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ENERGY LEVELS OF LIGHT NUCLEI. III

$Z = 11$ to $Z = 20$

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ADDENDA

By courtesy of the Editor these addenda, containing short references to material received in the period October 1, 1961–February 15, 1962, could be published together with the review article. In this way it was possible to shorten the period between the deadline and the date of publication appreciably. The data given in the addenda are *not* incorporated in the figures and master tables of the main text.

^{21}Na

^{20}Ne(d, n)^{21}Na

Analysis of the angular distribution measurements in Gr 61 yields reduced widths for groups (0) and (1)[29]. Analysis of the angular distributions reported in Aj 61 yields $l_p = 2, 4, 0, 0, 1, 1,$ and 1, and $(2J+1)\theta_p{}^2 = 0.12, 0.2, 0.77, 0.04, 0.18, 0.11,$ and 0.25 for transitions to ^{21}Na* $= 0 + 0.34, 1.72, 2.42, 2.81, 4.17 + 4.31, 4.44 + 4.48,$ and 5.00 MeV, respectively[1].

^{22}Na

^{22}Na(β^-)^{22}Ne

Deviation of the spectrum from the statistical shape is theoretically discussed[104].

^{23}Na

^{20}Ne(α, p)^{23}Na

At $E_\alpha = 27$ MeV, angular distributions of groups (0 + 1) and (2 + 3 + 4 + 5 + 6) have been measured[79].

$^{22}Ne(d, n)^{23}Na$

Besides the groups already mentioned in Gr 61, groups have also been observed to ^{23}Na states at $E_x = 3.90 \pm 0.10$, 4.45 ± 0.20, 4.75 ± 0.15, and 5.16 ± 0.10 MeV[29].

$^{23}Ne(\beta^-)^{23}Na$

The recoil energy spectrum agrees to within 1% with the supposition that the β^- transitions to $^{23}Na(0)$ and (1) both have pure axial vector character[16].

$^{23}Na(\gamma, \gamma)^{23}Na$

The mean life of $^{23}Na(1)$ has been measured as $(1.88 \pm 0.25) \times 10^{-12}$ sec in a bremsstrahlung resonance fluorescence experiment[50]. An analogous experiment yields the mean life of the 2.98 MeV level[8].

$^{23}Na(n, n')^{23}Na$

Cross section at $E_n = 14$ MeV[86].

$^{23}Na(p, p')^{23}Na$

Theoretical discussion of anomalies in the cross section for Coulomb excitation[87].

$^{24}Mg(\gamma, p)^{23}Na$

Angular distributions of photo-protons from deformed nuclei have been computed[30].

^{24}Na

$^{24}Na(\beta^-)^{24}Mg$

A half-life measurement yields 15.05 ± 0.03 hr[44]. The β^- spectrum between 300 and 1300 keV has the allowed shape within 0.5%[23]. An angular correlation measurement of the 2.75 and 1.37 MeV γ rays shows that both are pure E2, with an M3 admixture in the former of at most 0.003%[26]. A precision measurement of the energy of the $^{24}Mg(1) \rightarrow (0)$ transition yields $E_\gamma = 1368.41 \pm 0.20$ keV (after Doppler correction)[31].

$^{23}Na(d, p)^{24}Na$

At $E_d = 8.9$ MeV, excitation energies of many ^{23}Na levels up to $E_x = 5.42$ MeV, l_n values, and relative reduced widths have been measured[20].

$^{27}Al(n, \alpha)^{24}Na$

The total cross section has been measured in the $E_n = 12.0$–19.6 MeV region[9].

^{24}Mg

$^{16}O(^{12}C, \alpha)^{24}Mg$

Alpha-particle angular distributions in the neighbourhood of $\vartheta = 0°$ yield even parity for all ^{24}Mg states up to and including that at $E_x = 6.43$ MeV[80].

