Nuclear Data Sheets for A = 87^{*}

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(Received September 30, 2012; Revised September 03, 2015)

Abstract: The evaluated experimental data are presented for 14 known nuclides of mass 87 (Ga, Ge, As, Se, Br, Kr, Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru). New datasets have been added for ⁸⁷Ga, ⁸⁷Se, ⁸⁷Kr, ⁸⁷Rb, ⁸⁷Sr, ⁸⁷Nb, and ⁸⁷Tc. The observation of and new lifetime measurements for ⁸⁷As at the NSCL Coupled Cyclotron Facility and the Oak Ridge Isochronous Cyclotron at the HRIBF-ORNL Facility are included in the adopted levels for this isotope. The new evaluation also includes an isomeric level at unknown energy for ⁸⁷Tc, changes to the adopted levels for ⁸⁷Nb based on newly published data including an extension of the high spin levels and new lifetime measurements, and new heavy ion data for ⁸⁷Kr. New high spin levels for ⁸⁷Rb were observed, indicating possible neutron core excitations. In addition, the ground state lifetime of ⁸⁷Rb has been revised and a new lifetime measurement for an excited level in ⁸⁷Rb indicates a possible proton spin flip. New excitation levels have been observed for the first time in ⁸⁷Se. New direct and precise measurement of atomic masses of ⁸⁷Tc, ⁸⁷Mo, ⁸⁷Nb, ⁸⁷Zr, ⁸⁷Mo and ⁸⁷Tc have greatly improved the Q value landscape in this mass region. This work supersedes the previous A=87 evaluation published in 2002He09, and Q values for all isotopes were updated to incorporate the mass evaluation in 2012Wa38.

General Policies and Organization of Material: see <http://www.nndc.bnl.gov/nds/NDSPolicies.pdf>.

General Comments: In spite of significant experimental work on the isobaric nuclei of this mass chain some deficiencies remain. The identification of ⁸⁷Ru isotope was done via projectile fragmentation. However, excited state data remain nonexistent. Fragmentation data revealed new levels in ⁸⁷Tc, but the connection to the ground state has yet to be clarified and excited levels have yet to be established for ⁸⁷As, ⁸⁷Ga, and ⁸⁷Ge. The ground state spin and parity of ⁸⁷Br was changed to reflect new in-line measurements, but is tentative and more experimental work would be useful for further clarification.

Cutoff Date: Literature available up to July 27, 2015 has been consulted.

Acknowledgments: The evaluators are grateful to the XUNDL (Experimental Unevaluated Nuclear Data List) compilers for preparing several data sets used in this evaluation. The evaluators are also grateful to the compilers of Nuclear Science References (NSR) for providing professional and convenient access to reference materials. The evaluators are also grateful to M. Martin for a thorough and careful review of this manuscript and for many helpful suggestions.

The statistical analysis of γ -ray data and deduced level schemes is carried out through computer codes available at NNDC, BNL website: www.nndc.bnl.gov. The direct feedings to excited states in β^- and ε decays have generally been computed from $I(\gamma+ce)$ intensity balances at each level; the associated $\log ft$ values are calculated using LOGFT code. All Q values have been adopted from 2012Wa38. In cases where weighted averaging procedures have been used and the number of independent measurements is small (four or less), the assigned uncertainty is the higher of the two values: generally the one given by the averaging procedure and the lowest uncertainty quoted for a measurement. A general 1.4% uncertainty is assumed in quoted theoretical internal conversion coefficients taken from BrIcc code (2008Ki07).

^{*} Work supported by the Office of Nuclear Physics, Office of Science of the U.S. Department of Energy under contract DE-AC02-98CH10886.

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Skeleton Scheme for A=87

Adopted Levels

$Q(\beta^-)=14500$ SY; $S(n)=3200$ SY 2012Wa38.

Other: $Q(\beta^-n)=1.21\text{E4}$ syst. 9 (2012Wa38).

Uncertainties associated with the systematic Q values from 2012Wa38 are $Q(\beta^-)$ 900, $S(n)$ 1100.

From calculations in 1997Mo25, $Q(\beta^-n)=14370$, $S(n)=3630$, $S(p)=15510$, $Q(\alpha)=-11040$, $S(2n)=5510$, $S(2p)=35840$.

 ^{87}Ga Levels

E(level)	$T_{1/2}$	Comments
0.0	>634 ns	<p>β^-=100; $\beta^-n=?$; $\beta^-2n=?$</p> <p>$T_{1/2}$: lower limit from time-of-flight (2010Oh02), based on private communication from T. Kubo dated 14 July 2010. Actual half-life is predicted to be much longer, as suggested by the calculated values of 70 ms (2005Bo19), 24 ms and 118 ms (2002Pf04), 28.0 ms (1997Mo25).</p> <p>Probability of misidentification of ^{87}Ga isotope<0.001% (2010Oh02).</p> <p>$J\pi$: $3/2^-$ predicted in calculations (1997Mo25).</p> <p>Calculated $\beta^-n=90.8$, $\beta^-2n=7.4$ (1997Mo25). Calculated $\beta^-n=100$ (2002Pf04). More β^-n calculations are given in 2005Bo19.</p>

 $^9\text{Be}(^{238}\text{U},\text{F})$ 2010Oh02

Fission of $^{238}\text{U}^{86+}$ 0.22 pnA beam at 345 MeV/nucleon at RIBF. Particle identification determined using the BigRIPS separator. Atomic number and mass-to-charge ratio were deduced from the measured energy loss, time of flight, and magnetic rigidity.

Based on mass-to-charge state ratio (A/Q) spectrum and Z versus A/Q plot, 10 counts were assigned to ^{87}Ga isotope.

Probability of misidentification of ^{87}Ga isotope<0.001%.

 ^{87}Ga Levels

E(level)	$T_{1/2}$	Comments
0.0	>634 ns	<p>β^-=100; $\beta^-n=?$; $\beta^-2n=?$</p> <p>Estimated $\sigma=19$ pb based on ratio of the measured production rate to the LISE++ simulated production rate and the predicted cross section. The estimated systematic uncertainty is=50%.</p> <p>$T_{1/2}$: lower limit from time-of-flight, according to private communication from T. Kubo dated 14 July 2010.</p>

Adopted Levels

Q(β⁻)=10808 4; S(n)=4727 5; S(p)=13100 SY; Q(α)=-8786 4 2012Wa38.

Q(β⁻n)=6814 4 2012Wa38.

The uncertainty of the proton separation energy value is 300 keV.

2008Ha23: U(p,F), E=25 MeV; measured cyclotron frequency, determined mass excess; IGISOL facility.

1993Ru01: ²³⁵U(n,F) E=thermal; measured n, β, n(t), β(t); OSIRIS facility.

1978Cr03: ²³⁵U(n,F) E=thermal; measured n, β, n(t), β(t); LOHENGRIN facility.

⁸⁷As Levels

E(level)	Jπ	T _{1/2}	Comments
0.0	(3/2-)	484 ms 40	<p>%β⁻=100; %β⁻n=15.4 22.</p> <p>Jπ: from systematics of the odd-mass arsenic isotopes, see the nuclear-data evaluations for A=77 (1997Fa12), 79 (2002Si13), and 81 (2008Ba34).</p> <p>T_{1/2}: There have been several measurements of the half life. In 2013Ma22 a proton beam was provided by the Oak Ridge Isochronous Cyclotron (ORIC) at the HRIBF-ORNL facility with a ²³⁸U target. Fission fragment were ionized to charge state +1 then purified using H₂S gas, a mass pre-separator and electromagnetic separation. The purified beams were then sent to the Low-energy Radioactive Ion Beam Spectroscopy Station (LeRIBSS) and implanted in a moving tape collector. Measured E_γ, I_γ, E_β, βγ-coin, and half-life of the ⁸⁷As g.s. using two plastic scintillation counters and four HPGe detectors. Comparison with the Gross theory of beta decay, the finite-range droplet model and the continuum quasiparticle random-phase approximation. The half life was measured from a β-gated time distribution of γ rays in ⁸⁷Se and ⁸⁶Se. In 2012Qu01, a ¹³⁶Xe primary beam, E=120 MeV/nucleon, impinged on a 235 mg/cm² Be target. Experiment performed at the NSCL Coupled Cyclotron Facility. Fragments were separated by the A1900 fragment separator using the Bp-ΔE-Bp technique. Beta decays measured in the NSCL BETA Counting System (BCS) consisting of four silicon pin detectors, a double sided silicon strip detector and a single sided silicon strip detector. Measured energy loss total kinetic energy, time of flight, and isotopic isotopic half-life. A total of 27 implantations were observed with 12 correlated decay sequences. The value listed in Table I of 2012Qu01 is 1450 ms 550 (systematic) +3900=1100 (statistical) and used the maximum likelihood method for the T_{1/2} analysis. However, due to the large uncertainties, this was not included in the weighted average. Finally, the Adopted Value is taken from a weighted average of 0.485 s 40 (1993Ru01), neutron counting measurements, both values, 0.478 s 44 and 0.495 60 from 2013Ma22 and adopting the smallest uncertainty from that set. Others: ≤1.5 s (1967De01), 0.6 s 3(1970Kr05), =0.3 s (1973Kr06) 0.73 s 6 (1978Cr03), and 1.5 s 39-12 from maximum-likelihood method (2012Qu01).</p> <p>%β⁻n: from 1993Ru01; others: 44% (14) (1978Cr03) which was re-evaluated to 51% (35) in 1993Ru01.</p>

Adopted Levels, Gammas

$Q(\beta^-)=7466$ 4; $S(n)=3994$ 3; $S(p)=14753$ 4; $Q(\alpha)=-7875$ 3 2012Wa38.

Mass measurement: 2008HA23 (Penning trap, JYFLTRAP at IGISOL), mass excess=-66426.1 22 keV.

Identification and half-life of ^{87}Se were established mainly via neutron activity of bromine daughter after chemical separation from other ^{235}U fission products, 1993Ru01. Also see 2011SO33 for production using ^{86}Kr (15 MeV/nucleon) + ^{64}Ni .

 ^{87}Se Levels**Cross Reference (XREF) Flags**

A ^{248}Cm SF Decay

B ^{87}As β^- Decay

E(level)	$J\pi^\dagger$	XREF	$T_{1/2}$	Comments
0.0	(3/2+)	AB	5.50 s 14	<p>$\% \beta^- = 100$; $\% \beta^- n = 0.36$ 8.</p> <p>$J\pi$: Systematics of the N=53 isotones suggest either 5/2+ or 3//2+. Based on shell model calculations of for the E(5/2+) and E(3/2+) for the N=53 isotones. The calculations indicate large and nearly constant B(E2) values with a significant deformation. Calculations assuming a K=3/2 band were consistent with the excitation levels and B(E2) values, thus placing the 3/2+ spin level below that for 5/2+. See 2013Rz02 for details. with shell model calculations (2013Rz02).</p> <p>$T_{1/2}$: from unweighted average of 5.9 s 2 (1970De08), 5.85 s 15 (1970Kr05), 5.41 s 10 (1971To13, superseded 1968To06), 5.8 s 3 (1978Ze08) and 5.29 s 11 (1993Ru01) all determined from neutron counting. Other values are: 16 s 3 (1960Sa05) from ^{87}Br grow-in, 5.5 s 2 (1970ToZT, superseded by value from 1971To13), and 5.60 s 16 (1982Ru01, superseded by value from 1993Ru01).</p> <p>$\% \beta^- n$: from unweighted average of 0.26 7 (1970De08, Adjusted by 1993Ru01; original was 0.23 7), 0.51 17 and 0.24 8 (1970Kr05), 0.17 3 (1971To13, Adjusted by 1993Ru01; original 0.16 3), and 0.60 12 (1993Ru01). The reduced-χ^2 value for this average is 4.02, higher than the critical value 2.37, due to discrepant values. Therefore, an unweighted average is adopted. Other values are: ≤ 0.8 (1968To06); 0.44 20 (1969WaZS); 0.18 4 (1970ToZT; see 1971To13 value by same authors); and 0.19 3 (1982Ru01).</p>
91.9 2	(5/2+)	AB		$J\pi$: Comparison with shell model calculations, see 2013Rz02.
836.5 3	(7/2+)	A		
978.1 3	(9/2+)	A		

† Suggested values from systematics and comparisons with shell model calculations presented in 2013Rz02.

 $\gamma(^{87}\text{Se})$

E(level)	E_γ	I_γ	Mult.	Comments
91.9	91.9 2	100	M1+E2	Mult., δ : Based on angular correlations for the 91.9–886.2 keV cascade leading to $\delta=+0.53$ +3I-12 or +5.0 +I62, -27. Additionally, as B(M2)(W.u.)<1 from RUL, a half life can be calculated for E1+M2, assuming the lowest allowed δ of 0.41, resulting in $T_{1/2}>27$ μs . As this likely would not have been observed, E1+M2 may be excluded.
836.5	744.6 2	100		
978.1	886.2 2	100		

 ^{87}As β^- Decay 2013Ma22

Parent ^{87}As : E=0.0; $J\pi=(3/2^-)$; $T_{1/2}=484$ ms 40; $Q(\text{g.s.})=10808$ 4; $\% \beta^-$ decay=.

Proton beam was provided by the Oak Ridge Isochronous Cyclotron (ORIC) at the HRIBF-ORNL facility. Target= $^{238}\text{UC}_x$.

Fission fragment were ionized to charge state +1 then purified using H_2S gas, a mass pre-separator and electromagnetic separation. The purified beams were then sent to the Low-energy Radioactive Ion Beam Spectroscopy Station (LeRIBSS) and implanted in a moving tape collector (MTC). Measured E_γ , I_γ , E_β , $\beta\gamma$ -coin, half-life of ^{87}As g.s. using two plastic scintillation counters and four HPGe detectors. Comparison with the gross theory of β decay, the finite-range droplet model and the continuum quasiparticle random-phase approximation.

^{87}As β^- Decay 2013Ma22 (continued) ^{87}Se Levels

E(level)	$J\pi^\dagger$
0.0	(3/2+)
91.9 2	(5/2+)

† from Adopted Levels.

 $\gamma(^{87}\text{Se})$

E_γ	E(level)	Comments
92	91.9	E_γ : Not placed in 2013Ma22, but the 92γ was placed from ^{248}Cm spontaneous fission.

Decay Scheme **^{248}Cm SF Decay 2013Rz02**

Parent ^{248}Cm : $E=0$; $J\pi=0^+$; $T_{1/2}=3.48 \times 10^5$ y 6; $\% \text{SF decay}=?$

^{248}Cm SF decay: EUROGAM2 array of 52 large GE detectors with anti-Compton shields and 24 CLOVERs. Measured triple coincidences, E_γ , I_γ , $\gamma\gamma$ coin, $\gamma\gamma(\theta)$. Transitions in ^{87}Se were identified using mass correlations with the probable ^{158}Sm fission partner.

Compared observed level structure with large-scale shell model calculations and with known structure of $N=53$ isotones.

 ^{87}Se Levels

Structure interpreted (2013Rz02) as dominating of $3\nu d_{5/2+}$ and protons in $f_{5/2-}$ and $p_{3/2-}$. The level ordering is argued to be due to deformation.

E(level) †	$J\pi^\ddagger$	Comments
0.0	(3/2+)	$J\pi$: Systematics of the $N=53$ isotones suggest either $5/2+$ or $3//2+$. Based on shell model calculations of for the $E(5/2+)$ and $E(3/2+)$ for the $N=53$ isotones. The calculations indicate large and nearly constant $B(E2)$ values with a significant deformation. Calculations assuming a $K=3/2$ band were consistent with the excitation levels and $B(E2)$ values, thus placing the $3/2+$ spin level below that for $5/2+$. See 2013Rz02 for details.
91.9 2	(5/2+)	
836.5 3	(7/2+)	
978.1 3	(9/2+)	

† From least-squares fit to E_γ data.

‡ Authors' suggested values from systematics and comparisons with shell model calculations.

 $\gamma(^{87}\text{Se})$

E_γ	E(level)	I_γ	Mult.	Comments
91.9 2	91.9	100 8	M1+E2	Mult., δ : Based on angular correlations for the 91.9–886.2 keV cascade. $A_2=+0.10$ 5, $A_4=-0.11$ 9 leading to $\delta=+0.53$ +31–12 or +5.0 +162, –27. Additionally, as

Continued on next page (footnotes at end of table)

^{248}Cm SF Decay 2013Rz02 (continued)

$\gamma(^{87}\text{Se})$ (continued)

<u>E_γ</u>	<u>$E(\text{level})$</u>	<u>I_γ</u>
744.6 2	836.5	17 3
886.2 2	978.1	34 4

B(M2)(W.u.)<1 from RUL, a half life can be calculated for E1+M2, assuming the lowest allowed δ of 0.41, resulting in $T_{1/2}>27 \mu\text{s}$. As this likely would have been observed, E1+M2 may be excluded.

Level Scheme

Intensities: relative I_γ

Adopted Levels, Gammas

Q(β⁻)=6818 3; S(n)=6331 4; S(p)=10677 4; Q(α)=-6647 4 2012Wa38.

Mass measurement: 2007Ra23 (Penning trap, JYFLTRAP at IGISOL), mass excess=-73892 4 keV.

All data for excited levels are from ⁸⁷Se β⁻ decay (1980Ze04).

See 2013Co15 for production using proton-induced fission of uranium. and 2011So33 for ⁸⁶Kr (15 MeV/nucleon) on ^{124,112}Sn.

Other theory: 2011Ka28 (calculated decay spectra).

⁸⁷Br Levels

Cross Reference (XREF) Flags

A ⁸⁷Se β⁻ Decay

E(level) [†]	Jπ [‡]	XREF	T _{1/2}	Comments
0.0	(5/2-)	A	55.68 s 12	%β ⁻ =100; %β ⁻ n=2.60 4. Jπ: The shell model indicates that πf _{5/2} or πp/2 leads to (3/2-,5/2-). Two levels in ⁸⁷ Kr populated in β ⁻ decay are 4710 and 4961. These both have γ transitions to a 9/2+ level at 1578 keV. So the Jπ values for both levels are likely 5/2+ or 7/2-. The logft values for the 4710 and 4961, 5.5 and 5.7 respectively, are both allowed, implying ΔJ=0,1 and Δπ=no. For the ⁸⁷ Br ground state, this leads to 3/2+,5/2+,7/2+ or 5/2-,7/2-,9/2-. Combining with the shell model argument leads to (5/2-). This is the argument presented in 2006Po09. T _{1/2} : weighted average of 56.1 s 7 (1949Su14 by the extraction and measurement of ⁸⁷ Kr activity), 55.8 s 3 (1966Si09 by neutron counting), 55.4 s 7 (1966Wi03), 55.60 55.60 s 15 (1971De35 by neutron counting), 56.3 s 5 (1974Gr29 from milking and 4πβ counting), 55.9 s 16 (1974Kr21 by neutron counting), and 55.6 s 3 (1993Ru01 by neutron counting); the associated reduced-χ ² is 0.43. Other measurements: 54.5 s (1957Ke67 by neutron counting, though will include ⁸⁶ Br as well), 55.4 s 7 (1962Wi20 and 1963Wi02, superseded by 1966Wi03) 55.6 s 3 (1970DeZQ or 1970MaZT, superseded by 1971De35), 56.0 s 3 (1970OsZZ, superseded by 1974Gr29). %β ⁻ n: weighted average of 3.1 6 (1964Ar24), 3 1 (1967Ga19), 2.63 5 (1967Pa26), 2.3 3 (1971De35), 2.3 4 (1972Sc48), 2.35 40 (1975Iz03), 2.6 4 (1978Kr15), 2.57 15 (1980Lu04), 2.1 4 (1980ReZQ, with 10% systematic uncertainties added in quadrature to the reported statistical uncertainty of 3), and 2.56 10 (1993Ru01). Others: 2.1 3 (1970DeZQ, superseded by 1971De35), 2.3 5 (1974Kr21, superseded by 1978Kr15), 2.16 33 (1976ReZN, superseded by 1977Re05, 1980Lu04, and 1980ReZQ), 2.56 38 (1976ShZL), 2.55 49 (1976NiZZ), 2.5 3 (1977Re05, superseded by 1980Lu04 and 1980ReZQ). Jπ: from log ft=6.6, log f ^{lu} t=8.7 from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=6.2, from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=6.6, log f ^{lu} t=8.6 from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=6.4, log f ^{lu} t=8.4 from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=6.9. Jπ: from log ft=5.9 from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=5.7 from J ^π =(3/2 ⁺), γ to J ^π =(5/2 ⁻). Jπ: from log ft=6.0, log f ^{lu} t=7.5 from J ^π =(3/2 ⁺).
242.51 23	(1/2,3/2,5/2)	A		
334.0 3	(1/2,3/2,5/2)	A		
573.17 24	(1/2,3/2,5/2)	A		
710.51 21	(1/2,3/2,5/2)	A		
1035.5 6	(1/2,3/2,5/2)	A		
1878.14 21	(1/2,3/2,5/2)	A		
3926.4 4	(1/2,3/2,5/2)	A		
3987.1 6	(1/2,3/2,5/2)	A		

[†] From least-squares fit to γ energies.

[‡] J^π of excited states determined using log ft values and population of levels in decay to ⁸⁷Kr (2006Po09). Due to incomplete decay scheme, assignments are done with some risk.

γ(⁸⁷Br)

E(level)	Eγ	Iγ	E(level)	Eγ	Iγ	E(level)	Eγ	Iγ
242.51	242.5 3	100	710.51	710.5 3	40.9	1878.14	1878.1 3	100
334.0	334.0 3	100	1035.5	701.5 5	100	3926.4	3683.8 5	57.1
573.17	573.2 3	100	1878.14	1167.6 3	78.0		3926.3 5	100
710.51	468.0 3	100		1305.0 3	75.4	3987.1	3744.5 5	100

$^{87}\text{Se} \beta^-$ Decay 1980Ze04

Parent ^{87}Se : $E=0.0$; $J\pi=(3/2+)$; $T_{1/2}=5.50$ s 14; $Q(\text{g.s.})=7466$ 4; $\% \beta^-$ decay=?

1980Ze04: ^{87}Se produced by thermal neutron fission of ^{235}U , chemical separation of fission products, measured γ spectra with GeLi detectors and measured coincidences.

1975Hu02: ^{87}Se [from $^{235}\text{U}(\text{n},\text{f})$ $E=\text{thermal}$] chemically separated from fission products; measured γ , $\gamma(\text{t})$, assigned gamma rays at 468.0 and 1497.9 keV based on decay curve $T_{1/2}$ of 6 seconds.

See 2014Al15 for TAGs data and implication for decay heat.

 ^{87}Br Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$	$T_{1/2}$	Comments
0.0	(5/2-)	55.65 s 13	$J\pi$: From Adopted Levels. $T_{1/2}$: from ^{87}Br Adopted Levels.
242.51 23	(1/2, 3/2, 5/2)		
334.0 3			
573.17 24	(1/2, 3/2, 5/2)		
710.51 21	(1/2, 3/2, 5/2)		
1035.5 6	(1/2, 3/2, 5/2)		
1878.14 21	(1/2, 3/2, 5/2)		
3926.4 4	(1/2, 3/2, 5/2)		
3987.1 6	(1/2, 3/2, 5/2)		

† From least-squares fit to γ energies.

‡ From logft values and γ 's to daughter levels. However as the level scheme is very incomplete, assignments are done with some risk.

 β^- radiations

$E\beta^-$	$E(\text{level})$	$I\beta^-^\dagger$	$\text{Log } ft^\dagger$
(3479 4)	3987.1	1.4	6.0
(3540 4)	3926.4	2.8	5.7
(5588 4)	1878.14	14	5.9
(6431 4)	1035.5	2.5	6.9
(6755 4)	710.51	11	6.4
(6893 4)	573.17	7.8	6.6
(7132 4)	334.0	19	6.2
(7223 4)	242.51	9.5	6.6
(7466 4)	0.0	32	6.1

† I_β are computed from γ -ray intensity balances. Since the decay energy is over 7 MeV and only a few levels have been reported, this scheme must be considered incomplete. A comparison to the 1419 keV transition in the ^{87}Kr daughter indicates that ground state feeding may be as high as 32%. Further experimental investigation is warranted. Due to the incompleteness, no normalization given.

 $\gamma(^{87}\text{Br})$

$E\gamma^\dagger$	$E(\text{level})$	$I\gamma$	Comments
242.5 3	242.51	100	
334.0 † 3	334.0	93.6 †	
468.0 3	710.51	48.2	$E\gamma$: others: 469.1 (1977Pf01) and 468.0 10 (1975Hu02).
573.2 3	573.17	51.8	
701.5 † 5	1035.5	11.0 †	
710.5 3	710.51	19.7	
1167.6 3	1878.14	18.4	
1305.0 3	1878.14	17.8	
1878.1 3	1878.14	23.6	
3683.8 5	3926.4	4.4	
3744.5 5	3987.1	6.1	
3926.3 5	3926.4	7.7	

† 1980Ze04 suggest that the 334 and 701 γ 's, which are in coincidence with each other, might not belong to the ^{87}Se decay since they are not seen in coincidence with other strong γ 's. Their placement however, does not require any other coincidences. In this γ sequence, the larger intensity of the 334 γ suggests this to be the transition feeding the gs.

Footnotes continued on next page

$^{87}\text{Se} \beta^- \text{ Decay}$ 1980Ze04 (continued)

 $\gamma(^{87}\text{Br})$ (continued)

‡ From 1980Ze04, uncertainties are 0.3 keV for the stronger γ lines and 0.5 keV for those with weaker intensities. So for $\Delta I\gamma > 11$, the evaluators chose $\Delta E = 0.3$ keV and 0.5 for the rest.

§ A 1497.9 γ was reported by 1975Hu02, but not confirmed by 1980Ze04.

Adopted Levels, Gammas

$Q(\beta^-)=3888.27\ 25$; $S(n)=5515.17\ 25$; $S(p)=12366\ 3$; $Q(\alpha)=-7794\ 3\ 2012\text{Wa}38$.

 ^{87}Kr Levels

From ^{88}Rb decay, 95.9% 3 of the delayed neutron from levels in ^{88}Kr go to the ^{87}Kr ground state and 4.1% 3 go to the first excited level at 532 keV.

%IT: for the levels above the neutron binding energy, the γ decay fractions were computed from $g\Gamma(n)$ and $g\Gamma(n)\Gamma(\gamma)/\Gamma$ in (n,X).

Cross Reference (XREF) Flags

A $^{86}\text{Kr}(\text{d,p}),(\text{pol d,p})$

B $^{86}\text{Kr}(\text{n},\gamma)$ E=th

C $^{86}\text{Kr}(\text{n,X})$

D ^{87}Br β^- Decay

E ^{88}Br β^- n Decay

F $^{208}\text{Pb}(^{18}\text{O},\text{F}\gamma)$

G $^{238}\text{U}(^{82}\text{Se},\text{X}\gamma),^{192}\text{Os}(^{82}\text{Se},\text{X}\gamma)$

H $^2\text{H}(^{86}\text{Kr},\text{p})$

E(level) [†]	$J\pi^{\ddagger\S}$	XREF	$T_{1/2}$ [#]	Comments
0.0 ^b	5/2+	AB DEFGH	76.3 min 5	<p>%β^-=100; $\mu=-1.023\ 2$; $Q=-0.30\ 3$.</p> <p>From laser spectroscopy (1995Ke04), $\delta\langle r^2 \rangle_{86,87} = 0.125\ \text{fm}^2$; authors give three associated uncertainty components.</p> <p>$J\pi$: from laser spectroscopy (1995Ke04), L=2 in (d,p) and analyzing power in (pol d,p).</p> <p>$T_{1/2}$: weighted average of 76.3 m 6 (1972Eh02, β decay measurements), 76.4 m 10 (1964Cl01, mass spectrometer measurements), 78 m 2 (1949Ko13), and 74 m 2 (1937Sn02). This average has a reduced-χ^2 of 0.68. The weighted average is the same if the two older values are omitted; then the reduced-χ^2 is 0.01.</p> <p>μ: from 2011StZZ evaluation, based on laser spectroscopy data of 1995Ke04; other: see 1989Ra17 evaluation.</p> <p>Q: from 2011StZZ evaluation, based on laser spectroscopy data of 1995Ke04.</p>
531.99 4	1/2+	AB DEFGH		$J\pi$: L=0 in (d,p).
1419.65 ^b 4	(7/2+)	D FG		$J\pi$: From in-beam spectroscopy (2006Po09, 2007De37), γ to 5/2+.
1476.12 5	3/2+, 5/2+	AB D H		XREF: H(1465).
				$J\pi$: L=2 in (d,p). The direct feed from 1/2+ in (n, γ) makes the 5/2+ alternative less likely.
1570 3	(1/2+)	H		$J\pi$: L-transfer of (0) in $^2\text{H}(^{86}\text{Kr},\text{p})$.
1577.59 4	9/2+	A D FG		$J\pi$: From in-beam spectroscopy (2006Po09, 2007De37), γ to 5/2+.
1841.42 ^{@b} 5	(9/2+)	D FG		
1881.19 6	3/2+, 5/2+	A D H		<p>$J\pi$: from L=(2) in (d,p) and isobaric analog of the 15854 level in ^{87}Rb $J^\pi=(3/2+, 5/2+)$, confirmed by agreement of spectroscopic factors in $^{86}\text{Kr}(\text{d,p})$ and $^{86}\text{Kr}(\text{p,p}') \text{ IAR}$. and L=2 in $^2\text{H}(^{86}\text{Kr},\text{p})$</p> <p>XREF: H(1997).</p> <p>$J\pi$: L=2 in (d,p).</p>
2005.42 4	3/2+, 5/2+	AB D H		
2071.65 5		D		
2086.7 6	1/2+	A D H		$J\pi$: L=0 in $^2\text{H}(^{86}\text{Kr},\text{p})$.
2105.37 ^{@b} 8	(11/2+)	D FG		
2122.53 6	3/2+, 5/2+	AB D H		XREF: H(2112).
				$J\pi$: L=2 in (d,p) and L=2 in $^2\text{H}(^{86}\text{Kr},\text{p})$. The direct feed from 1/2+ in (n, γ) makes the 5/2+ alternative less likely.
2258.67 7	11/2-	A D FGH		XREF: H(2250).
				$J\pi$: from L=5 in $^2\text{H}(^{86}\text{Kr},\text{p})$ and isobaric analog of the 16240 level in ^{87}Rb ($J^\pi=9/2-, 11/2-$), confirmed by agreement of spectroscopic factors in $^{86}\text{Kr}(\text{d,p})$ and $^{86}\text{Kr}(\text{p,p}') \text{ IAR}$. Confirmed 11/2- with in-beam spectroscopy (2006Po09) from the expected yrast nature.
2300.02 6	(1/2+)	A D H		XREF: A(2277)H(2277).
				$J\pi$: L=(0) in (d,p) and $^2\text{H}(^{86}\text{Kr},\text{p})$.
2329.9 6		D		
2369.49 7		D		
2371.8 4	1/2, 3/2	B		$J\pi$: primary γ in thermal neutron capture from $J^\pi=1/2+$.
2372.35 6	(3/2+, 5/2+)	D		$J\pi$: from γ 's to 1/2+ and 5/2+ levels. the 952.66 γ to a (7/2+) weakly rules out 1/2+ and suggests $\pi=+$ for 3/2.
2451.91 5		D		
2462.86 10		D		

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	J $\pi^{\ddagger\S}$	XREF	T _{1/2} [#]	Comments
2498.59 5		D		
2513.75 9		D		
2518.91 9	7/2+, 9/2+	A D H		J π : L=4 and log $f^{lu}t=9.4$ from J $\pi=5/2-$.
2547.1 3		D		
2565.9 6		D		
2605.77 16		D		
2614.49 ^b 25	(13/2+) ^a	F		
2641.74 6		D		
2715.24 10		D		
2757.69 8		D		
2787.34 11	3/2+, 5/2+	A D H		XREF: H(2775). J π : L=2 in (d,p) and $^2\text{H}(^{86}\text{Kr},p)$.
2821.06 6		D		
2832.1 6		A D H		XREF: A(2823)H(2823). J π : L=2 in (d,p) and $^2\text{H}(^{86}\text{Kr},p)$ implies 3/2+ or 5/2+ for the 2832 or 2836 level, or both levels.
2836.55 5	(3/2, 5/2, 7/2)	A D H		XREF: A(2823)H(2823). J π : log $ft=6.7$, log $f^{lu}t=8.3$ from 5/2-, γ to 5/2+. L=2 in (d,p) and $2\text{H}(^{86}\text{Kr},p)$ implies 3/2+ or 5/2+ for the 2832 or 2836 level, or both levels.
2863.26 10		D		
3004.0 3		D		
3020.81 16		A D H		XREF: A(3015)H(3021). J π : L=2 in (d,p) implies 3/2+ or 5/2+ for the 3020 or 3026 level, or both levels.
3026.84 4		A D H		XREF: A(3015)H(3021). J π : L=2 in (d,p) and $^2\text{H}(^{86}\text{Kr},p)$ implies 3/2+ or 5/2+ for the 3020 or 3026 level, or both levels.
3080.78 15		D		
3142.91 15		D		
3171.86 16		D		
3217.86 5		D H		XREF: H(3229). J π : L=(0+2) in $^2\text{H}(^{86}\text{Kr},p)$ implies 1/2+&3/2+, 5/2+ for the 3217 or 3226 level, or both levels.
3225.97 10		D H		XREF: H(3229). J π : L=(0+2) in $^2\text{H}(^{86}\text{Kr},p)$ implies 1/2+&3/2+, 5/2+ for the 3217 or 3226 level, or both levels.
3237.19 10		A D		XREF: A(3223).
3256.90 8		A D		XREF: A(3237).
3288.4 3		D		
3297.13 21		D		
3301.9 4		D		
3361.9 7		D		
3434.76 11		D		
3444.9 3		D		
3525.26 25	(15/2-)	F		J π : From angular correlation and yrast arguments in $^{208}\text{Pb}(^{18}\text{O},\text{F}\gamma)$.
3559.7 3		A D		
3599.00 15		D		
3645.52 7	3/2+, 5/2, 7/2	D		J π : log $ft=7.1$ from 5/2-, γ to (7/2+).
3657.3 10		D		
3689.1 5		D		
3777.4 6		D		
3807.03 10		D		
3809.41 15		D		
3827 10		A		XREF: A(3819).
3874.18 8	3/2, 5/2, 7/2	A D		J π : log $ft=6.9$ from 5/2-, γ to 7/2+.
3909.8 7		D		
3914.3 ^b 4	(15/2+) ^a	F		
3917.16 10	3/2, 5/2, 7/2	D		J π : log $ft=6.5$, log $f^{lu}t=7.9$ from 5/2-, γ to 5/2+.
3923.0 6		D		
4027.2 5		D		
4088.2 3	(17/2-) ^a	F		

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Adopted Levels, Gammas (continued)

⁸⁷Kr Levels (continued)

E(level) [†]	Jπ ^{‡§}	XREF	T _{1/2} [#]	Comments
4136.3 4		D		
4180.82 6	3/2(-), 5/2, 7/2	D		Jπ: log ft=6.0, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+. The 2603 γ to 9/2+ makes 3/2+ unlikely.
4192.1 10		D		
4197.91 11		D		
4204.1 15		D		
4223.4 3		D		
4226.34 9		D		
4265.1 6		D		
4297.29 15	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=8.1 from 5/2-, γ to 5/2+.
4327.21 10	3/2, 5/2, 7/2	D		Jπ: log ft=6.6, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+.
4357.9 5	(17/2-) ^a	F		
4372.4 8	(17/2+) ^a	F		
4416.92 6	3/2(-), 5/2, 7/2	A D		Jπ: log ft=6.0, log f ^{lu} t=7.2 from 5/2-. The 2575 γ to (9/2+) makes 3/2+ unlikely.
4524.15 15	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=8.0 from 5/2-, γ to 5/2+.
4530.2 4	(19/2-) ^a	F		
4548.29 20		A D		XREF: A(4536).
4572.49 15	3/2, 5/2, 7/2	D		Jπ: log ft=6.4, log f ^{lu} t=7.6 from 5/2-, γ to 5/2+.
4595.51 6	3/2(-), 5/2, 7/2	D		Jπ: log ft=6.0, log f ^{lu} t=7.2 from 5/2-, γ to 5/2+. The 2754 γ to (9/2+) makes 3/2+ unlikely.
4620.90 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.7, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+.
4644.58 13	3/2(-), 5/2, 7/2	D		Jπ: log ft=6.3, log f ^{lu} t=7.5 from 5/2-, γ to 5/2+. The 3066 γ to 9/2+ makes 3/2+ unlikely.
4655.2 3		D		
4668.19 9	3/2(-), 5/2, 7/2	D		Jπ: log ft=6.4, log f ^{lu} t=7.5 from 5/2-. The 3091 γ to 9/2+ makes 3/2+ unlikely.
4710.35 6	5/2+, 7/2	D		Jπ: log ft=5.7 from 5/2-, γ to 9/2+.
4711.25 10	3/2, 5/2, 7/2	D		Jπ: log ft=6.7, log f ^{lu} t=7.8 from 5/2-.
4728.2 10		D		
4734.55 19	3/2, 5/2, 7/2	D		Jπ: log ft=6.7, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+.
4752.71 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.7, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+.
4784.46 14	3/2(-), 5/2, 7/2	D		Jπ: log ft=5.9, log f ^{lu} t=7.0 from 5/2-, γ to 5/2+. The 2943γ to (9/2+) makes 3/2+ unlikely.
4807.9 4	3/2, 5/2, 7/2	A D		Jπ: log ft=7.0, log f ^{lu} t=8.1 from 5/2-, γ to 5/2+.
4824.9 4	3/2, 5/2, 7/2	D		Jπ: log ft=7.0, log f ^{lu} t=8.1 from 5/2-, γ to 5/2+.
4836.29 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=7.9 from 5/2-, γ to 5/2+.
4858.87 13	3/2(-), 5/2, 7/2	A D		XREF: A(4856). Jπ: log ft=6.3, log f ^{lu} t=7.4 from 5/2-. The 3281γ to 9/2+ makes 3/2+ unlikely.
4872.05 15	3/2, 5/2, 7/2	A D		XREF: A(4856). Jπ: log ft=6.5, log f ^{lu} t=7.5 from 5/2-, γ to 5/2+.
4889.4 5		D		
4917.7 11	3/2, 5/2, 7/2	D		Jπ: log ft=7.0, log f ^{lu} t=8.0 from 5/2-, γ to 5/2+.
4925.7 7	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=7.9 from 5/2-, γ to 5/2+.
4961.55 7	3/2(-), 5/2, 7/2	D		Jπ: log ft=5.5 from 5/2-, γ to 5/2+. The 3383γ to 9/2+ makes 3/2+ unlikely.
4962.43 21	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=7.8 from 5/2-.
4976.1 9		D		
5003.2 5		D		
5021.7 3	3/2, 5/2, 7/2	D		Jπ: log ft=6.8, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+.
5033.9 6		D		
5044.7 3	3/2, 5/2, 7/2	D		Jπ: log ft=6.3, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+.
5059.69 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.5, log f ^{lu} t=7.5 from 5/2-, γ to 5/2+.
5065.9 3		D		
5076.19 17	3/2(-), 5/2, 7/2	D		Jπ: log ft=6.3, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+. The 34998γ to 9/2+ makes 3/2+ unlikely.
5088.9 4		D		
5103.55 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.3, log f ^{lu} t=7.2 from 5/2-, γ to 5/2+.
5120.39 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.2, log f ^{lu} t=7.1 from 5/2-, γ to 5/2+.
5136.08 20	3/2, 5/2, 7/2	D		Jπ: log ft=6.7, log f ^{lu} t=7.6 from 5/2-, γ to 5/2+.
5155.1 6		D		
5183.4 3	3/2, 5/2, 7/2	D		Jπ: log ft=6.6, log f ^{lu} t=7.5 from 5/2-, γ to 5/2+.

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	J $\pi^{\ddagger\S}$	XREF	T _{1/2} [#]	Comments
5195.25 18	3/2-, 5/2-, 7/2(-)	D		J π : log ft=5.8, log f ^{lu} t=6.8 from 5/2-, γ 's to 5/2+ and 1/2+, although an E3 seems unlikely.
5201.21 18	3/2-, 5/2-, 7/2(-)	D		J π : log ft=5.9, log f ^{lu} t=6.8 from 5/2-, γ 's to 5/2+ and 1/2+ although an E3 seems unlikely.
5214.25 14	3/2-, 5/2-, 7/2	D		J π : log ft=5.7, log f ^{lu} t=6.6 from 5/2-, γ to 5/2+.
5245.6 3	3/2-, 5/2-, 7/2	D		J π : log ft=6.5, log f ^{lu} t=7.4 from 5/2-, γ to 5/2+.
5280.70 14	3/2-, 5/2-, 7/2	D		J π : log ft=6.0, log f ^{lu} t=6.9 from 5/2-, γ to 5/2+.
5302.56 21	3/2-, 5/2(+)	D		J π : log ft=6.3, log f ^{lu} t=7.2 from 5/2-, γ to 1/2+.
5340.2 3	3/2-, 5/2-, 7/2	D		J π : log ft=6.5, log f ^{lu} t=7.4 from 5/2-, γ to 5/2+.
5370.1 3	3/2-, 5/2-, 7/2	D		J π : log ft=6.5, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+.
5383.1 3	3/2-, 5/2-, 7/2	D		J π : log ft=6.4, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+.
5406.34 20	3/2-, 5/2-, 7/2	D		J π : log ft=6.2, log f ^{lu} t=7.1 from 5/2-, γ to 5/2+.
5419.9 5		D		
5424.2 9		D		
5436.3 6	(21/2-) ^a	F		
5439.9 9		D		
5454.9 3	3/2-, 5/2-, 7/2	D		J π : log ft=6.2, log f ^{lu} t=7.0 from 5/2-, γ to 5/2+.
5466.79 13	3/2-, 5/2-, 7/2(-)	D		J π : log ft=5.6 from 5/2-, γ to (3/2)+ and 3167 γ to (1/2+), although an E3 seems unlikely.
5473.74 20	3/2-, 5/2-, 7/2	D		J π : log ft=5.9, log f ^{lu} t=6.7 from 5/2-, γ to 5/2+.
5519.9 7	(23/2-) ^a	F		
5520.72 25		C		
5526.67 25		C		
5534.184 6	1/2-	C		$\Gamma_n=14.8$ eV 4.
5540.70 25		C		
5542.71 25	(3/2)-	C		$\Gamma_n=7.9$ eV 3.
5546.7 6	(5/2-)	D		J π : L=1 in (n,x).
5551.66 2	1/2+	C	54 eV 2	J π : log ft=6.9, log f ^{lu} t=7.6 from 5/2-, γ to 5/2+, not observed as resonance in (n,X) (see 1983Ra21).
5558.606 15	1/2-	C	127 eV 3	J π : L=0 in (n,x).
5561.9 9	(5/2-)	D		J π : log ft=7.0, log f ^{lu} t=7.8 from 5/2-, γ to 5/2+, not observed as resonance in (n,X) (see1983Ra21).
5563.27 4		C		$\Gamma_n=45$ eV 1.
5564.28 26	1/2+	C	45 eV 1	J π : L=0 in (n,x).
5568.94 26	3/2-	C	201 eV 3	J π : L=1 in (n,x).
5583.05 26	(1/2)-	C		%IT=0.27 7; $\Gamma_n=200$ eV 3.
5593.4 8	1/2-	C	93 eV 4	J π : L=1 in (n,x).
5593.70 3	(1/2-)	C		%IT=0.38 14; $\Gamma_n=93$ eV 4.
5594.7 3	(5/2-)	D		%IT=3.4 10; $\Gamma_n=10.3$ eV 12.
5602.48 26	(3/2+)	C		J π : log ft=6.5, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5606.4 5	3/2-	CD	<311 eV&	J π : L=(2) in (n,x).
5635.2 5	(5/2-)	D		J π : L=1 in (n,x) and log ft=6.6, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+.
5638.40 26	1/2-	C		J π : log ft=6.7, log f ^{lu} t=7.4 from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5638.78 26	(3/2+)	C		J π : L=1 in (n,x).
5638.82 26	(3/2-)	C		J π : L=(2) in (n,x).
5648.8 9	(5/2-)	D		J π : L=(1) in (n,x).
5651.08 6	1/2+	C		J π : log ft=7.5, log f ^{lu} t=8.2 from 3/2-, γ to 5/2+, not observed as resonance in (n,X).
5655.5 10	3/2-	C	0.32 keV 4	
5659.9 4	(5/2-)	D		
5670.30 7	3/2-	C		J π : log ft=6.8, log f ^{lu} t=7.5 from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5671.14 26	1/2+	C		$\Gamma_n=0.54$ keV 3.
5671.57 26	(1/2-)	C		J π : L=0 in (n,x).
5672.3 4	(5/2-)	D		J π : L=(1) in (n,x).
5682.81 27	3/2-	C		J π : log ft=6.6, log f ^{lu} t=7.3 from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
				J π : L=1 in (n,x).

