Yad. Fiz. 60 (1997) 254; Phys. At. Nucl. 60 (1997) 195

1997DU15 S.B. Dubovichenko and A.V. Dzhazairov-Kakhramanov, Fiz. Elem. Chastits At. Yadra 28 (1997) 1529; Phys. Part. Nucl. 28 (1997) 615

1997ER05 S.N. Ershov, T. Rogde, B.V. Danilin, J.S. Vaagen, I.J. Thompson and F.A. Gareev, Phys. Rev. C56 (1997) 1483

1997FA17 W.R. Falk, R. Aryaeinejad, J.R. Campbell, D.B. Stetski, A.A. Mirzai, O.A. Abou-zeid, T.L. Belyaeva and N.S. Zelenskaya, Nucl. Phys. A624 (1997) 370

1997KA24 S. Karataglidis, B.A. Brown, K. Amos and P.J. Dortmans, Phys. Rev. C55 (1997) 2826

1997KU14 E.V. Kuznetsova and V.I. Kukulin, Yad. Fiz. 60 (1997) 608; Phys. Atomic Nucl. 60 (1997) 528

1997NO04 K. M. Nollett, M. Lemoine and D.N. Schramm, Phys. Rev. C56 (1997) 1144

1997OK01 A. Okihana, K. Ushiro, T. Yoshimura, S. Kakigi and T. Sekioka, Nucl. Phys. A614 (1997) 71

1997PO03 K.W. Potthast, H. Brand, H. Freiesleben, P. Rosenthal, B. Kamys, H.P.G. Schieck and L. Sydow, Nuc. Phys. A614 (1997) 95

1997PU03 B.S. Pudliner, V.R. Pandharipande, J. Carlson, S.C. Pieper and R.B. Wiringa, Phys. Rev. C56 (1997) 1720

1997RU06 K. Rusek, P.V. Green, P.L. Kerr and K.W. Kemper, Phys. Rev. C56 (1997) 1895; Erratum Phys. Rev. C58 (1998) 1353

1997SA57 C. Samanta, Y. Sakuragi, M. Ito and M. Fujiwara, J. Phys. G23 (1997) 1697

1997SM07 A. Smerzi, D.G. Ravenhall and V.R. Pandharipande, Phys. Rev. C56 (1997) 2549

1997VA06 J.S. Vaagen, B.V. Danilin, S.N. Ershov, T. Rogde, D. Ridikas, H. Heilberg-Andersen, J.M. Bang, M.V. Zhukov, I.J. Thompson and the Russian-Nordic-British Theory Collab., Nucl. Phys. A616 (1997) 426c.

1997WU01 J. Wurzer and H.M. Hofmann, Phys. Rev. C55 (1997) 688

1997YAZV Y. Yamashita and Y. Kudo, RCNP Ann. Rept. 1996 (1997) 113

1997ZA06 D. Zahnow, C. Rolfs, S. Schmidt and H.P. Trautvetter, Z. Phys. A359 (1997) 211

1998AH06 M. Ahmed, Md.A.E. Akhter, Md.A. Rahman, H.M. Sen Gupta and M. Rahman, Nuovo Cim. A111 (1998) 113

1998AL05 J.S. Al-Khalili and J.A. Tostevin, Phys. Rev. C57 (1998) 1846

1998AL10 D. Aleksandrov, T. Aumann, L. Axelsson, T. Baumann, M.J.G. Borge, L.V. Chulkov, J. Cub, W. Dostal, B. Eberlein, T.W. Elze et al., Nucl. Phys. A633 (1998) 234

1998AN02 M.A. Andreeva, I.M. Band, E.B. Karlsson, M.A. Listengarten and M.B. Trzhaskovskaya, Phys. Scr. 57 (1998) 142

1998BE09 G.F. Bertsch, K. Hencken and H. Esbensen, Phys. Rev. C57 (1998) 1366

1998BR10 C.R. Brune, W.H. Geist, H.J. Karwowski, E.J. Ludwig and K.D. Veal, Phys. Rev. C57 (1998) 3437

1998CE04 J. Cederberg, D. Olson, J. Larson, G. Rakness, K. Jarausch, J. Schmidt, B. Borovsky, P. Larson and B. Nelson, Phys. Rev. A57 (1998) 2539