^{20}Ne(α, γ)^{24}Mg

The following resonances have been found (with J^π values from angular distribution measurements): $E_\alpha = 1.630$, 1.916(2+), 2.029(2+), 2.212, 2.273, all ± 0.015, and 2.489(1−), 2.564(2+), 2.643(2+), 2.858, 2.898, 3.060(1−), and 3.190 MeV, all ± 0.010 MeV, corresponding to ^{24}Mg levels at $E_x = 10.672^b$, 10.911^b, 11.004^b, 11.157, 11.208, $11.388^{a,b}$, $11.450^{a,b}$, $11.516^{a,b}$, 11.696, 11.729^a, $11.863^{a,b}$, and $11.972^{a,c}$ MeV, respectively. The levels marked^a, marked^b, and ^{c}, were known from the ^{20}Ne(α, α)^{20}Ne, ^{23}Na(^{3}He, d)^{24}Mg, and ^{23}Na(p, α_0)^{20}Ne reactions, respectively[88].

^{23}Na(p, γ)^{24}Mg

Gamma-ray branchings and $\omega\gamma$ values have been measured at twelve resonances in the $E_p = 594$–1419 keV region. The ^{24}Mg levels at 4.23, 7.35, 7.62, and 7.75 MeV have $\Gamma_{\gamma_0}/\Gamma_{\gamma_1} = 2.7$, 1.5, 0.67, and 0.67, respectively[61].

^{23}Na(p, α)^{20}Ne

Yields and total widths have been measured of resonances in the $E_p = 200$–450 keV region. From angular distribution measurements, spins and parities are assigned to three resonances[25].

^{24}Mg(γ, γ)^{24}Mg

Betatron bremsstrahlung excites three levels in ^{24}Mg, at 8, 9.3, and 10.2 MeV, with $\Gamma_\gamma = 0.5$, 0.9, and $3.8^{+1.2}_{-0.6}$ eV, respectively[71]. An analogous experiment yields the excitation of states at 9.9 and 10.8 MeV[2].

^{24}Mg(n, n)^{24}Mg

The azimuthal asymmetry in elastic scattering has been measured of partially polarized neutrons at $E_n = 0.2$–0.7 MeV[42] and $E_n = 2.8$ MeV[36].

^{24}Mg(p, p')^{24}Mg

Angular distributions of groups (0) and (1) have been measured at several proton energies in the $E_p = 7$–16 MeV region[45]. The azimuthal asymmetry in elastic scattering has been observed of partially polarized 8 MeV protons[64].

In the main text of this review paper, erroneously no mention has been made of a measurement of the excitation of ^{24}Mg(6) : 6.432 ± 0.010 MeV (Co 61d).

^{24}Mg(α, α')^{24}Mg

At $E_\alpha = 42$ MeV, inelastic scattering angular distributions have been measured corresponding to $E_x = 4.12$, 4.23, 6.0, and 6.4 MeV levels[82].

^{27}Al(p, α)^{24}Mg

The ground-state Q value has been measured as 1.598 ± 0.003 MeV[24]. Angular distributions of α_0 and α_1 have been obtained at $E_p = 10.0, 10.5, 11.0, 11.5$, and 12.0 MeV[77].

REMARKS

The fine structure in the (γ, p) and (γ, n) cross sections on ^{24}Mg is computed[58]. Shell model calculations yield energy levels and branching ratios in ^{24}Mg[28]. Application of the random-phase approximation to the giant E1 resonance of ^{24}Mg yields two well separated peaks[108].

^{25}Mg

^{24}Mg(d, p)^{25}Mg

From the angular distribution measurements in Mi 61a, l_n values and reduced widths are extracted by D.W.B.A. analysis[15]. Comparison of the results of Hi 61h and Ja 61a indicates that several of the groups leading to levels given in table 25.9, column 1 (Ja 61a), have erroneously been ascribed to ^{25}Mg. Correction yields only the following ^{25}Mg levels: 4.727, 5.020, 5.123, 5.252, 5.479, and 5.508 MeV, all ± 0.004 MeV[102].