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	$J\pi^{\ddagger\S}$	XREF	Comments
5685.6 3	(5/2-)	D	$J\pi$: log $ft=6.2$, log $f^{1u}t=6.8$ from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5691.44 27	(3/2-)	C	$J\pi$: L=(1) in (n,x).
5698.8 4	(5/2-)	D	$J\pi$: log $ft=6.9$, log $f^{1u}t=7.6$ from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5701.8 8	1/2-	C	$\Gamma_n=1.48$ keV 12.
5712.46 27	1/2+	C	$J\pi$: L=0 in (n,x).
5714.7 9	(5/2-)	D	$J\pi$: log $ft=7.3$, log $f^{1u}t=8.0$ from 5/2-, γ to 5/2+, not observed as resonance in (n,X).
5719.70 27	1/2+	C	$J\pi$: L=0 in (n,x).
5724.36 28	3/2-	C	$J\pi$: L=1 in (n,x).
5735.89 28	(1/2-)	C	$J\pi$: L=1 in (n,x), but 1983Ra21 suggests 3/2-.
5736.68 28	3/2-	C	$J\pi$: L=1 in (n,x).
5740.04 28	1/2+	C	$J\pi$: L=0 in (n,x).
5750.32 28	3/2-	C	$J\pi$: L=1 in (n,x).
5761.4 8	3/2-	C	$\Gamma_n=2.38$ keV 3.
5779.65 29	(3/2+)	C	$\Gamma_n=24$ eV 12.
5782.46 29	(3/2+)	C	$J\pi$: L=(2) in (n,x).
5782.63 30	1/2-	C	$\Gamma_n=0.56$ keV 3.
			$J\pi$: L=1 in (n,x).
5784.20 30	3/2-	C	$\Gamma_n=95$ eV 10.
			$J\pi$: L=1 in (n,x).
5793.3 4	(5/2-)	D	$J\pi$: log $ft=6.2$, log $f^{1u}t=6.8$ from 3/2-, γ to 5/2+, not observed as resonance in (n,X).
5798.60 30	(3/2+)	C	$\Gamma_n=18$ eV 3.
			$J\pi$: L=(2) in (n,x).
5805.62 30	3/2-	C	$\Gamma_n=5.97$ keV 12.
			$J\pi$: L=1 in (n,x).
5818.91 31	(3/2-)	C	$\Gamma_n=35$ eV 6.
			$J\pi$: L=(1) in (n,x).
5821.28 31	(3/2+)	C	%IT>20; $\Gamma_n=20$ eV 3.
			$J\pi$: L=(2) in (n,x).
5824.64 31	1/2+	C	$\Gamma_n=3.21$ keV 3.
			$J\pi$: L=0 in (n,x).
5828.25 31	3/2-	C	$J\pi$: L=1 in (n,x).
			$\Gamma_n=75$ eV 8.
5828.61 31	(3/2+)	C	$\Gamma_n=93$ eV 9.
			$J\pi$: L=(2) (n,x).
5829.78 31	(1/2-)	C	$\Gamma_n=88$ eV 16.
			$J\pi$: L=(1) in (n,x).
5841.64 32	1/2+	C	$\Gamma_n=1.37$ keV 5.
			$J\pi$: L=0 in (n,x).
5850.97 32	1/2-	C	$\Gamma_n=140$ eV 14.
			$J\pi$: L=1 in (n,x).
5862.06 3	3/2-	C	$\Gamma_n=1488$ eV 15.
			$J\pi$: L=1 in (n,x).
5863.26 33	1/2-	C	$\Gamma_n=265$ eV 19.
			$J\pi$: L=1 in (n,x).
5874.26 33	3/2-	C	$\Gamma_n=2.72$ keV 3.
			$J\pi$: L=1 in (n,x).
5876.52 34	3/2+	C	$\Gamma_n=50$ eV 5.
			$J\pi$: L=2 in (n,x).
5877.38 34	(1/2+)	C	$\Gamma_n=25$ eV 5.
			$J\pi$: L=(0) in (n,x).
5877.72 34	(3/2+)	C	$\Gamma_n=53$ eV 15.
			$J\pi$: L=(2) in (n,x).
5883.85 34	1/2-	C	$\Gamma_n=5.62$ keV 11.
			$J\pi$: L=1 in (n,x).
5885.97 34	3/2-	C	$\Gamma_n=3.17$ keV 4.
			$J\pi$: L=1 in (n,x).
5900.95 35	1/2+	C	$\Gamma_n=1.36$ keV 5.
			$J\pi$: L=0 in (n,x).

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	J $\pi^{\ddagger\S}$	XREF	Comments
5901.50 35	1/2-	C	$\Gamma_n=340$ eV 17. J π : L=1 in (n,x).
5903.57 35	3/2+	C	$\Gamma_n=198$ eV 10. J π : L=2 in (n,x).
5908.18 36	3/2-, (3/2+)	C	E(level), J π , L, Γ_n : 1988Ca17 report an unresolved doublet in (n,x) with l=1 and l=(2). For the l=1 component, $\Gamma_n=780$ keV 25 and for the l=(2) component, $\Gamma_n=83$ eV 13, both for J=3/2.
5922.15 36	1/2-	C	$\Gamma_n=1.13$ keV 6. J π : L=1 in (n,x).
5925.16 37	3/2-	C	$\Gamma_n=13.09$ keV 13. J π : L=1 in (n,x).
5925.94 37	(3/2+)	C	$\Gamma_n=45$ eV 10. J π : L=(2) in (n,x).
5939.16 37	3/2-	C	$\Gamma_n=255$ eV 13. J π : L=1 in (n,x).
5944.64 37	(3/2+)	C	$\Gamma_n=70$ eV 10. J π : L=(2) in (n,x).
5951.87 38	(3/2+)	C	$\Gamma_n=30$ eV 6. J π : L=(2) in (n,x).
5953.5 4	1/2-	C	$\Gamma_n=230$ eV 25. J π : L=1 in (n,x).
5958.6 4	3/2+	C	$\Gamma_n=280$ eV 14. J π : L=2 in (n,x).
5964.4 4	3/2-	C	$\Gamma_n=1.86$ keV 4. J π : L=1 in (n,x).
5968.6 4	1/2+	C	$\Gamma_n=0.82$ keV 4. J π : L=0 in (n,x).
5976.7 4	3/2+	C	$\Gamma_n=175$ eV 9. J π : L=2.
5991.3 4	(3/2+)	C	$\Gamma_n=25$ eV 6. J π : L=(2) in (n,x).
5994.8 5	3/2-	C	$\Gamma_n=1.335$ keV 25. J π : L=1 in (n,x).
6002.4 5	1/2+	C	$\Gamma_n=0.34$ keV 3. J π : L=0 in (n,x).
6008.2 5	3/2+	C	$\Gamma_n=348$ eV 13. J π : L=2 in (n,x).
6013.8 5	1/2-	C	$\Gamma_n=4.64$ keV 12. J π : L=1 in (n,x).
6015.81 5	(3/2+)	C	$\Gamma_n=43$ eV 9. J π : L=(2) in (n,x).
6017.4 5	1/2+	C	$\Gamma_n=2.07$ keV 8. J π : L=0 in (n,x).
6022.4 5	1/2-	C	$\Gamma_n=155$ eV 17. J π : L=1 in (n,x).
6025.2 5	1/2-	C	$\Gamma_n=120$ eV 15. J π : L=1 in (n,x).
6026.4 5	3/2-	C	$\Gamma_n=4.66$ keV 5. J π : L=1 in (n,x).
6032.1 5	(1/2-)	C	$\Gamma_n=0.21$ keV 3. J π : L=(1) in (n,x).
6033.2 5	(1/2-)	C	$\Gamma_n=25$ eV 12. J π : L=(1) in (n,x).
6035.2 5	3/2+	C	$\Gamma_n=2.66$ keV 5. J π : L=2 in (n,x).
6041.2 5	(5/2+)	C	$\Gamma_n=47$ eV 10. J π : L=(2) in (n,x).
6042.2 5	(5/2+)	C	$\Gamma_n=132$ eV 17. J π : L=(2) in (n,x).
6043.3 5	3/2-	C	$\Gamma_n=1.12$ keV 4. J π : L=1 in (n,x).
6046.63 5	(1/2-)	C	$\Gamma_n=70$ eV 10. J π : L=(1) in (n,x).

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

$E(\text{level})^\dagger$	$J^\pi \ddagger$	XREF	Comments
6048.7 5	1/2+	C	$\Gamma_n=45$ eV 15. J^π : L=0 in (n,x).
6049.0 5	1/2-	C	$\Gamma_n=175$ eV 10. J^π : L=1 in (n,x).
6054.8 5	3/2+	C	$\Gamma_n=75$ eV 11. J^π : L=2 in (n,x).
6056.8 5	3/2+	C	$\Gamma_n=170$ eV 15. J^π : L=2 in (n,x).
6057.4 5	3/2-	C	$\Gamma_n=3.75$ keV 8. J^π : L=1 in (n,x).
6064.3 5	1/2-	C	$\Gamma_n=400$ eV 20. J^π : L=1 in (n,x).
6067.0 5	3/2-	C	$\Gamma_n=1.93$ eV 4. J^π : L=1 in (n,x).
6075.9 5	1/2-	C	$\Gamma_n=1.26$ keV 5. J^π : L=1 in (n,x).
6076.1 5	1/2+	C	$\Gamma_n=2.14$ keV 15. J^π : L=0 in (n,x).
6077.6 5	3/2-	C	$\Gamma_n=6.34$ keV 10. J^π : L=1 in (n,x).
6081.6 5	1/2-	C	$\Gamma_n=240$ eV 20. J^π : L=1 in (n,x).
6094.3 5	1/2-	C	$\Gamma_n=1.61$ keV 3. J^π : L=1 in (n,x).
6101.3 5	3/2-	C	$\Gamma_n=4.60$ keV 8. J^π : L=1 in (n,x).
6101.5 5	3/2+	C	$\Gamma_n=185$ eV 10. J^π : L=2 in (n,x).
6103.4 5	3/2+	C	$\Gamma_n=383$ eV 20. J^π : L=2 in (n,x).
6105.0 5	3/2-	C	$\Gamma_n=135$ eV 15. J^π : L=1 in (n,x).
6116.9 5	1/2-	C	$\Gamma_n=3.51$ keV 7. J^π : L=1 in (n,x).
6127.0 6	3/2+	C	$\Gamma_n=80$ eV 16. J^π : L=2 in (n,x).
6130.9 6	1/2-	C	$\Gamma_n=2.20$ keV 9. J^π : L=1 in (n,x).
6132.3 6	1/2+	C	$\Gamma_n=0.39$ keV 6. J^π : L=0 in (n,x).
6132.9 6	3/2-	C	$\Gamma_n=33.5$ keV 7. J^π : L=1 in (n,x).
6134.0 6	3/2+	C	$\Gamma_n=0.25$ keV 4. J^π : L=2 in (n,x).
6139.1 6	3/2-	C	$\Gamma_n=0.27$ eV 4. J^π : L=1 in (n,x).
6149.0 6	1/2+	C	$\Gamma_n=1.17$ keV 12. J^π : L=0 in (n,x).
6151.4 6	3/2-	C	$\Gamma_n=0.27$ keV 3. J^π : L=1 in (n,x).
6153.2 6	1/2-	C	$\Gamma_n=6.42$ keV 6. J^π : L=1 in (n,x).
6155.7 6	(5/2+)	C	$\Gamma_n=53$ eV 13. J^π : L=(2) in (n,x).
6164.8 6	1/2-	C	$\Gamma_n=1.37$ keV 9. J^π : L=1.
6172.8 6	3/2-	C	$\Gamma_n=12.3$ keV 4. J^π : L=1 in (n,x).
6177.9 6	3/2-	C	$\Gamma_n=21.2$ keV 4. J^π : L=1 in (n,x).
6187.3 6	1/2+	C	$\Gamma_n=190$ eV 15. J^π : L=0 in (n,x).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	J $\pi^{\ddagger\S}$	XREF	Comments
6188.0 6	3/2+	C	$\Gamma_n=0.12$ keV 4. J π : L=2 in (n,x).
6191.7 6	3/2-	C	$\Gamma_n=21.4$ keV 4. J π : L=1.
6193.5 6	(3/2+)	C	$\Gamma_n=0.12$ keV 4. J π : L=(2) in (n,x).
6201.4 6	(3/2+)	C	$\Gamma_n=0.12$ keV 4. J π : L=(2) in (n,x).
6202.3 6	1/2+	C	$\Gamma_n=0.60$ keV 8. J π : L=0 in (n,x).
6207.6 6	1/2-	C	$\Gamma_n=0.85$ keV 10. J π : L=1 in (n,x).
6208.4 6	3/2-	C	$\Gamma_n=5.51$ keV 17. J π : L=1 in (n,x).
6214.0 6	1/2-	C	$\Gamma_n=13.7$ keV 6. J π : L=1 in (n,x).
6217.4 6	3/2-	C	$\Gamma_n=2.20$ keV 22. J π : L=1 in (n,x).
6225.1 7	1/2-	C	$\Gamma_n=0.58$ keV 9. J π : L=1 in (n,x).
6225.6 6	3/2+	C	$\Gamma_n=0.18$ keV 5. J π : L=2 in (n,x).
6228.6 7	3/2+	C	$\Gamma_n=160$ eV 16. J π : L=2 in (n,x).
6232.8 7	3/2-	C	$\Gamma_n=3.40$ keV 4. J π : L=1 in (n,x).
6233.2 7	(5/2+)	C	$\Gamma_n=123$ eV 13. J π : L=(2) in (n,x).
6235.5 7	1/2+	C	$\Gamma_n=2.8$ eV 5. J π : L=0 in (n,x).
6237.1 7	3/2+	C	$\Gamma_n=0.60$ keV 4. J π : L=2 in (n,x).
6239.2 7	3/2-	C	$\Gamma_n=0.60$ keV 4. J π : L=1 in (n,x).
6241.0 7	1/2-	C	$\Gamma_n=7.0$ keV 5. J π : L=1 in (n,x).
6242.8 7	5/2+	C	$\Gamma_n=50$ eV 4. J π : L=2 in (n,x).
6247.6 7	3/2-	C	$\Gamma_n=1.38$ keV 4. J π : L=1 in (n,x).
6251.7 7	1/2+	C	$\Gamma_n=0.87$ keV 18. J π : L=0 in (n,x).
6255.0 7	3/2-	C	$\Gamma_n=5.9$ keV 6. J π : L=1 in (n,x).
6256.0 7	1/2-	C	$\Gamma_n=6.5$ keV 8. J π : L=1 in (n,x).
6258.9 7	(3/2+)	C	$\Gamma_n=240$ eV 24. J π : L=(2) in (n,x).
6261.4 7	1/2+	C	$\Gamma_n=1.8$ keV 4. J π : L=0 in (n,x).
6266.4 7	1/2-	C	$\Gamma_n=5.1$ keV 7. J π : L=1 in (n,x).
6267.5 7	3/2-	C	$\Gamma_n=7.3$ keV 7. J π : L=1 in (n,x).
6281.5 7	3/2-	C	$\Gamma_n=15.4$ keV 13. J π : L=1 in (n,x).
6283.2 7	1/2+	C	$\Gamma_n=0.27$ keV 8. J π : L=0 in (n,x).
6292.0 7	3/2-	C	$\Gamma_n=5.4$ keV 3. J π : L=1 in (n,x).
6293.2 7	(3/2+)	C	$\Gamma_n=162.5$ eV 25. J π : L=(2) in (n,x).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	$J\pi^{\ddagger\S}$	XREF	Comments
6297.5 7	1/2-	C	$\Gamma_n=3.56$ keV 4. $J\pi: L=1$ in (n,x).
6300.6? 8		F	
6303.2 7	1/2-	C	$\Gamma_n=9.87$ keV 10. $J\pi: L=1$ in (n,x).
6308.4 7	3/2-	C	$\Gamma_n=1.700$ keV 25. $J\pi: L=1$ in (n,x).
6318.9 7	3/2-	C	$\Gamma_n=952$ eV 17. $J\pi: L=1$ in (n,x).
6323.3 8	3/2-	C	$\Gamma_n=0.67$ keV 14. $J\pi: L=1$ in (n,x).
6326.0 8	1/2+	C	$\Gamma_n=0.76$ keV 19. $J\pi: L=0$ in (n,x).
6331.5 8	(1/2-)	C	$\Gamma_n=55$ eV 16. $J\pi: L=(1)$ in (n,x).
6334.0 8	1/2+	C	$\Gamma_n=0.16$ keV 5. $J\pi: L=0$ in (n,x).
6335.4 8	(3/2+)	C	$\Gamma_n=118$ eV 20. $J\pi: L=(2)$ in (n,x).
6336.6 8	1/2+	C	$\Gamma_n=0.14$ keV 5. $J\pi: L=0$ in (n,x).
6337.5 8	(3/2+)	C	$\Gamma_n=130$ eV 20. $J\pi: L=(2)$ in (n,x).
6341.9 8	3/2-	C	$\Gamma_n=9.9$ keV 5. $J\pi: L=1$ in (n,x).
6348.2 8	3/2-	C	$\Gamma_n=4.7$ keV 7. $J\pi: L=1$ in (n,x).
6348.4 8	(3/2+)	C	$\Gamma_n=1.90$ keV 19. $J\pi: L=(2)$ in (n,x).
6356.3 8	1/2+	C	$\Gamma_n=0.32$ keV 10. $J\pi: L=0$ in (n,x).
6357.8 8	3/2-	C	$\Gamma_n=0.76$ keV 19. $J\pi: L=1$ in (n,x).
6358.1 8	(3/2+)	C	$\Gamma_n=0.09$ keV 3. $J\pi: L=(2)$ in (n,x).
6365.2 8	1/2	C	$\Gamma_n=1.0$ keV 3. $J\pi: L=(1)$ in (n,x).
6366.7 8	(1/2-)	C	$\Gamma_n=1.45$ keV 18. $J\pi: L=(1)$ in (n,x).
6371.9 8	3/2-	C	$\Gamma_n=1.9$ keV 3. $J\pi: L=1$ in (n,x).
6373.6 8	(3/2+)	C	$\Gamma_n=0.13$ keV 3. $J\pi: L=(2)$ in (n,x).
6376.9 8	3/2-	C	$\Gamma_n=5.7$ keV 5. $J\pi: L=1$ in (n,x).
6379.0 8	1/2+	C	$\Gamma_n=98$ eV 20. $J\pi: L=0$ in (n,x).
6380.0 7	(5/2+)	C	$\Gamma_n=0.66$ keV 7. $J\pi: L=(2)$ in (n,x).
6382.7 8	(3/2+)	C	$\Gamma_n=108$ eV 11. $J\pi: L=(2)$ in (n,x).
6385.0 8	1/2-	C	$\Gamma_n=2.9$ keV 5. $J\pi: L=1$ in (n,x).
6385.2 8	(3/2+)	C	$\Gamma_n=0.10$ keV 3. $J\pi: L=(2)$ in (n,x).
6390.0 8	3/2-	C	$\Gamma_n=2.6$ keV 3. $J\pi: L=1$ in (n,x).
6392.7 8	3/21	C	$\Gamma_n=0.43$ keV 4. $J\pi: L=1$ in (n,x).
6394.1 8	(1/2+)	C	$\Gamma_n=0.08$ keV 4. $J\pi: L=(0)$ in (n,x).
6396.1 8	3/2-	C	$\Gamma_n=0.54$ keV 6. $J\pi: L=1$ in (n,x).

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Adopted Levels, Gammas (continued) ^{87}Kr Levels (continued)

E(level) [†]	$J\pi^{\ddagger\S}$	XREF	Comments
6398.5 8	1/2-	C	$\Gamma_n=1.88$ keV 19. $J\pi$: L=1 in (n,x).
6402.8 8	(5/2+)	C	$\Gamma_n=0.68$ keV 17. $J\pi$: L=(2) in (n,x).
6407.2 9	(3/2+)	C	$\Gamma_n=0.22$ keV 4. $J\pi$: L=(2) in (n,x).
6407.7 9	3/2-	C	$\Gamma_n=28.6$ keV 20. $J\pi$: L=1 in (n,x).
6410.0 9	(5/2+)	C	$\Gamma_n=0.21$ keV 6. $J\pi$: L=(2) in (n,x).
6413.2 9	(3/2+)	C	$\Gamma_n=0.11$ keV 4. $J\pi$: L=(2) in (n,x).
6414.9 9	(1/2-)	C	$\Gamma_n=0.24$ keV 7. $J\pi$: L=(1) in (n,x).
6418.2 9	(3/2+)	C	$\Gamma_n=0.26$ keV 4. $J\pi$: L=(2) in (n,x).
6419.5 9	(3/2+)	C	$\Gamma_n=0.63$ keV 7. $J\pi$: L=(2) in (n,x).
6422.5 9	(5/2+)	C	$\Gamma_n=0.22$ keV 6. $J\pi$: L=(2) in (n,x).
6428.1 9		C	E(level): Reported as a doublet with L=1 and $\Gamma_n=0.46$ keV 12 and $\Gamma_n=1.9$ keV 4.
6429.0 9	(3/2+)	C	$\Gamma_n=0.30$ keV 8. $J\pi$: L=(2) in (n,x).
6433.4 9	1/2+	C	$\Gamma_n=2.3$ keV 6. $J\pi$: L=0 in (n,x).
6436.7 9	(5/2+)	C	$\Gamma_n=0.18$ keV 6. $J\pi$: L=(2) in (n,x).
6438.5 9	(3/2+)	C	$\Gamma_n=0.25$ keV 8. $J\pi$: L=(2) in (n,x).
6439.1 9	3/2-	C	$\Gamma_n=4.0$ keV 5. $J\pi$: L=1 in (n,x).
6443.1 9	(3/2+)	C	$\Gamma_n=0.48$ keV 14. $J\pi$: L=(2) in (n,x).
6444.2 9	3/2-	C	$\Gamma_n=3.1$ keV 6. $J\pi$: L=1 in (n,x).
6445.3 9	(3/2+)	C	$\Gamma_n=0.20$ keV 6. $J\pi$: L=(2) in (n,x).
6446.2 9	1/2-	C	$\Gamma_n=13.7$ keV 20. $J\pi$: L=1 in (n,x).
6450.7 9	(3/2+)	C	$\Gamma_n=0.26$ keV 8. $J\pi$: L=(2) in (n,x).

[†] From least-squares fit to γ -ray energies for levels depopulated by γ rays.[‡] From (n,X) for levels above $S_n=5515$ keV, unless indicated otherwise. See comment on $J\pi$ in that data set.[§] The log ft values from the ^{87}Br β^- decay have been used in many $J\pi$ assignments, but as noted in that decay, the intensities of the β^- branches are not well determined because there are many unplaced γ 's. Therefore, the log ft 's have been used only if the I_β values are $> 0.3\%$ for levels below 4000 keV, $> 0.1\%$ from 4000 to 5515 keV; all values have been used above the neutron binding energy, 5515 keV. For these assignments it has also been assumed that any γ ray to the ground state is not an M2.# Calculated from γ branching ratio and $\Gamma(n)$ assuming no other decay branch.

@ From (n,X).

& From $\Gamma(n)$ assuming, as is the case for most of the low energy resonances, that $\Gamma\gamma/\Gamma(n) \leq 0.5\%$.^a Expected population of only yrast states in $^{208}\text{Pb}(^{18}\text{O},\text{FG})$ and assuming increasing J with excitation energy.^b (A): γ cascade. $\gamma(^{87}\text{Kr})$ Unplaced γ 's are not included here; see ^{87}Br β^- decay.

E(level)	$E_\gamma^{\ddagger}$	$I_\gamma^{\ddagger}$	Mult.	α	Comments
531.99	532.03 7	100			E_γ : from β^- . Others: 531.91 13 $^{86}\text{Kr}(n,\gamma)$, E=thermal, and 532.12 5 from ^{88}Br β -n decay,.
1419.65	1419.71 7	100	(E2)	2.88×10^{-4}	Mult.: Angular correlations.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Kr})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\dagger}$	Mult.	α	Comments
1476.12	944.12 7	17.7 13			$E\gamma, I\gamma$: from β^- decay. Others: 944.2 3 $^{86}\text{Kr}(n, \gamma)$, E=thermal.
	1476.06 7	100 8			$E\gamma, I\gamma$: from β^- decay Others: 1475.94 17 $^{86}\text{Kr}(n, \gamma)$, E=thermal.
1577.59	1577.60 7	100	[E2]		Mult.: γ to 5/2+.
1841.42	421.74 10	100	D		
1881.19	461.52 7	22.6 16			
	1349.19 7	23.7 16			
	1881.20 20	100 11			
2005.42	529.60 15	25 4			
	2005.52 7	100 8			
2071.65	230.33 9	23.5 18			
	651.96 7	48 4			
	2071.66 7	100 9			
2086.7	611.5 8	100			
2105.37	263.96 7	100	D		
	527.5 3	18 5			$E\gamma$: from $^{208}\text{Pb}(^{18}\text{O}, F\gamma)$.
2122.53	2122.62 9	100			
2258.67	417.1 3	8 3			$E\gamma$: Seen only in $(^{18}\text{O}, F\gamma)$.
	681.22 8	100 8	[E1]	4.72×10^{-4}	Mult.: Angular correlations gives d.
	2258.44 10	39 3	[E3]		
2300.02	824.0 3	21 4			
	1768.07 7	100 7			
	2299.93 8	55 4			
2329.9	853.8 6	100			
2369.49	893.42 9	71 6			
	2369.39 10	100 14			
2371.8	1839.8 4	100			$E\gamma$: from (n, γ) . This γ cannot be the 1840 γ seen in β^- decay because the stronger γ 's deexciting the 2372.35 level in β^- decay have not been seen in (n, γ) .
2372.35	896.0 4	13 3			
	952.66 15	74 7			
	1840.10 15	38 4			
	2372.38 7	100 8			
2451.91	610.46 7	90 9			
	874.30 7	58 5			
	2451.88 10	100 8			
2462.86	2462.82 10	100			
2498.59	617.5 3	21 7			
	920.98 7	91 7			
	1078.88 9	17.5 18			
	2498.58 7	100 7			
2513.75	1037.63 7	100			
2518.91	1099.88 10	7.6 8			$E\gamma$: Not included in the least squares adjustment to obtain level energies.
	2519.0 4	100 7			
2547.1	2547.1 3	100			
2565.9	1146.2 6	100			
2605.77	724.57 15	100			
2614.49	509.1 3	100	D		
2641.74	636.39 8	27.1 17			
	2641.67 8	100 9			
2715.24	2715.19 10	100			
2757.69	1338.03 7	100			
2787.34	1311.21 10	100			
2821.06	698.59 9	7.8 6			
	2820.97 7	100 6			
2832.1	1356.0 6	100			
2836.55	714.09 7	5.6 3			
	831.26 7	38 3			
	1360.59 20	100 6			
	2836.36 7	41 3			
2863.26	1285.66 9	100			
3004.0	3003.9 3	100			
3020.81	1443.21 15	100			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{87}\text{Kr})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult.	α	Comments
3026.84	955.1 3	26 5			
	1021.26 7	93 7			
	1449.24 7	79 6			
	1607.32 7	100 7			
	3026.77 7	93 7			
3080.78	3080.72 15	100			
3142.91	3142.85 15	100			
3171.86	1330.43 15	100			
3217.86	1095.16 15	15.5 17			
	1146.3 6	25 7			
	1212.60 9	32 3			
	1376.08 15	16.7 17			
	1798.31 7	100 7			
	3217.61 9	55 5			
3225.97	853.6 6	24 10			
	2693.94 10	100 8			
	3225.9 3	26.8 25			
3237.19	1659.58 9	100			
3256.90	737.96 7	31.3 20			
	1415.43 15	100 14			
	1836.78 $\frac{1}{2}$ 7	93 7			E γ : Not included in least squares fit for energy levels.
	3256.92 10	21.3 20			
3288.4	1868.7 3	100			
3297.13	1291.7 2	100			
3301.9	1043.3 6	20 7			
	1882.2 4	100 17			
3361.9	3361.8 7	100			
3434.76	1958.23 15	70 9			
	3435.07 15	100 9			
3444.9	3444.8 3	100			
3525.26	910.8 3	35 7			
	1266.6 3	100 22	E2	3.13 $\times 10^{-4}$	
3559.7	555.72 7	100			
3599.00	3598.92 15	100			
3645.52	1126.78 15	15.4 18			
	1640.24 20	33 6			
	2169.30 7	100 7			
	2226.1 3	27 6			
3657.3	3657.2 10	100			
3689.1	3689.0 5	100			
3777.4	940.8 6	100			
3807.03	1965.58 9	100			
3809.41	3809.32 15	100			
3874.18	1355.1 6	22 7			
	2398.01 7	100 7			
	2454.70 20	66 7			
3909.8	3909.7 7	100			
3914.3	1299.7 4	100			
3917.16	3917.06 10	100			
3923.0	2345.4 6	100			
4027.2	4027.1 5	100			
4088.2	173.9 2	17 5			
	562.9 2	100 16			
4136.3	4136.2 4	100			
4180.82	1344.60 15	5.2 5			
	2603.20 8	10.2 8			
	4180.54 10	100 8			
4192.1	4192.0 10	100			
4197.91	2192.46 10	100			
4204.1	4204.0 15	100			
4223.4	4223.3 3	100			
4226.34	1389.77 7	100			
4265.1	4265.0 6	100			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Kr})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$	E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$	E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$
4297.29	4297.18 15	100	4734.55	4734.44 20	100 9	5201.21	4669.9 4	51 7
4327.21	1685.58 15	47 5	4752.71	4752.57 20	100		5200.84 20	100 7
	2446.2 3	30 5	4784.46	2943.0 3	4.3 6	5214.25	3091.6 6	31 7
	2907.46 15	100 10		4784.32 15	100 6		3794.46 15	100 8
	4326.83 20	68 5	4807.9	4807.8 4	100		5214.3 3	28 3
4357.9	832.6 4	100	4824.9	4824.8 4	100	5245.6	5245.4 3	100
4372.4	1757.9 7	100	4836.29	4836.15 20	100	5280.70	2639.0 6	46 16
4416.92	2345.3 4	16 3	4858.87	3017.39 15	82 6		3804.6 3	65 23
	2411.74 15	5.7 5		3281.23 20	100 12		3860.90 15	100 8
	2575.37 9	25.2 22	4872.05	4871.90 15	100		5281.5 9	4.2 16
	2997.21 7	100 9	4889.4	4889.3 5	100	5302.56	4770.43 20	100
4524.15	3048.04 20	34 4	4917.7	4917.6 11	100	5340.2	5340.0 3	100
	4523.96 20	100 11	4925.7	4925.6 7	100	5370.1	5369.9 3	100
4530.2	441.8 3	100 30	4961.55	1044.3 6	3.0 10	5383.1	5382.9 3	100
	1005.2 4	100 30		1934.67 8	11.0 10	5406.34	5406.16 20	100
4548.29	4548.16 20	100		2509.63 20	8.5 10	5419.9	5419.7 5	100
4572.49	4572.36 15	100		2889.8 4	5.0 10	5424.2	5424.0 9	100
4595.51	2143.40 15	19.2 23		3383.3 7	8 3	5436.3	1348.1 5	100
	2523.97 10	23.8 23		3541.79 15	22.0 15	5439.9	5439.7 9	100
	2754.3 4	18.5 23		4961.54 15	100 5	5454.9	5454.7 3	100
	3175.74 7	100 7	4962.43	2125.85 20	100	5466.79	3166.81 15	100 10
	4596.4 6	17 5	4976.1	4975.9 9	100		3381.0 8	42 20
4620.90	4620.77 20	100	5003.2	5003.0 5	100		3461.06 20	90 10
4644.58	3066.85 15	15.9 12	5021.7	5021.5 3	100	5473.74	5473.56 20	100
	4644.58 20	100 9	5033.9	5033.7 6	100	5519.9	989.7 5	100
4655.2	3235.5 3	100	5044.7	5044.5 3	100	5546.7	5546.5 6	100
4668.19	2662.79 15	85 13	5059.69	5059.53 20	100	5561.9	5561.7 9	100
	3090.8 6	23 8	5065.9	4533.8 3	100	5594.7	5594.5 3	100
	3248.45 9	100 8	5076.19	3498.4 3	100 12	5606.4	5606.2 5	100
4710.35	2638.7 4	25 4		5076.08 20	73 8	5635.2	5635.0 5	100
	2704.88 7	100 6	5088.9	5088.7 4	100	5648.8	5648.6 9	100
	2828.79 20	11.8 12	5103.55	5103.39 20	100	5659.9	5659.7 4	100
	2869.20 15	14.1 12	5120.39	5120.23 20	100	5672.3	5672.1 4	100
	3132.64 9	14.7 12	5136.08	5135.92 20	100	5685.6	5685.4 3	100
	4710.23 20	22.9 24	5155.1	5154.9 6	100	5698.8	5698.6 4	100
4711.25	1493.38 8	100	5183.4	5183.2 3	100	5714.7	5714.5 9	100
4728.2	4728.1 10	100	5195.25	4663.4 4	79 8	5793.3	5793.1 4	100
4734.55	3314.6 6	46 13		5195.02 20	100 10	6300.6?	864.6 ‡ 5	100

 † From β^- decay, unless indicated otherwise. ‡ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)

Bands for ^{87}Kr

$^{87}_{36}\text{Kr}_{51}$

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09

Parent ⁸⁷Br: E=0.0; Jπ=5/2⁻; T_{1/2}=55.65 s 13; Q(g.s.)=6818 3; %β⁻ decay=100.

⁸⁷Br: Changed from 3/2⁻ due to observations from high spin experiments. See 2006Po09 for more details.

%β⁻n=2.60 4.

1983Ra21: thermal neutron fission of ²³⁵U, mass separated fission products, GeLi detectors, γ singles spectrum and coincidences.

1977Nu04: thermal neutron fission of ²³⁵U, radiochemical separation, measured delayed neutron and γ spectra.

1975To09: thermal neutron fission of ²³⁵U, mass-separated fission products, GeLi and SiLi detectors, measured γ spectra and βγ coincidences.

Other γ-ray spectrometry: 1966Wi03, 1970Lu06, 1971Er15, and 1975Hu02.

⁸⁷Kr Levels

%N: calculated from Γ(n) from Adopted Levels and Γ(γ) estimated (by previous evaluator, 1991Si02) to be < 0.04 keV for levels with odd parity and < 0.2 keV for levels with even parity.

E(level) [†]	Jπ [‡]	T _{1/2}	Comments
0.0	5/2 ⁺		
531.99 4	1/2 ⁺		
1419.67 3	(7/2 ⁺)		
1476.11 5	3/2 ⁺ , 5/2 ⁺		
1577.59 4	9/2 ⁺		
1841.41 5	(9/2 ⁺)		
1881.20 6	3/2 ⁺ , 5/2 ⁺		
2005.42 4	3/2 ⁺ , 5/2 ⁺		
2071.66 5			
2086.7 6	(1/2 ⁺)		
2105.37 9	(11/2 ⁺)		
2122.53 6	3/2 ⁺ , 5/2 ⁺		
2258.68 7	11/2 ⁻		
2300.02 6	(1/2 ⁺)		
2329.9 6			
2369.48 7			
2372.35 6	(3/2 ⁺ , 5/2 ⁺)		
2451.91 5			
2462.86 10			
2498.59 5			
2513.74 9			
2518.69 8	7/2 ⁺		
2547.1 3			
2565.9 6			
2605.78 16			
2641.74 6			
2715.24 10			
2757.72 8			
2787.33 11	3/2 ⁺ , 5/2 ⁺		
2821.06 6			
2832.1 6			
2836.55 5	(3/2 ⁺ , 5/2 ⁺)		
2863.26 10			
3004.0 3			
3020.81 16			
3026.85 4			
3080.78 15			
3142.91 15			
3171.86 16			
3217.87 5			
3225.97 10			
3237.19 10			
3256.64 6			
3288.4 3			
3297.13 21			
3301.9 4			
3361.9 7			
3434.75 11			
3444.9? 3			E(level): a question mark in Table V of 1983Ra21 indicates that this level may be considered tentative.
3559.7 3			

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^{87}Br β^- Decay 1983Ra21,1977Nu04,1975To09 (continued) **^{87}Kr Levels (continued)**

E(level) [†]	$J\pi^{\ddagger}$	$T_{1/2}$	E(level) [†]	$J\pi^{\ddagger}$	$T_{1/2}$
3599.00 15			4961.56 7	$3/2(-), 5/2, 7/2$	50 ns 25
3645.48 7	$3/2, 5/2, 7/2$		4962.43 21	$3/2, 5/2, 7/2$	
3657.3 10			4976.1 9		
3689.1 5			5003.2 5		
3777.4 6			5021.7 3	$3/2, 5/2, 7/2$	
3807.02 11			5033.9 6		
3809.41 15			5044.7 3	$3/2, 5/2, 7/2$	
3874.18 8	$3/2, 5/2, 7/2$		5059.69 20	$3/2, 5/2, 7/2$	
3909.8 7			5065.9 3		
3917.16 10	$3/2, 5/2, 7/2$		5076.19 17	$3/2(-), 5/2, 7/2$	
3923.0 6			5088.9 4		
4027.2 5			5103.55 20	$3/2, 5/2, 7/2$	
4136.3 4			5120.39 20	$3/2, 5/2, 7/2$	
4180.82 6	$3/2(-), 5/2, 7/2$		5136.08 20	$3/2, 5/2, 7/2$	
4192.1 10			5155.1 6		
4197.91 11			5183.4 3	$3/2, 5/2, 7/2$	
4204.1 15			5195.25 18	$3/2, 5/2, 7/2(-)$	
4223.4 3			5201.21 18	$3/2, 5/2, 7/2-$	
4226.34 9			5214.27 14	$3/2-, 5/2-, 7/2-$	
4265.1 6			5245.6 3	$3/2, 5/2, 7/2$	
4297.29 15	$3/2, 5/2, 7/2$		5280.72 14	$3/2, 5/2, 7/2$	
4327.22 10	$3/2, 5/2, 7/2$		5302.56 21	$3/2, 5/2(+)$	
4416.93 6	$3/2(-), 5/2, 7/2$		5340.2 3	$3/2, 5/2, 7/2$	
4524.15 15	$3/2, 5/2, 7/2$		5370.1 3	$3/2, 5/2, 7/2$	
4548.29 20			5383.1 3	$3/2, 5/2, 7/2$	
4572.49 15	$3/2, 5/2, 7/2$		5406.34 20	$3/2, 5/2, 7/2$	
4595.52 6	$3/2(-), 5/2, 7/2$		5419.9 5		
4620.90 20	$3/2, 5/2, 7/2$		5424.2 9		
4644.58 13	$3/2(-), 5/2, 7/2$		5439.9 9		
4655.2 3			5454.9 3	$3/2, 5/2, 7/2$	
4668.21 8	$3/2(-), 5/2, 7/2$		5466.79 13	$3/2, 5/2, 7/2(-)$	
4710.35 6	$5/2+, 7/2$		5473.74 20	$3/2, 5/2, 7/2$	
4711.26 10	$3/2, 5/2, 7/2$		5546.7 6	$(5/2-)$	
4728.2 10			5561.9 9	$5/2-$	
4734.55 19	$3/2, 5/2, 7/2$		5594.7 3	$(5/2-)$	
4752.71 20	$3/2, 5/2, 7/2$		5606.4 5	$3/2-$	
4784.46 14	$3/2(-), 5/2, 7/2$		5635.2 5	$(5/2-)$	
4807.9 4	$3/2, 5/2, 7/2$		5648.8 9	$(5/2-)$	
4824.9 4	$1/2, 3/2, 5/2$		5659.9 4	$(5/2-)$	
4836.29 20	$3/2, 5/2, 7/2$		5672.3 4	$(5/2-)$	
4858.87 13	$3/2(-), 5/2, 7/2$		5685.6 3	$(5/2-)$	
4872.05 15	$3/2, 5/2, 7/2$		5698.8 4	$(5/2-)$	
4889.4 5			5714.5 9	$(5/2-)$	
4917.7 11	$3/2, 5/2, 7/2$		5793.1 4	$(5/2-)$	
4925.7 7	$3/2, 5/2, 7/2$				

[†] From least-squares fit to γ energies.[‡] From ^{87}Kr Adopted Levels. Arguments made are from logft values presented here and connecting γ transitions. **β^- radiations**

$E\beta^-$	E(level)	$I\beta^{-\ddagger}$	Log $ft^{\ddagger}$	$E\beta^-$	E(level)	$I\beta^{-\ddagger}$	Log $ft^{\ddagger}$
(1025 3)	5793.1	0.068 9	6.21 7	(1223 3)	5594.7	0.061 5	6.54 5
(1104 4)	5714.5	0.0065 13	7.34 9	(1256 4)	5561.9	0.022 7	7.03 14
(1119 3)	5698.8	0.018 2	6.93 6	(1271 3)	5546.7	0.033 5	6.87 7
(1132 3)	5685.6	0.11 1	6.16 5	(1344 3)	5473.74	0.38 3	5.90 4
(1146 3)	5672.3	0.039 4	6.63 6	(1351 3)	5466.79	0.72 7	5.63 5
(1158 3)	5659.9	0.027 3	6.80 6	(1363 3)	5454.9	0.19 2	6.23 5
(1169 4)	5648.8	0.006 2	7.47 15	(1378 4)	5439.9	0.010 3	7.52 14
(1183 3)	5635.2	0.040 5	6.67 6	(1394 4)	5424.2	0.029 10	7.08 16
(1212 3)	5606.4	0.049 6	6.62 6	(1398 3)	5419.9	0.047 15	6.87 14

Continued on next page (footnotes at end of table)

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

β⁻ radiations (continued)

Eβ ⁻	E(level)	Iβ ^{-†‡}	Log ft [‡]	Eβ ⁻	E(level)	Iβ ^{-†‡}	Log ft [‡]
(1412 3)	5406.34	0.21 5	6.24 11	(2901 3)	3917.16	1.94 11	6.54 3
(1435 3)	5383.1	0.15 2	6.41 7	(2908 3)	3909.8	0.13 3	7.72 10
(1448 3)	5370.1	0.14 2	6.46 7	(2944 3)	3874.18	0.85 6	6.93 4
(1478 3)	5340.2	0.14 2	6.49 7	(3009 3)	3809.41	0.76 6	7.02 4
(1515 3)	5302.56	0.26 3	6.27 6	(3011 3)	3807.02	0.22 5	7.56 10
(1537 3)	5280.72	0.56 8	5.96 7	(3041 3)	3777.4	0.15 5	7.74 15
(1572 3)	5245.6	0.18 2	6.49 6	(3129 3)	3689.1	0.18 4	7.72 10
(1604 3)	5214.27	1.18 8	5.71 4	(3161 4)	3657.3	0.10 3	7.99 13
(1617 3)	5201.21	0.83 6	5.87 4	(3173 3)	3645.48	0.87 6	7.06 4
(1623 3)	5195.25	0.95 7	5.82 4	(3219 3)	3599.00	0.110 9	7.98 4
(1635 3)	5183.4	0.18 2	6.56 6	(3258 3)	3559.7	0.047 4	8.37 4
(1663 3)	5155.1	0.04 1	7.24 11	(3373 3)	3444.9?	0.100 20	8.11 9
(1682 3)	5136.08	0.16 2	6.66 6	(3383 3)	3434.75	0.39 3	7.53 4
(1698 3)	5120.39	0.53 5	6.15 5	(3456 3)	3361.9	0.11 3	8.11 12
(1714 3)	5103.55	0.43 4	6.26 5	(3516 3)	3301.9	0.72 11	7.33 7
(1729 3)	5088.9	0.088 10	6.96 6	(3521 3)	3297.13	0.110 10	8.15 4
(1742 3)	5076.19	0.45 4	6.27 5	(3530 3)	3288.4	0.130 20	8.08 7
(1752 3)	5065.9	0.068 7	7.10 5	(3561 3)	3256.64	3.69 23	6.65 3
(1758 3)	5059.69	0.28 3	6.49 5	(3581 3)	3237.19	0.210 20	7.90 5
(1773 3)	5044.7	0.44 4	6.31 5	(3592 3)	3225.97	0.62 5	7.44 4
(1784 3)	5033.9	0.046 10	7.30 10	(3600 3)	3217.87	1.30 8	7.12 3
(1796 3)	5021.7	0.16 3	6.77 9	(3646 3)	3171.86	0.140 20	8.11 7
(1815 3)	5003.2	0.054 4	7.26 4	(3675 3)	3142.91	0.160 10	8.07 3
(1842 4)	4976.1	0.070 20	7.17 13	(3737 3)	3080.78	0.170 20	8.07 6
(1856 3)	4962.43	0.19 3	6.75 7	(3791 3)	3026.85	5.24 19	6.61 2
(1856 3)	4961.56	3.14 13	5.53 3	(3797 3)	3020.81	0.140 20	8.19 7
(1892 3)	4925.7	0.18 4	6.81 10	(3814 3)	3004.0	0.073 11	8.48 7
(1900 4)	4917.7	0.13 4	6.96 14	(3955 3)	2863.26	0.22 4	8.07 8
(1929 3)	4889.4	0.082 20	7.18 11	(3981 3)	2836.55	5.6 3	6.68 3
(1946 3)	4872.05	0.45 3	6.46 4	(3986 3)	2832.1	0.070 20	8.58 13
(1959 3)	4858.87	0.60 5	6.35 4	(3997 3)	2821.06	1.94 10	7.13 7
(1982 3)	4836.29	0.220 20	6.80 5	(4031 3)	2787.33	0.160 20	8.24 6
(1993 3)	4824.9	0.140 20	7.01 7	(4060 3)	2757.72	0.74 5	7.59 3
(2010 3)	4807.9	0.150 20	6.99 6	(4103 3)	2715.24	0.190 20	8.20 5
(2034 3)	4784.46	1.88 10	5.92 3	(4176 3)	2641.74	0.44 7	7.87 7
(2065 3)	4752.71	0.32 3	6.71 5	(4212 3)	2605.78	0.082 10	8.62 6
(2083 3)	4734.55	0.35 4	6.69 6	(4252 3)	2565.9	0.16 4	8.34 11
(2090 4)	4728.2	0.051 20	7.53 18	(4271 3)	2547.1	0.38 4	7.98 5
(2107 3)	4711.26	0.34 3	6.72 5	(4299 3)	2518.69	0.74 7	9.41u
(2108 3)	4710.35	3.21 14	5.75 3	(4304 3)	2513.74	0.290 20	8.11 4
(2150 3)	4668.21	0.83 7	6.4	(4319 3)	2498.59	1.31 7	7.46 3
(2163 3)	4655.2	0.130 10	7.19 4	(4355 3)	2462.86	0.29 3	8.13 5
(2173 3)	4644.58	0.95 7	6.34 4	(4366 3)	2451.91	1.24 10	7.51 4
(2197 3)	4620.90	0.44 4	6.68 5	(4446 3)	2372.35	2.15 13	7.30 3
(2222 3)	4595.52	2.32 12	5.98 3	(4449 3)	2369.48	0.96 9	7.65 5
(2246 3)	4572.49	0.88 6	6.42 4	(4488 3)	2329.9	0.050 20	8.95 18
(2270 3)	4548.29	0.120 9	7.31 4	(4518 3)	2300.02	0.68 5	7.83 4
(2294 3)	4524.15	0.39 4	6.81 5	(4559 3)	2258.68	0.41 5	8.07 6
(2401 3)	4416.93	3.38 22	5.96 4	(4695 3)	2122.53	0.55 11	8.00 9
(2491 3)	4327.22	0.98 6	6.56 3	(4713 3)	2105.37	0.200 20	8.44 5
(2521 3)	4297.29	0.53 4	6.85 4	(4731 3)	2086.7	0.11 6	8.71 24
(2553 3)	4265.1	0.110 20	7.56 8	(4746 3)	2071.66	2.2 3	7.42 6
(2592 3)	4226.34	0.11 3	7.58 12	(4813 3)	2005.42	0.6 5	8.0 4
(2595 3)	4223.4	0.076 8	7.75 5	(4937 3)	1881.20	2.26 21	7.48 4
(2614 4)	4204.1	0.23 9	7.28 17	(5240 3)	1577.59	1.1 5	7.91 20
(2620 3)	4197.91	0.31 4	7.15 6	(5342 3)	1476.11	1.7 7	7.76 18
(2626 4)	4192.1	0.077 20	7.76 12	(5398 3)	1419.67	4.8 16	7.33 15
(2637 3)	4180.82	4.6 3	5.99 3	(6286 3)	531.99	1.2 5	8.23 19
(2682 3)	4136.3	0.26 8	7.27 14	(6818 3)	0.0	12.0 19	7.39 7
(2791 3)	4027.2	0.092 20	7.80 10				
(2895 3)	3923.0	0.12 4	7.75 15				

† From γ-ray intensity balances.