1998CH33 S. Chiba, K. Togasaki, M. Ibaraki, N. Baba, S. Matsuyama, N. Hirakawa, K. Shibata, O. Iwamoto, A.J. Koning, G.M. Hale et al., Phys. Rev. C58 (1998) 2205

1998CO06 J.P. Connelly, B.L. Berman, W.J. Briscoe, K.S. Dhuga, A. Mokhtari, D. Zubanov, H.P. Blok, R. Ent, J.H. Mitchell and L. Lapikas, Phys. Rev. C57 (1998) 1569

1998CO19 M.D. Cortina-Gil, A. Pakou, N. Alamanos, W. Mittig, P. Roussel-Chomaz, F. Auger, J. Barrette, Y. Blumenfeld, J.M. Casandjian, M. Chartier et al., J. Phys. G24 (1998) 1547

1998CO1M M.D. Cortina-Gil, A. Pakou, N. Alamanos, W. Mittig, P. Roussel-Choamz, F. Auger, J. Barrette, Y. Blumenfeld, J.M. Casandjian, M. Chartier et al., in Dubna 97 (1998) 97

1998CO28 M.D. Cortina-Gil, A. Pakou, N. Alamanos, W. Mittig, P. Roussel-Chomaz, F. Auger, J. Barrette, Y. Blumenfeld, J.M. Casandjian, M. Chartier et al., Nucl. Phys. A641 (1998) 263

1998DO16 P.J. Dortmans, K. Amos, S. Karataglidis and J. Raynal, Phys. Rev. C58 (1998) 2249

1998DU03 S.B. Dubovichenko, Yad. Fiz. 61 (1998) 210; Phys. At. Nucl. 61 (1998) 162

1998FUZP H. Fujita, K. Kume and S. Hirenzaki, RCNP (Osaka) Ann. Rept. 1997 (1998) 216

1998GA37 E. Garrido, D.V. Fedorov and A.S. Jensen, Phys. Rev. C58 (1998) R2654

1998GL01 F. Gluck, Nucl. Phys. A628 (1998) 493

1998GO1J S.A. Goncharov, in Dubna 97 (1998) 114

1998HA24 S.S. Hanna, C.J. Martoff, D. Pocanic, K. Wang, R.C. Byrd, C.C. Foster and I.J. van Heerden, Nucl. Instrum. Meth. Phys. Res. A401 (1998) 345

1998IB02 M. Ibaraki, M. Baba, S. Matsuyama, T. Sanami, T. Win, T. Miura and N. Hirakawa, J. Nucl. Sci. Tech. 35 (1998) 843

1998KE03 N. Keeley and K. Rusek, Phys. Lett. B427 (1998) 1

1998KH06 A. Kharbach and P. Descouvemont, Phys. Rev. C58 (1998) 1066

1998MU12 A. Mukherjee, U.D. Pramanik, S. Chattopadhyay, M.S. Sarkar, A. Goswami, P. Basu, S. Bhattacharya, M.L. Chatterjee and B. Dasmahapatra, Nucl. Phys. A635 (1998) 305; Erratum Nucl. Phys. A640, 509 (1998)

1998NAZP S. Nakayama, K. Fushimi, N. Koori, H. Akimune, Y. Arimoto, I. Daito, H. Fujimura, M. Fujiwara, T. Inomata, K. Ishibashi et al., in Tokyo 97 (1998) 238

1998NAZR S. Nakayama, H. Akimune, Y. Arimoto, I. Daito, H. Fujimura, Y. Fujita, M. Fujiwara, K. Fushimi, H. Kohri, N. Koori et al., RCNP (Osaka) Ann. Rept. 1997 (1998) 61

1998OR1B H. Orihara, A. Terakawa, C.C. Yun, K. Itoh, A. Yamamoto, Y. Teramoto, N. Matsumura, G.C. Jon, T. Nakagawa, K. Ishii et al., in Tokyo 97 (1998) 489

1998PI02 V.V. Pilipenko, Yad. Fiz. 61 (1998) 467; Phys. At. Nucl. 61 (1998) 406

1998PO03 K.W. Potthast, H. Freiesleben, P. Rosenthal, B. Kamys, Z. Rudy, H. Paetz gen Schieck and L. Sydow, Nucl. Phys. A629 (1998) 656