^{27}Al(γ, d)^{25}Mg

Yield measurement ($E_{max} = 35$ MeV) and comparison of (γ, d) and (γ, p) yields[89].

^{27}Al(n, t)^{25}Mg

The cross section has been measured for fission neutrons[33].

^{27}Al(d, α)^{25}Mg

Excitation energies are given of 66 levels in ^{25}Mg with 2–10 keV errors; $Q_0 = 6.690 \pm 0.011$ MeV[69]. A statistical model discussion of the $(2J + 1)$ intensity rule is given[106].

^{28}Si(n, α)^{25}Mg

In the $E_n = 4.6$–8.6 MeV region, strong resonance structure has been observed in the yield of groups α_0 through α_4[10].

REMARKS

Fine structure in (γ, p) and (γ, n) yields on ^{25}Mg has been computed[58]. The α-particle model has been applied to a description of the ^{25}Mg–^{25}Al level schemes[53]

^{26}Mg

^{25}Mg(d, p)^{26}Mg

In the $E_d = 1.5$–3.0 MeV region, angular distributions and exitation functions have been measured of groups p_1 and p_2[73].

$^{27}Al(\gamma, p)^{26}Mg$

Proton spectra and angular distributions have been measured at $E_\gamma = 17.6$ MeV[12], and with bremsstrahlung of $E_{max} = 21$ MeV[48]. Yield measurements with $E_{max} = 35$ MeV[89].

$^{27}Al(^{16}O, ^{17}F)^{26}Mg$

The cross section has been measured at $E(^{16}O) = 36$ MeV[90].

^{26}Al

$^{25}Mg(p, \gamma)^{26}Al$

In the $E_p = 0.9$–1.8 MeV region, 33 resonances have been observed. The γ-ray branching of 20 resonances and of 24 lower levels is given. The 2.08 MeV level is shown to be a doublet[57].

^{27}Mg

$^{27}Al(^{16}O, ^{16}F)^{27}Mg$

The cross section has been measured at $E^{16}(O) = 36$ MeV[90].

^{27}Al

$^{24}Mg(\alpha, p)^{27}Al$

The ground-state Q value is measured as -1.598 ± 0.005 MeV[24].

$^{26}Mg(p, \gamma)^{27}Al$

The γ-branching of the $E_p = 721$, 809, 839, and 954 keV resonances has been measured. Spins, parities, and mixing ratios were obtained from angular distribution and correlation measurements[59].

$^{27}Al(\gamma, \gamma)^{27}Al$

From a bremsstrahlung resonance fluorescence experiment the mean life has been obtained of the $E_x = 2.98 + 3.00$ MeV doublet (unresolved)[8]. The yield curve of resonantly scattered bremsstrahlung with an energy between E_{max} and $E_{max} - 1$ MeV shows a peak at 8.3 MeV[74]. Bremsstrahlung resonant scattering shows the giant resonance to be double; the angular distribution is consistent with dipole scattering[13].

$^{27}Al(n, n)^{27}Al$

The azimuthal asymmetry in elastic scattering has been measured of partially polarized neutrons at $E_n = 2.8$ MeV[36], and at $E_n = 24$ MeV[52]. Elastic scattering differential cross section at $E_n = 24$ MeV[54]. Inelastic scattering cross section at $E_n = 14.3$, 15.4, and 16.1 MeV[91].

$^{27}Al(p, p')^{27}Al$

Measurements have been performed of the elastic differential cross section at 6.8 MeV[62], of the azimuthal asymmetry in elastic scattering of 8 MeV polarized protons[64], of angular distributions of inelastically scattered protons (E_p = 6.5–7.4 MeV)[39], and of energies of γ rays resulting from inelastic scattering[46]. A theoretical discussion is given of the results in Jo 61b[65].