Footnotes continued on next page

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

β⁻ radiations (continued)

‡ As noted by 1983Ra21, for this complex decay scheme with many unplaced γ rays with I_γ > 0.1%, the computed intensities of the weak β branches, for example, I_β < 0.3%, may be unreliable.

γ(⁸⁷Kr)

I_γ normalization: 1983Ra21 normalize I_γ to the absolute intensity of 22.0 15 γ's per 100 decays for the 1419 γ, as reported to them by P. Hoff, based on absolute γ and β count rate measurements. 1975To09 give 12 2 and 1977Nu04 31.2 3 for the same intensity. The latter value cannot be correct since it leads to a ground-state feeding of 123%.

Eγ ^{‡‡}	E(level)	Iγ ^{§&}	Mult.	Comments
x93.54 7		0.130 9		
x121.42 7		0.036 4		
x175.59 10		0.052 9		
x190.29 7		0.078 10		
230.33 9	2071.66	0.54 4		
263.96 7	2105.37	0.20 2		
x346.06 7		0.080 6		
x380.14 7		0.15 1		
x389.14 20		0.031 6		
421.74 10	1841.41	3.2 3		
x447.61 15		0.10 2		
x454.4 5		0.031 10		
461.52 7	1881.20	0.43 3		
x493.39 7		0.100 9		
529.60 15	2005.42	1.3 2		
532.03 7	531.99	5.4 4		
555.72 7	3559.7	0.047 4		
x583.6 5		0.09 3		
x600.44 15		0.086 10		
610.46 7	2451.91	0.60 6		
611.5 8	2086.7	0.24 6		
x614.2 9		0.05 3		
617.5 3	2498.59	0.12 4		
636.39 8	2641.74	0.16 1		
651.96 7	2071.66	1.10 8		
681.22 8	2258.68	0.38 3		
x685.9 7		0.038 20		
x692.5 4		0.031 2		
698.59 9	2821.06	0.14 1		
714.09 7	2836.55	0.19 1		
x719.46 10		0.060 7		
724.57 15	2605.78	0.082 10		
737.96 7	3256.64	0.47 3		
x798.6 3		0.038 9		
824.0 3	2300.02	0.12 2		
831.26 7	2836.55	1.30 9		
x834.8 4		0.17 7		
853.6 6	3225.97	0.10 4		
853.8 6	2329.9	0.05 2		
x860.00 15		0.020 3		
874.30 7	2451.91	0.39 3		
x878.3 5		0.028 9		
x889.9 7		0.06 3		
893.42 9	2369.48	0.40 3		
896.0 [#] 4	2372.35	0.13 3		
x907.86 20		0.066 10		
920.98 7	2498.59	0.52 4		
940.8 6	3777.4	0.15 5		
944.12 7	1476.11	1.4 1		
952.66 15	2372.35	0.74 7		
955.1 3	3026.85	0.36 7		
x963.9 3		0.074 10		
x987.8 3		0.048 2		
x990.3 3		0.013 2		

Continued on next page (footnotes at end of table)

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

 $\gamma(^{87}\text{Kr})$ (continued)

$E\gamma^{\dagger\ddagger}$	E(level)	$I\gamma^{\S\&}$	Mult.	Comments
^x 998.6 3		0.042 10		
^x 1009.2 3		0.048 10		
^x 1017.7 3		0.10 2		
1021.26 7	3026.85	1.30 9		
1037.63 7	2513.74	0.29 2		
^x 1041.77 10		0.076 10		
1043.3 6	3301.9	0.12 4		
1044.3 6	4961.56	0.06 2		
^x 1060.69 15		0.089 10		
^x 1064.75 15		0.075 10		
1078.88 9	2498.59	0.10 1		
1095.16 15	3217.87	0.093 10		
1099.88 10	2518.69	0.099 10		
E _γ : The transition is a poor fit and is not included in the least square adjustment to fit the energy levels. That adjustment gives 1099.04 8.				
^x 1113.05 20		0.044 9		
^x 1120.19 15		0.072 9		
1126.78 15	3645.48	0.085 10		
^x 1139.7 4		0.044 9		
1146.2 6	2565.9	0.16 4		
1146.3 6	3217.87	0.15 4		
^x 1186.27 10		0.13 2		
^x 1198.1 3		0.064 10		
1212.60 9	3217.87	0.19 2		
^x 1220.7 4		0.038 10		
^x 1225.58 15		0.091 20		
^x 1255.1 5		0.11 3		
^x 1276.4 4		0.045 10		
1285.66 9	2863.26	0.22 4		
1291.7 2	3297.13	0.11 1		
^x 1298.6 5		0.058 20		
1311.21 10	2787.33	0.16 2		
1330.43 15	3171.86	0.14 2		
1338.03 7	2757.72	0.74 5		
1344.60 15	4180.82	0.21 2		
1349.19 7	1881.20	0.45 3		
1355.1 6	3874.18	0.10 3		
1356.0 6	2832.1	0.07 2		
1360.59 20	2836.55	3.4 2		
^x 1366.4 4		0.062 20		
1376.08 15	3217.87	0.10 1		
1389.77 7	4226.34	0.11 3		
1415.43 15	3256.64	1.5 2		
1419.71 7	1419.67	22.0 15		
^x 1436.2 4		0.021 5		
1443.21 15	3020.81	0.14 2		
1449.24 7	3026.85	1.10 8		
^x 1464.95 15		0.16 3		
^x 1471.68 15		0.44 5		
1476.06 7	1476.11	7.9 6		
^x 1488.39 10		0.015 9		
1493.38 8	4711.26	0.34 3		
^x 1496.80 20		0.061 7		
^x 1551.7 2		0.061 7		
^x 1554.58 15		0.11 1		
^x 1561.0 4		0.0053 20		
1577.60 7	1577.59	6.0 4		
^x 1602.0 4		0.094 20		
1607.32 7	3026.85	1.40 9		
1640.24 ^a 20	3217.87	0.18 ^a 3		
	3645.48	0.18 ^a 3		
^x 1655.3 4		0.059 10		
1659.58 9	3237.19	0.21 2		
1685.58 15	4327.22	0.19 2		

Continued on next page (footnotes at end of table)

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

γ(⁸⁷Kr) (continued)

Eγ ^{†‡}	E(level)	Iγ ^{§&}	Mult.	Eγ ^{†‡}	E(level)	Iγ ^{§&}
^x 1744.3 5		0.069 20		2575.37 9	4416.93	0.58 5
^x 1759.32 15		0.12 1		^x 2590.03 15		0.13 1
1768.07 7	2300.02	0.56 4		^x 2596.3 3		0.099 10
^x 1781.2 4		0.13 4		2603.20 8	4180.82	0.41 3
^x 1796.2 7		0.14 9		^x 2607.1 3		0.081 10
1798.31 7	3217.87	0.60 4		^x 2622.77 15		0.053 6
^x 1831.5 3		0.20 2		2638.7 4	4710.35	0.43 7
1836.78 7	3256.64	1.4 1		2639.0 6	5280.72	0.12 4
1840.10 15	2372.35	0.38 4		2641.67 8	2641.74	0.59 5
^x 1847.3 3		0.12 2		2662.79 15	4668.21	0.34 5
1868.7 3	3288.4	0.13 2		^x 2688.79 15		0.033 20
1881.20 20	1881.20	1.9 2		2693.94 10	3225.97	0.41 3
1882.2 4	3301.9	0.60 10		2704.88 7	4710.35	1.7 1
^x 1899.9 4		0.05 1		^x 2709.2 3		0.13 2
^x 1906.8 3		0.076 10		2715.19 10	2715.24	0.19 2
1934.67 8	4961.56	0.22 2		^x 2744.7 6		0.013 3
^x 1947.9 3		0.084 20		2754.3 4	4595.52	0.24 3
^x 1953.6 4		0.064 10		^x 2811.3 6		0.16 4
1958.23 15	3434.75	0.16 2		2820.97 7	2821.06	1.8 1
1965.58 9	3807.02	0.22 5		2828.79 20	4710.35	0.20 2
2005.52 7	2005.42	5.3 4		2836.36 7	2836.55	1.4 1
^x 2022.6 3		0.11 2		^x 2853.35 15		0.089 8
^x 2035.42 15		0.077 8		^x 2862.9 4		0.065 10
^x 2066.3 3		0.15 3		2869.20 15	4710.35	0.24 2
2071.66 7	2071.66	2.3 2		2889.8 4	4961.56	0.10 2
^x 2080.9 4		0.086 20		^x 2901.0 5		0.086 20
^x 2092.84 15		0.058 7		2907.46 15	4327.22	0.40 4
^x 2107.90 20		0.13 2		^x 2914.6 7		0.088 20
^x 2110.23 15		0.099 10		^x 2922.6 4		0.10 2
^x 2119.9 3		0.19 6		^x 2925.6 3		0.033 7
2122.62 9	2122.53	1.20 9		^x 2931.64 15		0.14 4
2125.85 20	4962.43	0.19 3		2943.0 3	4784.46	0.077 10
^x 2138.7 3		0.12 2		^x 2967.05 10		0.06 3
2143.40 15	4595.52	0.25 3		^x 2970.8 8		0.09 3
2169.30 7	3645.48	0.55 4		2997.21 7	4416.93	2.3 2
^x 2175.4 3		0.088 20		3003.9 3	3004.0	0.12 1
2192.46 10	4197.91	0.31 4		3017.39 15	4858.87	0.27 2
2226.1 3	3645.48	0.15 3		3026.77 7	3026.85	1.30 9
^x 2254.23 15		0.19 2		^x 3039.9 4		0.047 10
2258.44 10	2258.68	0.15 1	[E3]	3048.04 20	4524.15	0.10 1
2299.93 8	2300.02	0.31 2		3066.85 15	4644.58	0.13 1
^x 2318.6 3		0.051 10		3080.72 15	3080.78	0.17 2
^x 2339.90 15		0.12 1		3090.8 6	4668.21	0.09 3
2345.3 4	4416.93	0.37 6		3091.6 6	5214.27	0.23 5
2345.4 6	3923.0	0.12 4		^x 3112.9 3		0.10 2
2369.39 10	2369.48	0.56 8		3132.64 9	4710.35	0.25 2
2372.38 7	2372.35	1.00 8		3142.85 15	3142.91	0.16 1
2398.01 7	3874.18	0.45 3		3166.81 15	5466.79	0.31 3
2411.74 15	4416.93	0.13 1		3175.74 7	4595.52	1.30 9
^x 2417.76 15		0.18 2		3217.61 9	3217.87	0.33 3
^x 2434.30 15		0.12 1		3225.9 3	3225.97	0.11 1
2446.2 3	4327.22	0.12 2		3235.5 3	4655.2	0.13 1
2451.88 10	2451.91	0.67 5		3248.45 9	4668.21	0.40 3
2454.70 20	3874.18	0.30 3		3256.77 10	3256.64	0.32 3
2462.82 10	2462.86	0.29 3		^x 3275.2 2		0.034 4
^x 2469.4 3		0.059 9		3281.23 20	4858.87	0.33 4
2498.58 7	2498.59	0.57 4		^x 3294.1 7		0.04 3
2509.63 20	4961.56	0.17 2		^x 3305.9 5		0.049 20
2519.0 4	2518.69	1.30 9		3314.6 6	4734.55	0.11 3
2523.97 10	4595.52	0.31 3		^x 3317.8 9		0.058 20
^x 2536.2 9		0.07 3		^x 3343.7 5		0.028 5
2547.1 3	2547.1	0.38 4		3361.8 7	3361.9	0.11 3
^x 2570.8 3		0.12 2		^x 3364.8 7		0.068 20

Continued on next page (footnotes at end of table)

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

 $\gamma(^{87}\text{Kr})$ (continued)

$E_{\gamma}^{\dagger\ddagger}$	E(level)	$I_{\gamma}^{\S\&}$	$E_{\gamma}^{\dagger\ddagger}$	E(level)	$I_{\gamma}^{\S\&}$
3381.0 8	5466.79	0.13 6	4710.23 20	4710.35	0.39 4
3383.3 7	4961.56	0.15 6	4728.1 10	4728.2	0.051 20
^x 3395.1 7		0.063 [@] 20	4734.44 20	4734.55	0.24 2
3435.07 15	3434.75	0.23 2	4752.57 20	4752.71	0.32 3
3444.8 3	3444.9?	0.10 2	4770.43 20	5302.56	0.26 3
^x 3458.6 3		0.074 9	4784.32 15	4784.46	1.8 1
3461.06 20	5466.79	0.28 3	4807.8 4	4807.9	0.15 2
3498.4 3	5076.19	0.26 3	4824.8 4	4824.9	0.14 2
^x 3536.8 6		0.077 20	^x 4829.8 8		0.0038 10
3541.79 15	4961.56	0.44 3	4836.15 20	4836.29	0.22 2
^x 3559.5 6		0.016 5	4871.90 15	4872.05	0.45 3
3598.92 15	3599.00	0.110 9	4889.3 5	4889.4	0.082 20
^x 3611.9 4		0.097 10	4917.6 11	4917.7	0.13 4
^x 3645.97 20		0.082 8	4925.6 7	4925.7	0.18 4
3657.2 10	3657.3	0.10 3	4961.54 15	4961.56	2.0 1
^x 3683.2 8		0.057 10	4975.9 9	4976.1	0.07 2
3689.0 5	3689.1	0.18 4	5003.0 5	5003.2	0.054 10
^x 3693.2 5		0.067 10	5021.5 3	5021.7	0.16 3
^x 3738.2 5		0.074 20	5033.7 6	5033.9	0.046 10
^x 3781.5 7		0.10 3	5044.5 3	5044.7	0.44 4
3794.46 15	5214.27	0.74 6	^x 5049.4 22		0.016 10
3804.6 3	5280.72	0.17 6	5059.53 20	5059.69	0.28 3
3809.32 15	3809.41	0.76 6	5076.08 20	5076.19	0.19 2
^x 3829.0 8		0.038 10	5088.7 4	5088.9	0.088 10
3860.90 15	5280.72	0.26 2	5103.39 20	5103.55	0.43 4
^x 3874.0 8		0.085 20	5120.23 20	5120.39	0.53 5
3909.7 7	3909.8	0.13 3	5135.92 20	5136.08	0.16 2
3917.06 10	3917.16	2.0 1	5154.9 6	5155.1	0.04 1
^x 3930.2 10		0.11 5	^x 5166.6 16		0.016 9
^x 3970.0 10		0.059 20	5183.2 3	5183.4	0.18 2
^x 4012.3 3		0.0064 8	5195.02 20	5195.25	0.53 5
4027.1 5	4027.2	0.092 20	5200.84 20	5201.21	0.55 4
^x 4050.0 4		0.10 3	5214.3 3	5214.27	0.21 2
^x 4055.1 8		0.011 4	5245.4 3	5245.6	0.18 2
^x 4092.8 5		0.10 3	5281.5 9	5280.72	0.011 4
^x 4109.86 20		0.10 1	^x 5318.4 9		0.024 9
4136.2 4	4136.3	0.26 8	5340.0 3	5340.2	0.14 2
4180.54 10	4180.82	4.0 3	^x 5362.5 12		0.024 10
4192.0 10	4192.1	0.077 20	5369.9 3	5370.1	0.14 2
4204.0 15	4204.1	0.23 9	5382.9 3	5383.1	0.15 2
^x 4219.1 7		0.10 4	^x 5395.3 10		0.024 6
4223.3 3	4223.4	0.076 8	5406.16 20	5406.34	0.21 3
^x 4231.0 4		0.13 2	5419.7 5	5419.9	0.047 15
^x 4241.66 20		0.050 5	5424.0 9	5424.2	0.029 10
^x 4258.4 3		0.027 3	5439.7 9	5439.9	0.010 3
4265.0 6	4265.1	0.11 2	5454.7 3	5454.9	0.19 2
4297.18 15	4297.29	0.53 4	5473.56 20	5473.74	0.38 3
^x 4311.9 10		0.064 20	5546.5 6	5546.7	0.033 5
4326.83 20	4327.22	0.27 2	5561.7 9	5561.9	0.022 7
4523.96 20	4524.15	0.29 3	5594.5 3	5594.7	0.061 5
4533.8 3	5065.9	0.068 7	5606.2 5	5606.4	0.049 6
^x 4539.3 10		0.069 20	5635.0 5	5635.2	0.040 5
4548.16 20	4548.29	0.120 9	5648.6 9	5648.8	0.006 2
^x 4564.1 5		0.029 6	5659.7 4	5659.9	0.027 3
4572.36 15	4572.49	0.88 6	5672.1 4	5672.3	0.039 4
^x 4581.9 17		0.11 4	5685.4 3	5685.6	0.11 1
4596.4 6	4595.52	0.22 6	5698.6 4	5698.8	0.018 2
4620.77 20	4620.90	0.44 4	5714.5 9	5714.5	0.011 2
4644.58 20	4644.58	0.82 7	5793.1 4	5793.1	0.015 2
4663.4 4	5195.25	0.42 4			
4669.9 4	5201.21	0.28 4			

[†] From 1983Ra21, unless indicated otherwise.

Footnotes continued on next page

 ^{87}Br β^- Decay 1983Ra21,1977Nu04,1975To09 (continued)

 $\gamma(^{87}\text{Kr})$ (continued)

- $\ddagger$ In addition to the transitions listed here, 1977Nu04 report a transition at 5588.6 keV with $I_\gamma=0.0154$ (normalized to data of 1983Ra21). This transition is not seen by 1983Ra21. A 5821 keV γ transition was reported in 1975To09. This would be expected to have been seen in 1983Ra21 based on intensity comparisons, and so is not included here.
- $\S$ From 1983Ra21, unless otherwise noted. Intensities per 100 ^{87}Br decays. 1977Nu04 and 1975To09 give values of I_γ for about 20 γ 's based on very different assumptions of normalization for 1420 γ , but the relative I_γ 's are in good agreement.
- # Value of 896 keV given by 1983Ra21 is a misprint (private communication from first author).
- @ Value of 0.063 keV given by 1983Ra21 is a misprint (private communication from first author to 1991Si02).
- & Absolute intensity per 100 decays.
- ^a Multiply placed; undivided intensity given.
- ^x γ ray not placed in level scheme.

⁸⁷Br β⁻ Decay 1983Ra21,1977Nu04,1975To09 (continued)

Decay Scheme

Intensities: I_γ per 100 parent decays
& Multiply placed; undivided intensity given

⁸⁸Br β⁻n Decay 1980Ho03

Parent ⁸⁸Br: E=0.0; Jπ=(1,2-); T_{1/2}=16.5 s I; Q(g.s.)=1922 3; %β⁻n decay=6.4 5.

⁸⁸Br-%β⁻n decay: I_γ(775)/I_n=9.5 5 (1980Ho03) and 9.4 6 (1981Ho07).

The results of 1980Ho03 were given in 1981Ho07, by the same author, in abbreviated form, but some values differ.

Neutron spectrum measured by 1977Sh01 and 1974Ru08.

⁸⁷Kr Levels

E(level) [†]	Jπ [‡]
0.0	5/2+
532.12 5	1/2+

[†] No other γ's have been reported so branching to higher is less than 0.1%.

[‡] From ⁸⁷Kr Adopted Levels.

Delayed neutrons

E(n)	E(⁸⁷ Kr)	I(n) [†]
1390 130	532.12	4.1 3
1920 130	0.0	95.9 3

[†] For intensity per 100 decays, multiply by 0.064 5.

γ(⁸⁷Kr)

Eγ	E(level)	Iγ [†]
532.12 5	532.12	4.1 3

[†] For absolute intensity per 100 decays, multiply by 0.064 5.

²H(⁸⁶Kr,p) 2013Sh02,2012ShZZ

E=10 MeV/nucleon ⁸⁶Kr beam from Argonne Tandem-Linac Accelerator System (ATLAS). Target=50-75 μg/cm² (C₂D₄)_n.

Measured proton spectra, σ(θ) using the Helical-Orbit Spectrometer (HELIOS). FWHM = 80 keV. Deduced levels, and spectroscopic factors. DWBA analysis.

Uncertainties quoted for cross sections are purely statistical. There is additional systematic uncertainty of ≈20%.

Cross sections (dσ/dΩ mb/sr) from (d,p) data (2012ShZZ)

Angle θ is in degrees in c.m. system

Level	σ ₁	θ ₁	σ ₂	θ ₂	σ ₃	θ ₃
0	12.01 25	19.3	5.80 18	23.6	5.52 10	27.3
538 7	1.61 11	[17.1]	1.00 8	22.0	1.79 6	25.9
1465 5			1.75 11	18.6	2.09 7	23.3

Continued on next page (footnotes at end of table)

$^2\text{H}(^{86}\text{Kr},\text{p})$ 2013Sh02,2012ShZZ (continued)

1570 3	0.18 6	18.4	0.19 4	23.1
1883 8			0.30 5	22.0
1997 5			1.13 7	21.5
2080 2			0.61 15	21.2
2112 2			5.99 16	21.2
2250 2			1.26 9	21.0
2277 2			0.17 10	21.0
2517 4			2.96 8	19.6
2775 3			0.58 10	18.6
2823 3			2.86 12	18.3
3021 5			1.80 8	17.5
3229 16			0.41 6	16.4

 Cross sections ($\text{d}\sigma/\text{d}\Omega$ mb/sr) from (d,p) data (2012ShZZ)
 Angle θ is in degrees in c.m. system

Level	σ_4	θ_4	σ_5	θ_5	σ_6	θ_6
0	3.14 9	30.5	1.78 16	33.4	2.30 11	36.1
538 7	1.12 7	29.3	1.14 14	32.4	1.12 10	35.2
1465 5	1.01 7	27.1	0.67 15	27.1	0.75 9	33.4
1570 3	0.19 6	26.9	0.50 14	30.3	0.22 8	33.3
1883 8	0.17 5	26.0	0.07 9	29.6	0.14 7	32.6
1997 5	0.56 6	25.7	0.57 16	29.2	0.55 9	32.3
2080 2	0.69 13	25.4	0.26 37	28.9	0.39 20	32.1
2112 2	2.85 14	25.4	1.60 33	28.9	1.62 18	32.1
2250 2	1.04 17	25.0	1.13 13	29.0	0.84 15	32.0
2277 2	0.16 13	25.0	0.12 12	29.0	0.15 12	32.0
2517 4	2.17 9	24.2	2.17 14	27.9	2.13 10	31.2
2775 3	0.41 9	23.3	0.07 18	27.2	0.17 12	30.6
2823 3	1.15 7	22.5	1.01 11	26.6	0.63 7	30.0
3021 5	1.15 7	22.5	1.01 11	26.6	0.63 7	30.0
3229 16	0.22 5	21.7	0.35 9	25.9	0.39 5	29.5

 ^{87}Kr Levels

E(level) [†]	L [‡]	C ² S [§]	E(level) [†]	L [‡]	C ² S [§]	E(level) [†]	L [‡]	C ² S [§]
0.0	2	1.02	1997 5	2	0.11	2517 4	4	0.96
538 7	0	0.69	2080 2	0	0.19	2775 3	2	0.041
1465 5	2	0.19	2112 2	2	0.47	2823 3	2	0.18
1570 3	(0)	0.17	2250 2	(5)	0.75	3021 5	2	0.12
1883 8	2	0.030	2277 2	(0)	0.094	3229 16	(0+2)	0.13

[†] Uncertainties are from 2012ShZZ. In 2013Sh02, the authors quote values to just three digits (in MeV) and state that the estimated uncertainty is ≈ 10 keV. It is possible that uncertainties quoted in 2012ShZZ are statistical, and the ≈ 10 keV is the systematic uncertainty. A comparison with adopted levels indicates that the energies of 2012ShZZ are about 8 keV low and this shift is taken into account when making level associations in adopted levels.

[‡] The values are from 1970Ha16 in (d,p) with the tentative L(1873)=(2) and L(2080)=(0) from (d,p) being confirmed.

[§] For the DWBA calculation for L=2, the values are for $J^\pi=3/2+$, except for the ground state; for L=4 J^π is taken to be $7/2+$; and for L=5 J^π is taken to be $11/2-$. For the 3229 keV level, C²S is for $1/2+$. C²S=0.004 for $3/2+$ and 0.003 for $5/2+$.

⁸⁶Kr(n,X) 1983Ra21,1988Ca17

1983Ra21: 99.5% enriched ⁸⁶Kr target, FWHM=0.001×E(n), time-of-flight neutron spectroscopy. ⁸⁶Kr(n): E(n)=1-400 keV, measured total σ(E), determined L from the magnitude and shape of the transmission dip.

1988Ca17: ⁸⁶Kr(n), E(n)=15 keV to 25 MeV, FWHM=[8.4+68 MeV⁻¹E(n)]^{1/2}×E(n)^{1/2}×10⁻⁴, pulsed neutron techniques, R-matrix analysis, determined resonance parameters.

Γ_n from 1988Ca17.

⁸⁷Kr Levels

Values of gΓ(n)Γ(γ)/Γ are from 1983Ra21 determined from the ratio of σ(n,γ) and σ(n). g is defined here as (2J+1)/2.

Γ_n are from gΓ(n) for adopted J. For E below 300 keV, values are a weighted average from 1988Ca17 (R-matrix analysis of σ(E)) and 1983Ra21 (area analysis of the transmission dip), unless indicated otherwise. For E above 300 keV, values are from 1988Ca17. g is defined as (2J+1)/2.

Γ_n(f) The excitation function interferes with the s-wave resonance at nearly the same energy.

E(level) [†]	Jπ [§]	L [‡]	Comments
S(n)+5.609 [#] 4			Γ _n ,Γ _γ : gΓ(n)Γ(γ)/Γ=0.024 eV 2 (1983Ra21).
S(n)+11.629 [#] 9			Γ _n ,Γ _γ : gΓ(n)Γ(γ)/Γ=0.026 eV 3 (1983Ra21).
S(n)+19.238 6	1/2-	1	Γ _n =14.8 eV 4. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.17 eV 2 (1983Ra21).
S(n)+25.829 [#] 20			Γ _n ,Γ _γ : gΓ(n)=1.5 eV 3, gΓ(n)Γ(γ)/Γ=0.23 eV 2 (1983Ra21).
S(n)+27.863 9	(3/2)-	1	Γ _n =7.9 eV 3. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.11 eV 2 (1983Ra21).
S(n)+36.920 12	1/2+	0	Γ _n =54 eV 2. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.30 eV 8 (1983Ra21).
S(n)+43.945 15	1/2-	1	Γ _n =127 eV 3. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.39 eV 10 (1983Ra21).
S(n)+48.66 [#] 4			Γ _n ,Γ _γ : gΓ(n)=2.1 eV 8, gΓ(n)Γ(γ)/Γ=0.32 eV 6 (1983Ra21).
S(n)+49.680 18	1/2+	0	Γ _n =45 eV 1. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.20 eV 6 (1983Ra21).
S(n)+54.403 19	3/2-&	1&	Γ _n =200 eV 3. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.55 eV 15 (1983Ra21).
S(n)+68.674 25	(1/2)-	1	Γ _n =26 eV 3. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.14 eV 7 (1983Ra21).
S(n)+78.930 30	1/2-&	1&	Γ _n =93 eV 4. Jπ: other: (3/2-) (1988Ca17).
			Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.33 eV 12 (1983Ra21).
S(n)+79.452 30	(1/2-)	(1)	Γ _n =10.3 eV 12. Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.35 eV 9 (1983Ra21).
S(n)+88.329 34	(3/2+)	(2)	Γ _n =4 eV 1. Γ _n : From 1988Ca17. others: 2 1 (1983Ra21) Γ _n ,Γ _γ : Γ(n)Γ(γ)/Γ=0.23 eV 8 (1983Ra21).
S(n)+92.189 36	3/2-	1	Γ _n =309 eV 6.
S(n)+124.67 6	1/2-	1	Γ _n =381 eV 8.
S(n)+125.05 [@] 6	(3/2+)	(2)	Γ _n =2.5 eV 15.
S(n)+125.10 [@] 6	(3/2-)	(1)	Γ _n =15.0 eV 25.
S(n)+137.50 6	1/2+	0	Γ _n =3.08 keV 12.
S(n)+142.21 7	3/2-	1	Γ _n =0.32 keV 3.
S(n)+156.95 7	3/2-	1	Γ _n =0.560 keV 11.
			Γ _n : From 1988Ca17 Others: 0.485 keV 20 (1983Ra21).
S(n)+157.80 7	1/2+	0	Γ _n =1.400 keV 28. Γ _n : From 1988Ca17 Others: 0.810 keV 40 (1983Ra21).
S(n)+158.13 [@] 7	(1/2-)	(1)	Γ _n =40 eV 9.
S(n)+169.60 8	3/2-	1	Γ _n =317 eV 12.
S(n)+178.33 [@] 9	(3/2-)	(1)	Γ _n =10 eV 1.
S(n)+188.89 9	1/2-	1	Γ _n =1.48 keV 12.
S(n)+195.60 10	1/2+	0	Γ _n =0.35 keV 5.
S(n)+206.92 10	1/2+	0	Γ _n =4.40 keV 16.
S(n)+211.64 11	3/2-	1	Γ _n =1.52 keV 5.
S(n)+223.30 10	1/2-	1	Γ _n =1.66 keV 5. Jπ: other: 3/2- (1983Ra21).
			Γ _n : other: 2.30 keV 20 (1983Ra21).
S(n)+224.10 [@] 11	3/2-	1	Γ _n =285 eV 15.
S(n)+227.50 [@] 12	1/2+	0	Γ _n =135 eV 20.
S(n)+237.90 12	3/2-	1	Γ _n =1.165 keV 25.
S(n)+248.95 13	3/2-	1	Γ _n =2.51 keV 12.
S(n)+267.58 [@] 14	(3/2+)	(2)	Γ _n =24 eV 12.
S(n)+270.42 14	1/2+	0	Γ _n =1.96 keV 4.

Continued on next page (footnotes at end of table)

$^{86}\text{Kr}(\text{n},\text{X})$ 1983Ra21,1988Ca17 (continued) **^{87}Kr Levels (continued)**

E(level) [†]	J π [§]	L $\ddagger$	Comments
S(n)+270.60 15	1/2-	1	$\Gamma_n=0.56$ keV 3. Γ_n : other: 0.93 keV 10 (1983Ra21).
S(n)+272.18 [@] 15	3/2-	1	$\Gamma_n=95$ eV 10.
S(n)+286.75 [@] 16	(3/2+)	(2)	$\Gamma_n=18$ eV 3.
S(n)+293.85 16	3/2-	1	$\Gamma_n=5.97$ keV 12.
S(n)+307.30 [@] 17	(3/2-)	(1)	$\Gamma_n=35$ eV 6.
S(n)+309.70 [@] 17	(3/2+)	(2)	$\Gamma_n=20$ eV 3.
S(n)+313.10 17	1/2+	0	$\Gamma_n=3.21$ keV 3. Γ_n : other: 3.70 keV 19 (1983Ra21).
S(n)+316.75 18	3/2-	1	$\Gamma_n=75$ eV 8. Γ_n : other: 120 eV 15 (1983Ra21).
S(n)+317.11 18	(3/2+)	(2)	$\Gamma_n=93$ eV 9.
S(n)+318.30 18	(1/2-)	(1)	$\Gamma_n=88$ eV 16.
S(n)+330.30 19	1/2+	0	$\Gamma_n=1.37$ keV 5. Γ_n : other: 1.43 keV 15 (1983Ra21).
S(n)+339.73 20	1/2-	1	$\Gamma_n=140$ eV 14.
S(n)+350.95 20	3/2-	1	$\Gamma_n=1.488$ keV 15. Γ_n : other: 1.95 keV 10 (1983Ra21).
S(n)+352.17 21	1/2-	1	$\Gamma_n=265$ eV 19.
S(n)+363.30 21	3/2-	1	$\Gamma_n=2.72$ keV 3. Γ_n : other: 3.56 keV 15 (1983Ra21).
S(n)+365.58 22	3/2+	2	$\Gamma_n=50$ eV 5.
S(n)+366.45 22	(1/2+)	(0)	$\Gamma_n=25$ eV 5.
S(n)+366.80 22	(3/2+)	(2)	$\Gamma_n=53$ eV 15.
S(n)+373.00 22	1/2-	1	$\Gamma_n=5.62$ keV 11. J π : other: 3/2- (1983Ra21). Γ_n : other: 5.65 keV 3 for J=3/2 (1983Ra21).
S(n)+375.15 22	3/2-	1	$\Gamma_n=3.17$ keV 4. J π : other: 1/2- (1983Ra21). Γ_n : other: 2.0 keV 6 for J=1/2 (1983Ra21).
S(n)+390.30 24	1/2+	0	$\Gamma_n=1.36$ keV 5. Γ_n : other: 0.37 keV 4 for J=1/2 at 389.11 keV (1983Ra21).
S(n)+390.40 24	1/2-	1	$\Gamma_n=340$ eV 17.
S(n)+392.95 24	3/2+	2	$\Gamma_n=198$ eV 10. Γ_n : other: 0.76 keV 8 for J=1/2 (1983Ra21).
S(n)+397.63 24	3/2-, (3/2+)	1+(2)	E(level),J π ,L, Γ_n : 1988Ca17 report an unresolved doublet with l=1 and l=(2). For the l=1 component, $\Gamma_n=780$ keV 25 and for the l=(2) component, $\Gamma_n=83$ eV 13, both for J=3/2.
S(n)+411.75 25	1/2-	1	$\Gamma_n=1.13$ keV 6.
S(n)+414.80 26	3/2-	1	$\Gamma_n=13.09$ keV 13.
S(n)+415.58 26	(3/2+)	(2)	$\Gamma_n=45$ eV 10.
S(n)+428.96 27	3/2-	1	$\Gamma_n=255$ eV 13.
S(n)+434.50 27	(3/2+)	(2)	$\Gamma_n=70$ eV 10.
S(n)+441.82 28	(3/2+)	(2)	$\Gamma_n=30$ eV 6.
S(n)+443.4 3	1/2-	1	$\Gamma_n=230$ eV 25.
S(n)+448.6 3	3/2+	2	$\Gamma_n=280$ eV 14.
S(n)+454.5 3	3/2-	1	$\Gamma_n=1.86$ keV 4.
S(n)+458.7 3	1/2+	0	$\Gamma_n=0.82$ keV 4.
S(n)+466.9 3	3/2+	2	$\Gamma_n=175$ eV 9.
S(n)+481.8 3	(3/2+)	(2)	$\Gamma_n=25$ eV 6.
S(n)+485.3 3	3/2-	1	$\Gamma_n=1.335$ keV 25.
S(n)+492.9 3	1/2+	0	$\Gamma_n=0.34$ keV 3.
S(n)+498.9 3	3/2+	2	$\Gamma_n=348$ eV 13.
S(n)+504.5 4	1/2-	1	$\Gamma_n=4.64$ keV 12.
S(n)+506.5 4	(3/2+)	(2)	$\Gamma_n=43$ eV 9.
S(n)+508.1 4	1/2+	0	$\Gamma_n=2.07$ keV 8.
S(n)+513.2 4	1/2-	1	$\Gamma_n=155$ eV 17.
S(n)+516.0 4	1/2-	1	$\Gamma_n=120$ eV 15.
S(n)+517.2 4	3/2-	1	$\Gamma_n=4.66$ keV 5.
S(n)+523.0 4	(1/2-)	(1)	$\Gamma_n=0.21$ keV 3.
S(n)+524.2 4	(1/2-)	(1)	$\Gamma_n=25$ eV 12.
S(n)+526.1 4	3/2+	2	$\Gamma_n=2.66$ keV 5.
S(n)+532.2 4	(5/2+)	(2)	$\Gamma_n=47$ eV 10.

Continued on next page (footnotes at end of table)

$^{86}\text{Kr}(\text{n},\text{X})$ 1983Ra21,1988Ca17 (continued) **^{87}Kr Levels (continued)**

E(level) [†]	J π [§]	L $\ddagger$	Comments
S(n)+533.2 4	(5/2+)	(2)	$\Gamma_n=132$ eV 17.
S(n)+534.2 4	3/2-	1	$\Gamma_n=1.12$ keV 4.
S(n)+537.7 4	(1/2-)	(1)	$\Gamma_n=70$ eV 10.
S(n)+539.8 4	1/2+	0	$\Gamma_n=45$ eV 15.
S(n)+540.0 4	1/2-	1	$\Gamma_n=175$ eV 10.
S(n)+546.0 4	3/2+	2	$\Gamma_n=75$ eV 11.
S(n)+547.8 4	3/2+	2	$\Gamma_n=170$ eV 15.
S(n)+548.6 4	3/2-	1	$\Gamma_n=3.75$ keV 8.
S(n)+555.6 4	1/2-	1	$\Gamma_n=400$ eV 20.
S(n)+558.3 4	3/2-	1	$\Gamma_n=1.93$ keV 4.
S(n)+567.3 4	1/2-	1	$\Gamma_n=1.26$ keV 5.
S(n)+567.5 4	1/2+	0	$\Gamma_n=2.14$ keV 15.
S(n)+569.0 4	3/2-	1	$\Gamma_n=6.34$ keV 10.
S(n)+573.7 4	1/2-	1	$\Gamma_n=240$ eV 20.
S(n)+585.9 4	1/2-	1	$\Gamma_n=1.61$ keV 3.
S(n)+593.0 4	3/2-	1	$\Gamma_n=4.60$ keV 8.
S(n)+593.2 4	3/2+	2	$\Gamma_n=185$ eV 10.
S(n)+595.2 4	3/2+	2	$\Gamma_n=383$ eV 20.
S(n)+596.8 4	3/2-	1	$\Gamma_n=135$ eV 15.
S(n)+608.8 5	1/2-	1	$\Gamma_n=3.51$ keV 7.
S(n)+619.0 5	3/2+	2	$\Gamma_n=80$ eV 16.
S(n)+623.0 5	1/2-	1	$\Gamma_n=2.20$ keV 9.
S(n)+624.4 5	1/2+	0	$\Gamma_n=0.39$ keV 6.
S(n)+625.0 5	3/2-	1	$\Gamma_n=33.5$ keV 7.
S(n)+626.1 5	3/2+	2	$\Gamma_n=0.25$ keV 4.
S(n)+631.5 5	3/2-	1	$\Gamma_n=0.27$ keV 4.
S(n)+641.2 5	1/2+	0	$\Gamma_n=1.17$ keV 12.
S(n)+643.6 5	3/2-	1	$\Gamma_n=0.27$ keV 3.
S(n)+645.6 5	1/2-	1	$\Gamma_n=6.42$ keV 6.
S(n)+648.0 5	(5/2+)	(2)	$\Gamma_n=53$ eV 13.
S(n)+657.2 5	1/2-	1	$\Gamma_n=1.37$ keV 9.
S(n)+665.3 5	3/2-	1	$\Gamma_n=12.3$ keV 4.
S(n)+670.5 5	3/2-	1	$\Gamma_n=21.2$ keV 4.
S(n)+680.0 5	1/2+	0	$\Gamma_n=190$ eV 15.
S(n)+680.7 5	3/2+	2	$\Gamma_n=0.12$ keV 4.
S(n)+684.5 5	3/2-	1	$\Gamma_n=21.4$ keV 4.
S(n)+686.2 5	(3/2+)	(2)	$\Gamma_n=0.12$ keV 4.
S(n)+694.2 5	(3/2+)	(2)	$\Gamma_n=0.12$ keV 4.
S(n)+695.2 5	1/2+	0	$\Gamma_n=0.60$ keV 8.
S(n)+700.6 5	1/2-	1	$\Gamma_n=0.85$ keV 10.
S(n)+701.2 5	3/2-	1	$\Gamma_n=5.51$ keV 17.
S(n)+707.0 6	1/2-	1	$\Gamma_n=13.7$ keV 6.
S(n)+710.5 6	3/2-	1	$\Gamma_n=2.20$ keV 22.
S(n)+718.2 6	1/2-	1	$\Gamma_n=0.58$ keV 9.
S(n)+718.8 6	3/2+	2	$\Gamma_n=0.18$ keV 5.
S(n)+721.8 6	3/2+	2	$\Gamma_n=160$ eV 16.
S(n)+726.0 6	3/2-	1	$\Gamma_n=3.40$ keV 4.
S(n)+726.4 6	(5/2+)	(2)	$\Gamma_n=123$ eV 13.
S(n)+728.8 6	1/2+	0	$\Gamma_n=2.8$ keV 5.
S(n)+730.4 6	3/2+	2	$\Gamma_n=0.60$ keV 4.
S(n)+732.5 6	3/2-	1	$\Gamma_n=6.5$ keV 4.
S(n)+734.3 6	1/2-	1	$\Gamma_n=7.0$ keV 5.
S(n)+736.2 6	5/2+	2	$\Gamma_n=50$ eV 4.
S(n)+741.0 6	3/2-	1	$\Gamma_n=1.38$ keV 4.
S(n)+745.2 6	1/2+	0	$\Gamma_n=0.87$ keV 18.
S(n)+748.5 6	3/2-	1	$\Gamma_n=5.9$ keV 6.
S(n)+749.5 6	1/2-	1	$\Gamma_n=6.5$ keV 8.
S(n)+752.5 6	(3/2+)	(2)	$\Gamma_n=240$ eV 24.
S(n)+755.0 6	1/2+	0	$\Gamma_n=1.8$ keV 4.
S(n)+760.0 6	1/2-	1	$\Gamma_n=5.1$ keV 7.
S(n)+761.2 6	3/2-	1	$\Gamma_n=7.3$ keV 7.
S(n)+775.3 6	3/2-	1	$\Gamma_n=15.4$ keV 13.
S(n)+777.0 6	1/2+	0	$\Gamma_n=0.27$ keV 8.