1998SH33 V.B. Shostak, G.P. Palkin, N.I. Woloshin, V.P. Likachev, J.D.T. Arruda-Neto, M.T.F. da Cruz and M.N. Martins, Nucl. Phys. A643 (1998) 3

1998SU18 Y. Suzuki, N. Tanaka and K. Varga, J. Phys. G24 (1998) 1491

1998TE03 G.M. Ter-Akopian, A.M. Rodin, A.S. Fomichev, S.I. Sidorchuk, S.V. Stepantsov, R. Wolski, M.L. Chelnokov. V.A. Gorshkov, A. Yu. LavrentYev, V.I. Zagrebaev et al., Phys. Lett. B426 (1998) 251

1998TE1D G.M. Ter-Akopian, A.M. Rodin, A.S. Fomichev, S.I. Sidorchuk, S.V. Stepantsov, R. Wolski, M.L. Chelnokov, V.A. Gorshkov, A.Y. Lavrentev, V.B. Galinski et al., in Dubna 97 (1998) 105

1998TI06 D.R. Tilley, C.M. Cheves, J.H. Kelley, S. Raman and H.R. Weller, Nucl. Phys. A636 (1998) 249

1998VE03 K.D. Veal, C.R. Brune, W.H. Geist, H.J. Karwowski, E.J. Ludwig, A.J. Mendez, E.E. Bartosz, P.D. Cathers, T.L. Drummer, K.W. Kemper et al., Phys. Rev. Lett. 81 (1998) 1187

1998WA12 T. Wakasa, H. Sakai, H. Okamura, H. Otsu, S. Fujita, S. Ishida, N. Sakamoto, T. Uesaka, Y. Satou, T. Nonaka et al., Nucl. Instrum. Meth. Phys. Res. A404 (1998) 355

1998WI10 R.B. Wiringa, Nucl. Phys. A631 (1998) 70c.

1998WI28 R.B. Wiringa and R. Schiavilla, Phys. Rev. Lett. 81 (1998) 4317

1999AB37 B. Abu-Ibrahim, K. Fujimura and Y. Suzuki, Nucl. Phys. A657 (1999) 391

1999AN13 T. Annakkage, J. Janecke, J.S. Winfield, G.P.A. Berg, J.A. Brown, G. Crawley, S. DanczIk, M. Fujiwara, D.J. Mercer, K. Pham et al., Nucl. Phys. A648 (1999) 3

1999AN35 C. Angulo, M. Arnould, M. Rayet, P. Descouvemont, D. Baye, C. Leclercq-Willain, A. Coc, S. Barhoumi, P. Auger, C. Rolfs et al., Nucl. Phys. A656 (1999) 3

1999AR08 K. Arai, Y. Suzuki and R.G. Lovas, Phys. Rev. C59 (1999) 1432

1999AU01 T. Aumann, D. Aleksandrov, L. Axelsson, T. Baumann, M.J.G. Borge, L.V. Chulkov, J. Cub, W. Dostal, B. Eberlein, Th.W. Elze et al., Phys. Rev. C59 (1999) 1252

1999BB21 J. Ball, C.E. Allgower, M. Beddo, J. Bystricky, M. Combet, Ph. Demierre, G. Durand, J.-M. Fontaine, D. Grosnick, R. Hess et al., Eur. Phys. J. C11 (1999) 51

1999BE14 J.C. Bergstrom, R. Igarashi and J.M. Vogt, Phys. Rev. C59 (1999) 2588

1999CO11 S.G. Cooper, V.I. Kukulin, R.S. Mackintosh and V.N. Pomerantsev, Phys. Rev. C59 (1999) 2361

1999DE47 A. de Lesquen, C.E. Allgower, J. Ball, M. Beddo, J. Bystricky, M. Combet, Ph. Demierre, G. Durand, J.-M. Fontaine, D. Grosnick et al., Eur. Phys. J. C11 (1999) 69