^{27}Al(d, d)^{27}Al

The elastic scattering differential cross section has been measured at E_d = 11.8 MeV[22].

^{27}Al(α, α')^{27}Al

At $E_\alpha \approx 42$ MeV, $\sigma(\vartheta)$ has been measured for α_0 and for several inelastically scattered groups[51, 82].

^{28}Si(γ, p)^{27}Al

The proton energy spectrum and $\sigma(\vartheta)$ has been measured of bremsstrahlung of E_{max} = 24 MeV[68].

^{27}Si

^{28}Si(γ, n)^{27}Si

Threshold measurement yields $E_{thresh} = 17.14 \pm 0.12$ MeV[92].

^{28}Mg

^{28}Mg(β^-)^{28}Al

The half-life is 21.2 ± 0.1 hr[55].

^{28}Al

^{28}Al(β^-)^{28}Si

The half-life is 2.26 ± 0.01 m[55].

^{27}Al(^{16}O, ^{15}O)^{28}Al

At E(^{16}O) = 36 MeV, the cross section $\sigma \leqslant 7$ μb[90].

^{28}Si(n, p)^{28}Al

In the E_n = 4.6–8.6 MeV region, strong resonance structure has been observed in the yield of groups p_0 through p_9[10].

^{28}Si

^{16}O(^{16}O, α)^{28}Si

Alpha-particle angular distributions yield even parity for all ^{28}Si states up to and including that at 6.28 MeV[80].

^{24}Mg(α, γ)^{28}Si

The following resonances (E_α in MeV) have been found (in brackets relative intensities and J^π are given, the latter from angular distribution measurements): 3.21 (1.0; 2^+), 3.31 (0.1; 0^+ or 4^+), 3.36 (0.1; 4^+), 3.42 (0.3; 4^+), 3.51 (0.2; 1^-), 3.59 (0.1; 4^+), 3.66 (0.9; 2^+), 3.82 (0.2; (4^+)), 4.35 (0.4; 2^+)[73]. The resonance energies given in Sm 60a and Sm 61a have to be lowered by 0.28%. A new resonance at $E_\alpha = 2.932$ MeV, corresponding to the ^{27}Al(p, γ)^{28}Si resonance at $E_p = 936$ keV has $(2J+1)\gamma = 0.10$ eV[88].

^{27}Al(p, γ)^{28}Si

The "Lewis effect" was observed at the $E_p = 992$ keV resonance; it may have caused errors in former precision energy measurements[76].

The γ decay of the 759, 766, 773, and 993 keV resonances has been investigated[93]. The data given in reference Va 61c have been published[85].

^{28}Si(γ, γ)^{28}Si

The yield curve of resonantly scattered bremsstrahlung with an energy between E_{max} and $E_{max} - 1$ MeV shows peaks at 6, 10.4, and 12.0 MeV[74]. In the spectrum of resonantly scattered bremsstrahlung peaks have been observed at $E_\gamma = 9.8$ and 11.3 MeV, both corresponding to breaks in the yield curve. These levels have $\Gamma_\gamma = 0.9$ and 8.3 ± 2.5 eV, respectively[71].

^{28}Si(d, d)^{28}Si

At $E_d = 11.5$ MeV, $\sigma(\vartheta)$ has been measured for elastic scattering[22].

^{29}Si(γ, n)^{28}Si

The threshold has been measured as 8.47 ± 0.07 MeV[92].

^{29}Si

^{28}Si(n, p)^{28}Al, ^{28}Si(n, α)^{25}Mg } In the $E_n = 4.6$–8.6 MeV region, strong resonance structure has been observed in the yield of groups p_0 through p_6 and α_0 through α_4[10].

^{29}Si(γ, γ)^{29}Si

The mean life of the 2.43 MeV level has been determined from bremsstrahlung resonance scattering[8].

^{29}Si(p, p')^{29}Si

The angular distribution of the 1.28 MeV γ ray, excited in inelastic scattering, has been computed[72].