Continued on next page (footnotes at end of table)

$^{86}\text{Kr}(\text{n},\text{X})$ 1983Ra21,1988Ca17 (continued) **^{87}Kr Levels (continued)**

E(level) [†]	J π [§]	L $\ddagger$	Comments
S(n)+786.0 6	3/2-	1	$\Gamma_n=5.4$ keV 3.
S(n)+787.2 6	(3/2+)	(2)	$\Gamma_n=162.5$ eV 25.
S(n)+791.5 6	1/2-	1	$\Gamma_n=3.56$ keV 4.
S(n)+797.3 7	1/2-	1	$\Gamma_n=9.87$ keV 10.
S(n)+802.5 7	3/2-	1	$\Gamma_n=1.700$ keV 25.
S(n)+813.2 7	3/2-	1	$\Gamma_n=952$ eV 17.
S(n)+817.6 7	3/2-	1	$\Gamma_n=0.67$ keV 14.
S(n)+820.3 7	1/2+	0	$\Gamma_n=0.76$ keV 19.
S(n)+825.9 7	(1/2-)	(1)	$\Gamma_n=55$ eV 16.
S(n)+828.4 7	1/2+	0	$\Gamma_n=0.16$ keV 5.
S(n)+829.8 7	(3/2+)	(2)	$\Gamma_n=118$ eV 20.
S(n)+831.1 7	1/2+	0	$\Gamma_n=0.14$ keV 5.
S(n)+832.0 7	(3/2+)	(2)	$\Gamma_n=130$ eV 20.
S(n)+836.4 7	3/2-	1	$\Gamma_n=9.9$ keV 5.
S(n)+842.8 7	3/2-	1	$\Gamma_n=4.7$ keV 7.
S(n)+843.0 7	(3/2+)	(2)	$\Gamma_n=1.90$ keV 19.
S(n)+851.0 7	1/2+	0	$\Gamma_n=0.32$ keV 10.
S(n)+852.5 7	3/2-	1	$\Gamma_n=0.76$ keV 19.
S(n)+852.8 7	(3/2+)	(2)	$\Gamma_n=0.09$ keV 3.
S(n)+860.0 7	(1/2)	(1)	J π : Erratum from 1988Ca17. $\Gamma_n=1.0$ keV 3.
S(n)+861.55 71	(1/2-)	(1)	$\Gamma_n=1.45$ keV 18.
S(n)+866.8 7	3/2-	1	$\Gamma_n=1.9$ keV 3.
S(n)+868.5 7	(3/2+)	(2)	$\Gamma_n=0.13$ keV 3.
S(n)+871.8 7	3/2-	1	$\Gamma_n=5.7$ keV 5.
S(n)+874.0 7	1/2+	0	$\Gamma_n=98$ eV 20.
S(n)+875.0 7	(5/2+)	(2)	$\Gamma_n=0.66$ keV 7.
S(n)+877.8 7	(3/2+)	(2)	$\Gamma_n=108$ eV 11.
S(n)+880.0 8	1/2-	1	$\Gamma_n=2.9$ keV 5.
S(n)+880.2 8	(3/2+)	(2)	$\Gamma_n=0.10$ keV 3.
S(n)+885.0 8	3/2-	1	$\Gamma_n=2.6$ keV 3.
S(n)+887.8 8	3/2-	1	$\Gamma_n=0.43$ keV 4.
S(n)+889.2 8	(1/2+)	(0)	$\Gamma_n=0.08$ keV 4.
S(n)+891.3 8	3/2-	1	$\Gamma_n=0.54$ keV 6.
S(n)+893.7 8	1/2-	1	$\Gamma_n=1.88$ keV 19.
S(n)+898.0 8	(5/2+)	(2)	$\Gamma_n=0.68$ keV 17.
S(n)+902.5 8	(3/2+)	(2)	$\Gamma_n=0.22$ keV 4.
S(n)+903.0 8	3/2-	1	$\Gamma_n=28.6$ keV 20.
S(n)+905.3 8	(5/2+)	(2)	$\Gamma_n=0.21$ keV 6.
S(n)+908.6 8	(3/2+)	(2)	$\Gamma_n=0.11$ keV 4.
S(n)+910.3 8	(1/2-)	(1)	$\Gamma_n=0.24$ keV 7.
S(n)+913.6 8	(3/2+)	(2)	$\Gamma_n=0.26$ keV 4.
S(n)+914.9 8	(3/2+)	(2)	$\Gamma_n=0.63$ keV 7.
S(n)+918.8 8	(5/2+)	(2)	$\Gamma_n=0.22$ keV 6.
S(n)+923.6 8	1/2-	1	$\Gamma_n=0.46$ keV 12.
S(n)+923.6 8	3/2-	1	$\Gamma_n=1.9$ keV 4.
S(n)+924.6 8	(3/2+)	(2)	$\Gamma_n=0.30$ keV 8.
S(n)+929.0 8	1/2+	0	$\Gamma_n=2.3$ keV 6.
S(n)+932.3 8	(5/2+)	(2)	$\Gamma_n=0.18$ keV 6.
S(n)+934.2 8	(3/2+)	(2)	$\Gamma_n=0.25$ keV 8.
S(n)+934.8 8	3/2-	1	$\Gamma_n=4.0$ keV 5.
S(n)+938.8 8	(3/2+)	(2)	$\Gamma_n=0.48$ keV 14.
S(n)+939.9 8	3/2-	1	$\Gamma_n=3.1$ keV 6.
S(n)+941.0 8	(3/2+)	(2)	$\Gamma_n=0.20$ keV 6.
S(n)+942.0 8	1/2-	1	$\Gamma_n=13.7$ keV 20.
S(n)+946.5 8	(3/2+)	(2)	$\Gamma_n=0.26$ keV 8.

[†] Resonance energies in lab coordinates, S(n)=5515.17 keV 25. Energies are from 1988Ca17, unless indicated otherwise.[‡] From R-matrix analysis of $\sigma(E)$. The values from 1988Ca17 and 1983Ra21 generally agree.[§] From R-matrix analysis of $\sigma(E)$ (1988Ca17), unless indicated otherwise. The values agree with those obtained by 1983Ra21 from magnitude and shape of the transmission dip except for the cases specifically mentioned.

From 1983Ra21.

@ From 1988Ca17.

$^{86}\text{Kr}(\text{n},\text{X})$ 1983Ra21,1988Ca17 (continued) **^{87}Kr Levels (continued)**

& L and J π from magnitude and shape of the transmission dip. Limits on d-wave contributions are calculated by means of a probabilistic formula (1983Ra21).

 $^{86}\text{Kr}(\text{n},\gamma)$ E=th 1977Je03

This scheme is from 1977Je03 and is a tentative one with an intensity imbalance. γ -detection with Ge pair and Compton-suppressed spectrometers.

 ^{87}Kr Levels

E(level)	J π [†]	Comments
0.0	5/2+	
531.89 12	1/2+	
1475.96 15	1/2, 3/2	
2005.2 5		
2122.46? 22	1/2, 3/2	
2371.8 $\frac{1}{2}$ 3	1/2, 3/2	
(5515.17 25)	1/2+	E(level): neutron-capture state. J π : from L=0 neutron capture on 0+ target.

[†] From primary γ 's, except for the ground state and first-excited level which are from ^{87}Kr Adopted Levels and capture state. Primary γ 's are assumed to be dipole transitions.

[‡] The authors consider this level as uncertain because of intensity imbalance. Not identical to 2372.36 level observed in β -decay, because the 952 and 2372 γ 's with $I_\gamma/I_\gamma(1840.10)=2.0$ and 2.6, respectively, should otherwise have been seen here.

 $\gamma(^{87}\text{Kr})$

E γ	E(level)	I γ [†]	E γ	E(level)	I γ [†]	E γ	E(level)	I γ [†]
x181.59 $\frac{1}{2}$ 21		7 2	x1064.8 $\frac{1}{2}$ # 4		6 3	x2331.5 $\frac{1}{2}$ 5		10 5
x341.30 $\frac{1}{2}$ 11		15 3	x1304.9 $\frac{1}{2}$ 3		15 4	x2348.2 $\frac{1}{2}$ 4		28 12
531.91 13	531.89	71 11	1475.94 17	1475.96	89 12	x2887.8 4		23 8
x773.1 3		9 3	1839.8 4	2371.8	19 5	3143.3 4	(5515.17)	40 11
x866.15 23		33 6	2005.2@ 5	2005.2	9 5	3392.6 $\frac{1}{2}$ 3	(5515.17)	75 18
x892.15 21		23 5	x2062.9 $\frac{1}{2}$ 4		22 9	4039.6 6	(5515.17)	38 15
944.2 3	1475.96	12 5	2122.4 $\frac{1}{2}$ 3	2122.46?	26 7	4983.1 4	(5515.17)	25 7
x1055.4 $\frac{1}{2}$ 3		10 3	x2295.2 $\frac{1}{2}$ 3		29 8			

[†] Relative values.

[‡] Assignment to ^{87}Kr is uncertain.

$\S$ The 3393-keV γ ray to the 2122-keV level is 3 times as intense as the 2122-keV γ ray from this level. This imbalance suggests that part of the intensity could be placed elsewhere.

There is also an unplaced 1064.75 15 γ transition reported in ^{87}Br β -decay.

@ The authors state that the assignment to ^{87}Kr is uncertain; however, a transition with this energy from the 2005 keV level is established in β -decay.

x γ ray not placed in level scheme.

$^{86}\text{Kr}(n,\gamma)$ E=th 1977Je03 (continued)

Level Scheme

Intensities: relative I_γ **$^{86}\text{Kr}(d,p), (p,d)$ 1970Ha16, 1978De20**

1965Sa06: E=15 MeV, $\theta=12^\circ-45^\circ$. Level energies above 1 MeV are higher by 50–100 keV than those adopted.

1970Ha16: E=11 MeV, $\Delta E=30$ keV, $\theta=20^\circ-160^\circ$ in 5° steps. Finite-range DWBA analysis of $\sigma(\theta)$.

1971Co21: E=4.5–10.5 MeV, $\theta=100^\circ-160^\circ$ in 20° steps. Determined cross sections as a function of E(d) for levels at 0, 530, and 1470 keV.

1978De20: E=12 MeV, $\Delta E = 16$ keV, $\theta=25^\circ-100^\circ$ with polarized deuterons. Determined vector analyzing power for ground state transition and DWBA analysis of $\sigma(\theta)$ for ground state and 529 and 2112 levels.

Unless noted otherwise, data are from 1970Ha16.

 ^{87}Kr Levels

E(level) [†]	J^π	$L^\ddagger$	$S^\ddagger$	Comments
0.0	5/2+	2	0.56	J^π : from analyzing power (1978De20).
529		0	0.46	
1468		2	0.23	
1570				E(level): This level likely corresponds to the adopted 1570 level with 1577 level with $J^\pi=9/2+$.
1873		(2)	0.02	
1996		2	0.09	
2080		(0)	0.18	
2112		2	0.30	
2250		(5)	0.18	
2277		(0)	0.03	E(level): incompletely resolved from the 2250 level. J^π : (1/2+) assigned to level at 2300 keV.
2515		4	0.49	
2775		2	0.10	
2823		2	0.11	J^π : there are adopted levels at 2832, and 2836 to which this L might apply.
3015		2	0.08	J^π : there are adopted levels at 3020, and 3026 to which this L might apply.
3223		#	#	
3237		#	#	
3552				
3819				
3871				
4402				
4536				
4800				
4856				

[†] A comparison of energies of the first five excited levels with the adopted values shows these values are low by about 8 keV. A change of +5 keV in calibration energy accounts for part of this discrepancy. The evaluators have increased the authors' energies by 8 keV when making level associations in the Adopted Levels. The 3819 level is seen only in this reaction and in the Adopted Levels is given as E=3827.

[‡] For the DWBA calculation for L=2, the values are for $J^\pi=3/2+$, except for the ground state; for L=4 J^π is taken to be 7/2+; and for L=5 J^π is taken to be 11/2-.

[§] Assignments of 1965Sa06 agree with those of 1970Ha16, except where noted.

⁸⁶Kr(d,p),(pol d,p) 1970Ha16,1978De20 (continued)

⁸⁷Kr Levels (continued)

The 3223 and 3237 levels were not resolved. From the assumption that L=2 is valid for both members of the doublet, 1970Ha16 deduce S=0.12 for J^π=3/2+ and S=0.08 for J^π=5/2+. In 1965Sa06 a peak at 3310 keV was reported with L=(0+2) that probably corresponds to this doublet.

²⁰⁸Pb(¹⁸O,Fγ) 2006Po09

²⁰⁸Pb(¹⁸O,Fγ) with beam energy E=85 MeV. Measured Eγ, Iγ, γγ, γγ(θ), using Euroball IV array.

⁸⁷Kr Levels

E(level)	Jπ [‡]	E(level)	Jπ [‡]	E(level)	Jπ [‡]
0.0 [†]	5/2+	2614.2 [†] 4	(13/2+)	4529.9 5	(19/2-)
1419.80 [†] 25	(7/2+)	3525.0 4	(15/2-)	5307.1 13	
1577.53 25	(9/2+)	3914.0 [†] 4	(15/2+)	5436.0 7	(21/2-)
1841.3 [†] 3	(9/2+)	4087.9 4	(17/2-)	5519.6 7	(23/2-)
2105.0 [†] 3	(11/2+)	4357.6 6	(17/2-)	6300.6 8	
2258.4 3	(11/2-)	4372.1 8	(17/2+)		

[†] (A): γ sequence.

[‡] Suggested spins based on expected population of only yrast states in fusion-fission reaction and assuming increasing J with excitation energy.

γ(⁸⁷Kr)

Eγ	E(level)	Iγ	Mult.	α	Comments
172.7 [§] 3	4529.9	0.4 2			
173.9 2	4087.9	3.2 9			
263.6 2	2105.0	27 3	[M1] [‡]	0.01005	(263.6γ)(1419.7γ)(θ): R(22°)=0.92 6, R(46°)=0.96 4, R(75°)=1.00 4., (263.6γ)(421.5γ)(θ): R(22°)=1.07 5, R(46°)=1.04 4, R(75°)=1.00 4.
417.1 3	2258.4	2.6 8			
421.5 2	1841.3	38 4	[M1] [‡]	0.00320	(421.5γ)(1419.7γ)(θ): R(22°)=0.95 6, R(46°)=0.98 4, R(75°)=1.00 4.
441.8 3	4529.9	5.0 15			
509.1 3	2614.2	16 3	[M1] [‡]	0.00205	(509.1γ)(263.6γ)(θ): R(22°)=1.04 5, R(46°)=1.02 4, R(75°)=1.00 4. (509.1γ)(421.5γ)(θ): R(22°)=1.11 5, R(46°)=1.05 4, R(75°)=1.00 4.
527.5 3	2105.0	4.8 14			
562.9 2	4087.9	19 3			
680.9 2	2258.4	34 3	[E1] [†]	4.72×10 ⁻⁴	(680.9γ)(1577.6γ)(θ): R(22°)=0.94 6, R(46°)=0.98 4, R(75°)=1.00 4.
832.6 4	4357.6	4 1			
864.6 [§] 5	6300.6	1.5 7			
910.8 3	3525.0	8.0 15			
935 [§] 1	5307.1	0.4 2			
989.7 5	5519.6	3 1			
1005.2 4	4529.9	5.0 15			
1266.6 3	3525.0	23 5	[E2] [†]	3.13×10 ⁻⁴	(1266.6γ)(680.9γ)(θ): R(22°)=0.95 6, R(46°)=0.97 4, R(75°)=1.00 4. (1266.6γ)(1577.6γ)(θ): R(22°)=1.08 6, R(46°)=1.04 4, R(75°)=1.00 4.
1299.7 4	3914.0	3.8 9			
1348.1 5	5436.0	3.1 9			
1419.7 3	1419.80	55 4	[E2] [‡]	2.88×10 ⁻⁴	
1577.6 3	1577.53	45 3	[E2] [†]	3.02×10 ⁻⁴	
1757.9 7	4372.1	1.3 5			

[†] From the angular distribution R values, 2006Po09 conclude that the 1578 and 1267 γ transitions have the same character (dipole, or quadrupole), whereas the 681γ has a different character. From its placement in the level scheme, the 681γ must have Δπ=yes and is therefore [E1], and the 1578 and 1267γ's [E2].

[‡] From the angular distribution R values, 2006Po09 conclude that the 1420γ transition has different multipolarity than the 264, 421, and 509 γ's all of which have the same character. Based on the systematics of quadrupole transitions with lower energy being less likely close to shell closure, the 264, 421, and 509 γ's are assumed to be [M1], and thus the 1420γ is assumed to be [E2].

[§] Placement of transition in the level scheme is uncertain.

$^{208}\text{Pb}(^{18}\text{O},\text{F}\gamma)$ 2006Po09 (continued)

Level Scheme

Intensities: relative I_γ **$^{238}\text{U}(^{82}\text{Se},\text{X}\gamma), ^{192}\text{Os}(^{82}\text{Se},\text{X}\gamma)$ 2007De37**

Multi-nucleon transfer and deep-inelastic reactions.

2007De37: $E(^{82}\text{Se})=505$ MeV for ^{238}U target, 460 MeV for ^{192}Os target; isotopically enriched targets; thin target of ^{238}U studied with CLARA γ -ray spectrometer coupled with PRISMA magnetic spectrometer at Legnaro for A, Q identification; measured E_γ . Used thick target of ^{192}Os and GASP array (40 Compton-suppressed Ge detectors and an inner ball of BGO detectors) to measure $\gamma\gamma$ coin. Shell model calculations.

 ^{87}Kr Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$	Comments
0.0	5/2+	$J\pi$: From Adopted Levels.
1420	(7/2+)	
1578	(9/2+)	
1842	(11/2+)	$J\pi$: Adopted: (9/2+).
2106	(11/2-)	$J\pi$: Adopted: (11/2+) Not reported in (d,p).
2260	(13/2+)	$J\pi$: Adopted: (11/2-) L=(5) in the (d,p) dataset suggests $\pi=-$ for this level. It seems unlikely that a 13/2+ level could be populated in (d,p).
2615		$J\pi$: Adopted: (13/2+).
3526	(17/2+)	$J\pi$: Adopted: (15/2-).
4089		$J\pi$: Adopted: (17/2-).

† From E_γ based on the assumption that the uncertainties are the same for all the E_γ values.

‡ Authors' suggested values, based on shell model calculations including $1f_{5/2}$, $2p_{3/2}$, $2p_{1/2}$ and $1g_{9/2}$ active proton orbitals and a ^{78}Ni core. Assignments differ from those of 2006Po09 in $(^{18}\text{F},\text{F}\gamma)$ above the 1578 keV level.

 $\gamma(^{87}\text{Kr})$

$E_\gamma^\dagger$	$E(\text{level})$
264	2106
422	1842
509	2615

Continued on next page (footnotes at end of table)

$^{238}\text{U}(^{82}\text{Se},\text{X}\gamma), ^{192}\text{Os}(^{82}\text{Se},\text{X}\gamma)$ **2007De37 (continued)**

$\gamma(^{87}\text{Kr})$ (continued)

$E\gamma^\dagger$	E(level)
563	4089
682	2260
911	3526
1266	3526
1420	1420
1578	1578

[†] From 2007De37, uncertainty unstated by authors.

Level Scheme

Adopted Levels, Gammas

Q(β⁻)=282.2 11; S(n)=9922.10 20; S(p)=8621.10 1; Q(α)=-8009 4 2012Wa38.

Q(β⁻n)=-8145.9 11 Q(ep)=-16255 3.

Some recent nuclear structure theory, calculations: 2010Ro31, 2010Sh23 2006F102.

⁸⁷Rb Levels

Since ⁸⁷Rb has a closed neutron shell with N=50, the low-lying levels will have configurations based on the odd protons; these states include p_{3/2}, f_{5/2}, and g_{9/2}.

Cross Reference (XREF) Flags

A Coulomb Excitation
B ⁸⁶Kr(p,p') IAR
C ⁸⁶Kr(³He,d)
D ⁸⁷Kr β⁻ Decay

E ⁸⁷Rb(n,n'γ)
F ⁸⁷Rb(p,p')
G ⁸⁸Sr(d,³He)
H ⁸⁷Sr ε Decay (2.815 h)

I ¹⁹²Os(⁸²Se,Xγ)
J ¹⁷⁶Yb(²³Na,Xγ)
K ⁸⁷Rb(γ,γ')
L ¹²C(⁸⁶Kr,Xγ)

E(level) ^{†‡}	Jπ	XREF	T _{1/2}	Comments
0.0 ^a	3/2-	A CDE GHIJKL	4.97×10 ¹⁰ y 3	<p>β⁻=100; Q=+0.132 1; μ=+2.75131 12.</p> <p>Jπ: from atomic beam magnetic resonance (1962Pe14), optical spectroscopy (1976Fu06), confirmed by hyperfine-structure measurement (1981Th04). π from L=1 in (³He,d).</p> <p>T_{1/2}: Taken from most recent measurement using 4πβ liquid scintillation counting in a photomultiplier-tube spectrometer (2003Ko66) Full precision is 4.967×10¹⁰ 32.</p> <p>Others: 4.72 4 (1966Mc12), 4.88 8 (1974Ne14,1972Ne19), and 4.89 4 (1977De22), 5.560 25 [E. Akatsu, Radioisotopes 30 (1981) 647], 5.21 15 (1965Br25), 4.60 6 (1965ThZY, as cited in 1990Ho28), 4.77 10 (1964Ko11), 5.80 12 (1962Le08), 5.25 10 (1961Mc07), 5.82 10 (1961Eg01), 5.53 10 (1961Be41), 4.72 8 (1960Ra01), 5.02 20 [G. V. Ovchinnikova, Geochemica 5 (1959) 393, as cited in 1990Ho28], 4.7 1 (1959Fl40), 5.07 20 (1957Li42), 4.6 5 (1956Fr12), 5.0 2 (1956Al31), 6.2 3 (1954Ma31), 4.3 3 (1954Ge60), 6.2 2 (1954Fl18), 5.9 3 (1952Le24), and 6.15 30 (1951Cu30) where all numbers are in units of 1x10¹⁰ y.</p> <p>There are several other measurements reported before 1950. Many of these values have been taken from citations in 1961Be41 or 1990Ho28. In the previous evaluation, the evaluator averaged only the three recent measurements of 1966Mc12 and 1977De22, who determined the amount of ⁸⁷Sr produced in the ⁸⁷Rb β⁻ decay, and of 1974Ne14 (absolute counting in proportional counter), where systematic errors which were shown to be inherent in the older measurements (see 1976Ne10) were avoided to a large extent. This weighted average has an internal uncertainty of 0.027, a reduced-χ² of 4.9, and an external uncertainty of 0.06. This uncertainty was increased to 0.09 to include the two most precise values. It is clear that the adopted half-life depends greatly on which values are included in the average. For example, note that the four values from 1961 and 1962 range from 5.25 10 to 5.82 10. Others: in the process of analyzing some meteorite data, 1982Mi14</p>

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{87}Rb Levels (continued)

E(level) ^{†‡}	J π	XREF	T _{1/2}	Comments
				state that, if their ^{87}Rb - ^{87}Sr data are to agree with their U-Th-Pb data, the ^{87}Rb decay constant would need to be $1.402\ 8 \times 10^{-11}\ \text{y}^{-1}$, which corresponds to a half-life of $4.94\ 3 \times 10^{10}$ years. Determination of the half-life is, for some techniques, dependent on the β spectrum shape factor function, discussion of which may be found in 2007Gr05 and 2007Gr06. μ : from 2011StZZ evaluation and based on data of 1993Du08; others: $+2.751818\ 2$, and $+2.751235\ 3$ cited in 1989Ra17 evaluation. Q: from 2011StZZ evaluation, where the measured values are given as $+0.132\ 1$ (1973Fe05), $+0.127\ 1$ (1971St12) $+0.134\ 1$, $+0.128\ 1$ (1999Ke12). Other: $+0.13\ 2$ (1981Th04). $\delta\langle r^2 \rangle(^{85,87}\text{Rb})=0.03\ 6\ \text{fm}^2$ and $\delta\langle r^2 \rangle(^{87,89}\text{Rb})=0.28\ 6\ \text{fm}^2$ (1999GaZU). Plot in 1981Jo01 gives similar values. Octupole mom(mag): $-0.58\ \text{b}$ un 39 from combining measured hyperfine intervals with atomic structure calculations, 2009Ge02.
402.588 ^a 12	5/2-	A CDEFG IJKL	0.08 ns +9-5	J π : L=3 in ($^3\text{He},d$), M1+E2 γ to 3/2-. T _{1/2} : from Coulomb excitation.
845.44 4	1/2-	CDEFG KL	101 fs +9-11	J π : a comparison of T _{1/2} measured by DSAM in $^{12}\text{C}(86\text{Kr},x\gamma)$ with $g\Gamma_{\gamma 0}^2/\Gamma$ measured in (n,n' γ) gives J=1/2. T _{1/2} : DSAM (2013St05). Other: 95 fs +14-11 from Γ in (γ,γ').
1349.36 10 1389.78 8	3/2-	DE L DEF K	0.19 ps +5-3	J π : L=2 in (p,p') from 3/2-, comparison of γ excitation functions in (n,n' γ) with Hauser-Feshbach calculations gives 3/2-. T _{1/2} : Calculated from (γ,γ') level width. J π : γ excitation in (n,n' γ). T _{1/2} : Calculated from (γ,γ') level width.
1463.00 15	1/2-	C EF K	0.21 ps +12-6	XREF: G(1578). J π : L=4 in ($^3\text{He},d$), comparison with model calculation supports an assignment of $g_{9/2}$ (1975Me02). T _{1/2} : from (α,α') using a pulsed beam technique (1995Ka18). XREF: G(1578).
1577.9 ^a 3	9/2+	C EFG IJ L	6 ns 1	J π : L=1 in (d, ^3He). J π : L=2 in (p,p') from 3/2-, comparison of γ excitation functions in (n,n' γ) with Hauser-Feshbach calculations gives 3/2-.
1578.05 5	1/2-, 3/2-	D G IJK		J π : L=1 in ($^3\text{He},d$). J π : Comparison of γ excitation functions with Hauser-Feshbach calculations in (n,n' γ). J π : L=2 in (p,p') from 3/2- and direct excitation in ($\gamma\gamma'$). J π : L=2 in (p,p') from 3/2- and direct excitation in ($\gamma\gamma'$). J π : From ($\gamma\gamma'$). The 1/2+ can be ruled out since the the 1975 γ transtion to the 403 keV 5/2- level would then have mult=M2 with the $g\Gamma_{\gamma 0}^2/\Gamma$ value leading to B(M2)(W.u.)=830 exceeding RUL.
1740.57 5	3/2-	DEF K		
1893 10 1950.0 3	(1/2, 3/2)- (1/2)	C E		
2014 1	(1/2, 3/2, 5/2)-	F K		
2284 1	(1/2, 3/2, 5/2)-	F K		
2378.36 17	(1/2-, 3/2, 5/2)	D K		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁸⁷Rb Levels (continued)

E(level) ^{†‡}	J π	XREF	T _{1/2}	Comments
2379 8	(+)	F		J π : L=(5) in (p,p') from 3/2-, this level is probably not identical with the 2379 level observed in β^- decay because of γ to 3/2- from the latter level.
2398 [#] 1	1/2-, 3/2-	C F K		J π : L=1 in (³ He,d).
2414.43 6	(3/2-)	D G		XREF: G(2420). J π : logft=6.8, logf ^{1u} t=7.6 from 5/2+ L=(1) in (d, ³ He).
2415 [§] 8	(7/2, 9/2)+	F		J π : L=3 in (p,p') from 3/2-.
2530	1/2-, 3/2-	G		J π : L=1 in (d, ³ He).
2554.82 7	3/2+, 5/2+	CD F K		XREF: C(2548). J π : L=2 in (³ He,d) leads to 3/2+, 5/2+.
2731 [#] 4	7/2+, 9/2+	C F		J π : L=4 in (³ He,d).
2811.2 2	3/2+, 5/2+	CD F K		J π : L=2 in (³ He,d).
2960.62 7	(3/2, 5/2)+	D F		J π : L=3 in (p,p') from 3/2-, γ to 3/2-.
2974 [#] 4	7/2+, 9/2+	C F		J π : L=4 in (³ He,d).
3001.2 ^a 4	(11/2)+	F IJ		XREF: F(3002). J π : based on systematics of surrounding levels in ⁸⁷ Rb. J and L=5 in (p,p') from 3/2-.
3005 1	(1/2, 3/2, 5/2)+			J π : from ($\gamma\gamma'$).
3043 1	(1/2, 3/2, 5/2)			J from ($\gamma\gamma'$).
3055.15 24	3/2, 5/2, 7/2-	D F		XREF: F(3058). J π : logft=7.6, logf ^{1u} t=8.0 from 5/2+, γ to 3/2-.
3060 1	1/2+	C F K	24.4 fs +24-21	XREF: F(3058). E(level): only from (³ He,d) and (g,g'). J π : L=0 in (³ He,d). T _{1/2} : Calculated by evaluator from (γ, γ') level width.
3098.5 11	(13/2)+	F J		XREF: F(3099). J π : L=5 in (p,p') from 3/2- and γ from (17/2+).
3308.49 12	3/2+, 5/2+	CD F K		J π : L=2 in (³ He,d).
3338.1 [#] 7	1/2-, 3/2-	C F K		XREF: C(3335). J π : L=1 in (³ He,d).
3356 8		F		
3409.1 ^a 3	(13/2+)	F IJ		XREF: F(3411). J π : Based on one $\gamma(0)$ data in (82Se,x γ) and band placement.
3411 8		F		
3436 8		F		
3480 8	(7/2, 9/2)+	F		J π : L=3+(5) in (p,p') from 3/2-.
3534 8		F		
3586 8	-	F		J π : L=4 in (p,p') from 3/2-.
3618 8	+	F		J π : L=5 in (p,p') from 3/2-.
3644.1 ^a 3	(15/2+)	F IJ		XREF: F(3647). J π : Based on one $\gamma(0)$ data in (82Se,x γ) and band placement.
3685 [§] 8	(7/2, 9/2)+	C F		J π : L=3+(5) in (p,p') from 3/2-.
3692 7	1/2-, 3/2- and (5/2)-	C		J π : L=1+(4) in (³ He,d) and possible doublet with 3702 in (p,p') with L=4.
3702 1	(1/2, 3/2, 5/2)-	F K		XREF: F(3707). J π : L=4 in (p,p') from 3/2- and (γ, γ') and possible doublet with L=1+(4) in (³ He,d).
3744 8		F		
3767 [#] 1	1/2-, 3/2-	C F K		XREF: C(3764). J π : L=1 in (³ He,d).
3824 8	-	F		J π : L=2 in (p,p') from 3/2-.
3837 1	1/2+	C K	3.9 fs +4-3	J π : L=0 in (³ He,d) and (γ, γ'). T _{1/2} : Calculated by evaluator from (γ, γ') level width.
3910 8	+	F		J π : L=5 in (p,p') from 3/2-.

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Adopted Levels, Gammas (continued)
⁸⁷Rb Levels (continued)

E(level) ^{†‡}	J π	XREF	T _{1/2}	Comments
3958 8	—	F		J π : L=4 in (p,p') from 3/2-.
3974 [#] 4	3/2+, 5/2+	C F		J π : L=2 in (³ He,d).
4014 [§] 8		F		
4029 8	—	F		J π : L=4 in (p,p') from 3/2-.
4057 8		F		
4068 8		F		
4090.0 11		f J		XREF: f(4094).
4106 8	—	F		J π : L=4 in (p,p') from 3/2-.
4146 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
4150.6 ^a 3	(17/2+)	I J		J π : Based on one $\gamma(\theta)$ data in (82Se,x γ) and band placement.
4153 8	—	F		J π : L=2 in (p,p') from 3/2-.
4209 8	—	F		J π : L=4 in (p,p') from 3/2-.
4266 5	&	C		
4314.1 15		J		
4379 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
4492 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
4681 5	1/2-, 3/2-	C		J π : L=1 in (³ He,d).
4854.7 ^a 4	(19/2+)	I J		J π : Based on one $\gamma(\theta)$ data in (82Se,g θ) and band placement.
4862 5	(1/2+) and (3/2+, 5/2+)	C		J π : L=(0+2) in (³ He,d).
4941 5	1/2+	C		J π : L=0 in (³ He,d).
5026.4 ^a 4	(21/2+)	I J		J π : Based on one $\gamma(\theta)$ data in (82Se,g θ) and band placement.
5118 9	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5196 5	1/2+	C		J π : L=0 in (³ He,d).
5233 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5316 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5347 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5480.8 ^a 5	(23/2+)	I J		J π : Based on one $\gamma(\theta)$ data in (82Se,X γ) and band placement.
5491 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5542 5	(1/2+) and (3/2+, 5/2+)	C		J π : L=(0+2) in (³ He,d).
5634 7	1/2+	C		J π : L=0 in (³ He,d).
5750 5	1/2+	C		J π : L=0 in (³ He,d).
5790.0 11		J		
5802 5	(1/2+) and (3/2+, 5/2+)	C		J π : L=(0+2) in (³ He,d).
5845 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5884 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
5978 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6018 5	1/2+	C		J π : L=0 in (³ He,d).
6089 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6176 5	1/2+	C		J π : L=0 in (³ He,d).
6206 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6307 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6345.9 11		J		
6375 5	(1/2+) and (3/2+, 5/2+)	C		J π : L=(0+2) in (³ He,d).
6468 5	1/2+	C		J π : L=0 in (³ He,d).
6512 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6548 5	1/2+	C		J π : L=0 in (³ He,d).
6565.5 ^a 6		I J		
6618 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6652 5	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6744 10	3/2+, 5/2+	C		J π : L=2 in (³ He,d).
6791 9	(1/2+) and (3/2+, 5/2+)	C		J π : L=(0+2) in (³ He,d).
6821.3 ^a 6		I J		
6838 5	1/2+	C		J π : L=0 in (³ He,d).
6989 5	1/2+	C		J π : L=0 in (³ He,d).
7242.1 9		J		
13969	5/2+ [@]	B	36.0 keV	J π : isobaric analog to the 5/2+ ground state in ⁸⁷ Kr.
14491	1/2+ [@]	B	77.0 keV	J π : L=0 in (p,p') IAR.
15447	3/2+, 5/2+ [@]	B	49.6 keV	J π : L=2 in (p,p') IAR.

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Adopted Levels, Gammas (continued)
⁸⁷Rb Levels (continued)

E(level) ^{†‡}	J π	XREF	T _{1/2}	Comments
15855	3/2+, 5/2+ [@]	B	30.0 keV	J π : L=2 in (p,p') IAR.
15969	3/2+, 5/2+ [@]	B	36.0 keV	J π : L=2 in (p,p') IAR.
16041	1/2+ [@]	B	60.0 keV	J π : L=0 in (p,p') IAR.
16084	3/2+, 5/2+ [@]	B	62.0 keV	J π : L=2 in (p,p') IAR.
16241	9/2-, 11/2- [@]	B	45.0 keV	J π : L=5 in (p,p') IAR.
16513	7/2+ [@]	B	30.0 keV	J π : isobaric analog to the 2519 level in ⁸⁷ Kr (J π =7/2+).
16763	3/2+, 5/2+ [@]	B	65.0 keV	J π : L=2 in (p,p') IAR.
16884	3/2+, 5/2+ [@]	B	65.0 keV	J π : L=2 in (p,p') IAR.
16995	5/2-, 7/2- [@]	B	35.0 keV	J π : L=3 in (p,p') IAR.
17194	1/2+ [@]	B	70.0 keV	J π : L=0 in (p,p') IAR.
17514	3/2+, 5/2+ [@]	B	38.0 keV	J π : L=2 in (p,p') IAR.

[†] From least-squares fit to γ energies.

[‡] Questionable level at 1999 keV from (n,n' γ) has been omitted.

[§] From ⁸⁷Rb(p,p').

[#] Weighted average from (³He,d) and ⁸⁷Rb(p,p').

[@] The assignment of isobaric analogs in ⁸⁷Kr is confirmed by the agreement of spectroscopic factors in ⁸⁶Kr(p,p') and ⁸⁶Kr(d,p).

[&] J π =(1/2-, 3/2-) and 3/2+, 5/2+ from L=(1)+2 in (³He,d).

^a (A): Yrast sequence.

 $\gamma(^{87}\text{Rb})$

E(level)	E $\gamma^{\dagger\dagger}$	I $\gamma^{\S}$	Mult.	δ	α	Comments
402.588	402.588 12	100	M1+E2	-0.24 +9-12	0.00411 6	Mult., δ : from Coulomb excitation. B(M1)(W.u.)=0.0042 +6I-23; B(E2)(W.u.)=1.63 15.
845.44	845.43 4	100	M1		7.30 $\times 10^{-4}$	Mult.: Dominant M1 character interpreted as proton spin flip from 2p _{1/2} to 2p _{3/2} . B(M1)(W.u.)=0.36 4; B(E2)(W.u.)>300. B(E2)(W.u.): Limit from RUL, which leads to $\delta < 1.1$.
1349.36	946.69 13	100				
1389.78	987.2# 2	24#				
	1389.77 8	100				
1463.00	1060.4# 2	15#	[E2]		4.68 $\times 10^{-4}$ 7	B(E2)(W.u.)=11 +4-3.
	1463.0# 2	100#				
1577.9	1175.3# 3	100#c	M2		8.04 $\times 10^{-4}$	Mult.: Deduced from half-life (1995Ka18). B(M2)(W.u.)=0.103 18.
	1578.0 5	14 ^c 1	[E3]		4.08 $\times 10^{-4}$	B(E3)(W.u.)=2.3 5.
1578.05	1175.40@ 8	100 3				
	1578.03@ 14	11.7 9				
1740.57	894.2# 8	2#a				
	1337.99 7	31.1 17				
	1740.54 7	100 2				
1950.0	1547.4# 3	100#				
2014	2014	100				
2284	1881	49 9				
	2284	100 9				
2378.36	1975 1	43 9				Only observed in ($\gamma\gamma'$) from 2002Ka25.
	2378.5@ 3	100 9				
2398	1553 1	8 2				Only observed in ($\gamma\gamma'$) from 2002Ka25.
	1995 1	11 1				Only observed in ($\gamma\gamma'$) from 2002Ka25.
	2398 1	100 2				Only observed in ($\gamma\gamma'$) from 2002Ka25.
2414.43	673.83@ 8	65.6 17				
	836.37@ 6	26.7 7				
	2011.88@ 10	100 4				
2554.82	814.25@ 6	1.77 6				
	976.5@ 3	0.61 4				
	2554.8@ 2	100 5				
2811.2	1461.3@ 6	15.4 16				

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Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Rb})$ (continued)

E(level)	$E_{\gamma}^{\dagger \ddagger}$	$I_{\gamma}^{\S}$	Mult.	α	Comments
2811.2	2408.5@ 2	71 6			
	2811.4@ 2	100 5			
2960.62	582.3@ 2	0.9 3			
	1382.55@ 6	7.3 3			
	1611.18@ 14	2.7 4			
	2558.1@ 2	100 5			
	2961.2@ 8	1.8 5			
3001.2	1423.3& 4	100 ^b 20			
3005	3005 1	100			
3043	3043	100			
3055.15	2652.5@ 4	28 5			
	3055.1@ 3	100 6			
3060	3060	100	[E1]	1.29×10^{-3} 2	B(E2)(W.u.)=0.00049 5.
3098.5	1520.0 5	100			
3308.49	894.02@ 13	10.1 7			
	3308.5@ 2	100 6			
3338.1	1760 1	100 21			I_{γ} : From $(\gamma\gamma')$.
	3338 1	52 21			I_{γ} : From $(\gamma\gamma')$.
3409.1	408.0 5	11.1 ^b 22			
	1831.1 1	100 ^b 21			
3644.1	235.0 1	100 ^b 20	D+Q		
3702	2312 1	8 3			E_{γ} : Only in $(\gamma\gamma')$.
	3702 1	100 3			E_{γ} : Only in $(\gamma\gamma')$.
3767	3767 1	100			E_{γ} : Only in $(\gamma\gamma')$.
3837	3837	100	[E1]	1.64×10^{-3} 3	E_{γ} : Only in $(\gamma\gamma')$.
					B(E1)(W.u.)=0.00156 +12-6.
4090.0	1088.8 10	100 32			E_{γ} : Only in $^{176}\text{Yb}(^{23}\text{Na}, x\gamma)$ deep inelastic.
4150.6	506.5& 1	100 ^c 10	D(+Q)		
	1052.1 10	8 ^c 2			E only in $^{176}\text{Yb}(^{23}\text{Na}, X\gamma)$ deep inelastic.
4314.1	224.1 10	<100			
4854.7	704.1& 2	100 ^b 19	(D+Q)		
	1210.8& 4	27 ^b 4			
5026.4	171.7& 1	100 ^c 27	(D+Q)		
	875.9& 4	32 ^c 9			
5480.8	454.4& 3	100 ^c 15	(D+Q)		
5790.0	935.3 10	100 32			
6345.9	865.1 10	100 20			
6565.5	1084.6& 4	100 ^c 34			
	1539.2 10	50 33			E Seen only in $^{176}\text{Yb}(^{23}\text{Na}, X\gamma)$.
6821.3	255.8 5	100 ^b 20			
	1340.5 5	100 ^b 20			
7242.1	420.8 6	100 40			

[†] Weighted average from β^- decay and $(n, n'\gamma)$, unless indicated otherwise.

[‡] γ rays which are reported in only one decay mode, such as $(n, n'\gamma)$ or β^- decay, and are reported as questionable are omitted.

[§] From β^- decay, unless indicated otherwise.

From only $(n, n'\gamma)$.

@ From β^- decay.

& Weighted average from 2005Fo05 and 2004Zh27.

^a Note that a transition with $E_{\gamma}=894.02$ 13 and $I_{\gamma}(894)/I_{\gamma}(1740)=0.0221$ 15 is seen in β^- decay, but is placed from the 3308 level.

Note that energy of the β^- does not fit the 1740 level. Also the 3308 level is not populated in $(n, n'\gamma)$, so the transition can not be placed from that level.

^b From $^{192}\text{Os}(^{82}\text{Se}, x\text{G})$ deep inelastic.

^c From $^{176}\text{Yb}(^{23}\text{Na}, x\text{G})$ deep inelastic.

Adopted Levels, Gammas (continued)

⁸⁷Kr β⁻ Decay 1971Sh01,1973BIZH,1973GeYV

Parent ⁸⁷Kr: E=0.0; Jπ=5/2⁺; T_{1/2}=76.3 min 5; Q(g.s.)=3888.27 25; %β⁻ decay=100.

⁸⁷Rb Levels

The level scheme is that proposed by 1971Sh01, with one additional level at 1389 keV from 1973BIZH.

E(level) [†]	Jπ [‡]	T _{1/2}	E(level) [†]	Jπ [‡]
0.0	3/2 ⁻	4.97×10 ¹⁰ y 3	2378.38 18	
402.588 12	5/2 ⁻		2414.44 6	(3/2 ⁻)
845.44 4	(1/2 ⁻)		2554.82 7	3/2 ⁺ , 5/2 ⁺
1349.36 10			2811.25 14	3/2 ⁺ , 5/2 ⁺
1389.88 12	(3/2 ⁻)		2960.62 7	(3/2, 5/2) ⁺
1578.05 6	1/2 ⁻ , 3/2 ⁻		3055.15 24	3/2, 5/2, 7/2(-)
1740.58 5	(3/2, 5/2) ⁻		3308.49 12	3/2 ⁺ , 5/2 ⁺

[†] From least-squares fit to γ-ray energies.

[‡] From ⁸⁷Rb Adopted Levels.