1999EG02 P. Egelhof, Pramana 53 (1999) 365

1999ER02 R.A. Eramzhyan, G.G. Ryzhikh and Yu.M. Tchvilsky, Yad. Fiz. 62 (1999) 42; Phys. At. Nucl. 62 (1999) 37

1999FU03 K. Fujimura, D. Baye, P. Descouvemont, Y. Suzuki and K. Varga, Phys. Rev. C59 (1999) 817

1999GE02 E.A. George and L.D. Knutson, Phys. Rev. C59 (1999) 598

1999GN01 I.A. Gnilozub, G.G. Ryzhikh, R.A. Eramzhian and N.P. Yudin, Bull. Russ. Acad. Sci. Phys. 63 (1999) 1; Izv. Ross. Akad. Nauk. Ser. Fiz. 63 (1999) 2

1999GO36 O.K. Gorpinich, O.M. Povoroznik, A.P. Pshedzyal and B.G. Struzhko, Bull. Russ. Acad. Sci. Phys. 63 (1999) 1780; Izv. Ross. Akad. Nauk. Ser. Fiz. 63 (1999) 2298

1999HO02 T. Hotta, T. Tamae, T. Miura, H. Miyase, I. Nakagawa, T. Suda, M. Sugawara, T. Tadokoro, A. Takahashi, E. Tanaka and H. Tsubota, Nucl. Phys. A645 (1999) 492

1999LA13 L. Lapikas, J. Wesseling and R.B. Wiringa, Phys. Rev. Lett. 82 (1999) 4404

1999MA02 R.S. Mackintosh, S.G. Cooper and V.I. Kukulin, Nucl. Phys. A645 (1999) 399

1999MA16 A.M.M. Maciel, P.R.S. Gomes, J. Lubian, R.M. Anjos, R. Cabezas, G.M. Santos, C. Muri, S.B. Moraes, R. Liguori Neto, N. Added et al., Phys. Rev. C59 (1999) 2103

1999OG06 Yu.Ts. Oganessian, V.I. Zagrebaev and J.S. Vaagen, Phys. Rev. Lett. 82 (1999) 4996

1999OG09 Yu.Ts. Oganessian, V.I. Zagrebaev and J.S. Vaagen, Phys. Rev. C60 (1999) 044605

1999RA15 R. Raabe, A. Piechaczek, A. Andreyev, D. Baye, W. Bradfield-Smith, S. Cherubini, T. Davinson, P. Descouvemont, A. Di Pietro, W. Galster et al., Phys. Lett. B458 (1999) 1

1999RO13 O.A. Rondon, Phys. Rev. C60 (1999) 035201

1999SH05 K. Shoda and T. Tanaka, Phys. Rev. C59 (1999) 239

1999TI07 N.K. Timofeyuk, Nucl. Phys. A652 (1999) 132

1999VO01 A. Volya, S. Pratt and V. Zelevinsky, Phys. Rev. C59 (1999) 305

1999WAZV T. Wakasa, H. Sakai, K. Hatanaka, H. Okamura, H. Otsu, S. Fujita, T. Nonaka, T. Uesaka, Y. Satou, T. Ohnishi et al., RCNP (Osaka), Ann. Rept. 1998 (1999) p. 23

1999WO13 R. Wolski, A.S. Fomichev, A.M. Rodin, S.I. Sidorchuk, S.V. Stepantsov, G.M. Ter-Akopian, M.L. Chelnokov, V.A. Gorshkov, A.Yu. Lavrentev, Yu.Ts. Oganessian et al., Phys. Lett. B467 (1999) 8

1999ZHZN J. Zhang, B. Yu and Y. Han, INDC(CPR)-049/L (1999) 35

2000AB25 B.M. Abramov, Yu.A. Borodin, S.A. Bulychiev, I.A. Dukhovskoy, A.P. Krutenkova, V.V. Kulikov, M.A. Matsyuk, I.A. Radkevich, E.N. Turdakina and A.I. Khanov, Pisma Zh. Eksp. Teor. Fiz. 71 (2000) 524; JETP Lett. 71 (2000) 359

2000AL04 D. Aleksandrov, T. Aumann, L. Axelsson, T. Baumann, M.J.G. Borge, L.V. Chulkov, J. Cub, W. Dostal, B. Eberlein, Th.W. Elze et al., Nucl. Phys. A669 (2000) 51