^{30}Si(γ, n)^{29}Si

Threshold measurement yields $E_{thresh} = 10.62 \pm 0.07$ MeV[92].

^{29}P

^{28}Si(p, p)^{28}Si

Improved analysis of the experiments given in Br 61a yields an additional resonance at $E_p = 6.60$ MeV with $\Gamma \approx 150$ keV, and changes the l_p values of the following levels: ^{29}P* = 7.50 ($l_p = 2$), 7.74(2), 7.92(3), 8.20(2), 8.26(1), 8.49((0)), 8.51(2), 8.62((1)), 8.89(2), 9.06(1), 9.28(1), and 9.37((2,0)) MeV[94]

^{30}Si

^{27}Al(α, p)^{30}Si

At $E_{\alpha} = 42$ MeV, $\sigma(\vartheta)$ has been measured of several proton groups[43].

^{29}Si(d, p)^{30}Si

Angular distributions of the groups to ^{30}Si(0) and (1) yield $l_n = 0$ and 2, respectively[95].

^{31}P(γ, p)^{30}Si

The proton energy spectrum and $\sigma(\vartheta)$ have been measured with bremsstrahlung of $E_{max} = 24$ MeV[68].

^{30}P

^{29}Si(p, γ)^{30}P

Angular distribution measurements at the $E_p = 1330$ keV resonance yield $J^{\pi} = 2^+$ and $T = 1$ for the resonance level[97]. The results given in Ba 60f are discussed[107].

^{32}S(n, t)^{30}P

Cross section at $E_n = 14.7$ MeV, $\sigma = 20 \pm 5$ μb[96].

^{31}P

^{30}Si(p, γ)^{31}P

Yields and γ-decay modes have been measured of resonances in the $E_p = 975$–1840 keV region. The $E_x = 4.26$ MeV level in ^{31}P mainly decays by a γ_0. An angular distribution measurement shows the 1480 keV resonance to have $J^{\pi} = \frac{3}{2}^+$[31]. Gamma-ray angular distribution and polarization measurements yield $J^{\pi} = \frac{3}{2}^+, \frac{3}{2}^+, \frac{3}{2}^+$, and $\frac{5}{2}^+$, for the resonances at 773, 939, 979.5, and 1393 keV, respectively[75].

^{31}P(γ, γ)^{31}P

The mean life of the 2.23 and 3.13 MeV levels has been found from bremsstrahlung resonant fluorescence[7, 8].

^{31}P(p, p$'$)^{31}P

Angular distributions have been measured of groups p_1 and p_2 in the $E_p = 6.5$–7.4 MeV region[39].

^{31}P(d, d)^{31}P

At $E_d = 11.5$ MeV, $\sigma(\vartheta)_{elast}$ has been measured[22].

^{32}S(γ, p)^{31}P

The angular distribution has been obtained with bremsstrahlung of $E_{max} = 21$ MeV[48].

^{32}P

$^{32}P(\beta^-)^{32}S$

The Kurie plot of the β^- spectrum shows deviations from linearity[23]. The log *ft* value and deviations from the allowed shape are theoretically discussed[17, 104].

^{32}S

$^{28}Si(\alpha, \gamma)^{32}S$

The resonance energies given in Sm 61a have to be lowered by 0.28%[88].

$^{28}Si(\alpha, \alpha)^{28}Si$

The α_0 yield measured at several angles in the $E_\alpha = 3.0$–5.3 MeV range shows resonances at $E_\alpha = 3.90$, 4.32, 4.45, and 4.72 MeV, corresponding to ^{32}S levels at 10.33, 10.70, 10.81, and 11.05 MeV[83].

$^{31}P(p, \gamma)^{32}S$

Gamma decay and angular distribution measurements yield $J^\pi = 1^+$ for the $E_p = 355$ and 440 keV resonances[56]. This reference replaces Sc 61c. Precision measurements yield the following values for the resonance energies: $E_p = 354.6 \pm 0.4$, 439.1 ± 0.5, 541.1 ± 0.6, and 642.0 ± 0.7 keV[98].