β⁻ radiations

Eβ ^{-†}	E(level)	Iβ ^{-‡§}	Log ft	Comments
(579.8 3)	3308.49	0.49 4	6.33 4	Iβ ⁻ : other: 0.91 (1973Wo01); this value may include some scattered electrons or it may indicate additional γ rays from this level.
(833.1 4)	3055.15	0.108 9	7.55 4	
(927.6 3)	2960.62	4.4 4	6.11 4	
(1077.0 3)	2811.25	0.60 4	7.22 3	Iβ ⁻ : other: 0.42 (1973Wo01).
(1333.4 3)	2554.82	9.4 7	6.38 4	Iβ ⁻ : other: 8.09 (1973Wo01).
(1473.8 3)	2414.44	5.5 3	6.788 24	Iβ ⁻ : other: 5.07 (1973Wo01).
(1509.9 3)	2378.38	0.060 12	8.79 9	
(2147.7 3)	1740.58	0.62 9	8.40 7	
(2310.2 3)	1578.05	0.12 5	9.24 18	
(2498.4 3)	1389.88	0.119 8	9.39 3	
(3042.8 3)	845.44	7.3 4	9.371 ^{1u} 24	
(3485.7 3)	402.588	41 3	7.47 4	Iβ ⁻ : other: 42.9 (1973Wo01).
(3888.27 25)	0.0	30.5 22	7.81 4	

[†] β⁻ energies were measured with σ=50 keV to 100 keV by 1969Bo02. For other measurements, see 1969On01 and 1969Ly01.

[‡] A measurement in a magnetic spectrometer and detailed analysis of the β⁻ spectrum was carried out by 1973Wo01. The decomposition of this spectrum was done without intensity constraints from the decay scheme and with constraints based on several previous decay schemes. Their results which differ significantly from those from the intensity balances are noted.

[§] The value for the decay to the ground state, 30.5, is from 1973Wo01 and those for the excited levels are from the γ-ray intensity balances. Where they differ significantly, the values recommended by 1973Wo01 are given in comments. The analysis of 1973Wo01 does not include the level at 1389 and it does not give values for branches of less than 0.4%.

[#] The β strength function has been reported by 1973Jo02 in graphical form. These data support the absence of any strong β branches to levels between 900 and 1500 keV.

@ Absolute intensity per 100 decays.

γ(⁸⁷Rb)

γ-ray data for about 30 γ's were measured with good accuracy by 1971Sh01, 1973BIZH, and 1973GeYV. They are in good agreement even for very weak transitions. γγ-coincidences (Ge(Li)) were measured by 1971Sh01. Shorter sets of γ data are given by 1967Ho17, 1969Bo02, 1969Ly01, 1969On01, and 1 γ ray by 1979Bo26.

Iγ normalization: calculated to give 100% feeding of ground state with direct β⁻ feeding of 30.5% 22 (1973Wo01).

Eγ [†]	E(level)	Iγ ^{†@}	Mult.	δ	α	Comments
^x 129.4 [#] 3		0.09 2				
402.588 12	402.588	100 4	M1+E2	-0.24 12	0.00411 18	Eγ: From 1979Bo26. Others: 402.7 3, (1971Sh01), 402.60 10, and 402.578 20, (1973GeYV). δ: from ⁸⁷ Rb Adopted Gammas.
^x 510.78 [‡] 14		0.16 4				
582.32 [‡] 21	2960.62	0.07 2				
673.83 8	2414.44	3.81 10				
814.25 6	2554.82	0.33 2				
836.38 5	2414.44	1.56 4				

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$\gamma(^{87}\text{Rb})$ (continued)

$E\gamma^\dagger$	E(level)	$I\gamma^\dagger@$	Comments
845.44 4	845.44	14.8 4	
894.02 13	3308.49	0.092 7	$E\gamma$: uncertainty in energy of this weak γ seems to be underestimated by 1973B1ZH and was increased by the evaluator from 0.1 to 0.2 keV.
$\times$ 901.5# 3		0.053 9	
946.69 13	1349.36	0.26 1	
976.14 12	2554.82	0.113 8	
$\times$ 1063.2 $\frac{3}{2}$ 4		0.054 12	
1175.41 7	1578.05	2.23 8	
1338.00 7	1740.58	1.28 7	
1382.55 7	2960.62	0.58 2	
1389.87 12	1389.88	0.24 1	
1461.3# 7	2811.25	0.10 1	
1531.2#& 4	2378.38	0.72 11	$E\gamma$: from 1971Sh01, but is a poor fit and not resolved by 1973GeYV from the double-escape peak of the 2554 γ . Not included in the least-squares fit which gives $E\gamma=1532.96$ 12 for this transition.
1578.03 14	1578.05	0.26 2	
1611.18 14	2960.62	0.23 3	
1740.51 7	1740.58	4.11 9	
$\times$ 1842.61 $\frac{5}{2}$ 23		0.28 2	
2011.88 10	2414.44	5.81 23	
2378.5 3	2378.38	0.19 1	
2408.46 15	2811.25	0.46 4	
2554.75 25	2554.82	18.6 9	
2558.08 19	2960.62	8.0 5	
2652.48 38	3055.15	0.047 8	
2811.36 20	2811.25	0.65 3	
2961.2 $\frac{3}{2}$ 8	2960.62	0.14 4	
3055.1 3	3055.15	0.162 13	
3308.5 2	3308.49	0.90 5	
$\times$ 3704.6 $\frac{3}{2}$ # 10		0.03 1	

^x γ ray not placed in level scheme.

^{87}Sr ϵ Decay (2.815 h) 1969Zo04

Parent ^{87}Sr : $E=388.533\ 3$; $J\pi=1/2^-$; $T_{1/2}=2.815\ \text{h}\ 12$; $Q(\text{g.s.})=-282.2\ 11$; $\%\epsilon\ \text{decay}=0.30\ 8$.

Measured X_K with Si(Li) detector and from ratio of Rb $X_{K\alpha}$ to Sr $X_{K\alpha}$ determined a value of 0.30% 8 for the ϵ branch from the ^{87}Sr isomer to the ^{87}Rb ground state. Other: 0.65% 25 (1960Su06). The remaining decay is via an isomeric decay to the ^{87}Sr ground state.

 ^{87}Rb Levels

<u>E(level)</u>	<u>$J\pi$</u>
0.0	$3/2^-$

 β^+, ϵ Data

<u>$E\epsilon$</u>	<u>E(level)</u>	<u>$I\epsilon^\dagger$</u>	<u>Log ft</u>
(106.3 11)	0.0	0.30 8	4.40 12

† Absolute intensity per 100 decays.

 $^{12}\text{C}(^{86}\text{Kr}, X\gamma)$ 2013St05

$E=2.85/u$ MeV from the UNILAC accelerator of the GSI Helmholtzzentrum fuer Schwerionenforschung. The target consisted of a layer of 0.33 mg/cm² ^{nat}C followed by 10.9 mg/cm² ^{nat}Gd , 1.7 mg/cm² ^{nat}Ta , and 6.82 mg/cm² ^{nat}Cu . The goal of the experiment was to Coulomb excite ^{86}Kr and ^{90}Sr . However, ^{87}Rb was also produced, the authors assume by a proton pickup from ^{12}C .

 ^{87}Rb Levels

<u>E(level)†</u>	<u>$J\pi^\ddagger$</u>	<u>$T_{1/2}$</u>	<u>Comments</u>
0.0	$3/2^-$		
402.586 10	$5/2^-$		
845.44 4	$1/2^-$	101 fs +9-11	$T_{1/2}$: From DSAM.
1349.36 10			
1577.9 3	$9/2^+$		

† From Adopted Levels.

‡ From Adopted Levels.

 $\gamma(^{87}\text{Rb})$

<u>$E\gamma^\dagger$</u>	<u>E(level)</u>
402.6	402.586
845.4	845.44
946.7	1349.36
1175.3 3	1577.9

† As given by 2013St05.

$^{12}\text{C}(^{86}\text{Kr}, \text{X}\gamma)$ 2013St05 (continued)Level Scheme **$^{86}\text{Kr}(\text{p}, \text{p}') \text{ IAR}$ 1972Ho15, 1972Ho16**

1969RiZW: $E=4.76\text{--}10.1$ MeV, $p'(\theta)$ measured.

1972Ho15: $E=4.76\text{--}10.1$ MeV, FWHM = 35 keV, $\theta=95^\circ\text{--}165^\circ$. Measured excitation functions for 14 resonances, which are identified as analogs of levels in ^{87}Kr . Deduced L-values, total and partial widths, and spectroscopic factors.

The results are in agreement with $^{86}\text{Kr}(\text{d}, \text{p})$ studies.

1972Ho16: measured $\sigma(\theta)$ at 9 of the 14 IAR for proton decay to inelastic channels.

1972Sp02: related model calculations.

 ^{87}Rb Levels

$E(\text{level})^\dagger$	$T_{1/2}^\ddagger$	$L^\ddagger$	$S^\ddagger_\dagger$	Comments
$\text{S}(\text{p})+5348$	36.0 keV	2	0.62	E(level): isobaric analog of ^{87}Kr ground state, confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+5870$	77.0 keV	0	0.62	E(level): isobaric analog of 532 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+6826$	49.6 keV	2	0.22, 0.18	S: $S=0.22$ for $J^\pi=3/2^+$ or $S=0.18$ for $J^\pi=5/2^+$. E(level): isobaric analog of 1476 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7234$	30.0 keV	2	0.02	E(level): isobaric analog of 1881 level in ^{87}Kr , consistent with tentative spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7348$	36.0 keV	2	0.10	E(level): isobaric analog of 2004 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7420$	60.0 keV	0	0.20	E(level): isobaric analog of 2087 level in ^{87}Kr , consistent with tentative spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7463$	62.0 keV	2	0.50	E(level): isobaric analog of 2123 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7620$	45.0 keV	5		E(level): isobaric analog of 2259 level in ^{87}Kr , consistent with tentative spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+7892$	30.0 keV	4	0.60	E(level): isobaric analog of 2520 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+8142$	65.0 keV	2	0.18	E(level): unresolved doublet. E(level): isobaric analog of 2787 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+8263$	65.0 keV	2	0.01	
$\text{S}(\text{p})+8374$	35.0 keV	3	0.03	E(level): weak resonance. E(level): isobaric analog of 3020 level in ^{87}Kr , confirmed by agreement with spectroscopic factor in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+8573$	70.0 keV	0	0.11	E(level): isobaric analog of 3218 level in ^{87}Kr , consistent with one of the tentative spectroscopic factors in $^{86}\text{Kr}(\text{d}, \text{p})$.
$\text{S}(\text{p})+8893$	38.0 keV	2	0.03	
$\text{S}(\text{p})+9250^\#$		(0)		
$\text{S}(\text{p})+9639^\#$				

† c.m. energies, $\text{S}(\text{p})=8621.10$ keV I .

‡ From 1972Ho15, except for $\text{s}(\text{p})+9250$ resonance; data analysis by an energy-averaged scattering matrix method (1969Za03).

⁸⁶Kr(p,p') IAR 1972Ho15,1972Ho16 (continued)

⁸⁷Rb Levels (continued)

§ Defined as the square of the coupling coefficient for coupling to the target gs. Except for the 5348 and 6826 resonances, for the calculation of S, J^π=3/2+, 7/2-, 7/2+, and 11/2- is assumed for the resonances with L=2, 3, 4, and 5, respectively.

From 1969RiZW and 1972Ho16.

⁸⁶Kr(³He,d) 1975Me18

E=18 MeV, FWHM=20 keV, θ=7°-41°, multi-angle spectrograph, measured σ(θ), DWBA analysis.

⁸⁷Rb Levels

E(level) [†]	L [‡]	(2J+1)C ² S [‡]	Comments
0.0	1	1.36	
399 5	3	1.18	
846 5	1	2.04	
1468 5	1	0.031	E(level): 1463 in Adopted Levels.
1578# 5	4	9.87	
1893 10	1	0.023	
2396 5	1	0.17	
2548 7	2	0.11	
2731 5	4	0.14	
2810 5	2	0.024	
2973 5	4	0.13	
3060 5	0	0.036	
3309 5	2	0.25	
3335 8	1	0.058	
3692§ 7	1+(4)	0.016+0.12	
3764 5	1	0.021	
3834 5	0	0.024	
3973 5	2	0.24	
4146 5	2	0.021	
4266§ 5	(1)+2	0.014+0.031	
4379 5	2	0.39	
4492 5	2	0.19	
4681 5	1	0.034	
4862§ 5	(0+2)	0.003+0.008	
4941 5	0	0.012	
5118 9	2	0.12	
5196 5	0	0.056	
5233 5	2	0.11	
5316 5	2	0.089	
5347 5	2	0.13	
5491 5	2	0.43	
5542§ 5	(0+2)	0.026+0.17	
5634 7	0	0.17	
5750 5	0	0.044	
5802§ 5	(0+2)	0.016+0.081	
5845 5	2	0.056	
5884 5	2	0.051	
5978 5	2	0.13	
6018 5	0	0.076	
6089 5	2	0.073	
6176 5	0	0.030	
6206 5	2	0.071	
6307 5	2	0.085	
6375§ 5	(0+2)	0.022+0.083	
6468 5	0	0.034	
6512 5	2	0.086	
6548 5	0	0.056	
6618 5	2	0.092	
6652 5	2	0.12	
6744 10	2	0.10	
6791§ 9	(0+2)	0.022+0.075	

Continued on next page (footnotes at end of table)

$^{86}\text{Kr}(^3\text{He},d)$ 1975Me18 (continued) **^{87}Rb Levels (continued)**

E(level) [†]	L [‡]	(2J+1)C ² S [‡]
6838 5	0	0.056
6989 5	0	0.053

[†] Uncertainties of 5 keV are from general statement.

[‡] From DWBA analysis of $\sigma(\theta)$. For L=1, 2, and 4, $2p_{1/2}$, $2d_{5/2}$, and $1g_{9/2}$ configurations were assumed, unless the spin is known otherwise. The exceptions are for J=3/2 for the ground state and the J(399 level), for L=3, J is taken as 5/2.

§ Doublet.

Level appears to contain most of the $g_{9/2}$ single-particle proton strength.

 $^{87}\text{Rb}(\gamma,\gamma')$ 2002Ka25

$E_{\text{max}}=4.0$ MeV from bremsstrahlung spectrum. Measured $E\gamma$, $I\gamma$, $\gamma\gamma(0)$, cross sections using three high-resolution HPGe detectors. Deduced widths and transition rates.

 ^{87}Rb Levels

E(level) [§]	$J\pi^{\dagger}$	Γ	Integrated cross section in eVb	Comments
0.0	3/2-			
403	5/2-			
845	(1/2)- [‡]	0.0048 eV 6	12.9 17	$g\Gamma_0^2/\Gamma=0.00239$ eV 32. B(M1) $\uparrow=0.34$ 5. Γ : For $\Gamma_0/\Gamma=1.0$.
1390	(3/2)-	0.0024 eV 5	3.1 7	$g\Gamma_0^2/\Gamma=0.00157$ eV 33. Γ : For $\Gamma_0/\Gamma=0.81$ using branching from the Adopted Levels. No uncertainty is available for this branching, so the uncertainty quoted for Γ is a lower limit.
1463	(1/2)-	0.0022 eV 8	1.5 6	B(M1) $\uparrow=0.062$ 13. $g\Gamma_0^2/\Gamma=0.00084$ eV 31. Γ : For $\Gamma_0/\Gamma=0.87$ using branching from the Adopted Levels. No uncertainty is available for this branching, so the uncertainty quoted for Γ is a lower limit.
1578	1/2-, 3/2-		0.6 4	B(M1) $\uparrow=0.027$ 10. $g\Gamma_0^2/\Gamma=0.00042$ eV 28.
1741	(3/2, 5/2)-		13.6 10	B(M1) $\uparrow=0.09$ 6. $g\Gamma_0^2/\Gamma=0.0107$ eV 8.
2014	(1/2, 3/2, 5/2)- [‡]		1.0 3	B(M1) $\uparrow=0.26$ 2. $g\Gamma_0^2/\Gamma=0.0011$ eV 4.
2284	(1/2, 3/2, 5/2)- [‡]		3.6 4	B(M1) $\uparrow=0.011$ 4. $g\Gamma_0^2/\Gamma=0.0049$ eV 5.
2378	(1/2, 3/2, 5/2) [‡]		4.0 4	B(M1) $\uparrow=0.054$ 5. $g\Gamma_0^2/\Gamma=0.0059$ eV 6.
2398	1/2-, 3/2-		29.0 17	$g\Gamma_0^2/\Gamma=0.0434$ eV 26. B(M1) $\uparrow=0.32$ 2.
2555	3/2+, 5/2+		12.1 8	$g\Gamma_0^2/\Gamma=0.0206$ eV 14. B(E1) $\uparrow=12.1\times 10^{-6}$ 8.
2811	3/2+, 5/2+		1.14 21	$g\Gamma_0^2/\Gamma=0.0016$ eV 4. B(E1) $\uparrow=1.3\times 10^{-6}$ 3.
3005	(1/2, 3/2, 5/2)+ [‡]		4.6 4	$g\Gamma_0^2/\Gamma=0.0108$ eV 10. B(E1) $\uparrow=3.8\times 10^{-6}$ 4.
3043	(1/2, 3/2, 5/2) [‡]		0.37 12	$g\Gamma_0^2/\Gamma=0.00089$ eV 29.
3055	(3/2, 5/2, 7/2-)		0.66 13	$g\Gamma_0^2/\Gamma=0.0016$ eV 3. B(M1) $\uparrow=0.0062$ 12.
3060	1/2+	0.0187 eV 17	3.9 4	$g\Gamma_0^2/\Gamma=0.0094$ eV 9. B(E1) $\uparrow=3.1\times 10^{-6}$ 3. Γ : For $\Gamma_0/\Gamma=1.0$.

Continued on next page (footnotes at end of table)

$^{87}\text{Rb}(\gamma, \gamma')$ 2002Ka25 (continued) ^{87}Rb Levels (continued)

E(level) [§]	$J\pi^{\dagger}$	Γ	Integrated cross section in eVb	Comments
3309	$3/2+, 5/2+$		9.5 7	$g\Gamma_0^2/\Gamma=0.0270$ eV 21. $B(E1)\uparrow=7.8\times 10^{-6}$ 6.
3338	$1/2-, 3/2-$		0.94 18	$g\Gamma_0^2/\Gamma=0.0027$ eV 5. $B(M1)\uparrow=0.019$ 3.
3702	$(1/2-, 3/2-, 5/2-)^{\ddagger}$		31.5 22	$g\Gamma_0^2/\Gamma=0.113$ eV 15. $B(M1)\uparrow=0.21$ 1.
3767	$1/2-, 3/2-$		1.2 4	$g\Gamma_0^2/\Gamma=0.0046$ eV 13. $B(M1)\uparrow=0.0074$ 21.
3837	$1/2+$	0.117 eV 11	15.4 22	$g\Gamma_0^2/\Gamma=0.059$ eV 9. $B(E1)\uparrow=10.0\times 10^{-6}$ 15. Γ : For $\Gamma_0/\Gamma=1.0$.

[†] From Adopted Levels for ^{87}Rb unless indicated otherwise.

[‡] From $\gamma\gamma(\theta)$.

[§] Uncertainties are reported as less than 1 keV. Therefore, because of the reported precision, 1 keV is assigned when the level is used in the Adopted Levels.

 $\gamma(^{87}\text{Rb})$

E(level)	E_{γ}	$I_{\gamma}^{\dagger}$	Comments
403	403	100	
845	845	100	
1390	987		
	1390		
1463	1060		
	1463		
1578	1578		
1741	1741		
2014	2014	100	
2284	1881	33 6	
	2284	67 6	
2378	1975	30 6	
	2378	70 6	
2398	1553	7 2	
	1995	8 1	
	2398	85 2	
2555	2555		
2811	2811		
3005	3005	100	E_{γ} : superimposed by a ^{27}Al peak.
3043	3043	100	
3055	3055		
3060	3060	100	
3309	3309		
3338	1760	66 14	
	3338	34 14	
3702	2312	7 3	
	3702	93 3	
3767	3767	100	
3837	3837	100	

[†] % branchings from each level as measured by 2002Ka25.

$^{87}\text{Rb}(\gamma, \gamma)$ 2002Ka25 (continued)

Level Scheme

Intensities: % photon branching from each level

$^{87}\text{Rb}(n, n'\gamma)$ 1980Ba29

Data are from 1980Ba29, $E(n)=0.55-2.1$ MeV, γ excitation functions measured and compared with Hauser-Feshbach calculations.

1972To16: $E(n)=0.3-2.2$ MeV, measured neutrons (BF3-detector) and γ 's. γ 's above 1800 keV were not analyzed because of interference with background, ^{85}Rb lines also present.

1973Ba25: $E(n)=0.12-1.91$ MeV, neutron time-of-flight spectrometer.

 ^{87}Rb Levels

E(level)	J^π	Comments
0.0	$3/2^-$	
402.56 6	$5/2^-$	
845.42 10	$(1/2)^-$	J^π : The authors state that the 845 keV γ excitation function leads to a better fit for $1/2^-$ than for $3/2^-$.
1349.6? 10		
1389.72 9	$(3/2)^-$	J^π : $L(p,p')=2$ allows $1/2^-$ to $7/2^-$. γ excitation rules out $1/2^-$, $5/2^-$, and $7/2^-$.
1462.99 15	$(1/2)^-$	J^π : $L(p,p')=2$ allows $1/2^-$ to $7/2^-$. $L(^3\text{He},d)=1$ limits to $1/2^-$, $3/2^-$ and the Hauser-Feshbach fit in 1980Ba29 narrows this to $1/2^-$.
1577.6 3	$9/2^+$	J^π : J^π is fit best by $J^\pi=11/2^+$ in the Hauser-Feshbach analysis, but $J^\pi=9/2^+$ is also allowed. Note also that the deexciting 1578 γ may be from the $1/2^-$, $3/2^-$ level at 1578 keV, and the 1175 γ is the one measured, not the 1578 γ .
1740.60 17	$(3/2)^-$	J^π : $L(p,p')=2$ allows $1/2^-$ to $7/2^-$. γ excitation rules out $1/2^-$, $5/2^-$, and $7/2^-$.
1950.0 3	$(1/2)^{\ddagger}$	
1999.3? 7	$(1/2)^{\ddagger}$	

$\dagger$ From ^{87}Rb Adopted Levels, unless otherwise noted.

$\ddagger$ From comparison of γ excitation functions with Hauser-Feshbach calculations.

⁸⁷Rb(p,p') 1975Hu11 (continued)

⁸⁷Rb Levels (continued)

E(level) [†]	L	BL [‡]	E(level) [†]	L	BL [‡]	E(level) [†]	L	BL [‡]
3618 8	5	0.020	3910 8	5	0.016	4094 8		
3647 8			3958 8	4	0.022	4106 8	4	0.018
3685 8	3+(5) #	0.028	3976 8			4153 8	2	0.037
3707 8	4	0.033	4014 8			4209 8	4	0.032
3744 8			4029 8	4	0.019			
3773 § 8			4057 8					
3824 8	2	0.018	4068 8					

[†] From authors' general statement, the uncertainties ranges from 3 keV for the low-lying levels to 8 keV for the weakly excited high-lying levels. The individual uncertainties are assigned by evaluator.

[‡] BL[‡] is defined as $d\sigma/d\omega(\exp)/[d\sigma/d\omega(\text{DWBA})]^{1/2}$.

§ Probably unresolved doublet.

Authors suggest L=3 at forward angles, but between 50° and 90° the cross sections are too high, while L=3+5 gives a good fit.

Coulomb Excitation 1973Bo24,1964Al28

1956Fa29: E(α)=4.4 MeV.

1959Al04: E(¹⁴N)=16-26 MeV and E(²⁰Ne)=23 MeV.

1964Al28: E(¹⁴N)=16.1 MeV, measured γ(θ).

1973Bo24: E(³⁵Cl)=60 MeV, measured excitation function, Ge(Li) detector.

⁸⁷Rb Levels

E(level) [†]	Jπ [‡]	T _{1/2}	Comments
0.0	3/2-		
402.6 2	5/2-	0.078 ns +11-60	B(E2) [†] =0.0056 5. Jπ: A ₂ =-0.148 27 consistent only with J=5/2 (1964Al28). T _{1/2} : from B(E2)=0.0056 5 and δ(402)=-0.24 +9-12, the level half-life is 0.080 ns +11-60. B(E2) [†] : weighted average of 0.0054 6 (1973Bo24), 0.0058 12 (1956Fa29), and 0.0073 25 (1959Al04, with ΔE _γ from a general comment).

[†] Nominal value from ⁸⁷Rb Adopted Levels.

[‡] From ⁸⁷Rb Adopted Levels.

γ(⁸⁷Rb)

E(level)	E _γ	I _γ	Mult.	δ	α	Comments
402.6	402.58 2	100	M1+E2	-0.24 +9-12	0.00411 18	δ: from a ₂ =-0.148 27 from γ(θ) (1964Al28). 1964Al28 also report another δ=-1.70 +35-40, but rule it out because the resulting B(M1)(W.u.)=8x10 ⁻⁵ is considered to be unacceptably low.

Level Scheme

Intensity: % photon
branching from each
level

⁸⁸Sr(d,³He) 1972Ha24,1973Co28,1972NeZR

1967Ka15: E(d)=21 MeV, $\theta=17.5^\circ-52.5^\circ$. Si surface-barrier detectors arranged in $\Delta E-E$ system.

1971NeZN: E(d)=29 MeV, $\theta=20^\circ-45^\circ$. Magnetic spectrograph.

1972Ha24: E(d)=35 MeV, $\theta=12^\circ-60^\circ$, $\Delta E=20-30$ keV. Si detectors in $\Delta E-E$ arrangement. 1972NeZR: E(d)=29 MeV, $\theta=20^\circ-45^\circ$; same authors as 1971NeZN. 1973Co28: E(d)=28 MeV, $\theta=8^\circ-50^\circ$, FWHM ≈ 50 keV. 1987Li12: E(d)=27.9 MeV, $\theta=0^\circ-50^\circ$.

⁸⁷Rb Levels

E(level) [†]	L [§]	C ² S [#]	Comments
0.0	1	3.8	
403	3	6.0	
846	1	0.40	
1580	1	≈ 0.15	L: 1972Ha24 give L=1 with a good fit to angular distribution, 1973Co28 give L=1+3 with a poor fit, although their datapoints are still consistent with L=1, although the situation there is ambiguous. 1972NeZR give L=4, and 1987Li12 give L=(4). But the level is a doublet in ⁸⁷ Rb Adopted Levels with $J^\pi=1/2-, 3/2-$ at 1578.01 and $J^\pi=(9/2)+$ at 1578.10. C ² S: C ² S=0.15 for L=1 from 1971NeZN should be considered approximate since other values in 1971NeZN were revised in 1971NeZR. Also, C ² S=0.22 for L=1 (1972Ha24) and C ² S ≤ 0.35 for L=1 (1973Co28). E(level): Uncertainty from 1972Ha24.
2420 [@]	(1)	0.22	
2530 [@]	1	0.27	

[†] From 1972Ha24, unless indicated otherwise.

[§] The L values agree in all measurements, except for the 1580 level as noted.

[#] From 1972NeZR, unless indicated otherwise, normalized to give C²S=6.0 for the 403 level. The values agree with those from the other measurements, except for the 1580 level. 1972NeZR assume $J^\pi=3/2-, 5/2-, 1/2-, 9/2+, 1/2-,$ and $1/2-$ for the six levels. 1971NeZN assumed $J^\pi=1/2-$ for the 1580 level.

[@] Observed by 1971NeZN and 1972NeZR, same authors, only.

¹⁷⁶Yb(²³Na,X γ) 2005Fo05

Includes ¹⁷³Yb(²⁴Mg,X γ) and ²⁰⁸Pb(¹⁸O,X γ).

⁸⁷Rb isotope produced in fission of compound nucleus in three independent experiments: 1. ¹⁷³Yb(²⁴Mg,X γ) E=134.5 MeV; 2. ¹⁷⁶Yb(²³Na,X γ) E=129 MeV; 3. ²⁰⁸Pb(¹⁸O,X γ) E=91 MeV.

Measured E γ , I γ , $\gamma\gamma$, fragment- γ coin with the Gammasphere array. For the first experiment, the array consisted of 92 Compton-suppressed large volume HPGe detectors while in the latter two, the number of Ge detectors was increased to 100.

⁸⁷Rb Levels

E(level) ^{†#}	J π [@]	T _{1/2}	Comments
0.0	3/2-		J π : From Adopted Levels.
402.50 19	5/2-		J π : From Adopted Levels.
1578.01 25	9/2+	6 ns 1	T _{1/2} : From Adopted levels. Earlier Configuration, in the literature, was proposed as: 85%[(g _{9/2} ⊗0+)]+14%[(g _{9/2} ⊗2+)]; 2005Fo05 suggest a small admixture of p _{3/2} ⊗3- based upon observation of proposed E3 transition from isomer. Proposed configuration= $\pi g_{9/2} \otimes 2+$. J π : From Adopted Levels.
3001.7 5	(11/2)+		J π : Based on L=5 in (p,p') and transition to 9/2+ See Adopted Levels.
3098.0 5	(11/2, 13/2)+		Proposed configuration= $\pi g_{9/2} \otimes 2+$.
3409.0 4	(13/2+)		Proposed configuration= $\pi g_{9/2} \otimes 2+$.
3643.8 4	(15/2, 17/2+)		Proposed configuration= $\pi g_{9/2} \otimes 4+$. J π : (15/2+) in Adopted Levels.
4090.5 [‡] 12			
4150.1 [‡] 4			
4314.6 [‡] 15			
4854.2 [‡] 5			J π : (19/2+) in Adopted Levels.
5025.7 [‡] 5			
5480.0 [‡] 7			
5789.5 [‡] 11			
6345.1 [‡] 12			
6564.7 [§] 8			
6820.3 [§] 8			

Continued on next page (footnotes at end of table)

$^{176}\text{Yb}(^{23}\text{Na},\text{X}\gamma)$ 2005Fo05 (continued) **^{87}Rb Levels (continued)**E(level)[†]#

7241.1 § 10

[†] Possible origin of states above 3644 level suggested in discussion of 2005Fo05.[‡] Proposed configuration= $\pi g_{9/2} \otimes [5-, 6-, 7- \text{ and/or } \nu g_{9/2}^{-1} d_{5/2}]$.[§] Possible configuration= $[\pi f_{5/2}^{-1} g_{9/2}^2] \otimes [\nu g_{9/2}^{-1} d_{5/2}]$.[#] From least-squares fit to E γ 's (by evaluators).[@] Assignments proposed to levels above 9/2+ isomer based upon comparison with experimental and theoretical results on states energetically comparable in ^{85}Kr and ^{89}Y as well with shell model calculations and suggested coupling configurations. **$\gamma(^{87}\text{Rb})$**

E $\gamma^{\dagger}$	E(level)	I $\gamma^{\ddagger}$	Mult.	α	Comments
171.5 2	5025.7	22 6			
224.1 10	4314.6	<2			
234.8 2	3643.8	55 8			
255.4 6	6820.3	5 2			
402.5 2	402.50	100 §			
407.3 6	3409.0	5 1			
420.8 6	7241.1	5 2			Mult.: transition may be part of sequence of strong M1 transitions, similar to that which is observed above 7 MeV in ^{89}Y .
454.2 5	5480.0	20 3			
506.2 2	4150.1	48 5			
545.9 10	3643.8	3 1			
704.0 2	4854.2	22 6			
865.1 10	6345.1	2.5 5			
876.0 6	5025.7	7 2			
935.3 10	5789.5	2.5 8			
1052.1 10	4150.1	4 1			
1084.4 6	6564.7	6 2			
1088.8 10	4090.5	2.2 7			
1175.5 2	1578.01	77 § 9	M2	8.03×10^{-4} 12	
1210.6 6	4854.2	5 2			
1340.5 6	6820.3	5 2			
1423.7 6	3001.7	8 2			
1520.0 5	3098.0	11 3			
1539.2 10	6564.7	3 1			
1578.0 5	1578.01	11 § 3	[E3]	4.08×10^{-4} 6	E γ : this transition was suggested as depopulating a (1/2,3/2)-state 1578.05 level in the literature. 2005Fo05 note that the two levels at 1578.05 and 1577.9 cannot be resolved based either on energy or the branching ratios (which are almost the same for both levels), however, the assignment of this γ ray to (1/2,3/2)- level seems unlikely as the population of such a non-yrast state in the fission of the compound nuclei is not expected. Mult.: E3 multipolarity proposed for this γ ray as it is seen in coincidence with all the transitions above the isomer.
1831.0 2	3409.0	57 9			

[†] 2005Fo05 quote uncertainties on γ -ray energies as varying from 0.2–0.5 keV for strong transitions and from 0.6–1.0 keV for the weaker ones. Therefore the following uncertainties are assigned: 0.2 keV for I γ >20, 0.5 keV for I γ =10–20, 0.6 keV for I γ =5–10 and 1.0 for I γ <5.[‡] Obtained from $^{176}\text{Yb}(^{23}\text{Na},\text{X}\gamma)$ reaction in second experiment.[§] Obtained from double gate on known transitions of ^{106}Ru complementary fragment from fission of ^{199}Tl in second experiment.

$^{176}\text{Yb}(^{23}\text{Na},\text{X}\gamma)$ 2005Fo05 (continued)

Level Scheme

Intensities: relative I γ **$^{192}\text{Os}(^{82}\text{Se},\text{X}\gamma)$ 2004Zh27**

$^{192}\text{Os}(^{82}\text{Se},\text{x}\gamma)$ with beam energy $E=460$ MeV. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$, $\gamma\gamma(\theta)$ with the 4π spectrometer GASP consisting of 40 Compton-suppressed, large-volume Ge detectors and of an inner BGO ball acting as a multiplicity filter and total-energy spectrometer. Deep inelastic reaction. The level scheme of 2004Zh27 is also given in 2005Lu07. Shell model calculations suggest that particle-hole excitations across the $N=50$ neutron core become important after levels above spin $17/2$. However, it is argued that some remaining discrepancy between experimental results and shell model calculations may be due to not having accounted for collectivity. See 2004Zh27 for more details.

 ^{87}Rb Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$	$T_{1/2}$	Comments
0.0§	$3/2^-$		
402.60§ 10	$5/2^-$	0.08 ns 5	
1577.91§ 15	$9/2^+$	6 ns 1	$T_{1/2}$: From Adopted levels.
3001.0§ 4	$(11/2)^+$		$J\pi$: based on systematics of surrounding levels in ^{87}Rb . $(11/2)^+$ is also listed in table I with final level for 408.0 γ . π from Adopted Levels.
3409.03§ 18	$(13/2^+)$		$J\pi$: Inferred from R(ADO) of 1831 γ assuming (Q) to be E2. It is suggested that the somewhat smaller than expected value may be due to a loss of alignment due to higher lying isomeric states.
3644.03§ 20	$(15/2^+)$		
4150.63§ 23	$(17/2^+)$		
4855.0§ 4	$(19/2^+)$		
5026.7§ 4	$(21/2^+)$		
5481.2§ 5	$(23/2^+)$		
6565.9§ 6			
6821.7§ 6			

† From least-squares fit to $E\gamma$'s (by evaluator).

‡ Deduced by 2004Zh27 from values of R(ADO), wherever possible. Differences from Adopted Levels noted.

§ (A): Yrast sequence.

¹⁹²Os(⁸²Se,Xγ) 2004Zh27 (continued)

γ(⁸⁷Rb)

Eγ [†] §	E(level)	I _γ [#]	Mult. [‡]	δ	α	Comments
171.7 1	5026.7	33 7	(D+Q)			R(ADO)=0.60 7.
235.0 1	3644.03	54 11	(D+Q)			R(ADO)=0.56 6.
255.8 5	6821.7	7.0 14				
402.6 1	402.60	100 20	M1+E2	-0.24 12	0.00411 18	R(ADO)=1.05 6. Mult.: From Adopted levels and consistent with R(ADO). δ: From Adopted levels.
408.0 5	3409.03	7.0 14				
454.5 3	5481.2	19 4	(D+Q)			R(ADO)=1.0 3.
506.6 1	4150.63	50 10	D(+Q)			R(ADO)=0.79 10.
704.4 3	4855.0	26 5	(D+Q)			R(ADO)=1.29 20.
875.9 5	5026.7	7.0 14				
1084.7 5	6565.9	7.0 14				
1175.3 1	1577.91	74 15	M2		8.04×10 ⁻⁴	R(ADO)=1.02 7. Mult.: From Adopted levels and consistent with the Q multipolarity determined from R(ADO).
1211.0 5	4855.0	7.0 14				
1340.5 5	6821.7	7.0 14				
1423.0 5	3001.0	7.0 14				
1831.1 1	3409.03	63 13	(Q)			R(ADO)=1.13 7.

[†] Cross γ-ray coincidences (the γ rays coming from the decay of the "target-like" fragments in coincidence with those coming from the "beam-like" reaction products) were used to distinguish between the different reaction partners, due to the nature of the binary reaction mechanism.

[‡] For the angular distribution of oriented nuclei, R(ADO)=I_γ(34°)/I_γ(90°). Stretched quadrupole (ΔJ=2) transitions have R(ADO) values =1.4, whereas R(ADO)=0.8 for stretched dipole; stretched quadrupole transitions cannot be distinguished from ΔJ=0 dipole transitions or certain M1+E2 admixtures of ΔJ=1 transitions (see 2004Zh27).

§ 2004Zh27 state that uncertainty ranges from 0.1–0.5 keV; Based on this statement, uncertainties are assigned with the following criterion: ΔE_γ=0.1 keV for I_γ>30; ΔE_γ=0.3 keV for 10≤I_γ≤30; ΔE_γ=0.5 keV for I_γ<10.

2004Zh27 quote that the uncertainties in relative intensities are within 20%.

Level Scheme

Intensities: relative I_γ

Adopted Levels, Gammas

Q(β⁻)=-1861.7 11; S(n)=8428.15 12; S(p)=9422.0 11; Q(α)=-7314.9 11 2012Wa38.
Q(β⁻n)=-13668 14, Q(εp)=-8903.3 11.

⁸⁷Sr Levels

Levels that occur in only one decay mode and are questioned there are not included here.

Cross Reference (XREF) Flags

A ⁸⁶Kr(α,3nγ),⁸⁴Kr(α,nγ)
B ⁸⁶Sr(d,p),(pol d,p)
C ⁸⁶Sr(n,γ) E=th
D ⁸⁷Rb(p,nγ), (p,n)

E ⁸⁷Sr IT Decay
F ⁸⁷Y ε Decay (79.8 h)
G ⁸⁸Sr(³He,α),(p,d),(¹²C,¹³C)...
H ⁸⁹Y(d,α),⁸⁹Y(p,³He)

I ⁸⁷Sr(p,p')
J ⁸⁷Rb β⁻ Decay
K ⁸⁷Y ε Decay (13.37 h)
L ⁸²Se(⁹Be,4nγ)

E(level) [†]	Jπ [‡]	XREF	T _{1/2} [§]	Comments
0.0 ^c	9/2+	ABCDEFGHIJKL	stable	μ=-1.0928 7; Q=+0.305 2. Jπ: from paramagnetic resonance (1976Fu06) and laser spectroscopy (1987An02,1987Bu11,1990Li28). π from L(d,p)=4. Configuration is g _{9/2} . μ: from 2011StZZ evaluation as quoted in 1990Bu12 and based on data of 1972Ol01; other: -1.0936030 13 cited in 2011StZZ, -1.089274 7 from 1974Sa25, -1.0924 7 (1987An02). Q: from 2006Sa21; calculated by combining the B/Q value from RCC theory and the measured B value from the 4D ² _{5/2} state of singly ionized ⁸⁷ Sr from Barwood, et al., Phys. Rev. A 67, 013402 (2003). other: +0.323b 20 (2004Yu05), +0.327b 24 (2002Ma09), +0.335 20 (1977He21), +0.36 (1962Bu14).
388.5287 23	1/2-	ABCDEFGH I L	2.815 h 12	%ε=0.30 8; %IT=99.70 8; μ=+0.624 4. Jπ: from laser spectrometry (1987An02,1987Bu11,1990Li28) and π from L(d,p)=1. T _{1/2} : from IT decay. %ε,%IT: from ^{87m} Sr ε+β+ decay. μ: from 2011StZZ evaluation and based on data of 1990Bu12; other: +0.787 9 (1987An02).
873.339 6	3/2-	ABCD FGHI	1.7 ps 7	Jπ: L=1 in (pol d,p) (1986Bu14) and γ(θ) and linear polarization measurements in (α,nγ) (1981Ek01).
1228.427 16	5/2+	ABCD GHI	1.0 ps 4	Jπ: from E1 γ to 3/2- level and E2 γ to 9/2+.
1253.941 13	5/2-	ABCD GHI	2.8 ps +28-9	Jπ: L=3 in (³ He,α), E2 γ to J ^π =1/2- level. T _{1/2} : other: 0.25 ps +23-9 from (p,nγ), but this value is considered by evaluator as not probable because of a large BE2W for 865 γ.
1740.0 ^c 4	13/2+	A G L	0.28 ps 9	Jπ: E2 γ to J ^π =9/2+; from γ yield function in (α,nγ) it follows that 1740 γ is part of the yrast cascade.
1742.0 [#] 9	5/2+, 7/2+	B HI		XREF: H(1739)I(1740).
1770.48 2	5/2+	ABCD G I	5.5 ps +63-21	Jπ: from L=3 from 1/2- in (d,α).
1920.49 13	7/2+	A D GHI	0.14 ps ^b 3	Jπ: L=2 in (d,p), E2 γ to J ^π =9/2+ level. Jπ: Coupled-channel analysis in (³ He,α) and γ linear polarization and angular distribution in (α,nγ) give 7/2+.
2110.07 2	3/2-	A CD GHI	0.092 ps ^b +21-16	Jπ: L=1 in (³ He,α), L=3 from 9/2+ in (p,p').
2153.5 6	(11/2)+	A GHI	<0.09 ps	XREF: H(2166). Jπ: M1+E2 γ to 9/2+, coupled-channel analysis in (³ He,α) gives 11/2+.
2169.43 2	1/2+	ABCD H	≥0.15 ps	T _{1/2} : from (p,nγ). XREF: H(2166). Jπ: L(d,p)=0, but a γ to 5/2- level suggests an interesting configuration allowing a competitive M2 transition.
2235.7 10	9/2+	AB D G I	0.15 ps 4	T _{1/2} : from (p,nγ). Jπ: L=4 in (³ He,α) and angular distribution and polarization in (α,nγ).
2262 8		I		

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Adopted Levels, Gammas (continued)
⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	XREF	T _{1/2} [§]	Comments
2414.520 20	3/2-, 5/2-	ABCD HI	0.13 ps ^b 4	XREF: H(2413). Jπ: L=3 from 9/2+ in (p,p'), γ to 1/2- rules out 7/2- or higher.
2420.4 8	(5/2-)	A GH	0.08 ps 4	XREF: H(2413). Jπ: L=3 in (³ He,α) leads to 5/2-, 7/2-. γ excitation function for (α,nγ) suggests 5/2-.
2488 8	-	I		Jπ: L=3 from 9/2+ in (p,p').
2532.8 [#] 3	7/2+, 9/2+	B D G		XREF: D(2531)G(2536). Jπ: L=4 in (³ He,α).
2536.3 6	11/2-	A D	0.19 ps 8	XREF: D(2531). Jπ: E1 γ to 9/2+ and M1 γ from 13/2-.
2539 8	-	D HI		XREF: D(2552)H(2550). Jπ: L=3 from 9/2+ in (p,p').
2550.0 7	(7/2)+	A D H	0.22 ps 7	XREF: D(2552)H(2550). Jπ: M1 γ to 5/2+; γ(θ), linear polarization, and excitation function in (α,nγ) favor J ^π =(7/2)+.
2555.0 7	(9/2)-	A D GHI	0.06 ps 4	XREF: D(2552)H(2550). Jπ: L=3 from 9/2+ in (p,p'); Jπ=(9/2-) from coupled-channel analysis in (³ He,α).
2596.0 5	13/2-	A G I L	1.0 ps 3	Jπ: L=3 from 9/2+ in (p,p') which gives π=-, and J=13/2 is the only J value from (α,nγ) with π=-.
2633 6	1/2-, 3/2-	D GHI		E(level): weighted average of 2631 15 from (p,n), 2633 20 from (p,d), 2630 15 from (d,α), and 2634 8 from (p,p'). Jπ: L=1 in (p,d). Jπ: L=3 in (p,d).
2656 9	5/2-, 7/2-	G		XREF: D(2682)I(2681).
2676.880 20	3/2+	BCD I		XREF: D(2682).
2679 10	1/2-, 3/2-	D G		Jπ: L=1 in (³ He,α).
2682.0 5	(3/2)+	A D I	0.25 ps 9	XREF: D(2682)I(2681). Jπ: M1 γ to 5/2+; γ(θ), linear polarization, and excitation function in (α,nγ) favor J ^π =(3/2)+.
2707.5 5	7/2+, 9/2+	A D GHI	0.55 ps 14	Jπ: L=4 in (³ He,α).
2803.15 [#] 24		B D I		XREF: D(2810).
2818.89 [#] 18	9/2+	B D		XREF: D(2810).
2821.0 5	(9/2)+	A D	0.7 ps 3	XREF: D(2810). Jπ: from γ(θ), linear polarization, and excitation function in (α,nγ).
2831.2 ^c 5	15/2-	A G I L	<0.35 ps	Jπ: L=3 from 9/2+ in (p,p'); coupled-channel analysis of (³ He,α) gives J ^π =15/2-.
2850.54 3	1/2-, 3/2-	BCD G		Jπ: L=1 in (³ He,α).
2893 8	(-)	I		Jπ: L=(3) from 9/2+ in (p,p').
2904.1 [#] 9		B D		
2920.8 12	7/2+, 9/2+	AB d GH		XREF: B(2921)d(2925)H(2925). Jπ: L=4 in (³ He,α).
2921.12 5	3/2-	BCD HI		XREF: B(2921)D(2925)H(2925). Jπ: L=3 from 9/2+ in (p,p') and primary γ from 1/2+ in (n,γ).
2940.73 3	1/2+	BCD HI		XREF: H(2925).
2980 7	-	D I		E(level): weighted average of 2980 8 from (p,p') and 2975 15 from (p,n). Jπ: L=3 from 9/2+ in (p,p').
3007.21 4	3/2-	CD I		XREF: D(3016). Jπ: L=3 from 9/2+ in (p,p'), primary γ from 1/2+ in (n,γ).
3019.208 20	1/2-, 3/2-	CD GH		XREF: D(3016). Jπ: L=1 in (³ He,α).
3035.5 5		A I		
3047.2 3		B		
3066.358 22	(1/2-, 3/2)	BCD H		Jπ: primary γ from 1/2+ in (n,γ) and γ's to 5/2- and 1/2-.
3102 7		D I		E(level): weighted average of 3103 8 from (p,p') and 3098 15 from (p,n).