2000AN15 M. Andersson, Chr. Bargholtz, K. Fransson, L. Holmberg, K. Lindh, L. Martensson, I. Sitnikova, P.-E. Tegner, P. Thorngren Engblom, G. Weiss et al., Phys. Lett. B481 (2000) 165; Erratum Phys. Lett. B484 (2000) 375

2000AN31 M. Andersson, Chr. Bargholtz, K. Fransson, L. Holmberg, K. Lindh, L. Martensson, I. Sitnikova, P.-E. Tegner, P. Thorngren Engblom, G. Weiss et al., Acta Phys. Pol. B31 (2000) 2343

2000ANZX L.N. Andronenko, M.N. Andronenko, D.M. Seliverstov and W. Neubert, in Croatia (2000) 370

2000AV02 M. Avrigeanu, G.S. Anagnostatos, A.N. Antonov and J. Giapitzakis, Phys. Rev. C62 (2000) 017001

2000BO45 D.V. Bolotov, O.M. Knyazkov, I.N. Kuchtina and S.A. Fayans, Yad. Fiz. 63 (2000) 1631; Phys. At. Nucl. 63 (2000) 1546

2000DE43 P.K. Deb, K. Amos and S. Karataglidis, Phys. Rev. C62 (2000) 037601

2000DE61 P.K. Deb, K. Amos and S. Karataglidis, Aust. J. Phys. 53 (2000) 767

2000DOZY A.V. Dobrovolsky, G.D. Alkhazov, M.N. Andronenko, A. Bauchet, P. Egelhof, S. Fritz, G.E. Gavrilov, H. Geissel, C. Gross, A.V. Khanzadeev et al., GSI 2000-1 (2000) 26

2000GA49 L. I. Galanina and N. S. Zelenskaya, Phys. At. Nucl. 63 (2000) 1792; Yad. Fiz. 63 (2000) 1881

2000GA59 L.I. Galanina and N.S. Zelenskaya, Bull. Russ. Acad. Sci. Phys. 64 (2000) 764; Izv. Ross. Akad. Nauk Ser. Fiz. 64 (2001) 954

2000GO35 O.K. Gorpinich, O.M. Povoroznik, A.P. Pshedzyal and B.G. Struzhko, Bull. Russ. Acad. Sci. Phys. 64 (2000) 82; Izv. Ross. Akad. Nauk. Ser. Fiz. 64 (2000) 100

2000GU19 D. Gupta, C. Samanta and R. Kanungo, Nucl. Phys. A674 (2000) 77

2000HA33 T. Hagner, R. von Hentig, B. Heisinger, L. Oberauer, S. Schonert, F. von Feilitzsch and E. Nolte, Astropart. Phys. 14 (2000) 33

2000IG03 S.B. Igamov and R. Yarmukhamedov, Nucl. Phys. A673 (2000) 509

2000ISZZ K. Ishii, K. Ochiai, I. Murata, H. Miyamaru and A. Takahashi, INDC(JPN)-185/U (JAERI-Conf 2000-005) (Jpn. Atomic Energy Res.) (2000)166

2000KO52 Yu.E. Kozyr, Bull. Russ. Acad. Sci. Phys. 64 (2000) 385; Izv. Ross. Akad. Nauk Ser. Fiz. (Russia) 64 (2000) 483

2000KO67 Yu.E. Kozyr, Bull. Russ. Acad. Sci. Phys. 64 (2000) 705; Izv. Ross. Akad. Nauk.Ser. Fiz. 64 (2000) 883

2000LA17 L. Lapikas, J. Wesseling and R.B. Wiringa, Nucl. Phys. A663-664 (2000) 377c.