$^{31}P(p, p)^{31}P$

In the $E_p = 1.2$–1.9 MeV region, five resonances have been observed in $\sigma(\vartheta)_{\mathrm{elast}}$[18].

$^{31}P(^3He, d)^{32}S$

At $E_d = 7$ MeV, angular distribution measurements yield $l_p = 2$ and 0, for groups d_1 and d_2, respectively[34].

$^{32}S(\gamma, \gamma)^{32}S$

The yield curve of resonantly scattered bremsstrahlung with energies between $E_{\max}$ and $E_{\max} - 1$ MeV shows a peak at 8.5 MeV[74].

$^{32}S(e, e')^{32}S$

Coulomb excitation of the 3.78 MeV level in ^{32}S indicates that the transition is certainly not E2, but perhaps E0[84].

$^{32}S(n, n)^{32}S$

At $E_n = 14$ MeV, $\sigma(\vartheta)_{\mathrm{elast}}$ has been measured[70].

$^{32}S(p, p')^{32}S$

Several γ transitions have been observed following inelastic proton scattering; no e^+–e^- pairs are seen de-exciting $^{32}S(2)$[35].

$^{32}S(d, d)^{32}S$

At $E_d = 11.5$ MeV, $\sigma(\vartheta)_{elast}$ has been measured[22].

^{33}S

$^{32}S(d, p)^{33}S$

At $E_d = 8.9$ MeV, excitation energies, l_n values, and relative reduced widths have been measured of many ^{33}S levels up to $E_x = 7.45$ MeV[20].

$^{36}Ar(n, \alpha)^{33}S$

The thermal cross section is 235 ± 5 mb[32].

^{33}Cl

$^{32}S(p, p')^{32}S$

Broad resonances in the yield of $E_\gamma = 2.24$ MeV have been observed at $E_p = 4.8$, 5.1, (5.3), and (5.6) MeV[35].

^{34}S

$^{31}P(\alpha, p)^{34}S$

At $E_\alpha = 42$ MeV, $\sigma(\vartheta)$ of groups p_0 and p_1 has been measured[43].

$^{33}S(d, p)^{34}S$

The final text of the paper quoted as Br 61e contains several small changes in excitation energies; the levels at (4.26), (5.85), 7.78, 7.914, and (8.12) MeV have been dropped; new levels are found at 6.690, 6.959, (7.398), 7.750, and 7.783 MeV[11].

$^{34}S(p, p')^{34}S$

Several γ transitions have been observed following inelastic proton scattering[35].

^{34}Cl

$^{34}Cl(\beta^+)^{34}S$

The half-life has been measured as 1.56 ± 0.014 sec[37].

^{35}S

$^{34}S(d, p)^{35}S$

At $E_d = 8.9$ MeV, an angular distribution measurement of p_0 yields $l_n = 2$; the reduced width is 0.94 times that of $^{32}S(d, p)^{33}S(0)$[20].

^{35}Cl

$^{35}Cl(\gamma, \gamma)^{35}Cl$

From bremsstrahlung resonance fluorescence the mean lives of the 1.76, 2.65, and 3.01 MeV levels have been found[7, 8].

^{36}S

$^{40}Ar(\gamma, \alpha)^{36}S$

At $E_{\gamma\,max} = 70$ MeV, the α-particle energy distribution has been measured and compared with statistical theory calculations[105].

^{36}Ar

$^{32}S(\alpha, \gamma)^{36}Ar$

In the energy range $E_\alpha = 2.2$–3.2 MeV, resonances have been found at $E_\alpha = 2.550$ ($J^\pi = 2^+$), 2.785 ($J^\pi = 1^-$), 3.056 ($J^\pi = 2^+$), and 3.182 MeV, all ± 0.005 MeV[99].