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Adopted Levels, Gammas (continued)
⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	XREF		T _{1/2} [§]	Comments
3117.4 6	13/2-	A	I	0.38 ps 12	XREF: I(3121). Jπ: M1 γ to 11/-: γ(θ) and linear polarization in (α,nγ) gives 13/2-.
3118.50 [#] 15		B D	I		XREF: D(3126)I(3121).
3125.28 4	1/2+	BCD			XREF: D(3126). Jπ: L = 0 in (d,p) and (pol d, p).
3136 6	5/2-, 7/2-	G I			E(level): weighted average of 3133 8 from (p,p') and 3140 10 from (³ He,α).
3151.57 3	(3/2)+	BCD	H		Jπ: L=3 in (³ He,α). XREF: D(3151)H(3156). Jπ: L=2 in (d,p); isobaric analog to one of the members of the unresolved 11960 doublet in ⁸⁷ Y with J ^π =(3/2)+ and (5/2)+ while the other part of this doublet is assigned to the 3166 level [J ^π =(5/2)+].
3155.0 15		A D	HI		XREF: D(3151,3167)H(3156).
3166.38 [#] 9	(5/2)+	B D	HI		XREF: D(3167)H(3156)I(3172). Jπ: L=2 in (d,p) and J ^π =(5/2+) in (pol d,p).
3232.27 6	(1/2, 3/2)	BCD			XREF: B(3220). Jπ: primary γ from 1/2+ in (n,γ) and γ to 1/2-.
3249.4 ^c 5	(17/2)-	A	I L	1.3 ps +16-6	Jπ: from γ(θ), linear polarization, and excitation function in (α,nγ).
3258.85 3	5/2+	BCD			Jπ: L=2 in (d,p) and γ to 9/2+.
3271 9	9/2+	GHI			XREF: G(3260)H(3274)I(3278). Jπ: L=0 from 9/2+ in (p,p'). E(level): weighted average of 3278 8 from (p,p') and 3260 10 from (³ He,α).
3277.50 5	5/2+	BCD	H		XREF: H(3274). Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2+.
3371.55 4	1/2+, 3/2, 5/2+	C			XREF: H(3397).
3385.32 [#] 11	5/2+	B	H		Jπ: L=(5) from 9/2+ in (p,p'), (D) γ to 17/2. From γ yield functions in (α,nγ), it follows that 142 γ is part of the yrast cascade.
3390.9 ^c 5	(19/2-)	A	I L		Jπ: L=(5) from 9/2+ in (p,p'), primary γ from 1/2+ in (n,γ), and γ to 1/2- and 5/2-.
3415.76 4	1/2(-), 3/2(-)	BC	I		XREF: H(3434). Jπ: L=3 in (³ He,α) and γ to 1/2-. Fed by a primary from 1/2+ in (n,γ), so there is a conflict as the 5/2- assignment would require the primary to have mult=M2.
3425.56 4	(5/2-)	C	GH		XREF: H(3434). Jπ: L=3 in (³ He,α) and γ to 1/2-. Fed by a primary from 1/2+ in (n,γ), so there is a conflict as the 5/2- assignment would require the primary to have mult=M2.
3431.39 4	1/2-, 3/2, 5/2+	BC	H		XREF: H(3434). Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2-.
3447 8	(-)		I		Jπ: L=(5) from 9/2+ in (p,p').
3483 8			I		
3507.09 5	(3/2)+	C	H		Jπ: L=3 from 1/2- in (d,α) and the 3118γ branching to 1/2- is too strong to be M2 so 5/2+ can be ruled out.
3521 9	5/2-, 7/2-	G I			E(level): weighted average of 3528 8 from (p,p') and 3510 10 from (³ He,α). Jπ: L=3 in (³ He,α).
3547.9 6	5/2+	B			Jπ: L=(5) from 9/2+ in (p,p').
3551 8	(-)		I		Jπ: L=(5) from 9/2+ in (p,p').
3591.07 16	(3/2+, 5/2+)	B			Jπ: L(d,p)=(2).
3602.61 4	3/2+	BC			
3607.63 3	1/2+, 3/2, 5/2+	C	I		XREF: I(3612). Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2+.
3610.9 ^c 6	(21/2)	A	L		Jπ: (D) γ to 19/2, from γ yield functions in (α,nγ) it follows that 220 γ is part of the yrast cascade.
3628.1 [#] 3	(1/2-, 3/2-)	B	GHI		XREF: G(3620)I(3635). Jπ: L=(1) in (³ He,α).
3657 8			I		
3668.39 20		B			

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Adopted Levels, Gammas (continued)

⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	XREF		Comments
3674.19 6	(3/2+)	BC	I	XREF: B(3673.97)I(3679). Jπ: primary γ in thermal (n,γ) and γ to 5/2- level and L=(2) in (pol d,p). XREF: I(3679). Jπ: L=4 in (³ He,α).
3682.3# 5	7/2+, 9/2+	B	G I	
3685.9 6	(17/2)		L	
3691 8			I	
3705.7# 3		B	H	XREF: H(3713).
3716.81 4	1/2, 3/2, 5/2+	C	HI	XREF: H(3713)I(3716). Jπ: primary γ from 1/2+ in (n,γ) and γ to 1/2-.
3718.0c 6	(19/2)	A	I L	XREF: I(3716). Jπ: from γ yield functions and correlation of alignment to initial J in (α,nγ).
3731.35 7	3/2	BC	I	XREF: I(3736). Jπ: primary γ from 1/2+ in (n,γ) and γ's to 5/2+ and 5/2-.
3739.7# 11		B	I	XREF: I(3736).
3750 10	7/2+, 9/2+		G	Jπ: L=4 in (³ He,α).
3765.49 7	1/2-, 3/2, 5/2	BC	H	XREF: H(3772). Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2-.
3776.00 4	3/2+	BC	HI	XREF: H(3772). Jπ: primary γ in thermal (n,γ). and L=2 (d,p) and comparison to DWBA calculations.
3792.28# 17		B	G I	
3824 8			I	
3872.24 5	1/2+	BC		Jπ: L(d,p)=0.
3874 8	(-)		I	Jπ: L=(5) from 9/2+ in (p,p').
3880.63# 23	7/2+, 9/2+	B	G	Jπ: L=4 in (³ He,α).
3894 8			I	
3919.51# 17		B	HI	XREF: H(3934).
3943.4# 3		B	HI	XREF: H(3934).
3951.45 4	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
3958.667 12	3/2+	BC		Jπ: L=2 in (d,p) and γ to 1/2-.
3960 10	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
3981 8	(+)		I	Jπ: L=(4) from 9/2+ in (p,p').
4020 20	7/2+, 9/2+		G	Jπ: L=4 in (³ He,α).
4026.41 4	1/2-, 3/2	C	HI	XREF: H(4025). Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2-.
4031.5# 4	7/2+, 9/2+	B	GH	XREF: G(4020)H(4025). Jπ: L=4 in (³ He,α).
4051.1 4		B		
4056.35 4	1/2, 3/2, 5/2+	BC		Jπ: primary γ from 1/2+ in (n,γ).
4080.79 5	(3/2+, 5/2+)	BC	HI	XREF: H(4096). Jπ: primary γ from 1/2+ in (n,γ) and L=(2) in (d,p).
4090 8			I	
4114.6# 4	(5/2-, 7/2-)	B	G	Jπ: L=(3) in (³ He,α).
4116 8	(+)		I	Jπ: L=(4) from 9/2+ in (p,p').
4150 8	(-)		I	Jπ: L=(5) from 9/2+ in (p,p').
4164.97 2	1/2(-), 3/2(-)	C	I	Jπ: L=(5) from 9/2+ in (p,p') and primary γ from 1/2+ in (n,γ).
4171.9d 6	(17/2+)		L	Jπ: From DCO ratio in (⁹ Be,4nγ) and cascade placement.
4180 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
4182.36 5	1/2+	BC		Jπ: L(d,p)=0.
4187 8	(+)		I	Jπ: L=(2) from 9/2+ in (p,p').
4196.82 5	3/2+	BC		Jπ: L=2 in (d,p) and γ to 1/2-.
4224.03 3	1/2+, 3/2+	C	I	Jπ: L=4 from 9/2+ in (p,p') and primary γ from 1/2+ in (n,γ).
4235.66 6	3/2+, 5/2+	BC	I	Jπ: L=2 in (d,p).
4251.6# 4	7/2+, 9/2+	B	G I	Jπ: L=4 in (³ He,α).
4288 8			I	
4310.19 18		B		
4323# 8			I	
4337.06 4	1/2+, 3/2	BC	I	Jπ: primary γ from 1/2+ in (n,γ) and γ's to 1/2- and 5/2+.
4354.50# 24	(5/2-, 7/2-)	B	G I	Jπ: L=(3) in (³ He,α).
4379.72# 12		B	I	
4413.65# 24	@	B	G I	XREF: G(4420).
4433.4# 4	@	B	G I	XREF: G(4420)I(4435).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{87}Sr Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	XREF		Comments
4435.60 5	1/2+, 3/2	BC	G I	XREF: G(4420)I(4435). $J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 1/2- and 5/2+.
4440.4 ^c 8	(23/2)	A	L	$J\pi$: presumably dipole γ to 21/2+; from γ yield functions in (α ,n γ) it follows that 829 γ is part of the yrast cascade.
4442.6 4		B		
4449.47 25		B		
4462.6 [#] 6	@	B	G I	XREF: G(4470). $J\pi$: Both 4462.6 and 4485.0 levels possibly correspond to the 4470 level in XREF= γ and therefore no J assignment is adopted.
4485.9 [#] 7	@	B	G	XREF: G(4470). $J\pi$: Both 4462.6 and 4485.0 levels possibly correspond to the 4470 level in XREF= γ and therefore no J assignment is adopted.
4501 8			I	
4514.3 [#] 3	&	B	G	XREF: G(4530). $J\pi$: Assigned (7/2+,9/2+) in XREF=G, however overlaps with several levels so no J adopted.
4536.56 5	1/2-, 3/2	C		$J\pi$: primary γ from 1/2+ in (n, γ) and γ to 5/2-.
4540.8 [#] 3	&	B	G I	XREF: G(4530)I(4546). $J\pi$: Assigned (7/2+,9/2+) in XREF=G, however overlaps with several levels so no J adopted.
4551.19 6	1/2+, 3/2	C	I	XREF: I(4546,4559). $J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 1/2- and 5/2+.
4564.9 3		B	I	XREF: I(4559).
4571.4 ^d 6	(19/2+)		L	$J\pi$: DCO ratios and cascade placement.
4584.9 3		B	I	
4595.6 3		B		
4604.86 4	1/2, 3/2, 5/2+	BC		$J\pi$: primary γ from 1/2+ in (n, γ).
4618.5 [#] 5	a	B	G I	XREF: G(4620)I(4612).
4631.7 [#] 3	a	B	G I	XREF: G(4620).
4644.07 4	1/2+, 3/2	BC		$J\pi$: primary γ from 1/2+ in (n, γ) and γ to 5/2+.
4651.28 5	1/2+, 3/2, 5/2+	C	I	XREF: I(4659). $J\pi$: primary γ from 1/2+ in (n, γ) and γ to 5/2+.
4653.2 3		B	I	XREF: I(4659).
4671.8 ^d 6	(21/2+)		L	$J\pi$: DCO ratio and cascade placement.
4676.3 4		B	I	
4684.61 3	1/2-, 3/2	C	I	$J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 1/2- and 5/2-.
4689.3 7		B		
4695.8 5		B		
4708.16 [#] 23		B	G I	XREF: G(4720)I(4716).
4717.8 [#] 4	5/2-, 7/2-	B	G I	XREF: G(4720)I(4716). $J\pi$: L=3 in (^3He , α).
4751 8			I	
4783.75 4	1/2+, 3/2, 5/2+ [@]	C	G I	XREF: G(4780)I(4785). $J\pi$: primary γ from 1/2+ in (n, γ) and γ to 5/2+.
4789.87 6	3/2 [@]	BC	G I	XREF: G(4780)I(4785). $J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 5/2+ and 5/2-.
4799.42 [#] 16	@	B	G	XREF: G(4780).
4822.78 25		B		
4826.84 6	1/2+, 3/2	C		$J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 1/2- and 5/2+.
4846.46 [#] 20	1/2-, 3/2-	B	G	XREF: G(4860). $J\pi$: L=1 in (^3He , α).
4878 8			I	
4887.22 22		B		
4905.2 7		B		
4921.90 4		C	I	XREF: I(4918).
4925.6 [#] 4		B	I	XREF: I(4918).
4934.24 [#] 23	@	B	G	XREF: G(4950).
4943.3 [#] 4	@	B	G I	XREF: G(4950)I(4951).
4948.63 [#] 24	@	B	G I	XREF: G(4950)I(4951).
4953.11 6	1/2, 3/2, 5/2+ [@]	C	G I	XREF: G(4950)I(4951). $J\pi$: primary γ from 1/2+ in (n, γ).
4964.32 4	1/2+, 3/2 [@]	C	G	XREF: G(4950). $J\pi$: primary γ from 1/2+ in (n, γ) and γ 's to 1/2- and 5/2+.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	XREF		Comments
4969.1# 5	@	B	G	XREF: G(4950).
4975.1 4		B		
4990.7 3		B		
5020 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
5063.08 4	1/2+, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2+.
5067.58 5	1/2+, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2+.
5082.46 6	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5091.04 3	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5106.55 9	1/2-, 3/2-	C	G	XREF: G(5120).
				Jπ: L=1 in (³ He,α).
5120 8	5/2-, 7/2-		G I	E(level): from (p,p').
				Jπ: L=3 in (³ He,α).
5142.3 3	1/2, 3/2, 5/2+	C		Jπ: γ to 1/2+.
5169 8			I	
5173.7 ^d 7	(23/2+)		L	Jπ: From DCO ratio and cascade placement.
5207.25 6	1/2+, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ's to 1/2- and 5/2+.
5260 20	5/2-, 7/2-		G	XREF: G(5260).
				Jπ: L=3 in (³ He,α).
5282.37 10	1/2-, 3/2-	C	G	XREF: G(5260).
				Jπ: L=1 in (³ He,α).
5296.15 6	1/2+, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ's to 1/2- and 5/2+.
5333.29 8	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5379.02 8	1/2-, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2-.
5397.14 6	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5420 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
5560 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
5647.33 7	1/2-, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 1/2- and 5/2-.
5673.18 6	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5770 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
5811.16 4	1/2, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ).
5843.34 5	3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2- and 5/2+.
5885.3 ^d 8	(25/2+)		L	Jπ: DCO ratio and cascade placement.
5920 20	5/2-, 7/2-		G	Jπ: L=3 in (³ He,α).
5943.16 6	3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2- and 5/2+.
6074.44 8	1/2+, 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2+.
6074.7 7	(25/2+)		L	E(level): The high spin of this level makes it unlikely to be the 6074.44 level populated in (n,γ).
				Jπ: From DCO ratio and cascade placement.
6093.68 6	1/2+, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ's 1/2- and 5/2+.
6189.07 6	1/2(+), 3/2, 5/2+	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to (5/2)+.
6374.1 ^d 9	(27/2+)		L	Jπ: From DCO ratio and cascade placement.
6674.6 ^d 10	(29/2+)		L	Jπ: DCO ratio and cascade placement.
7032.43 8	1/2-, 3/2	C		Jπ: primary γ from 1/2+ in (n,γ) and γ to 5/2-.
7442.5 ^d 10	31/2(+)			Jπ: From DCO ratio and cascade placement.
10720 20	3/2-		G	E(level): isobaric analog to ⁸⁷ Rb gs (J ^π =3/2-).
				Jπ: L=1 in (³ He,α), isobaric analog to ⁸⁷ Rb gs (J ^π =3/2-).
11120 20	5/2-		G	E(level): isobaric analog to the 403 level in ⁸⁷ Rb.
				Jπ: L=3 in (³ He,α); isobaric analog to the 403 level in ⁸⁷ Rb (J ^π =5/2-).
11550 20	1/2-		G	E(level): isobaric analog to the 845 level in ⁸⁷ Rb.
				Jπ: L=1 in (³ He,α); isobaric analog to the 845 level in ⁸⁷ Rb (J ^π =1/2-).

[†] From least-squares fit to γ-ray energies for levels with depopulating γ rays.

[‡] From (d,p), (pol d,p), unless indicated otherwise.

§ From (α,nγ), (α,3nγ), unless indicated otherwise.

From (d,p).

@ J^π=1/2-, 3/2- from L=1 for the level observed in (³He,α).

& J^π=(7/2+, 9/2+) from L=(4) for the level observed in (³He,α).

a J^π=1/2-, 3/2- or J^π=5/2-, 7/2- from L=1+3 for the level observed in (³He,α).

b Weighted average from (α,nγ), (α,3nγ) and (p,nγ).

c (A): γ cascade based on g.s.

d (B): γ cascade based on 17/2(+).

Adopted Levels, Gammas (continued)

$\gamma(^{87}\text{Sr})$						
E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$	Mult. [‡]	$\delta^{\ddagger}$	α	Comments
388.5287	388.5276 [§] 23	100	M4		0.213	Mult.: from α_K and K/L from ^{87m}Sr IT decay. B(M4)(W.u.)=11.24 6.
873.339	484.805 [§] 5	100	M1+E2	+0.19 5	0.00286 5	B(M1)(W.u.)=0.11 5; B(E2)(W.u.)=19 +17-10.
1228.427	355.08 [#] 3	17.9 [#] 11	E1(+M2)	$\leq +0.005$	0.00270	δ : from RUL. $\delta=+0.07 +2-5$ is reported in ($\alpha,3n\gamma$). B(E1)(W.u.)>0.00081; B(M2)(W.u.)<1. B(E2)(W.u.)=7.5 23.
1253.941	1228.44 [#] 3	100 [#] 3	E2		3.78×10^{-4}	
	380.57 [#] 3	18.7 [#] 16				
	865.411 [#] 22	100 [#] 3	E2		8.17×10^{-4} 12	B(E2)(W.u.)=15 +5-15.
1740.0	1739.8 [@] 4	100 [@]	E2		3.67×10^{-4} 6	B(E2)(W.u.)=5.5 17.
1770.48	517.3 [@] 10	31 [@] 9	(E1)		1.04×10^{-3}	B(E1)(W.u.)=7. $\times 10^{-5}$ +4-7.
	542.04 3	45 3	M1(+E2)	-0.04 8	0.00218 4	B(M1)(W.u.)=(0.0059 +21-59); B(E2)(W.u.)=(0.04 +15-4).
1920.49	1770.48 3	100 3	E2		3.75×10^{-4}	B(E2)(W.u.)=0.13 +5-13.
	691.8 [@] 4	20 [@] 7				
	1920.49 13	100 3	M1+E2	+0.70 5	3.96×10^{-4}	E_{γ}, I_{γ} : weighted average from ($\alpha,3n\gamma$), ($\alpha,n\gamma$) and (p,n γ). B(M1)(W.u.)=0.013 3; B(E2)(W.u.)=1.9 5.
2110.07	856.07 3	7.4 12				
	881.51 13	0.56 12	(E1)		3.19×10^{-4}	B(E1)(W.u.)=2.4 $\times 10^{-5}$ 9.
	1236.72 3	100 16	M1+E2		3.73×10^{-4}	E_{γ} : from (n, γ); others: 1236.5 4 from ($\alpha,3n\gamma$), ($\alpha,n\gamma$), 1237.50 6 from (p,n γ).
2153.5	1721.61 3	19 3				
	2153.5 [@] 7	100 [@]	M1+E2	-0.80 10	4.78×10^{-4} 8	B(M1)(W.u.)>0.013; B(E2)(W.u.)>2.0.
	2169.43	0.98 18	(M2)		1.65×10^{-3}	E_{γ}, I_{γ} : From (n, γ). B(M2)(W.u.)<159.
2235.7	1296.00 ^{&} 3	100 ^a 15	(E1)		2.62×10^{-4}	B(E1)(W.u.)<0.00096.
						I_{γ} : From (n, γ).
	2235.7 [@] 10	100 [@]	E2(+M1)	>4	5.35×10^{-4}	B(M1)(W.u.)<0.00098; B(E2)(W.u.)>2.0.
2414.520	643.83 9	0.85 16	(E1)		6.23×10^{-4}	B(E1)(W.u.)=7. $\times 10^{-5}$ 3.
	1541.20 3	21 3				
	2026.02 6	100 10				
2420.4	1166.9 [@] 12	100 [@] 4	D+Q			Mult.: D+Q from $^{86}\text{Kr}(\alpha,3n\gamma)$ and from $\pi(1254)$ and $\pi(2420)$.
	1546.7 [@] 10	76 [@] 29				
2536.3	2536.7 [@] 7	100 [@]	E1+M2	-0.09 4	1.02×10^{-3} 2	δ : from RUL and $\delta=-0.18 +13-22$ from ($\alpha,3n\gamma$). B(E1)(W.u.)=0.00011 5; B(M2)(W.u.)=0.6 7.
2550.0	1321.6 [@] 7	100 [@]	M1+E2			
2555.0	2555.0 [@] 7	100 [@]	E1(+M2)	+0.03 3	1.04×10^{-3}	B(E1)(W.u.)=(0.0003 2); B(M2)(W.u.)=(0.2 +4-2).
2596.0	855.9 [@] 3	100 [@]	E1(+M2)	-0.10 12	3.39×10^{-4}	B(E1)(W.u.)=0.0006 2; B(M2)(W.u.)=(30 +90-30).
2676.880	566.55 10	1.3 3				E_{γ} : There is a possibility for a second placement from the 6074 level, but the evaluators are adopting the placement suggested by 1986Wi16 in (n, γ).
	1422.99 4	6.8 10				
2682.0	1803.47 3	17 3				
	2288.23 6	100 12				
	911.5 [@] 5	100 [@]	M1+E2	-0.5 +3-13	6.90×10^{-4} 24	B(M1)(W.u.)=0.09 4; B(E2)(W.u.)=30 +40-30.
2707.5	787.0 [@] 4	100 [@]	M1(+E2)	0.00 9	9.39×10^{-4}	B(M1)(W.u.)=(0.082 21).
2821.0	1050.5 [@] 5	100 [@]	E2		5.17×10^{-4}	B(E2)(W.u.)=28 12.
2831.2	235.2 [@] 5	6.7 [@]	(M1)		0.01662	B(M1)(W.u.)>0.30.
	1091.3 [@] 3	100 [@]	E1+(M2)	+0.12 17	0.00022 6	B(E1)(W.u.)>0.00067.

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Adopted Levels, Gammas (continued)
 $\gamma(^{87}\text{Sr})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. ‡	$\delta^{\ddagger}$	α	Comments
2850.54	740.58 4	4.2 7				
	1977.11 3	100 14				
2920.8	2920.7@ 12	100@				
2921.12	811.09 12	17 4				
	1667.12 6	100 17				
2940.73	1712.09 11	100 17				
	2552.24 6	<2217				
3007.21	1753.24 16	5.5 11				
	2133.87 10	22.8 25				
	2618.95 10	100 11				
3019.208	1248.55 6	2.1 3				
	1765.23 3	30 5				
	2145.87 6	19.8 20				
	2630.70 6	100 11				
3035.5	882.0@ 8	100@ 30				I γ : Based on branching from level scheme from ($\alpha,3n\gamma$),($\alpha,n\gamma$) shown in 1981Ek01.
	1295.5@ 3	100@ 42				I γ : Based on branching from level scheme from ($\alpha,3n\gamma$),($\alpha,n\gamma$) shown in 1981Ek01.
3066.358	1812.37 3	40 6				
	2193.04 6	100 10				
	2677.87 6	70 8				
3117.4	521.0@ 7	63@ 4	M1+E2	+0.29 16	0.00245 9	B(M1)(W.u.)=0.15 5; B(E2)(W.u.)=50 +60-50.
	581.3@ 5	100@ 4	M1+E2	+0.047 +12-23	0.00185	B(M1)(W.u.)=0.18 6; B(E2)(W.u.)=1.3 8.
3125.28	1896.87 5	36 6				
	2251.89 6	100 10				
3151.57	737.07 15	4.5 10				
	1041.56 10	7.8 14				
	1381.18 5	47 8				
	1923.27 6	22 4				
	2762.68 6	100 10				
3155.0	3154.9@ 15	100@				
3232.27	2843.64 7	100				
3249.4	418.2@ 2	100@	M1+E2		0.0052 12	B(M1)(W.u.)=0.12 +13-12. BM1 calculated assuming a small mixing ratio as the known mixing ratios for transitions for isotope seem to be consistently small at less than 0.5 (absolute) with with one exception for the 2235 γ from the 2235 keV level.
3258.85	581.83 10	24 5				
	844.35 3	100 18				
	1148.76 9	29 5				
	1488.59 13	25 5				
	3258.56 13	84 8				
3277.50	2049.05 12	20 3				
	2404.02 7	100 11				
	2888.94 16	20 3				
3371.55	1600.94 8	15.3 25				
	2498.33 7	100 10				
3390.9	141.5@ 2	100@	(M1)		0.0630	
3415.76	1246.31 4	100 14				
	2161.63 21	40 7				
	3027.16 13	36.7 24				
3425.56	2196.89 13	15.1 19				
	2552.24 6	<205				
	3036.86 9	100 5				
3431.39	2177.39 8	100				

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Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Sr})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\dagger}$	Mult. ‡	Comments
3507.09	2278.71 7	100 11		
	3118.47 9	34.1 19		
3602.61	1832.12 4	100 15		
	2729.45 17	32 6		
3607.63	666.80 13	10.8 22		
	1497.29 7	44 7		
	2378.6 5	59 7		
	2734.09 8	100 11		
3610.9	220.0@ 2	100@	(D)	
3674.19	823.50 17	18.3 46		
	1563.7 4	100 17		
	2419.98 18	58.7 83		
	2445.52 11	80.7 92		
	3285.87 14	<121		
3685.9	1945.8 7	100		
3716.81	795.58 25	5.0 18		
	3328.25 9	100 5		
3718.0	327.1@ 3	100@	(D)	
3731.35	2477.36 8	100 11		
	2503.2 4	40 4		
3765.49	1351.01 11	32 6		
	2511.73 13	100 13		
3776.00	709.67 5	17 3		
	925.21 9	8.3 13		
	2902.66 7	100 10		
3872.24	1702.76 13	9.3 21		
	2101.93 25	14 3		
	2998.95 7	100 12		
3951.45	580.03 9	26 5		
	1781.95 5	100 18		
3958.667	3085.27 1	100 6		
	3570.21 11	46 3		
4026.41	1611.84 5	100 16		
	2772.51 8	84 9		
4056.35	1115.50 17	7.7 17		
	2828.06 14	20.3 25		
	3182.62 10	100 5		
	3667.78 10	41.6 25		
4080.79	1061.52 5	29 5		
				E γ : There is a possibility for a second placement from the 4863 keV level, but the evaluators are adopting the placement suggested by 1986Wi16 in (n, γ).
	3207.58 9	100		
4164.97	557.23 6	5.1 9		
	1145.71 3	45 7		
	1224.26 3	5.5 9		
	1243.80 9	4.6 8		
	1995.46 3	100 15		
	2054.88 7	28 4		
	2394.79 15	5.3 7		
	2911.24 13	3.9 5		
	3291.72 9	29.2 15		
4171.9	1340.8 7	65 12		
	2431.7 7	100 18		
4182.36	465.53 5	25 5		
	2072.8 6	99 13		
	2411.73 13	18.3 22		
	3309.2 4	38.4 20		
	3793.78 10	100 5		
4196.82	765.25 16	4.6 11		
	2426.37 8	33 4		
	2942.76 7	100 11		
	2968.58 16	19 3		
	3808.39 12	33.1 21		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{87}\text{Sr})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. ‡	E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. ‡
4224.03	1547.08 3	100 16		4783.75	1276.6 3	4.2 13	
	2453.63 10	15.4 17			1632.08 8	19 3	
	2995.86 12	50 7			1933.23 4	50 8	
	3350.58 10	21.9 12			2369.36 16	17.3 24	
4235.66	1084.13 13	14 3			3555.10 9	100 5	
	1169.26 13	24 5			3910.32 11	37.2 21	
	2981.77 9	36 4		4789.87	1187.31 12	11.2 22	
	3007.01 11	100 7			2375.38 12	14.9 17	
4337.06	571.74 15	1.7 4			3535.92 9	66 4	
	662.71 11	2.2 5			3561.07 22	100 5	
	911.34 25	100 15			3916.30 12	32.0 24	
	965.67 13	2.1 5		4826.84	1455.23 7	48 8	
	2227.05 12	6.8 9			2717.4 4	12 3	
	2566.50 7	35 4			3056.60 13	24.6 18	
	3948.55 12	4.5 3			4438.12 11	100 5	
4435.60	1019.61 11	5.2 11		4921.90	1314.28 4	100 15	
	1158.04 9	11.6 20			2245.06 9	92 10	
	1428.46 5	19 3			2506.95 18	50 7	
	2664.4 7	28 3			3693.34 11	63 4	
	4046.92 10	100 6		4953.11	770.77 9	13.2 24	
4440.4	829.4 [@] 8	100 [@]	(D)		2031.96 7	100 12	
4536.56	1120.71 16	12.1 25			4079.84 16	19.4 15	
	1411.19 6	44 7			4564.35 15	11.5 9	
	2122.04 9	94 10		4964.32	627.32 6	22 4	
	3282.72 10	100 6			781.85 10	12.1 24	
4551.19	876.94 10	3.8 8			799.26 7	18 3	
	1273.61 18	2.6 7			1199.04 16	10.0 21	
	1399.48 12	4.0 8			2854.25 7	74 8	
	3677.91 9	100 6			3736.1 5	43.1 24	
	4162.6 5	22 7			4575.54 11	100 5	
4571.4	399.5 7	73 9	(D)	5063.08	1111.68 6	31 5	
	885.4 7	<6			1286.94 8	44 8	
	1180.6 7	46 6			2648.52 7	100 11	
	1322.1 7	100 6	(D)		2893.55 15	34 5	
4604.86	828.68 9	17 4			3834.68 14	39 3	
	874.05 21	8 3			4189.65 11	92 5	
	997.11 8	31 5		5067.58	1915.99 5	100 16	
	1453.37 6	67 11			2126.47 14	54 7	
	1538.51 4	100 14			2653.09 8	93 10	
4644.07	927.39 8	18 3			3297.24 17	21.8 19	
	1137.01 9	15 3			3839.2 3	35 7	
	1212.30 18	7.9 21		5082.46	1130.94 6	99 16	
	1366.36 15	11.0 21			4209.24 14	34.7 24	
	1385.19 6	32 5			4693.93 15	100 7	
	2873.7 3	100 11		5091.04	1034.64 4	45 7	
	3415.8 3	21 4			1064.63 7	18 3	
	3770.46 10	70 4			1132.54 8	24 4	
4651.28	934.45 3	100 18			1659.66 4	100 15	
	2236.95 19	43 7			1665.43 4	<5	
	2880.63 10	36 4			2921.50 8	72 7	
4671.8	100.4 4	100 9			4218.02 19	7.6 6	
	954.0 7	53 7	(D)	5106.55	1050.28 17	8.6 17	
	985.8 7	<4			2099.46 17	33 5	
	1060.9 7	22 3			4717.76 12	100 5	
	1281.0 7	25 4		5142.3	1864.3 3	80 24	
4684.61	953.10 12	21 4			2974.0 5	100 28	
	1076.91 4	74 12		5173.7	501.9 4	100 7	(D)
	1559.42 6	74 12			1562.8 7	11 2	
	1665.43 4	<100		5207.25	1791.65 11	8.2 16	
	1677.37 7	53 9			2530.24 9	26 3	
	3431.18 23	13 2			2792.66 25	4.6 7	
	3811.07 12	100 6			3436.76 14	10.4 9	
	4295.93 13	45 3			3978.65 10	100 5	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{87}\text{Sr})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. ‡	E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. ‡
5207.25	4333.9 3	3.0 5		5843.34	1971.15 6	100 16	
	4818.9 4	5.3 16			4589.04 18	23.8 17	
5282.37	2157.13 23	31 6			4615.0 3	41 4	
	4408.74 20	27 4		5885.3	711.6 4	100	(D)
	4893.73 12	100 6		5943.16	990.11 14	33 7	
5296.15	759.57 17	5.2 13			1606.02 8	100 17	
	3186.08 9	100 5			2167.42 15	87 12	
	4067.75 13	11.4 8			4688.97 13	83 5	
	4422.44 13	37.7 24			4714.5 5	40 6	
	4907.5 4	4.2 8			5074.1 15	16 10	
5333.29	2266.85 10	68 8		6074.44	2018.06 11	100 13	
	2918.69 24	24 5			2308.94 10	86.1 99	
	4459.90 11	100 5			4304.18 21	45.1 66	
5379.02	774.29 15	5.5 13			5200.56 21	27.0 25	
	4124.93 13	16.8 10		6074.7	901.0 4	100 9	(D)
	4505.50 12	100 6			1634.1 7	10 2	
5397.14	1172.97 12	34 6		6093.68	1869.44 10	33 6	
	1890.05 5	100 15			2816.6 4	8.4 21	
	1965.72 17	27 6			2834.89 8	100 11	
	2720.17 13	63 8			3172.48 20	14.7 16	
	5008.68 20	30 3			3924.28 22	13.7 16	
5647.33	2044.77 8	100 11			5220.12 13	62 3	
	2414.93 9	69 7			5704.95 20	27 3	
	2970.6 3	20 5		6189.07	1362.24 7	36 6	
	4392.7 3	35 10			2929.83 25	10.0 19	
	5258.74 18	36 3			3122.51 13	29.0 19	
5673.18	1028.64 19	13 3			3512.21 10	100 6	
	1714.49 8	55 9			5315.3 4	23 5	
	3563.20 13	98 9		6374.1	299.4 7	91 10	
	4798.1 6	23 11			488.8 7	100 8	(D)
	5284.63 13	100 6		6674.6	300.5 4	100	(D)
5811.16	1614.44 10	17 3		7032.43	1941.42 19	13 3	
	1646.04 7	24 4			2495.79 8	100 11	
	1938.92 8	27 5			2976.1 7	4.5 24	
	2035.24 7	100 11			4618.3 9	2.4 11	
	2385.70 11	21.6 25			5778.7 4	5.2 7	
	3396.51 9	47.3 25			6159.0 4	6.9 11	
	3700.86 11	25.4 16		7442.5	767.9 4	100	(D)
5843.34	1192.01 5	89 14					

 $\dagger$ From (n, γ), unless indicated otherwise.

 $\ddagger$ From (α ,3n γ),(α ,n γ), unless indicated otherwise.

 $\S$ From ⁸⁷Y ϵ + β + decay. The other values are less precise and those from (p,n γ) deviate from these values by more than two standard deviations.

 $\#$ Weighted average from (n, γ), (p,n γ), (α ,3n γ), and (α ,n γ).

 $@$ Only from (α ,3n γ),(α ,n γ).

 $\&$ Weighted average from (n, γ), (p,n γ), (α ,3n γ), and (α ,n γ).

 a Only from (⁹Be,4n γ).

Adopted Levels, Gammas (continued)

⁸⁷Rb β⁻ Decay

Parent ⁸⁷Rb: E=0.0; Jπ=3/2⁻; T_{1/2}=4.81×10¹⁰ y 9; Q(g.s.)=282.2 11; %β⁻ decay=100.

See also 1961Eg01, 1959F140, 1969Sa02, 1971Ko28, 1976Sz03.

β spectral shape was measured with the following techniques: 4π proportional counter (1973Ru02), NaI(Tl) scintillator (1961Be41,1961Eg01), doped liquid scintillator (1959F140).

The measured spectrum shape is in agreement with the assumed non-unique third-forbidden decay.

Earlier β spectral shape factors were analyzed in terms of nuclear matrix elements by 1969Sa02, 1971Ko28, and 1976Sz03.

⁸⁷Sr Levels

E(level)	Jπ [†]
0.0	9/2 ⁺

[†] From ⁸⁷Sr Adopted Levels.

β⁻ radiations

Eβ ⁻	E(level)	Iβ ^{-†}	Log ft	Comments
(282.2 11)	0.0	100	17.499 10	Eβ ⁻ : measured values are 274 3 (1961Be41), 275 5 (1961Eg01), and 272 3 (1959F140), which are all lower than the adopted Q. Log ft: The β ⁻ is third-forbidden unique but the logft is that for an allowed transition.

[†] Absolute intensity per 100 decays.

⁸⁷Sr IT Decay

Parent ⁸⁷Sr: E=388.533 3; Jπ=1/2⁻; T_{1/2}=2.815 h 12; %IT decay=99.70 8.

⁸⁷Sr-%IT decay: from a measurement of the ratio of ⁸⁷Rb X_{Kα} to ⁸⁷Sr X_{Kα}, 1969Zo04 determined a value of 0.30% 8 for the ε branch to ⁸⁷Rb.

⁸⁷Sr Levels

E(level)	Jπ [†]	T _{1/2}	Comments
0.0	9/2 ⁺		
388.533 3	1/2 ⁻	2.815 h 12	T _{1/2} : weighted average of 2.80 h 3 (1951Hy24), 2.83 h 2 (1965Bo42), 2.805 h 1 (1968Go30, with reported uncertainty divided by 3 to give 1σ value), 2.83 h 5 (1969Zo04), 2.793 h 9 (1970Le07), 2.81 h 2 (1970LyZZ), 2.97 h 10 (1971Bu08), 2.83 h 1 (1971Ja24 and 1971Oo01), 2.81 h 2 (1972Em01), 2.795 h 13 (1982Gr07), 2.827 h 1 (1992An19), and 2.811 h 27 (1997We13). The two most precise values, 2.805 1 and 2.827 1, differ by about 20 σ and the reduced-χ ² value for the average is 28. Although the 2.805 value is somewhat old, it is from a reliable lab and measured by T1/2 experts, who have provided metrology standards for several nuclei. The next most precise value is 2.793 9, which supports this lower value. With the two uncertainties of 0.001 increased to 0.003, the reduced-χ ² is 3.7 and the Limitation of Relative Statistical Weight method (1985ZiZY,1992Ra09) expands the final uncertainty to include the most precise value; and this uncertainty of 0.012 is adopted. T _{1/2} : a change in this half-life has been measured to be 0.8% 5 for a change in temperature from 293 K to 77 K (2001Al23).

[†] From ⁸⁷Sr Adopted Levels.

γ(⁸⁷Sr)

Eγ	E(level)	Iγ [†]	Mult.	α	I(γ+ce) [†]	Comments
388.531 3	388.533	82.44 21	M4	0.213	100	Mult.: From α(exp). Eγ: from 1988AL01 as measured in ⁸⁷ Y (80 h) ε+β ⁺ decay. α(K)exp=0.177 6; K/L=6.82 13. α(exp)=0.212 3.

Continued on next page (footnotes at end of table)

⁸⁷Sr IT Decay (continued)

$\gamma(^{87}\text{Sr})$ (continued)

E γ	E(level)	I $\gamma^\dagger$	Mult.	α	I(γ +ce) †	Comments
						$\alpha(\text{K})_{\text{exp}}$: weighted average of 0.180 15 (1961Hu12), 0.16 2 (1970Ca17), 0.162 10 (1970Kl02), 0.177 6 (1970Le07), and 0.19 1 (1971Vo06). K/L from 1966Sa16; other 7.5 (1963Gr41). $\alpha(\text{exp})$: from average of 0.212 3 (1968Go30) and 0.211 6 (1970Le07). $I\gamma$: from $I_\gamma(1+\alpha)=100$ and $\alpha=0.213$ 3. B(M4)(W.u.)=11.24 6.

† For absolute intensity per 100 decays, multiply by 0.9970 8.

Decay Scheme

Intensity: I(γ +ce) per
100 parent decays
%IT=99.70 8

⁸⁷Y ϵ Decay (79.8 h)

Parent ⁸⁷Y: E=0.0; J π =1/2-; T_{1/2}=79.8 h 3; Q(g.s.)=1861.7 11; % ϵ +% β^+ decay=100.
1988AL01: Source preparation by ⁸⁷Sr(p,n) with E_p=18 MeV. Measured precise E γ and relative I γ ; deduced ϵ branching.
1993Va03: Measured P_K to 873 level.
1984Pr01: Measured parent T_{1/2} and relative I γ .
1971Ja24: Measured E γ and I γ .
1970Kl02 and 1970Ca17: Measured α_K for both γ 's.
1969Zo04: Measured parent T_{1/2} and I γ .
1969Cl11: Measured E γ (388).
1967Mi13: Measured parent T_{1/2} and β^+ spectrum.
1963Gr41: Measured K/L for 388 γ .

⁸⁷Sr Levels

Note that the level at 388 keV decays 99.70 8% by an isomeric transition to the ground state and 0.30 8% by ϵ + β^+ decay to ⁸⁷Rb.

E(level) †	J $\pi^\ddagger$	T _{1/2}	Comments
0.0	9/2+		
388.5276 23	1/2-	2.815 h 12	T _{1/2} : from ^{87m} Sr decay.
873.338 6	3/2-		

† From γ energies.

‡ From ⁸⁷Sr Adopted Levels.

⁸⁷Y ε Decay (79.8 h) (continued)

β⁺,ε Data

The decay to the ⁸⁷Sr ground state is unique third forbidden for which the log ft is expected to be about 21 (1998Si17) with a corresponding $I_{\epsilon+\beta^+}$ of $1.0 \times 10^{-13}\%$.

Eε	E(level)	Iβ ⁺ †	Iε†	Log ft	I(ε+β ⁺)†	Comments
(988.4 11)	873.338		93.4 4	5.444 4		Iε: from from analysis of γ data (1988Al01); others: 97 from γ data (1971Ja24), 87.4 from decomposition of β ⁺ spectrum (1967Mi13). From the analysis of 1988Al01, the authors used %IT(388 level) = 99.70 8, Iγ(484γ)/Iγ(388γ)=1.093 5, α(388γ)=0.212 2, α(484γ)=0.00298, T1/2(⁸⁷ Y)=79.8 h 3 and T1/2(^{87m} Sr)=2.81 h 1, all consistent with the present adopted values for these quantities. The measured P _K =0.91 5 (1993Va03), which agrees with the theoretical value of 0.873.
(1473.2 11)	388.5276	0.18 2	6.4 4	6.96 5	6.6 7	

† Absolute intensity per 100 decays.

γ(⁸⁷Sr)

α(K)exp are weighted average of values from 1970Kl02 and 1961Hu12, normalized to the 661 γ from the decay of ¹³⁷Cs.
Other: 1970Ca17.

Iγ normalization: from the intensity of the 484 γ, the normalization factor is 93.4 / (113.3 x 1.0029), where the 113.3 would be the relative intensity of the 484 γ if the half-life of the 388 level were insignificant.