2000LA40 L.M. Lazarev and B.M. Dzyuba, Bull. Russ. Acad. Sci. Phys. 64 (2000) 778; Izv. Ross. Akad. Nauk.Ser. Fiz. 64 (2000) 970

2000MA12 F.M. Marques, M. Labiche, N.A. Orr, J.C. Angelique, L. Axelsson, B. Benoit, U.C. Bergmann, M.J.G. Borge, W.N. Catford, S.P.G. Chappell et al., Phys. Lett. B476 (2000) 219

2000MA43 F. Marechal, T.L. Drummer and K.W. Kemper, Phys. Rev. C61 (2000) 064607

2000MI17 O.V. Miklukho, N.P. Aleshin, S.L. Belostotsky, O.G. Grebenyuk, O.Ya. Fedorov, A. A. Izotov, A.Yu. Kisselev, Yu.G. Naryshkin,V.V. Nelyubin et al., Yad. Fiz. 63 (2000) 894; Phys. At. Nucl. 63 (2000) 824

2000NA22 S. Nakayama, T. Yamagata, H. Akimune, I. Daito, H. Fujimura, Y. Fujita, M. Fujiwara, K. Fushimi, T. Inomata, H. Kohri et al., Phys. Rev. Lett. 85 (2000) 262

2000NA35 T. Nakamura, T. Aumann, D. Bazin, Y. Blumenfeld, B.A. Brown, J. Caggiano, R. Clement, T. Glasmacher, P.A. Lofy, A. Navin et al., Phys. Lett. B493 (2000) 209

2000RU03 K. Rusek and K.W. Kemper, Phys. Rev. C61 (2000) 034608

2000TI02 N.K. Timofeyuk and I.J. Thompson, Phys. Rev. C61 (2000) 044608

2000VO08 V.T. Voronchev and V.I. Kukulin, J. Phys. G26 (2000) L103

2000WE03 S.P. Weppner, O. Garcia and Ch. Elster, Phys. Rev. C61 (2000) 044601

2000ZH40 W.N. Zhang, G.X. Tang, X.J. Chen, L. Huo, Y.M. Liu and S. Zhang, Phys. Rev. C62 (2000) 044903

2001AR05 K. Arai, P. Descouvemont and D. Baye, Phys. Rev. C63 (2001) 044611

2001AU06 S.M. Austin and D.J. Mercer, Nucl. Phys. A688 (2001) 70c

2001BA47 F.C. Barker and Y. Kondo, Nucl. Phys. A688 (2001) 959

2001BO38 M.J. Boland, M.A. Garbutt, R.P. Rassool, M.N. Thompson, A.J. Bennett, J.W. Jury, J.-O. Adler, B. Schroder, D. Nilsson, K. Hansen et al., Phys. Rev. C64 (2001) 031601

2001DE19 A. de Vismes, P. Roussel-Chomaz, W. Mittig, A. Pakou, N. Alamanos, F. Auger, J.-C. Angelique, J. Barrette, A.V. Belozyorov, C. Borcea et al., Phys. Lett. B505 (2001) 15

2001EG02 P. Egelhof for the IKAR Collaboration, Prog. Part. Nucl. Phys. 46 (2001) 307

2001LE01 T.-S.H. Lee and R.B. Wiringa, Phys. Rev. C63 (2001) 014006

2001ME13 D.J. Mercer, S.M. Austin, J.A. Brown, S.A. Danczyk, S.E. Hirzebruch, J.H. Kelley, T. Suomijarvi, D.A. Roberts and T.P. Walker, Phys. Rev. C63 (2001) 065805

2001MI07 O.V. Miklukho, N.P. Aleshin, S.L. Belostotsky, Yu.V. Elkin, O.G. Grebenyuk, O.Ya. Fedorov, A.A. Izotov, A.A. Jgoun, A.Yu. Kisselev, M.P. Levchenko et al., Nucl. Phys. A683 (2001) 145

2001NA18 S. Nakayama, Nucl. Phys. A687 (2001) 84c

2001NO01 K.M. Nollett, R.B. Wiringa and R. Schiavilla, Phys. Rev. C63 (2001) 024003

2001SH03 V.B. Shostak, G.P. Palkin, N.I. Woloshin, V.P. Likhachev, M.N. Martins and M.T.F. da Cruz, Phys. Rev. C63 (2001) 017602

2001TE03 F. Terrasi, L. Gialanella, G. Imbriani, F. Strieder, L. Campajola, A. D’Onofrio, U. Greife, G. Gyurky, C. Lubritto, A. Ordine et al., Nucl. Phys. A688 (2001) 539c

2001TH12 I.J. Thompson and A.M. Eiro, Nucl. Phys. A689 (2001) 365c