$^{35}Cl(p, \gamma)^{36}Ar$

New resonances have been found at $E_p = 624$, 873 and 986 keV, all ± 1.5 keV[99]. Precision measurements of resonance energies yield $E_p = 441.1 \pm 0.5$, 532.9 ± 0.6, 575.2 ± 0.6, 643.2 ± 0.7, and 656.0 ± 0.7 keV[98].

^{37}Ar

$^{37}Ar(EC)^{37}Cl$

The L/K capture ratio has been measured as $(9.71 \pm 0.05) \times 10^{-2}$ [49].

$^{36}Ar(n, n)^{36}Ar$

Analysis of the scattering cross section measured in the $E_n = (0.1$–$6) \times 10^3$ eV range, yields a resonance at $E_n = -9.8$ keV, with $\Gamma_n = 82$ eV, and $\Gamma_\gamma = 1.85$ eV[19].

^{37}K

$^{36}Ar(p, p)^{36}Ar$

Yield curves of the p_0 group at several angles yield $J^\pi = \frac{3}{2}^-$ for the $E_p = 1.494$ MeV resonance, corresponding to the 3.44 MeV level in ^{37}K[38]. This reference replaces Ki 61a.

^{38}Ar

$^{34}S(\alpha, \gamma)^{38}Ar$

With enriched ^{34}S targets, resonances have been found at $E_\alpha = 2.670$, 2.772, 2.911, 3.025, 3.116, and 3.161 MeV, all ± 0.005 MeV. All six resonance levels have $J^\pi = 1^-$ [99].

$^{37}Cl(p, \gamma)^{38}Ar$

Resonances have been reported at $E_p = 426.9 \pm 0.5$, 503.5 ± 0.6, 600.5 ± 0.6, 624.2 ± 0.7, 690.1 ± 0.7 keV[98]. The 724 keV resonance is a doublet: $E_p = 722$ and 725 keV, both ± 1.5 keV[99].

$^{37}Cl(p, n)^{37}Ar$

Yield curves of the n_0 and n_1 groups show many resonances in the $E_p = 1.5$–4.0 MeV region[5, 47]. These references replace Ba 61e and Ma 61.

^{38}K

$^{38}K^{m}(\beta^{+})^{38}Ar$

The half-life has been measured as 0.948 ± 0.010 sec, the β^{+} end point is 5.00 ± 0.07 MeV[37]. This reference replaces Ju 61.

$^{40}Ca(n, t)^{38}K$

At $E_n = 14.7$ MeV, $\sigma \leqslant 0.1$ mb[96].

^{39}K

$^{39}K(\gamma, \gamma)^{39}K$

A yield curve of resonantly scattered bremsstrahlung with an energy between E_{max} and $E_{max} - 1$ MeV shows a peak at 7.0 MeV[74]. From the same reaction the mean lives of the 3.02 and 3.88 MeV levels have been found[7].

^{40}Ar

$^{40}Ar(p, p')^{40}Ar$

At $E_p = 7.3$ and 9.4 MeV, inelastic scattering has been observed, exciting 22 ^{40}Ar levels, up to $E_x = 6.65$ MeV[6]. At $E_p = 8$ MeV, the azimuthal asymmetry of elastically scattered polarized protons has been measured[64].

^{40}Ca

$^{39}K(p, \gamma)^{40}Ca$

From branchings, yield, and angular distribution measurements, $J = 1$ and 2^{+} has been assigned to the $E_p = 1575.5$ and 1580 keV resonances, respectively[66]. A resonant absorption measurement of γ_0 at the lower resonance yields the total and radiation width[63]. Resonances have been reported at $E_p = 1.106$, 1.133, 1.241, 1.309, 1.310, 1.315, 1.348, 1.579, 1.583, and 2.045 MeV, all ± 0.003 MeV, and at $E_p = 1.475 \pm 0.010$ MeV. The decay of the resonance levels proceeds partly through new levels at 7.00, 7.49, 7.88, 8.48, and 9.06 MeV, all ± 0.02 MeV[100].