Eγ†	E(level)	Iγ§@	Mult.#	δ#	α	Comments
388.5276 [±] 23	388.5276	100	M4		0.213	α(K)exp=0.168 8.
484.805 [±] 5	873.338	109.3 5	M1(+E2)	<0.6	0.00298 17	α(K)exp=0.00260 11. Iγ: weighted average of 108.7 11 (1969Zo04), 110.0 5 (1984Pr01), and 108.8 5 (1988Al01); average gives a reduced-χ ² =1.62 and the external uncertainty has been adopted. This is the measured value at secular equilibrium, which is 0.966 times the value that would be observed if the 388 level had an insignificant half-life.

† From 1988Al01, on a scale where the strong ¹⁹⁸Au line has E_γ=411.8044 keV; if the energies of the reference lines are adjusted to those of the evaluation of 2000He14, the 388 and 484 energies would be lower by 4 and 3 eV, respectively.

‡ The authors' value has been corrected for the reference data in 200He14.

§ Due to the significant half-life of the 388-keV level, the measured relative intensity of the two γ rays will vary with time and the secular equilibrium ratio is 1.0352 2 times the relative intensity.

From α_K(exp).

@ For absolute intensity per 100 decays, multiply by 0.822 7.

Decay Scheme

⁸⁷Y ϵ Decay (13.37 h) 1969Zo04,1967Mi13

Parent ⁸⁷Y: E=380.82 7; J π =9/2+; T_{1/2}=13.37 h 3; Q(g.s.)=1861.7 11; % ϵ +% β^+ decay=1.57 10.
1969Zo04 and 1967Mi13 observed a β^+ branch a half-life of 13 h to the ground state of ⁸⁷Sr. 1971Ja24 did not observe this branch and suggest the reported β^+ 's are from the decay of 14.7 h ⁸⁶Y.

⁸⁷Sr Levels

E(level)	J $\pi^\dagger$
0.0	9/2+

† From ⁸⁷Sr Adopted Levels.

β^+, ϵ Data

E $\epsilon^\dagger$	E(level)	I $\beta^+\$$	I $\epsilon\$$	Log ft	I($\epsilon+\beta^+$) $^\ddagger\$$
(2242.5 11)	0.0	0.75 5	0.82 6	7.44 3	1.57 11

† Q=2172 40 keV from measured E β_+ =1150 40 (1969Zo04). Other E β_+ measurements: 1540 (1967Mi13), 1500 (1970Ak05). From the Q value, E β_+ =1220.4 11.

‡ From the logft systematics (1998Si17) and the data of 1969Zo04, one can obtain upper limits on the intensities of the ϵ branches to the excited levels in ⁸⁷Sr. From the logft systematics these limits are: 388-keV level, 1.0x10⁻¹³%; 873-keV level, 1.0x10⁻¹⁰%; 1228-keV level, 1.0x10⁻⁴%; 1253-keV level, 1.0%; and 1740-keV level, 2.0x10⁻⁵%. From the measurements of 1969Zo04, the branches to the 1228 and 1740 levels are <0.05%.

$\$$ Absolute intensity per 100 decays.

⁸²Se(⁹Be,4n γ) 2014Li28

2014Li28: E=46 MeV. Measured E γ , I γ , $\gamma\gamma$ coin, directional correlation of oriented nuclei (DCO) ratios using an array of nine Compton-suppressed HPGe detectors at HI-13 tandem accelerator facility of CIAE. Deduced high-spin levels, J, π , bands, multipolarity, configurations.

⁸⁷Sr Levels

E(level) †	J $\pi^\ddagger$	Comments
0.0@	9/2+	Configuration= $\nu g_{9/2}^{-1}$.
1739.6@ 4	13/2+	Configuration= $\pi(p_{3/2}^{-1}p_{1/2})\otimes \nu g_{9/2}^{-1}$.
2595.3\$ 7	13/2-	
2830.5\$@ 6	15/2-	
3248.7#@ 6	17/2(-)	
3390.2#@ 7	19/2(-)	
3610.3#@ 7	21/2(-)	
3685.4 7	17/2(+)	J π : Assigned as (17/2) in Adopted Levels. Although the authors take the 1946 γ as a stretched quadrupole, the large uncertainty for the DCO ratio does not exclude dipole character.
3717.2@ 8	19/2(-)	
4171.3& 7	17/2(+)	
4440.0@ 9	23/2(-)	Configuration= $\pi(f_{5/2}^{-1}g_{9/2})\otimes \nu g_{9/2}^{-1}$. J π : As the dipole character of the 830 γ only establishes ΔJ , this is assigned as (23/2) in Adopted Levels.
4570.8& 7	19/2(+)	
4671.2& 7	21/2(+)	
5173.1& 8	23/2(+)	
5884.7& 9	25/2(+)	
6074.2 8	25/2(+)	
6373.6& 9	27/2(+)	
6674.1& 10	29/2(+)	
7442.0& 11	31/2(+)	

† From least-squares fit (by compiler) to E γ data.

‡ As proposed in 2014Li28 based on their DCO data, band associations and previous assignments.

$\$$ Configuration= $\pi(p_{3/2}^{-1}g_{9/2})\otimes \nu g_{9/2}^{-1}$.

Configuration= $\pi(p_{3/2}^{-1}g_{9/2})\otimes \nu g_{9/2}^{-1}$ or $\pi(f_{5/2}^{-1}g_{9/2})\otimes \nu g_{9/2}^{-1}$.

Footnotes continued on next page

⁸²Se(⁹Be,4n γ) ²⁰¹⁴Li28 (continued)

⁸⁷Sr Levels (continued)

@ (A): γ cascade based on g.s.

& (B): γ cascade based on 17/2(+). Configuration= $\pi[(p_{3/2}f_{5/2}p_{1/2})^{-2}(g_{9/2}^2)]\otimes \nu g_{9/2}^{-1}$.

$\gamma(^{87}\text{Sr})$

DCO ratios correspond to 90° and 140° geometry with gates on $\Delta J=2$, quadrupole transitions or $\Delta J=1$, dipole transitions. Expected DCO values are: 1.0 for $\Delta J=2$, quadrupole and 0.5 for $\Delta J=1$, dipole when gated on $\Delta J=2$, quadrupole. 1.0 for $\Delta J=1$, dipole and 1.6 for $\Delta J=2$, quadrupole when gated on $\Delta J=1$, dipole. Gates are on $\Delta J=2$, quadrupole, unless otherwise stated. The authors note that the DCO ratios can not distinguish stretched quadrupole from $\Delta J=0$ dipole transitions, and that for these cases cross checks from from crossover or parallel transitions were used to provide additional support.

E γ	E(level)	I $\gamma^\dagger$	Mult.	Comments
100.4 4	4671.2	11.6 10		
141.5 4	3390.2	33.8 18		DCO=0.68 18.
220.1 4	3610.3	25.5 13	(D)	DCO=0.57 7.
235.2 7	2830.5	1.0 3	(D)	DCO=0.33 13.
299.4 7	6373.6	6.9 7		
300.5 $\ddagger$ 4	6674.1	14.2 6	(D)	DCO=0.88 22.
327.0 7	3717.2	7.5 4	(D)	DCO=0.89 19.
399.5 7	4570.8	6.2 7	(D)	DCO=0.65 11.
418.2 4	3248.7	58.9 28	(D)	DCO=0.54 4.
488.8 7	6373.6	7.6 6	(D)	DCO=0.49 8.
501.9 4	5173.1	22.5 14	(D)	DCO=0.47 5.
711.6 4	5884.7	11.8 7	(D)	DCO=0.40 7.
767.9 $\ddagger$ 4	7442.0	12.0 10	(D)	DCO=0.97 16.
829.7 $\ddagger$ 7	4440.0	9.6 10	(D)	DCO=0.87 7.
855.7 7	2595.3	5.1 3		DCO=1.05 44.
Mult.: The authors did not assign a multipolarity based on this work, but used that from 1975Ar06 and 1981Ek01.				
885.4 7	4570.8	<0.5		
901.0 4	6074.2	10.1 9	(D)	DCO=0.30 4.
954.0 7	4671.2	6.2 8	(D)	DCO=0.45 18.
985.8 7	4671.2	<0.5		
1060.9 7	4671.2	2.5 3		
1090.9 4	2830.5	67.5 33		DCO=0.44 4.
Mult.: The authors did not assign a multipolarity based on this work, but used that from 1975Ar06 and 1981Ek01.				
1180.6 $\ddagger$ 7	4570.8	3.9 5		DCO=1.40 30.
1281.0 $\ddagger$ 7	4671.2	2.9 4		DCO=0.91 25.
1322.1 7	4570.8	8.5 5	(D)	DCO=0.41 8.
1340.8 7	4171.3	1.1 2		
1562.8 7	5173.1	2.4 5		
1634.1 7	6074.2	1.0 2		
1739.6 4	1739.6	100.0 17		
1945.8 7	3685.4	3.1 4		DCO=0.82 29.
2431.7 7	4171.3	1.7 3		

$\dagger$ Based on a general comment by 2014Li28, uncertainty=0.4 keV for $I_\gamma \geq 10$, 0.7 keV for $I_\gamma < 10$.

$\ddagger$ For DCO value, gate is on $\Delta J=1$, dipole transition.

82Se(9Be,4nγ) 2014Li28 (continued)

Level Scheme

Intensities: relative I_γ

87Sr49

86Kr(α,3nγ), 84Kr(α,nγ) 1981Ek01, 1975Ar06

1981Ek01: ⁸⁴Kr(α,nγ), E=11–17 MeV, Ge detectors, measured γ spectra, angular distributions, linear polarization, excitation functions, γγ coincidences, and DSA half-life measurements.

1975Ar06: ⁸⁴Kr(α,xnγ), E=10–14 MeV and ⁸⁶Kr(α,3nγ), E=11–40 MeV, Ge detectors, measured γ spectra, angular distributions, γγ coincidences, and DSA half-life measurements.

87Sr Levels

E(level)	Jπ [†]	T _{1/2} [‡]	Comments
0.0	9/2+		
388.54 18	1/2-	2.815 h 12	T _{1/2} : from Adopted Levels. Jπ: From Adopted Levels.
873.29 24	3/2-	1.7 ps 7	Jπ: linear polarization measurements and additional arguments in Adopted Levels.
1228.36 23	5/2+	1.0 ps 4	Jπ: from E1 γ to 3/2- level and E2 γ to 9/2+ supported by γ(θ) and γ(pol).
1254.0 3	5/2-	2.8 ps +28-9	Jπ: γ(θ) and γ(pol) supporting E2 γ to 1/2-; additional argument in Adopted Levels.
1740.0 4	13/2+§	0.28 ps 9	Jπ: γ yield function and yrast argument.
1770.7 3	5/2+	5.5 ps +63-21	Jπ: γ(θ) and polarization supporting E2 γ to 9/2+; additional argument in Adopted Levels.
1919.9 4	7/2+	0.15 ps 5	Jπ: γ(θ) and γ(pol) are consistent only with J ^π =7/2+ and J ^π =11/2+ (1981Ek01).
2109.8 5	3/2-	0.10 ps 3	Jπ: Adopted Levels and consistent with γ(θ) and polarization.
2153.5 6	(11/2)+	<0.09 ps	Jπ: γ(θ) and polarization supporting M1+E2 γ to 9/2+; additional argument in Adopted Levels.
2168.8 4	(1/2+)		
2235.7 10	9/2+	0.15 ps 4	Jπ: γ(θ) and γ(pol) are consistent only with J ^π =9/2+ (1981Ek01).
2414.7 3	3/2-	0.12 ps 4	Jπ: γ excitation function suggests J=(3/2) (1981Ek01).
2420.4 8	(5/2)-	0.08 ps 4	Jπ: γ excitation function suggests J=(5/2) (1981Ek01).
2536.3 6	11/2-	0.19 ps 8	T _{1/2} : from measurement at E _α =11 MeV; at E _α =14 MeV 1981Ek01 measure 0.19 ps 4. Jπ: from γ(θ) and γ(pol) for 591 γ 1981Ek01 derive J ^π =11/2-.
2550.0 8	(7/2)+	0.22 ps 7	Jπ: γ excitation function suggests J=(7/2) (1981Ek01); further supported by γ(θ) and γ(pol).

Continued on next page (footnotes at end of table)

⁸⁶Kr($\alpha, 3n\gamma$), ⁸⁴Kr($\alpha, n\gamma$) 1981Ek01, 1975Ar06 (continued)

⁸⁷Sr Levels (continued)

E(level)	J $\pi^\dagger$	T _{1/2} [‡]	Comments
2555.0 7	(9/2)-	0.06 ps 4	J π : From Adopted Levels.
2596.0 5	13/2-	1.0 ps 4	J π : Supported by $\gamma(0)$ and $\gamma(\text{pol})$ with additional argument in Adopted Levels.
2682.2 6	(3/2)+	0.25 ps 9	J π : $\gamma(0)$, $\gamma(\text{pol})$, and excitation function in ($\alpha, n\gamma$) favor J π =(3/2)+.
2704.3? 20			E(level): not confirmed by 1981Ek01.
2706.9 6	7/2+, 9/2+	0.55 ps 14	J π : From Adopted Levels.
2821.2 6	(9/2)+	0.7 ps 3	J π : $\gamma(0)$ and polarization for 1050 γ give 5/2+, 7/2+, 9/2+ and J γ excitation function suggests J $\geq$ 9/2 (1981Ek01).
2831.2 5	15/2-	<0.35 ps	J π : From Adopted Levels.
2920.8 12	7/2+, 9/2+		J π : From Adopted Levels.
3035.5 5			
3117.4 6	13/2-	0.38 ps 12	J π : from $\gamma(0)$ and $\gamma(\text{pol})$ 1981Ek01 derive J π =13/2-.
3155.0 15			
3249.4 5	(17/2)- [§]	1.3 ps +16-6	J π : from $\gamma(0)$, $\gamma(\text{pol})$, and excitation function.
3390.9 6	(19/2)- [§]		J π : yield function and additional arguments in Adopted Levels.
3610.9 6	(21/2) [§]		J π : Yield functions.
3718.0 6	(19/2)		J π : from γ yield functions and correlation of alignment to initial J.
4440.3 10	(23/2) [§]		J π : presumably dipole γ to 21/2+; from γ yield functions in it follows that 829 γ is part of the yrast cascade.

[†] Assignments are from these data while those from Adopted Levels are indicated.

[‡] From DSAM analysis (1981Ek01), unless indicated otherwise.

[§] From γ yield functions, 1975Ar06 conclude that the 1740-1091-418-142-220-829 cascade forms the yrast cascade whereby the 1740 transition is an E2 transition and the other transitions are dipole transitions.

 $\gamma(^{87}\text{Sr})$

Coin from 1981Ek01.

E $\gamma^\dagger$	E(level)	I $\gamma^\ddagger$	Mult. [§]	$\delta^\S$	α	Comments
141.5 2	3390.9	14 5	(D) ^a			
220.0 2	3610.9	1.6 2	(D) ^a			
235.2 [#] 4	2831.2	2.2				E γ : Not reported by 1981Ek01. From I $\gamma(235\gamma)/I\gamma(1091\gamma)=0.067$ in 1975Ar06. A ₂ =-0.29 11, A ₄ =0 (1975Ar06). A ₂ =+0.39 5, A ₄ =-0.10 7. A ₂ =-0.106 18, A ₄ =-0.005 21. Pol=+0.25 5. B(E1)(W.u.)=(0.0012 4); B(M2)(W.u.)=(210 140). Mult.: M2 exceeds RUL by 1 to 2 σ . Using the minimum δ and maximum T _{1/2} , B(M2)(W.u.)>12, while the maximum δ and minimum T _{1/2} yields B(M2)(W.u.)<575. The RUL limit is 1. B(E1)(W.u.)=0.0012 4.
327.1 3	3718.0	1.85 8				
355.1 2	1228.36	17.9 5	E1 (+M2)	+0.07 +2-5	0.00280 11	
380.8 3	1254.0	11 4				
388.6 ^{#b} 2	388.54		M4			
418.2 2	3249.4	20.0 6	M1+E2		0.0052 12	Mult.: From Adopted Levels. A ₂ =-0.239 16, A ₄ =-0.007 20. Pol=-0.29 5. A ₂ =-0.018 18, A ₄ =-0.023 22. Pol=-0.14 2.
484.9 ^{#b} 3	873.29	123 4	M1+E2	+0.19 5	0.00286 5	
517.3 [@] 10	1770.7	10 3				
521.0 [@] 7	3117.4	3.6 2	M1+E2	+0.29 16	0.00245 9	A ₂ =+0.50 8, A ₄ =-0.09 8. Pol=+0.37 23. A ₂ =+0.139 18, A ₄ =-0.018 22. Pol=+0.25 7.
542.3 3	1770.7	15.1 5	M1 (+E2)	-0.04 8	0.00217 4	
581.3 5	3117.4	5.7 2	M1+E2	+0.047 +12-23	0.00185	A ₂ =-0.21 4, A ₄ =0.00 4. Pol=-0.68 15. POL=-0.02 7.
691.8 4	1919.9	9 3				
787.0 4	2706.9	8.1 3	M1 (+E2)	0.00 9	9.39 $\times 10^{-4}$	A ₂ =-0.312 23, A ₄ =-0.012 27. Pol=-0.41 15.
x806.8 [#] 6						

Continued on next page (footnotes at end of table)

$^{86}\text{Kr}(\alpha, 3n\gamma)$, $^{84}\text{Kr}(\alpha, n\gamma)$ 1981Ek01, 1975Ar06 (continued) $\gamma(^{87}\text{Sr})$ (continued)

$E\gamma^\dagger$	E(level)	$I\gamma^\ddagger$	Mult.§	$\delta^\S$	α	Comments
829.4# 8	4440.3		(D) ^a			$A_2=-0.25$ 22, $A_4=0$ (1975Ar06).
855.9 3	2596.0	37.9 11	E1+(M2)	-0.10 12	0.00035 6	$A_2=+0.299$ 24, $A_4=+0.001$ 28. Pol=-0.62 9.
865.4#b 4	1254.0	64.4 19	E2		8.17×10^{-4}	$A_2=+0.190$ 20, $A_4=-0.031$ 24. Pol=+0.30 4. δ : $\delta(M3/E2)=0.00$ +11-27.
882.0@ 8	3035.5	10 3				
911.5 5	2682.2	6.2 3	M1+E2	-0.5 +3-13	6.90×10^{-4} 24	$A_2=+0.08$ 4, $A_4=-0.01$ 5. Pol=-0.04 17.
^x 1034.4# 8						
1050.5 5	2821.2	7.5 3	E2		5.17×10^{-4}	$A_2=+0.30$ 3, $A_4=-0.01$ 4. Pol=0.29 16.
1091.3 3	2831.2	32.9 12	E1(+M2)	+0.012 17	2.11×10^{-4}	$A_2=-0.256$ 16, $A_4=-0.021$ 20. Pol=+0.39 5. δ : $\delta(M2/E1)=+0.012$ 17.
1166.9@ 12	2420.4	10.5 4	D+Q			$A_2=+0.36$ 3, $A_4=-0.03$ 4. Pol=-0.51 25.
1228.5#b 4	1228.36	100 3	E2		3.78×10^{-4}	$A_2=+0.107$ 16, $a_4=-0.024$ 20. Pol=+0.14 3.
1236.5 4	2109.8	8.9 4	M1+E2		3.73×10^{-4}	$A_2=+0.15$ 4, $A_4=-0.10$ 4. Pol=+0.15 19.
1295.5 ^d 3	2168.8	5 ^{cd} 4				
	3035.5	10 ^{cd} 3				
1321.6 7	2550.0	14.1 6	M1+E2		3.43×10^{-4} 6	$A_2=-0.166$ 22, $A_4=0.007$ 27. Pol=+0.07 12.
1546.7@ 10	2420.4	8 3				
1739.8 4	1740.0	165 5	E2		3.67×10^{-4}	$A_2=+0.369$ 19, $A_4=-0.095$ 23. Pol=+0.62 5. δ : $\delta(M3/E2)=+0.02$ 3.
1770.4 5	1770.7	32.5 10	E2		3.75×10^{-4}	$A_2=+0.059$ 16, $A_4=-0.033$ 20. Pol=+0.10 18.
1919.4 6	1919.9	44.5 13	M1+E2	+0.70 5	3.96×10^{-4}	$A_2=-0.537$ 14, $A_4=0.003$ 16. Pol=+0.07 7.
2026.2 ^b 10	2414.7	≈ 3				
2153.5 7	2153.5	46 2	M1+E2	-0.80 10	4.78×10^{-4} 8	$A_2=-0.907$ 18, $A_4=0.110$ 20. Pol=+0.20 6.
2235.7 10	2235.7	30.7 9	E2(+M1)	>4	5.35×10^{-4}	$A_2=-0.142$ 20, $A_4=-0.085$ 24. Pol=-0.35 14.
2536.7 7	2536.3	30.6 12	E1+M2	-0.18 +13-22	0.00101 6	$A_2=-0.28$ 3, $A_4=0.02$ 3. Pol=+0.13 12.
2555.0 7	2555.0	22.5 9	E1		1.04×10^{-3}	$A_2=+0.39$ 4, $A_4=-0.04$ 5. Pol=-0.47 20. δ : $\delta(M2/E1)=+0.03$ 3.
2704.3# 20	2704.3?					
2920.7 12	2920.8					
3154.9@ 15	3155.0					

[†] Weighted average from 1981Ek01 and 1975Ar06, unless indicated otherwise.

[‡] From 1981Ek01, measured at $E_\alpha=14$ MeV, unless indicated otherwise; other: 1975Ar06 values given without uncertainties.

[§] From γ angular distribution and γ linear polarization at 90° (1981Ek01), unless noted otherwise.

From 1975Ar06 only.

@ From 1981Ek01 only.

^a From γ angular distribution at $E_\alpha=14$ MeV in $^{84}\text{Kr}(\alpha, n\gamma)$ and A_2 at $E_\alpha=31$ MeV in $^{86}\text{Kr}(\alpha, 3n\gamma)$ (1975Ar06).

^b Used from 1977Ba61 by 1981Ek01 for internal calibration lines.

^c The authors' statement that the $I\gamma$ ratio from the 3035 and 2169 levels is approximately 1:2 appears to be a misprint. From their level scheme, and $I\gamma=15$ 2 for the doublet, one gets $I\gamma=10$ +7-5 for placement from the 3035 level, and 5 -5+7 for placement from the 2168 level.

^d Multiply placed; intensity suitably divided.

^x γ ray not placed in level scheme.

⁸⁶Kr(α,3nγ),⁸⁴Kr(α,nγ) 1981Ek01,1975Ar06 (continued)

Level Scheme

@ Multiply placed; intensity suitably divided
Intensities: relative I(γ+ce)

⁸⁶Sr(n,γ) E=th 1986Wi16

E_n=thermal, 95.8% enriched ⁸⁶Sr target, pair and intrinsic Ge spectrometer and report 759 γ's. The establishment of levels by 1986Wi16 is based on the assumption that primary γ transitions are dipole transitions only. Because of the large number of unplaced γ's and large deviations in γ intensity balance, the level scheme above 2900 keV is to be considered as tentative. Other: 1968Ir01 and 1969Ly07 report 4 to 8 γ rays from capture in natural Sr and 1972Gr23 report 31 γ's from capture in an enriched target. 1989Wi09 discuss strength functions for the primary γ's.

⁸⁷Sr Levels

E(level) [†]	Jπ [‡]	T _{1/2}	Comments
0.0	9/2+		
388.528 27	1/2-	2.815 h 12	T _{1/2} : from ^{87m} Sr isomeric decay n.
873.355 § 28	3/2-		
1228.421 § 23	5/2+		
1253.940 § 26	5/2-		
1770.46 3	5/2+		
2110.07 § 4	3/2-		

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	Comments
2169.43 \$ 4	(1/2+)	
2414.52 \$ 4	3/2-	
2676.86 \$ 4	3/2+	
2850.52 \$ 5	1/2-, 3/2-	
2921.08 \$ 7	3/2-	Jπ: 1986Wi16 assign 3/2,5/2+.
2940.70 \$ 6	1/2+	
3007.24 \$ 8	3/2-	
3019.17 \$ 7	1/2-, 3/2-	
3066.33 \$ 7	(1/2-, 3/2)	
3125.28 \$ 7	1/2+	Jπ: For additional support see Adopted Levels.
3151.54 \$ 8	(3/2)+	
3232.17 \$ 8	(1/2, 3/2)	
3258.80 8	(5/2)+	
3277.49 \$ 8	5/2+	Jπ: 1986Wi16 assign 3/2+.
3371.55 \$ 9	1/2+, 3/2	
3415.74 \$ 9	(1/2-, 3/2-)	
3425.54 8	5/2-	Jπ: 1986Wi16 assign 3/2.
3431.32 \$ 9	1/2-, 3/2	
3507.06 \$ 8	(3/2)+	
3602.58 \$ 8	3/2+	
3607.55 \$ 9	1/2+, 3/2	
3674.09 \$ 10	(1/2-, 3/2)	Jπ: (3/2+) in Adopted Levels.
3716.78 \$ 9	(1/2, 3/2)	
3731.32 \$ 10	3/2	
3765.39 \$ 11	1/2-, 3/2	
3775.92 \$ 10	1/2, 3/2	Jπ: 3/2+ in Adopted Levels.
3872.10 \$ 10	1/2+, 3/2	
3951.40 \$ 10	1/2, 3/2	
3958.51 \$ 10	3/2+	
4026.36 \$ 9	1/2-, 3/2	
4056.20 \$ 10	1/2, 3/2	
4080.79 \$ 11	(3/2+)	
4164.92 \$ 9	(1/2-, 3/2-)	
4182.33 \$ 9	1/2+, 3/2	
4196.75 \$ 10	3/2+	
4223.99 \$ 10	1/2+, 3/2+	
4235.61 \$ 10	3/2+, 5/2+	
4336.93 \$ 9	(1/2+, 3/2)	
4435.66 \$ 11	(1/2+, 3/2)	
4536.55 \$ 10	1/2-, 3/2	
4551.23 \$ 10	1/2+, 3/2	
4604.83 \$ 11	1/2, 3/2	
4643.94 \$ 11	1/2+, 3/2	
4651.20 \$ 10	1/2+, 3/2	
4684.57 \$ 10	1/2-, 3/2	
4783.69 \$ 10	1/2+, 3/2	
4789.82 \$ 11	3/2	
4826.79 \$ 11	1/2+, 3/2	
4921.76 \$ 13		
4953.03 \$ 11	1/2, 3/2	
4964.22 \$ 11	1/2+, 3/2	
5062.99 \$ 11	1/2+, 3/2	
5067.57 \$ 12	1/2+, 3/2	
5082.43 \$ 11	1/2, 3/2	
5090.94 \$ 11	1/2, 3/2	
5106.38 \$ 13	1/2-, 3/2-	
5142.27 \$ 18	1/2, 3/2, 5/2+	
5207.13 \$ 11	1/2+, 3/2	
5282.21 \$ 12	1/2-, 3/2-	
5296.01 \$ 12	1/2+, 3/2	
5333.18 \$ 12	1/2, 3/2	
5378.82 \$ 12	1/2-, 3/2	
5397.10 \$ 12	1/2, 3/2	

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

⁸⁷Sr Levels (continued)

E(level) [†]	Jπ [‡]	Comments
5647.19 § 13	1/2-, 3/2	
5673.09 § 14	1/2, 3/2	
5811.05 § 12	1/2, 3/2	
5843.19 § 13	3/2	
5943.04 § 14	3/2	
6074.27 § 14	1/2+, 3/2	
6093.48 § 14	1/2+, 3/2	
6189.05 § 14	1/2(+), 3/2	
7032.40 § 14	1/2-, 3/2	
(8428.15 12)	1/2+	E(level): neutron-capture state. E is from adopted S(n). The authors give E=8428.16 17. Jπ: from s-wave capture on a 0+ target.

[†] As given by 1986Wi16 from a least-squares fit to E_γ's. The uncertainties includes a systematic component assigned by the authors.

[‡] From ⁸⁷Sr Adopted Levels; where the assignment of 1986Wi16 differs significantly, this is noted.

§ Fed by primary γ.

γ(⁸⁷Sr)

I_γ normalization: 1986Wi16 normalize I_γ so that Σ_i (E_{γ_i} * I_{γ_i})/S(n)=100.

E _γ [†]	E(level)	I _γ ^{‡§c}	Comments
355.075 30	1228.421	1.11 22	
380.570 29	1253.940	1.4 3	
388.517 28	388.528	54.8 ^a 11	
465.53 & 5	4182.33	0.100 21	
484.789 & 27	873.355	29 6	
542.039 & 27	1770.46	1.36 20	
557.23 6	4164.92	0.061 10	
^x 561.26 13		0.027 6	
566.55 & 10	2676.86	0.035 7	
571.74 15	4336.93	0.023 5	
580.03 & 9	3951.40	0.044 8	
581.83 10	3258.80	0.041 8	
627.32 & 6	4964.22	0.063 10	
643.83 9	2414.52	0.044 8	
^x 645.75 13		0.029 6	
^x 651.24 7		0.055 9	
^x 657.45 8		0.044 8	
662.71 11	4336.93	0.031 6	
666.80 & 13	3607.55	0.025 5	
^x 691.39 3		0.21 3	
709.67 & 5	3775.92	0.101 16	
^x 711.70 5		0.110 17	
737.07 & 15	3151.54	0.022 5	
740.58 4	2850.52	0.122 19	
759.57 17	5296.01	0.020 5	
765.25 16	4196.75	0.022 5	
770.77 & 9	4953.03	0.045 8	
774.29 15	5378.82	0.022 5	
^x 777.66 8		0.044 8	
781.85 & 10	4964.22	0.035 7	
795.58 25	3716.78	0.014 5	
799.26 7	4964.22	0.051 9	
^x 808.87 10		0.037 7	
811.09 & 12	2921.08	0.030 6	
^x 816.06 14		0.029 6	
823.50 & 17	3674.09	0.020 5	
828.68 9	4604.83	0.035 7	
^x 841.66 7		0.058 10	
844.35 & 4	3258.80	0.17 3	
856.07 & 3	2110.07	0.37 6	

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⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ [±] %c	Comments
865.414& 25	1253.940	6.8 10	
874.05 21	4604.83	0.017 6	
876.94 10	4551.23	0.035 7	
881.51 13	2110.07	0.028 6	
908.96# 4	3019.17	0.123 19	
911.343 25	4336.93	1.39 21	
915.56@ 8	2169.43	0.046 8	
925.21 9	3775.92	0.050 8	
927.39 8	4643.94	0.052 9	
934.45 3	4651.20	0.23 4	
x936.67 4		0.18 3	
953.10 12	4684.57	0.036 7	
965.67 13	4336.93	0.029 6	
990.11& 14	5943.04	0.027 6	
x995.36 4		0.18 3	
997.11& 9	4604.83	0.065 11	
x1000.21 6		0.069 11	
x1008.78 8		0.051 9	
x1017.10 7		0.059 10	
1019.61 14	4435.66	0.029 6	
x1023.14 10		0.039 7	
1028.64 19	5673.09	0.021 5	
1034.64 4	5090.94	0.150 23	
1041.56& 10	3151.54	0.038 7	
1050.28 17	5106.38	0.025 5	
1061.52& 5	4080.79	0.107 17	
1064.63 7	5090.94	0.059 10	
x1067.31 9		0.047 8	
1076.91 4	4684.57	0.126 19	
1084.13 13	4235.61	0.029 6	
1111.68 6	5062.99	0.068 11	
1115.50& 17	4056.20	0.022 5	
1120.71 16	4536.55	0.024 5	
1130.94& 6	5082.43	0.123 19	
1132.54 8	5090.94	0.081 13	
1137.01 9	4643.94	0.044 8	
1145.71& 3	4164.92	0.54 8	
1148.76 10	3258.80	0.049 8	
1158.04 9	4435.66	0.065 11	
x1166.44 3		0.45 7	
1169.26 13	4235.61	0.049 9	
1172.97 12	5397.10	0.044 8	
x1182.78 7		0.091 15	
1187.31& 12	4789.82	0.066 13	
x1188.69 8		0.097 17	
1192.01 5	5843.19	0.109 17	
1199.04& 16	4964.22	0.029 6	
x1209.42 8		0.058 10	
1212.30 18	4643.94	0.023 6	
1224.26& 3	4164.92	0.066 11	
1228.42 3	1228.421	9.2 14	
1236.72& 3	2110.07	5.0 8	
1243.80 9	4164.92	0.055 9	
1246.31 4	3415.74	0.21 3	
1248.55& 6	3019.17	0.096 15	
1273.61 18	4551.23	0.024 6	
1276.6& 3	4783.69	0.016 5	
1286.94 8	5062.99	0.097 17	
x1288.51 15		0.052 11	
1296.02 3	2169.43	4.7 7	
1314.28& 4	4921.76	0.150 23	
x1329.15 7		0.072 12	
1351.01& 11	3765.39	0.041 8	

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ ^{‡§c}	Comments
1362.24 7	6189.05	0.075 12	
1366.36& 15	4643.94	0.032 6	
^x 1377.70 4		0.23 4	
1381.18 6	3151.54	0.23 4	
1385.19& 6	4643.94	0.094 15	
1395.74 3	(8428.15)	0.30 5	
1399.48& 12	4551.23	0.037 7	
^x 1403.23 3		0.34 5	
1411.19& 6	4536.55	0.087 14	
^x 1415.01 5		0.106 17	
1422.99& 4	2676.86	0.177 27	
1428.46& 5	4435.66	0.106 17	
1453.37 6	4604.83	0.141 22	
1455.23& 7	4826.79	0.110 18	
^x 1481.76 11		0.066 11	
^x 1485.61 7		0.148 24	
1488.59& 13	3258.80	0.042 8	
1497.29 7	3607.55	0.101 16	
^x 1507.77 6		0.111 17	
^x 1512.91 12		0.052 9	
^x 1520.39 9		0.060 10	
1538.51& 4	4604.83	0.21 3	
1541.20 3	2414.52	1.10 17	
1543.85#& 6	3958.51	0.124 19	
1547.08 3	4223.99	0.70 11	
1549.37 8	4826.79	0.091 15	
1559.42 6	4684.57	0.125 20	
1563.7& 4	3674.09	0.109 18	
^x 1568.95 9		0.067 11	
^x 1574.44 10		0.076 13	
^x 1586.18 7		0.089 14	
1600.94 8	3371.55	0.081 13	
^x 1603.40 12		0.059 10	
1606.02 8	5943.04	0.083 14	
1611.84 6	4026.36	0.135 21	
1614.44 10	5811.05	0.063 11	
^x 1627.10 14		0.038 8	
1632.08& 8	4783.69	0.074 12	
1646.04 7	5811.05	0.089 14	
1659.66 4	5090.94	0.33 5	
1665.43& 4	4684.57	<0.17	
	5090.94	<0.17	
1667.12 6	2921.08	0.18 3	
^x 1673.36 15		0.035 7	
1677.37 7	4684.57	0.090 14	
^x 1695.11 16		0.040 8	
1702.76 13	3872.10	0.040 9	
1712.09 11	2940.70	0.060 10	
1714.49 8	5673.09	0.090 14	
1721.61& 3	2110.07	0.93 14	
^x 1749.20 11		0.053 9	
1753.24& 16	3007.24	0.035 7	
1765.23 3	3019.17	1.35 20	
1770.48 3	1770.46	4.5 7	
1781.95 5	3951.40	0.17 3	
1791.65 11	5207.13	0.047 9	
1803.47 4	2676.86	0.45 7	
^x 1808.47 6		0.132 21	
1812.37 3	3066.33	1.59 24	
^x 1821.79 11		0.063 11	
^x 1829.85 10		0.078 13	
1832.12& 4	3602.58	0.34 5	
^x 1841.83 5		0.161 25	

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ [±] % ^c	Comments
^x 1853.89 16		0.047 9	
^x 1856.12 5		0.24 4	
1864.3& 3	5142.27	0.020 6	
1869.44 10	6093.48	0.062 11	
^x 1872.97 7		0.090 14	
^x 1876.16 6		0.129 20	
1890.05& 5	5397.10	0.131 20	
1896.87& 5	3125.28	0.35 6	
^x 1898.50 12		0.142 24	
^x 1900.90 10		0.088 14	
^x 1908.77 12		0.095 16	
^x 1911.84 4		0.38 6	
1915.99& 5	5067.57	0.156 24	
^x 1919.96 3		0.83 12	
1923.27 6	3151.54	0.108 17	
1933.23 5	4783.69	0.19 3	
1938.92 8	5811.05	0.099 16	
1941.42& 19	7032.40	0.037 8	
^x 1952.46 15		0.063 11	
^x 1955.43 10		0.068 11	
^x 1962.20 4		0.27 4	
1965.72& 17	5397.10	0.035 8	
1971.15 7	5843.19	0.122 19	
1977.11 3	2850.52	2.9 5	
^x 1987.89 4		0.23 4	
1995.46 3	4164.92	1.19 18	
^x 2002.24 8		0.30 3	
^x 2006.16 14		0.092 12	
^x 2011.95 8		0.231 25	
2018.06 11	6074.27	0.122 15	
2026.02 6	2414.52	5.2 5	
2031.96 8	4953.03	0.34 4	
2035.24 7	5811.05	0.37 4	
2044.77 8	5647.19	0.220 24	
2049.05 12	3277.49	0.114 14	
2054.88 7	4164.92	0.33 4	
2071.14& 14	5943.04	0.20 3	
2072.8& 6	4182.33	0.40 5	
^x 2088.02 20		0.153 23	
^x 2089 3		≤0.029	I _γ : The authors give 0.010 19.
2099.46 17	5106.38	0.096 14	
2101.93& 25	3872.10	0.059 12	
2122.04& 9	4536.55	0.187 20	
2126.47& 14	5067.57	0.085 11	
2133.87 10	3007.24	0.146 16	
2145.87 6	3019.17	0.89 9	
2157.13 23	5282.21	0.072 13	
2161.63& 21	3415.74	0.085 15	
2167.42& 15	5943.04	0.072 10	
2177.39& 8	3431.32	0.198 21	
2184.84# 15	5106.38	0.066 9	
2193.04 6	3066.33	4.0 4	
2196.89 13	3425.54	0.098 12	
^x 2208.57 9		0.161 17	
^x 2213.25 14		0.073 9	
2227.05& 12	4336.93	0.094 12	
2236.95 19	4651.20	0.100 16	
2238.99 7	(8428.15)	0.44 5	
2245.06 9	4921.76	0.138 15	
2251.89 6	3125.28	0.98 10	
^x 2256.46 7		0.26 3	
2266.85 10	5333.18	0.104 12	
2278.74 8	3507.06	0.54 6	

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ ^{‡§c}	Comments
2288.23 6	2676.86	2.6 3	
^x 2293.83 9		0.193 21	
^x 2296.26 8		0.35 4	
^x 2299.93 10		0.126 14	
2308.94 10	6074.27	0.105 12	
^x 2319.66 10		0.180 21	
^x 2324.53 7		0.218 23	
2334.88 7	(8428.15)	0.40 4	
^x 2338.00 10		0.134 15	
2353.91 7	(8428.15)	0.44 5	
2369.36& 16	4783.69	0.066 9	
2375.38 12	4789.82	0.088 10	
2378.6& 5	3607.55	0.137 15	
2385.70& 11	5811.05	0.080 9	
2394.79 15	4164.92	0.063 8	
2404.06 7	3277.49	0.57 6	
^x 2407.08 14		0.079 10	
2411.73& 13	4182.33	0.074 9	
2414.93 9	5647.19	0.152 16	
2419.98& 18	3674.09	0.064 9	
^x 2422.44 23		0.050 8	
2426.37& 8	4196.75	0.160 17	
^x 2431.37 9		0.134 14	
2445.52& 11	3674.09	0.088 10	
^x 2449.77 8		0.182 19	
2453.63 10	4223.99	0.108 12	
^x 2462.40 8		0.43 5	
^x 2468.86 9		0.130 14	
2477.36 8	3731.32	0.29 3	
2485.12 7	(8428.15)	0.71 7	
2495.79& 8	7032.40	0.29 3	
2498.33 7	3371.55	0.53 5	
2503.2 4	3731.32	0.115 12	
2506.95 18	4921.76	0.075 10	
^x 2509.55 18		0.115 15	
2511.73& 13	3765.39	0.129 17	
^x 2526.98 8		0.225 23	
2530.24 9	5207.13	0.151 16	
^x 2541.52 8		0.189 20	
2552.24 ^d 6	2940.70	1.21 ^d 12	
	3425.54	1.21 ^d 12	
^x 2560.26 8		0.127 13	
2566.50 7	4336.93	0.49 5	
2585.11 7	(8428.15)	0.43 5	
^x 2593.18 13		0.059 7	
^x 2602.0 4		0.030 7	
^x 2604.10 16		0.060 9	
2617.17 7	(8428.15)	0.94 10	
2618.95 7	3007.24	0.64 7	
2630.70 6	3019.17	4.5 5	
2648.52& 8	5062.99	0.222 23	
2653.09 8	5067.57	0.145 15	
2664.4& 7	4435.66	0.156 17	
^x 2669.65 15		0.059 8	
^x 2672.70 10		0.134 14	
2677.87& 7	3066.33	2.8 3	
2685.83 8	5811.05	0.145 15	
^x 2694.95 7		0.42 4	
^x 2698.28 13		0.067 8	
^x 2703.18 9		0.098 11	
^x 2709.30 11		0.066 8	
^x 2714.40 12		0.071 9	
2717.4& 4	4826.79	0.027 6	

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ [±] %c	Comments
2720.17 13	5397.10	0.082 10	
^x 2723.60 14		0.060 7	
2727.76 16	5142.27	0.113 19	
2729.45 17	3602.58	0.108 19	
2734.03 8	3607.55	0.231 24	
^x 2748.58 11		0.068 8	
2755.05 7	(8428.15)	0.36 4	
^x 2760.63 13		0.121 16	
2762.68 7	3151.54	0.49 5	
2772.51 8	4026.36	0.113 12	
2781.01 7	(8428.15)	0.55 6	
^x 2788.15 21		0.030 5	
2792.66 25	5207.13	0.026 4	
^x 2796.08 10		0.079 9	
^x 2807.97 13		0.070 8	
2816.6& 4	6093.48	0.016 4	
2828.06 14	4056.20	0.058 7	
2834.89 8	6093.48	0.190 20	
^x 2841.21 9		0.156 17	
2843.64 ^d 7	3232.17	0.171 ^d 19	
	3716.78	0.171 ^d 19	
2854.25 7	4964.22	0.215 22	
2873.7 3	4643.94	0.29 3	
2880.63 10	4651.20	0.082 9	
2888.99@e 16	3277.49	0.113 18	
^x 2890.91 20		0.123 17	
2893.55 15	5062.99	0.075 10	
2902.66& 7	3775.92	0.60 6	
^x 2905.55 8		0.193 20	
2911.24& 13	4164.92	0.046 6	
2918.69 24	5333.18	0.036 7	
2921.50 8	5090.94	0.236 24	
2929.83 25	6189.05	0.021 4	
^x 2934.72 20		0.039 6	
^x 2937.94 7		0.39 4	
2942.76 7	4196.75	0.48 5	
^x 2950.13 10		0.073 8	
2968.58& 16	4196.75	0.090 13	
2970.6& 3	5647.19	0.045 10	
2974.0 5	5142.27	0.025 7	
2976.1 8	7032.40	0.013 7	
2981.77 10	4235.61	0.075 8	
^x 2994.32 11		0.30 5	
2995.86& 12	4223.99	0.35 5	
2998.95 7	3872.10	0.43 5	
^x 3002.85 9		0.239 13	
3007.01& 11	4235.61	0.206 14	
^x 3013.86 10		0.103 6	
^x 3021.28 19		0.079 13	
^x 3023.15 15		0.129 14	
3027.16& 13	3415.74	0.077 5	
3031.04 9	(8428.15)	0.350 18	
3036.86 9	3425.54	0.65 4	
3049.43 9	(8428.15)	0.301 16	
^x 3052.50 20		0.041 4	
3056.60 13	4826.79	0.056 4	
3085.27 10	3958.51	0.181 11	Eγ: The authors' uncertainty of 0.01 keV is likely a typo as none of the other transitions have such a small uncertainty. Evaluators increased to 0.10 keV based on the uncertainties of nearby transitions.
3095.03 9	(8428.15)	0.295 15	
^x 3099.04 10		0.098 6	
^x 3108.18 9		0.202 11	
3118.53 9	3507.06	0.184 10	

Continued on next page (footnotes at end of table)