$^{40}Ca(\gamma, \gamma)^{40}Ca$

The yield curve of resonantly scattered bremsstrahlung shows a giant resonance with a maximum at 20.5 MeV; the angular distribution is consistent with dipole scattering[13]. The yield curve of resonantly scattered bremsstrahlung with energies between E_{max} and $E_{max} - 1$ MeV shows a peak at 8.0 MeV[74].

$^{40}Ca(e, e')^{40}Ca$

At $E_e = 120$, 150, and 180 MeV, inelastically scattered electron groups have been observed corresponding to levels at 3.8, ≈ 6.5, 15.2, 17, 18, 19.2, 20.5, and 40–45 MeV[60].

$^{40}Ca(p, p')^{40}Ca$

The azimuthal asymmetry in elastic scattering of polarized 8 MeV protons has been measured[64]. The probability of two-photon de-excitation of $^{40}Ca(1)$ compared to pair formation is less than 0.7%[27].

REMARKS

Yield curves and angular distributions have been computed for the (γ, n) and (γ, p) reactions on ^{40}Ca[3].

^{41}K

$^{40}Ar(p, p')^{40}Ar$ }
$^{40}Ar(p, \alpha)^{37}Cl$ } In the $E_p = 1.8$–3.5 MeV region, many resonances have been observed in the yield of the p_0, p_1, and α_0 groups[4]. This reference replaces Ba 60d. For proton elastic scattering, see also ref.[18].

^{42}K

$^{42}K(\beta^-)^{42}Ca$

The β–γ ($E_\gamma = 1.52$ MeV) circular polarization correlation has been measured[21].

^{42}Ca

$^{41}K(p, p')^{41}K$ }
$^{41}K(p, \alpha')^{38}Ar$ } Energies, $\omega\gamma$ values, and angular distributions of the $E_\gamma = 1.00$ and 2.16 MeV γ rays have been measured in the $E_p = 2.3$–3.4 MeV region[67]. This reference replaces Sh 58c, Sh 59a, Sh 61.

$^{42}Sc(\beta^+)^{42}Ca$

The half-life has been measured as 0.69 ± 0.02 sec; the β^+ end point is 5.32 ± 0.10 MeV[37]. This reference replaces Ju 61. For a theoretical discussion of the lowest $T = 0$ and $T = 1$ levels, and the expected spin sequence, see reference[101].

^{43}Ca

$^{43}Sc(\beta^+)^{43}Ca$

A theoretical discussion is given of the ft value[41].

^{45}K

$^{45}K(\beta^-)^{45}Ca$

A $\tau_{\frac{1}{2}} = 20 \pm 1$ min activity from alpha ($E_\alpha = 52$ MeV) and deuteron ($E_d = 26$ MeV) bombardment of ^{48}Ca has been assigned to ^{45}K by chemical separation and measurement of the γ-ray energies. Coincidence of the strongest γ rays ($E_\gamma = 0.175$ and 1.71 ± 0.02 MeV) suggests a $1.902 \rightarrow 0.176 \rightarrow 0$ cascade. The most intensive β^- component, probably proceeding to $^{45}Ca^* = 1.902$ MeV, has an end point of about 2 MeV, yielding a ^{45}K mass excess of -37 MeV. The allowed character of this β^- transition ($\log ft = 5.4 \pm 0.2$) would imply an unexpected odd parity for the ^{45}K ground state[103].

^{45}Ca

$^{45}Ca(\beta^-)^{45}Sc$

A theoretical discussion is given of the ft value[41].

$^{44}Ca(d, p)^{45}Ca$

The polarization of the p_0 group is computed from D.W.B.A. analysis[14].

$^{45}Sc(n, p)^{45}Ca$

The cross section has been measured for fission neutrons[40].

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