86Sr(n,γ) E=th 1986Wi16 (continued)**γ(87Sr) (continued)**

Eγ [†]	E(level)	Iγ ^{‡§c}	Eγ [†]	E(level)	Iγ ^{‡§c}
3122.51 13	6189.05	0.061 4	^x 3593.80 13		0.056 4
3132.28 9	(8428.15)	0.279 14	3601.32& 10	(8428.15)	0.355 18
^x 3136.84 12		0.058 4	^x 3623.43 14		0.084 6
3145.98 9	(8428.15)	0.56 3	^x 3627.88 14		0.049 4
^x 3161.06 9		0.437 23	3638.33 9	(8428.15)	1.14 6
^x 3165.73 11		0.100 6	3644.44 10	(8428.15)	1.07 6
^x 3168.72 25		0.032 4	^x 3651.46 11		0.091 6
3172.48& 20	6093.48	0.028 3	3667.78& 10	4056.20	0.119 7
^x 3179.86 11		0.127 8	3677.91 10	4551.23	0.92 5
3182.62& 10	4056.20	0.286 15	^x 3688.76 10		0.65 4
3186.08 9	5296.01	0.385 20	3693.34 11	4921.76	0.095 6
^x 3195.42 11		0.069 5	3700.86 11	5811.05	0.094 6
^x 3200.6 7		0.007 3	^x 3720.09 10		0.245 13
3207.58 9	4080.79	0.366 19	3736.1 5	4964.22	0.125 7
^x 3211.45 16		0.052 4	^x 3739.70 10		0.276 14
^x 3215.26 11		0.165 10	3743.51 10	(8428.15)	0.243 13
^x 3218.45 9		0.62 3	^x 3763.76 10		0.139 8
3221.07 10	(8428.15)	0.239 14	3770.46 10	4643.94	0.204 11
^x 3227.18 13		0.046 4	3777.01 10	(8428.15)	0.255 14
^x 3235.14 9		0.164 9	3784.36 10	(8428.15)	1.08 6
^x 3241.48 13		0.048 4	3793.78 10	4182.33	0.404 21
^x 3252.42 18		0.060 7	^x 3803.52 13		0.054 4
3258.56& 13	3258.80	0.143 14	3808.38 12	4196.75	0.159 10
^x 3260.41 12		0.175 15	3811.07 12	4684.57	0.170 10
3282.72 10	4536.55	0.199 11	^x 3814.47 12		0.091 6
3285.87& 14	(8428.15)	0.123 8	3823.27 10	(8428.15)	0.501 25
3291.72 9	4164.92	0.347 18	3834.68 14	5062.99	0.086 6
3297.24& 17	5067.57	0.034 3	3839.2 3	5067.57	0.054 10
^x 3304.91 10		0.180 10	^x 3848.14 10		0.165 9
3309.2& 4	4182.33	0.155 8	^x 3853.00 11		0.112 6
3321.68 9	(8428.15)	1.20 6	^x 3865.83 10		0.206 11
3328.25 9	3716.78	0.281 14	^x 3872.86 10		0.268 14
3337.36 9	(8428.15)	0.306 16	3876.83& 10	(8428.15)	1.33 7
3345.68 9	(8428.15)	0.269 14	3892.5 4	(8428.15)	0.024 4
3350.58 10	4223.99	0.153 8	3910.32 11	4783.69	0.142 8
3360.48 9	(8428.15)	0.68 4	3916.30 12	4789.82	0.189 14
3365.25 9	(8428.15)	0.72 4	3924.28 22	6093.48	0.026 3
^x 3387.06 9		0.87 5	^x 3928.99 10		0.394 20
3396.51 10	5811.05	0.175 9	^x 3940.44 18		
^x 3404.7 3		0.022 5	3948.55 12	4336.93	0.062 4
^x 3407.8 6		0.014 4	3953.34& 11	4826.79	0.074 4
^x 3411.50 24		0.026 4	3978.65 10	5207.13	0.57 3
3415.8& 3	4643.94	0.060 12	3992.36 10	(8428.15)	1.11 6
^x 3421.37 13		0.061 5	^x 4003.17 12		0.068 4
3431.18& 23	4684.57	0.022 3	^x 4014.71 11		0.115 6
3436.76 14	5207.13	0.059 5	^x 4020.62 24		0.087 19
^x 3439.9 5		0.019 4	4047.02 10	4435.66	0.56 3
^x 3442.8 3		0.029 4	4067.75 13	5296.01	0.044 3
3463.89 9	(8428.15)	1.00 5	4079.84 16	4953.03	0.066 5
^x 3469.5 4		0.013 3	4091.14 10	(8428.15)	1.21 6
3475.15 10	(8428.15)	0.351 18	^x 4097.6 3		0.012 2
^x 3492.98 23		0.020 3	^x 4110.57 10		0.333 17
3506.73# 10	(8428.15)	0.304 19	^x 4113.9 3		0.031 3
^x 3508.98 10		0.48 3	^x 4117.16 19		0.037 3
3512.21 10	6189.05	0.210 12	4124.93 13	5378.82	0.067 4
^x 3523.09 9		0.446 23	4162.6 5	4551.23	0.020 6
3535.92 10	4789.82	0.392 20	^x 4166.99 12		0.078 5
3555.10 9	4783.69	0.382 19	^x 4171.7 3		0.027 3
3561.07 22	4789.82	0.59 3	4189.65 11	5062.99	0.204 11
3563.20 13	5673.09	0.159 14	4192.52 12	(8428.15)	0.172 10
3570.21 11	3958.51	0.084 5	4204.06 10	(8428.15)	1.05 6
^x 3575.84 10		0.174 9	4209.24 14	5082.43	0.043 3
^x 3581.43 12		0.065 4	4218.02 19	5090.94	0.025 2

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86Sr(n,γ) E=th 1986Wi16 (continued)γ(87Sr) (continued)

Eγ [†]	E(level)	Iγ ^{‡§c}	Eγ [†]	E(level)	Iγ ^{‡§c}
4231.43 10	(8428.15)	0.74 4	^x 4779.87 15		0.042 3
4245.76 10	(8428.15)	1.01 5	^x 4790.9 4		0.043 15
^x 4253.88 21		0.027 3	4798.1 6	5673.09	0.038 18
4263.26 10	(8428.15)	2.61 13	^x 4804.61 12		0.115 6
^x 4270.16 18		0.044 4	4818.9 4	5207.13	0.030 9
^x 4282.9 3		0.014 3	4821.2& 5	(8428.15)	0.030 8
^x 4289.79 22		0.073 11	4825.44 13	(8428.15)	0.078 5
^x 4291.94 25		0.068 10	^x 4833.66 19		0.040 3
4295.93 13	4684.57	0.077 5	^x 4865.72 17		0.032 3
4304.18 21	6074.27	0.055 8	^x 4875.60 12		0.161 9
^x 4316.8 5		0.026 8	^x 4879.0 3		0.043 4
4333.9 3	5207.13	0.017 3	^x 4882.8 3		0.025 3
^x 4338.00 19		0.030 3	^x 4891.1 4		0.028 6
4347.34 10	(8428.15)	0.66 4	4893.73 12	5282.21	0.231 13
^x 4351.17 13		0.085 5	4907.5 4	5296.01	0.016 3
^x 4356.6 3		0.038 7	^x 4917.12 15		0.064 4
^x 4358.80 20		0.058 8	4921.05 13	(8428.15)	0.097 6
4372.14 11	(8428.15)	0.480 24	^x 4933.22 21		0.053 6
^x 4377.22 17		0.035 3	^x 4936.05 14		0.141 10
^x 4382.5 5		0.009 2	4996.44 17	(8428.15)	0.040 4
4392.7 3	5647.19	0.077 22	5002.65 12	(8428.15)	0.177 10
^x 4394.37 13		0.28 3	5008.68 20	5397.10	0.039 4
4401.84 11	(8428.15)	0.111 6	5012.8 4	(8428.15)	0.018 3
4408.74 20	5282.21	0.063 8	^x 5017.07 15		0.056 4
^x 4411.06 20		0.073 8	^x 5023.8 4		0.023 6
4422.44 13	5296.01	0.145 9	^x 5026.3 4		0.026 6
^x 4431.4 6		0.010 3	^x 5037.17 19		0.036 3
4438.12 11	4826.79	0.228 12	^x 5041.9 6		0.016 3
^x 4445.68 15		0.098 9	^x 5045.1 3		0.028 4
^x 4447.9 5		0.025 7	5056.52 12	(8428.15)	0.201 10
^x 4453.02 15		0.043 3	^x 5070.68 13		0.146 9
4459.90 11	5333.18	0.153 8	5074.1 15	5943.04	0.013 8
4469.61 11	(8428.15)	0.236 12	^x 5085.2 8		0.006 2
4476.94 13	(8428.15)	0.168 12	^x 5089.5 7		0.006 2
^x 4479.22 15		0.132 11	^x 5101.44 13		0.088 5
^x 4503.2 3		0.095 15	^x 5106.6 6		0.011 2
4505.50 12	5378.82	0.398 25	^x 5110.4 4		0.016 2
^x 4517.77 11		0.325 17	^x 5133.2 6		0.019 7
^x 4530.44 14		0.233 17	^x 5135.5 15		0.007 7
^x 4551.0 5		0.032 11	5150.63 12	(8428.15)	0.357 18
4556.26 12	(8428.15)	0.227 13	^x 5181.4 4		0.012 2
4564.35 15	4953.03	0.039 3	^x 5187.97 22		0.022 2
4575.54 11	4964.22	0.290 15	5196.04 12	(8428.15)	0.220 11
4589.04 18	5843.19	0.029 2	5200.56 21	6074.27	0.033 3
^x 4599.57 16		0.040 3	^x 5206.1 3		0.015 2
4615.0 3	5843.19	0.050 5	5220.12 13	6093.48	0.117 6
4618.3 10	7032.40	0.007 3	^x 5224.2 3		0.006 2
^x 4642.75 13		0.082 5	^x 5229.8 4		0.010 2
^x 4647.58 11		0.353 18	5258.74 18	5647.19	0.080 7
4652.41 11	(8428.15)	1.74 9	^x 5267.16 18		0.104 8
4663.06 25	(8428.15)	0.018 3	5276.71 12	(8428.15)	1.18 6
^x 4675.82 12		0.138 8	5284.63 13	5673.09	0.163 9
4688.97 13	5943.04	0.069 4	^x 5288.36 23		0.034 3
4693.93 15	5082.43	0.124 9	5302.73 12	(8428.15)	1.32 7
4696.82 12	(8428.15)	0.340 18	^x 5310.15 21		0.032 3
^x 4701.19 14		0.075 5	5315.3 4	6189.05	0.049 11
4711.34 12	(8428.15)	0.164 9	^x 5317.5 4		0.048 11
4714.5 5	5943.04	0.033 5	^x 5327.6 4		0.010 2
4717.76 12	5106.38	0.291 15	^x 5341.5 4		0.024 4
4754.27& 19	(8428.15)	0.052 5	^x 5344.58 19		0.057 5
^x 4757.82 20		0.171 21	^x 5351.55 14		0.073 6
^x 4759.81 15		0.233 23	5361.73 12	(8428.15)	9.7 5
^x 4764.5 3		0.021 2	^x 5368.43 21		0.057 6

Continued on next page (footnotes at end of table)

⁸⁶Sr(n,γ) E=th 1986Wi16 (continued)

γ(⁸⁷Sr) (continued)

Eγ [†]	E(level)	I _γ ^{‡§c}	Eγ [†]	E(level)	I _γ ^{‡§c}
^x 5373.84 19		0.041 5	^x 6140.3 10		0.018 9
5408.96 12	(8428.15)	5.6 3	^x 6142.4 5		0.027 9
^x 5415.96 19		0.059 5	^x 6151.0 6		0.029 5
5421.00 15	(8428.15)	0.149 11	^x 6154.1 5		0.027 5
^x 5431.17 22		0.030 4	6159.0 5	7032.40	0.020 3
^x 5445.4 4		0.010 2	^x 6163.0 8		0.013 3
5455.14 22	5843.19	0.022 2	^x 6166.92 24		0.034 3
^x 5478.53 16		0.041 3	^x 6176.2 4		0.017 3
5487.31 13	(8428.15)	0.195 10	^x 6180.9 7		0.014 4
5507.40 16	(8428.15)	0.059 4	^x 6184.22 20		0.056 5
^x 5511.21 18		0.042 3	^x 6190.57 14		0.099 5
^x 5543.0 3		0.017 2	^x 6198.23 21		0.031 3
^x 5551.21 17		0.050 4	^x 6203.2 3		0.020 2
^x 5555.17 14		0.113 6	^x 6208.4 4		0.013 2
5577.61 12	(8428.15)	1.40 7	^x 6242.41 24		0.022 3
^x 5590.06 13		0.129 7	^x 6248.26 21		0.028 3
^x 5635.46 20		0.029 2	6258.62 15	(8428.15)	1.36 7
^x 5646.43 15		0.041 3	^x 6293.6 3		0.016 2
^x 5658.1 5		0.013 2	6318.05 14	(8428.15)	2.10 11
^x 5662.2 4		0.026 4	^x 6338.8 6		0.015 3
^x 5670.0 3		0.016 2	^x 6350.68 15		0.095 5
^x 5692.57 23		0.025 2	^x 6358.08 ^b 14		0.176 9
^x 5702.02 17		0.070 6	^x 6366.28 19		0.050 4
5704.95 20	6093.48	0.051 5	^x 6371.64 24		0.025 3
^x 5719.78 18		0.040 3	^x 6379.69 15		0.136 7
5751.34 13	(8428.15)	2.03 10	^x 6393.75 17		0.047 3
^x 5759.77 23		0.022 2	^x 6408.4 6		0.015 5
5778.7 4	7032.40	0.015 2	^x 6416.83 23		0.030 3
^x 5783.5 5		0.010 2	^x 6421.9 11		0.017 11
^x 5796.56 14		0.100 6	^x 6424.2 5		0.040 12
^x 5819.4 4		0.009 2	^x 6434.65 21		0.037 3
^x 5828.8 6		0.007 2	^x 6440.4 5		0.014 3
^x 5836.64 15		0.061 4	^x 6444.3 4		0.018 3
^x 5862.8 3		0.049 5	^x 6453.4 6		0.007 2
^x 5866.02 25		0.041 5	^x 6489.5 6		0.021 4
^x 5876.5 5		0.009 2	^x 6492.7 7		0.014 4
^x 5882.66 20		0.051 4	^x 6500.29 23		0.020 2
^x 5886.2 5		0.018 3	^x 6510.3 4		0.020 2
^x 5894.25 24		0.048 4	^x 6519.0 5		0.011 2
^x 5899.1 4		0.022 3	^x 6524.3 4		0.015 2
^x 5906.2 3		0.034 5	^x 6531.5 5		0.008 2
^x 5917.16 14		0.094 5	^x 6543.42 24		0.019 2
^x 5929.0 4		0.011 2	^x 6560.0 4		0.009 2
^x 5940.79 14		0.086 5	^x 6577.8 4		0.011 2
^x 5946.1 3		0.022 2	^x 6593.57 25		0.026 2
^x 5951.4 4		0.018 2	^x 6597.9 4		0.016 2
^x 5961.2 5		0.014 3	^x 6613.1 4		0.012 2
^x 5965.7 4		0.074 18	^x 6625.08 20		0.035 3
^x 5967.8 5		0.045 19	^x 6633.8 3		0.016 2
^x 5973.1 7		0.007 2	^x 6644.41 18		0.037 3
^x 5986.33 18		0.036 3	^x 6678.9 3		0.017 2
^x 5995.5 4		0.020 3	^x 6686.2 3		0.016 2
6013.58 13	(8428.15)	3.54 18	^x 6706.73 21		0.054 4
^x 6020.47 21		0.039 5	^x 6710.6 7		0.011 3
^x 6025.2 4		0.029 6	^x 6721.1 6		0.007 2
^x 6028.1 4		0.024 6	^x 6752.9 5		0.008 2
^x 6036.52 22		0.025 3	^x 6759.6 5		0.008 2
^x 6052.4 4		0.016 2	^x 6770.3 5		0.009 2
^x 6057.3 4		0.014 2	^x 6776.76 23		0.029 2
^x 6064.83 22		0.025 2	^x 6781.97 18		0.044 3
^x 6079.2 3		0.017 2	^x 6795.1 4		0.012 2
^x 6129.5 3		0.035 4	^x 6851.8 3		0.016 2
^x 6132.8 3		0.039 4	^x 6857.3 7		0.006 2

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86Sr(n,γ) E=th 1986Wi16 (continued)γ(87Sr) (continued)

$E\gamma^\dagger$	E(level)	$I\gamma^\ddagger\text{\%c}$	$E\gamma^\dagger$	E(level)	$I\gamma^\ddagger\text{\%c}$
^x 6868.7 4		0.009 2	^x 7134.5 6		0.007 1
^x 6897.4 4		0.013 2	7172.4@e 7	(8428.15)	0.005 1
^x 6903.6 4		0.013 2	7199.87 25	(8428.15)	0.019 2
^x 6908.59 16		0.107 6	^x 7230.6 3		0.016 2
^x 6918.3 5		0.008 2	^x 7279.6 3		0.016 2
^x 6927.67 23		0.022 2	^x 7297.6 4		0.033 5
^x 6991.3 13		0.003 1	^x 7309.7 7		0.006 1
^x 7000.6 15		0.003 2	^x 7324.3 5		0.008 2
^x 7004.9 4		0.017 2	^x 7338.7 14		0.003 2
^x 7016.6 5		0.009 2	^x 7351.1 5		0.009 2
^x 7030.0 6		0.007 2	^x 7380.97 25		0.021 2
^x 7034.1 16		0.004 2	7554.74 16	(8428.15)	1.34 7
^x 7048.2 5		0.007 1	8039.58 17	(8428.15)	24.2 12
^x 7063.1 5		0.009 1			
^x 7086.4 13		0.003 2			
^x 7123.5 7		0.005 1			

[†] Not corrected for recoil.

[‡] The normalization is that of 1986Wi16 and is intended to represent γ's per 100 captures. With this normalization, the sum of the I_γ for the γ rays populating the ground state is 68.6 20 and that depopulating the capture state is 85.1 14.

[§] Since there are many γ rays that the authors (1986Wi16) suggest may have multiple placements, intensity balances at individual levels are not expected to be particularly useful.

[#] Placed by 1986Wi16, but E_γ disagrees with calculated level energy differences by more than three standard deviations.

[@] Placed by 1986Wi16, but J^π values indicate that mult must be at least M2.

[&] The authors note possibility for multiple placement, but only this placement is given, based on energy, intensity, or spin arguments. See 1986Wi16 for details.

^a The feeding of this level is 83 7.

^b γ is out of order in the list of 1986Wi16. E_γ may possibly be a misprint of 6388.08 instead of 6358.08.

^c Absolute intensity per 100 neutron captures.

^d Multiply placed; undivided intensity given.

^e Placement of transition in the level scheme is uncertain.

^x γ ray not placed in level scheme.

86Sr(d,p),(pol d,p) 1986Bu14,1986Wi16,1971Mo02

1986Bu14: (pol d,p), $E_d=11$ MeV, FWHM=45 keV, $\theta=20^\circ-105^\circ$, report 19 levels.

1986Wi16: $E_d=20$ MeV, FWHM=4.0 keV-5.5 keV, Q3D spectrometer, energy calibration based on level energies from (n,γ).

1971Mo02: $E_d=12$ MeV, FWHM = 10 keV, $\theta=5^\circ-90^\circ$, report 34 levels.

1971Bu20: $E_d=8$ MeV, FWHM=12-30 keV, $\theta=5^\circ-60^\circ$, report 27 levels.

1970Be24: $E_d=20.65$ MeV, FWHM=40 and 70 keV, report 15 levels.

1977Bu20: review earlier data and quote data from 1971Bu20.

87Sr Levels

E(level) [†]	$J\pi^\ddagger$	L [§]	(2J+1)S [#]	Comments
0.0	9/2+	4	1.55	
388.52 17	1/2-	1	0.22	
873.35 15	3/2-	1	0.19	
1228.41 15	5/2+	2	0.63	
1254.0 4	5/2-&			
1742.0 9	5/2+, 7/2+&			
1770.46 9	5/2+	2	2.68	
2169.42 11	1/2+	0	0.57	$J\pi$: Listed as tentative in Adopted Levels due since γ to 5/2- must be M2.
2236.1 9	9/2+&			
2340? 10				E(level): from 1971Bu20 only.
2414.52 15	3/2-&			
2532.8 3	7/2+, 9/2+&			
2676.86 13	3/2+	2	0.33	
2785.12 21				

Continued on next page (footnotes at end of table)

$^{86}\text{Sr}(\text{d,p}),(\text{pol d,p})$ 1986Bu14,1986Wi16,1971Mo02 (continued) ^{87}Sr Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	L [§]	(2J+1)S [#]	Comments
2803.15 24				
2818.89 18	9/2+	4	0.9	L: from 1986Wi16. (2J+1)S: from 1986Bu14.
2848.8 13				
2904.0 9				
2921.2 4				
2940.68 16	1/2+	0	0.22	$J\pi$: From L=0.
3047.2 3				
3065.9 9	(1/2-, 3/2)&			
3118.50 15				
3125.15 13	1/2+	0	0.23	
3151.66 11	(3/2)+&	2	0.27	
3166.38 9	(5/2)+	2	0.41	
3258.91 11	5/2+&	2	0.05	E(level): given as 3161 in 1971Mo02, but is misprint (see 1971Ve13).
3277.4 4	5/2+	2	0.04	
3385.32 11	5/2+	2	0.23	
3414.44 25				
3431.36 22	1/2-, 3/2, 5/2+&			
3547.7 6	5/2+	2	0.05	
3591.07 16	(3/2+, 5/2+)&	(2)	0.02	
3602.62 14	3/2+&	(2)	0.50	
3628.4 3	(1/2-, 3/2-)&			
3668.39 20				
3673.97 14	(3/2+)&	(2)	0.12	
3682.6 5	7/2+, 9/2+&			
3705.7 3				
3731.0 6	3/2&			
3739.7 11				
3764.0 3				
3775.97 20	3/2+	2	0.14	
3792.28 17				
3871.9 4	1/2+	0	0.15	$J\pi$: From L=0.
3880.63 23	7/2+, 9/2+&			
3919.51 17				
3943.4 3				
3958.61 22	3/2+&	2	0.05	
4013?@ 10				
4031.5 4	7/2+, 9/2+&			
4051.1 4				
4057.1 6	1/2, 3/2, 5/2+&			
4081@ 10	(3/2+, 5/2+)&	(2)	0.05	E(level): not observed by 1986Wi16 in (d,p), but confirmed in (n, γ).
4114.6 4	(5/2-, 7/2-)			
4182.36 24	1/2+	0	0.03	$J\pi$: From L=0.
4196.95 25	3/2+	2	0.14	
4235.46 11	3/2+, 5/2+&	2	0.23	
4251.6 4	7/2+, 9/2+&			
4310.19 18				
4336.94 12	1/2+, 3/2&			
4354.50 24	(5/2-, 7/2-)&			
4379.72 12				
4413.65 24				
4433.4 5				
4442.6 5				
4449.47 25				
4462.6 6				
4485.9 8				
4514.3 3				
4540.8 4				
4564.9 3				
4584.9 4				
4595.6 3				
4605.4 3	1/2, 3/2, 5/2+&			
4618.5 5				

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$^{86}\text{Sr}(\text{d,p}),(\text{pol d,p})$ 1986Bu14,1986Wi16,1971Mo02 (continued) **^{87}Sr Levels (continued)**

E(level) [†]	$J\pi^{\ddagger}$	E(level) [†]	$J\pi^{\ddagger}$	E(level) [†]
4631.7 4		4717.8 4	5/2-, 7/2-&	4925.6 4
4643.8 4	1/2+, 3/2&	4789.84 17	3/2&	4934.24 23
4653.2 8		4799.42 16		4943.3 4
4676.3 4		4822.78 25		4948.63 24
4689.3 7		4846.46 20	1/2-, 3/2-&	4969.0 5
4695.8 5		4887.22 22		4975.1 4
4708.16 23		4905.2 7		4990.6 3

[†] From 1986Wi16, unless indicated otherwise. The assignment to levels observed by 1971Mo02 was taken from 1986Wi16.

[‡] From 1986Bu14; DWBA analysis of vector analyzing power. Assignment is same as that in Adopted Levels, unless otherwise noted.

[§] From 1971Mo02: DWBA analysis of $\sigma(\theta)$, unless otherwise noted.

From 1971Mo02: DWBA analysis of $\sigma(\theta)$, from their Set ii results, unless indicated otherwise; values are in good agreement with 1986Bu14.

@ From 1971Mo02.

& From Adopted Levels.

 $^{87}\text{Rb}(\text{p,n}\gamma), (\text{p,n})$ 1977Ba61,1969Bu17

1977Ba61: E(p)=3.8 MeV, measured γ , $\gamma\gamma$ -coincidences with Ge and NaI detectors.

1969Bu17: determined n-groups by time-of-flight measurements.

 ^{87}Sr Levels

E(level)	$J\pi^{\dagger}$	$T_{1/2}^{\ddagger}$	Comments
0.0	9/2+		
388.42 5	1/2-	2.815 h 12	
873.32 6	3/2-		
1228.50 5	5/2+	≥ 0.21 ps	
1253.86 7	5/2-	0.25 ps +23-9	$T_{1/2}$: 2.8 ps +23-9 in Adopted levels.
1770.49 5	5/2+	≥ 0.19 ps	
1920.50 7	7/2+	0.13 ps 3	
2110.83 9	3/2-	0.087 ps +28-21	
2169.33 9	(1/2+)	≥ 0.15 ps	
2237 [§] 15	9/2+		
2414.74 11	3/2-	0.20 ps +12-6	
2531 [§] 15			
2552 [§] 15			
2629 [§] 15	1/2-, 3/2-		
2682 [§] 15	(3/2)+		E(level): This may correspond to the 2676 level with 3/2+, the 2679 level with 1/2-, 3/2-, or the 2682 level with (3/2)+ in the Adopted Levels.
2698.5? 5			E(level): this level is not included in ^{87}Sr Adopted Levels.
2706 [§] 15	7/2+, 9/2+		
2810 [§] 15			
2848 [§] 15	1/2-, 3/2-		
2901 [§] 15			
2925 [§] 15			
2945 [§] 15	1/2+		
2979 [§] 15	-		
3016 [§] 15			
3067 [§] 15	(1/2-, 3/2)		
3098 [§] 15			
3126 [§] 15	1/2+		
3151 [§] 15			
3167 [§] 15	(5/2)+		
3220 [§] 15	(1/2, 3/2)		
3258 [§] 15	(5/2)+		
3276 [§] 15	5/2+		

[†] From ^{87}Sr Adopted Levels.

Footnotes continued on next page

⁸⁷Rb(p,n γ), (p,n) 1977Ba61,1969Bu17 (continued)

⁸⁷Sr Levels (continued)

[‡] Deduced from centroid shifts obtained from singles spectra measured at 0° and 90° to the beam direction (1977Ba61).

[§] Observed only by 1969Bu17.

 $\gamma(^{87}\text{Sr})$

$E\gamma^{\dagger}$	E(level)	$I\gamma^{\dagger}$	$E\gamma^{\dagger}$	E(level)	$I\gamma^{\dagger}$	$E\gamma^{\dagger}$	E(level)	$I\gamma^{\dagger}$
355.1 1	1228.50	14.2 10	865.42 5	1253.86	40 3	1920.50 7	1920.50	15.2 15
380.6 1	1253.86	7.5 5	1228.51 5	1228.50	69 5	2026.3 1	2414.74	18.4 20
388.40 5	388.42	78 4	1237.50 6	2110.83	14.2 9	2310.0 5	2698.5?	19.3 20
484.90 5	873.32	100	1296.00 6	2169.33	18.5 16			
542.0 1	1770.49	13.4 17	1770.47 5	1770.49	26.3 24			

[†] From 1977Ba61.

Level Scheme

Intensities: relative $I\gamma$

⁸⁷Sr(p,p') 1978Ka37

Measurements done with E_p=20.5 MeV, Enge split-pole spectrograph with FWHM 9-14 keV, measured σ(θ), DWBA analysis.

⁸⁷Sr Levels

E(level) [†]	Jπ	L [‡]	β _L ^{1/2} ×10 ^{3‡}	E(level) [†]	L [‡]	β _L ^{1/2} ×10 ^{3‡}	E(level) [†]	L [‡]	β _L ^{1/2} ×10 ^{3‡}
0.0	9/2+			3159 8			4150 8	(5)	
389 4				3172 8			4169 8	(5)	
876 4				3247 8	(5)		4187 8	(2)	0.16
1229 4		2	1.63	3278 8	0		4218 8	4	0.95
1254 4				3300? 8			4241 8	(2)	0.20
1740 4		2	2.96	3394 8	(5)		4259 8		
1772 4				3415 8	(5)		4288 8		
1921 4		2	1.45	3447 8	(5)		4323 8	(5)	
2112 8		3	1.47	3483 8			4340 8		
2156 8		2	3.36	3528 8			4354 8		
2238 8		2	1.59	3551 8	(5)		4371 8		
2262 8				3612 8			4408 8		
2422 8		3	1.43	3635 8	(5)		4435 8		
2488 8		3	0.30	3657 8			4470 8		
2539 8		3	4.2	3679 8			4501 8		
2555 8		3	5.0	3691 8			4546 8		
2597 8		3	4.8	3716 8			4559 8		
2634 8				3736 8			4584 8		
2681 8				3774 8			4612 8		
2705 8		(4)	1.35	3788 8			4635 8		
2806 8				3824 8			4659 8		
2832 8		3	7.9	3874 8	(5)		4675 8		
2893 8		(3)	0.53	3894 8			4684 8		
2922 8		3	1.5	3915 8			4716 8		
2943 8				3939 8			4751 8		
2980 8		3	0.73	3981 8	(4)	0.67	4785 8		
3005 8		3	1.23	4000? 8			4878 8		
3036 8				4024 8			4918 8		
3103 8				4077 8			4951 8		
3121 8		(5)		4090 8			5120 8		
3133 8		3	1.23	4116 8	(4)		5169 8		

[†] 1978Ka37 give Δ(E)=4-8 keV depending on level energy. From comparison with adopted levels, evaluator assigns Δ(E) = 4 keV for levels below 2000 keV and Δ(E)=8 keV otherwise.

[‡] From DWBA analysis of σ(θ).

⁸⁸Sr(³He,α),(p,d),(¹²C,¹³C),(d,t) 1989Fo01,1982In01,1977B108

1989Fo01: (³He,α), E(³He)=36 MeV, FWHM=20 and 25 keV, θ=3°-80°, measured σ(θ), DWBA and coupled-channel analysis, report 54 levels.

1982In01: (¹²C,¹³C), E(¹²C)=18 MeV, θ=10°-50°, measured σ(θ) and polarization of ¹³C, DWBA analysis, report 5 levels.

1977B108: (p,d), E_p=27.1 MeV, FWHM=20 keV, θ=2°-80°, report 14 levels.

1973Ta07: (p,d), E_p=52 MeV, FWHM=70 keV, θ=5°-55°, report 10 levels.

1973Ta05: (d,t), E_d=21.1 MeV, FWHM=50 keV, θ=12.5°-95°, report 8 levels.

1970Be24: (d,t), E_d=20.7 MeV, FWHM=70 keV, report 15 levels.

1969Ba21: (³He,α), E(³He)=18 MeV, FWHM=60-70 keV, θ=25°-80°, report 5 levels.

⁸⁷Sr Levels

E(level) [†]	Jπ [‡]	L [§]	C ² S [§]	Comments
0.0	9/2+	4	8.16	
388 10	1/2-	1	2.52	
873 10	3/2-	1	3.36	
1228 10	5/2+	2	0.17	L: weak assignment only by 1989Fo01; however, confirmed by 1977B108.
				Jπ: Definitive assignment in Adopted Levels.
1254 10	5/2-	3	2.76	
1550? 20				E(level): only observed by 1973Ta07.

Continued on next page (footnotes at end of table)

$^{88}\text{Sr} (^3\text{He}, \alpha), (\text{p}, \text{d}), (^{12}\text{C}, ^{13}\text{C}), (\text{d}, \text{t})$ 1989Fo01, 1982In01, 1977B108 (continued) ^{87}Sr Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	$L^{\S}$	$C^2S^{\S}$	Comments
1740 10	(13/2+)&			$J\pi$: Definitive assignment Adopted Levels.
1770 10	5/2+			E(level), L: 1989Fo01 report that the excitation of this level is not direct.
1920 10	(7/2+)&			$J\pi$: Definitive assignment Adopted Levels.
2111 10	3/2-	1	0.54	$J\pi$: From L=1 and additional arguments in Adopted Levels.
2159 10	(11/2+)&			E(level): 2153.5 in Adopted Levels.
				$J\pi$: (11/2)+ in Adopted Levels.
2236 10	9/2+	4	0.89	
2415 10	(5/2-)	3	0.67	
2536 10	7/2+, 9/2+	4	0.10	
2554 10	(9/2-)&			
2596 10	(13/2-)&			
2633?# 20		1	0.22	
2656?# 20		3	0.57	
2679 10		1	0.16, 0.13	
2706 10		4	0.12	
2831 10	(15/2-)&			
2851 10		1	0.13, 0.11	
2920 10		4	0.04	
3020 10		1	0.10, 0.08	
3140 10		3	0.36, 0.23	
3260 10	9/2+	(4)	0.08	
3430 10	5/2-	3	0.58, 0.38	
3510 10		3	0.15, 0.10	
3620 10		(1)	0.08, 0.07	
3690 10		4	0.08	
3750 10		4	0.04	
3800@ 10				
3880 10		4	0.11	
3960 10		3	0.09, 0.06	
4020 20		4	0.08	
4100 20		(3)	0.19, 0.13	
4180 20		3	0.26, 0.17	
4270 20		4	0.04	
4350 20		(3)	0.06, 0.04	
4420 20		1	0.05, 0.04	
4470 20		1	0.04, 0.04	
4530 20		(4)	0.03	E(level): Overlaps with 4541 in Adopted Levels, but the L=(4) conflicts with adopted 1/2-, 3/2.
4620@ 20		1+3		C^2S : $C^2S=0.11$ for $J\pi=1/2-$, 0.09 for $J\pi=3/2-$, 0.18 for $J\pi=5/2-$, and 0.12 for $J\pi=7/2-$.
4720 20		3	0.36, 0.24	
4780 20		1	0.24, 0.21	E(level): Three possible level candidates in Adopted Levels, 4783, 4789, or 4799.
4860 20		1	0.17, 0.15	
4950 20		1	0.16, 0.14	E(level): Three possible level candidates in Adopted Levels, 4934, 4943, or 4748.
5020 20		3	0.35, 0.23	
5120@ 20		1+3		C^2S : $C^2S=0.09$ for $J\pi=1/2-$, 0.08 for $J\pi=3/2-$, 0.14 for $J\pi=5/2-$, and 0.09 for $J\pi=7/2-$.
5260@ 20		1+3		C^2S : $C^2S=0.20$ for $J\pi=1/2-$, 0.17 for $J\pi=3/2-$, 0.32 for $J\pi=5/2-$, and 0.21 for $J\pi=7/2-$.
5420 20		3	0.46, 0.30	
5560 20		3	0.36, 0.23	
5770@ 20		3	0.54, 0.35	
5920@ 20		3	0.26, 0.17	
10720 20	(3/2-)	1	0.50	
11120 20	(5/2-)	3	1.00	
11550 20	(1/2-)	1	0.24	

[†] From 1989Fo01, unless indicated otherwise. 1989Fo01 report unresolved structures between 6 MeV and 12 MeV.[‡] From adopted levels except where noted otherwise, and given only when one of the pair of values following from the L value can be eliminated.[§] From 1989Fo01, unless indicated otherwise. 1989Fo01 report unresolved structures with L=1+3 between 6 MeV and 12 MeV for which spectroscopic factors for all possible spin configurations are given in intervals of 1 MeV. Where two values are given, they correspond to L-1/2 and L+1/2, respectively. For L=4, the authors give a value only for 9/2+.

⁸⁸Sr(³He,α),(p,d),(¹²C,¹³C),(d,t) 1989Fo01,1982In01,1977B108 (continued)

⁸⁷Sr Levels (continued)

From 1977B108, not confirmed by 1989Fo01.
 @ Unresolved multiplet.
 & From coupled-channel analysis (1989Fo01).

⁸⁹Y(d,α),⁸⁹Y(p,³He) 1972Br13

Target J^π is 1/2-.
 1986Ka27: (pol d,α), E_d=9.0, 12.0, and 16.0 MeV, measured σ(θ) and analyzing power, DWBA analysis, discussion of the structure of three lowest levels.
 1985Sa18: E_d=9.0, 12.0, and 16.0 MeV, measured σ(θ) for analyzing power for 3 lowest levels; some authors in common with 1986Ka27.
 1973Pe01: E_d=16 MeV, FWHM=60 keV, θ=5°-95°, and (p,³He), E_p=27 MeV, FWHM=120 keV, report 8 excited levels in (d,α) and 9 in (p,³He).
 1972Br13: E_d=12.0 MeV, FWHM=40 keV, θ=10°-160°, DWBA analysis of σ(θ), report 21 excited levels.
 1962Mi06: E_d=15 MeV, report 10 excited levels.

⁸⁷Sr Levels

E(level) [†]	L	Comments
0.0	3	L: other: L=3+5 (1973Pe01) in (p, ³ He) and (d,α).
388.42 § 5	0	L: other: L=0+2 (1973Pe01) in (p, ³ He) and L=2 in (d,α).
873.32 § 6	0	L: other: L=2 (1973Pe01) in (d,α).
1230 15	#	
1255 15	#	
1739 15	3	L: other: L=1+3 (1973Pe01) in (d,α).
1914 15		
2111 15		
2166 15		
2413 15	1, 2	
2550@ 15		
2630 15	2	
2706 15	3	
2925 15		
3029 15	0	
3075@ 15		
3156 15	3	
3274 15		
3397 15	3	
3434 15		
3512 15	3	
3625 ^a 15	(2)	
3713 ^a 15		
3772 ^a 15		
3934 15	2	
4025& 15		
4096& 15		

[†] From 1972Br13, unless otherwise noted; above 1 MeV, uncertainties are from authors' general comment that they are believed to be 15 keV for the absolute energies and 10 keV for the relative energies.

§ From adopted levels.

L=2 for the 1230+1255 levels; these levels could not be resolved in the analysis of σ(θ) (1972Br13,1973Pe01). In the Adopted Levels, J^π=5/2+ and 5/2- for these two levels, respectively. See authors' paper for a discussion.

@ Level obscured by impurity or other groups.

& Doublet.

^a Broad group containing more than one level.

Adopted Levels, Gammas

Q(β⁻)=-3672 4; S(n)=11806 14; S(p)=5784.1 11; Q(α)=-6373 3 2012Wa38.

Q(β⁻n)=-13121 4 Q(εp)=-7560.3 16.

For model calculation of level energies and moments, see 1976Kr12.

Shape evolution in this region discussed in 2011Ro08.

Band structure analysis in 2012Sh36.

⁸⁷Y Levels

Cross Reference (XREF) Flags

A ⁸⁵Rb(α,2nγ),⁷⁴Ge(¹⁸O,4nγ)
B ⁸⁴Sr(α,p)
C ⁸⁶Sr(p,γ)
D ⁸⁶Sr(p,p'),(pol p,p') IAR
E ⁸⁶Sr(³He,d), (d,n)

F ⁸⁷Y IT Decay (13.37 h)
G ⁸⁷Zr β⁺ Decay
H ⁸⁸Sr(p,2nγ)
I ⁸⁹Y(p,t)
J ⁹⁰Zr(p,α), (pol p,α)

K ⁸⁶Sr(p,γ) IAR
L ⁸⁰Se(¹¹B,4nγ)
M ⁸⁷Sr(p,nγ)

E(level) [†]	Jπ	XREF	T _{1/2} [‡]	Comments
0.0 ^a	1/2-	ABC EFGHIJ LM	79.8 h 3	%ε+%β ⁺ =100. μ=-0.19 2. μ: from 2007Ch07 using laser spectroscopy. Δ<r ² >=+0.057 fm ² relative to ⁸⁹ Y (2007Ch07). Jπ: J from atomic-beam resonance (1975Ru06) and π from L=1 in (³ He,d). T _{1/2} : weighted average of 79.6 h 2 (1984Pr01), and 80.3 h 3 (1969Zo04); both from ⁸⁷ Y ε decay.
380.82 ^c 7	9/2+	ABC EFGHIJ LM	13.37 h 3	%IT=98.43 11; %ε+%β ⁺ =1.57 11. μ=6.24 2. Q=-0.50 6. %IT: and %EC+%B calculated from measured I _{β+} =0.75 5 and theoretical ε/β ⁺ ratio for decay to ⁸⁷ Sr. Jπ: J from atomic-beam resonance (1975Ru06) and π from L=4 in (³ He,d). T _{1/2} : from 1984Pr01 by γ(t); others: 12.5 2 (1967Mi13) and 13.2 2 (1969Zo04). All values are from ⁸⁷ Y ε decay. μ: from 2007Ch07 using laser spectroscopy other: 6.05 7 (1991Hi04) by nuclear magnetic resonance on oriented nuclei and relative to 6.23 7 for ^{89m} Y, 6.10 +32-15 (1978Ma02) by nuclear orientation. Q: from 2007Ch07 using laser spectroscopy. Δ<r ² >=+0.032 fm ² relative to the ground state (2007Ch07). Jπ: L=3 in (³ He,d), Q γ to Jπ=1/2- level. Jπ: L=1 in (³ He,d) and L=2 in (p,t) from Jπ=1/2-.
793.73 ^a 8	5/2-	ABC E GHIJKLM	≤10 ns	Jπ: L=2 in (³ He,d) and γ to Jπ=9/2+ level.
982.89 10	3/2-	BC E IJK M		Jπ: L=2 in (³ He,d) and γ to Jπ=9/2+ level.
1152.71 11	5/2+	BC E G J M		XREF: I(1177).
1182.00 9	3/2-	C IJ M		Jπ: L=2 in (p,t) from Jπ=1/2- and Jπ=5/2- is ruled out in (p,α).
1203.01 9	5/2-	BC HIJK M		Jπ: L=2 in (p,t) from Jπ=1/2- and Jπ=(3/2-) is ruled out in (p,α).
1321 8		B		
1404.47 12	13/2+	Ab e H J LM	≤10 ns	XREF: b(1403)e(1400). Jπ: band structure, angular distribution and analyzing powers in (pol p, α).
1405.3 4	(7/2+, 9/2+) [#]	bC e G	≤10 ns	XREF: b(1403)e(1400). Jπ: From intensity arguments in (p,γ). It is unlikely to populate the 1404.47 level at 13/2+ in this reaction. Also as this level is populated by feeding from a 7/2- at 1979 keV, there is very little likelihood that this level is the same as the 13/2+ level at 1404.47.
1504 8		B		
1590.92 14	11/2+	A C GH LM	≤10 ns	Jπ: From excitation in (p,nγ) Jπ is limited to 9/2-, 11/2+, or 13/2. In addition γ(θ) for the 1210γ transition to the 9/2+ level at 380 is consistent only with J=11/2.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{87}Y Levels (continued)

E(level) [†]	J π	XREF	T _{1/2} [‡]	Comments
1608.31 12	7/2+, 9/2+	BC E G M		XREF: B(1618).
1609 5	3/2-	I J		J π : L=4 in (^3He ,d) for 1605 4 level.
1623.50 21	(5/2-, 7/2)	A C H J		J π : L=2 in (p,t) from J π =1/2- and 5/2- ruled out in analyzing power measurements in (p, α), (pol p, α).
1629.94 13	(1/2-, 3/2-) [#]	C LM		J π : from γ angular distribution in (p,2n γ).
1641 5	1/2-	I		J π : other: 7/2- from (p,n γ).
1704.7 4		C J M		J π : L=0 in (p,t) from 1/2- level.
1719 4	3/2-, 5/2-	I		J π : (p,n γ) resonance data allows 3/2+ or 5/2+, while excitation data rules out 5/2+. (p, α), (pol p, α) data rule out 5/2- and 3/2+.
1756.08 11	5/2 [#]	BC J M		J π : L=2 in (p,t) from 1/2-.
1768.2 ^a 5	(9/2-)	L		J π : 5/2- from (p,n γ) and 5/2+ from (p, α), (pol p, α).
1801.64 15	5/2-	C J M		J π : from γ to (5/2-) level and band structure.
1814 5	3/2-, 5/2-	I		J π : From (p, α), (pol p, α).
1849 3	1/2-	BC E I J		J π : L=2 in (p,t) from 1/2-.
1979.95 12	7/2-	C I J M		E(level): average of 1851 8 from (α ,p), 1848 4 from (^3He ,d), 1857 5 from (p,t) and 1846 3 from (p, α); other: 1846.7 in (p, γ).
2008.8 3	(7/2)	B H J LM		J π : L=0 in (p,t) from 1/2-, L=1 in (^3He ,d) and (α ,p). XREF: C(1979)I(1991)J(1979).
2021 5	(7/2-, 9/2-)	B I		J π : from L=4 in (p,t) from 1/2- level; J π =7/2- from (p, α).
2038.05 11	(11/2+)	A LM	≤ 10 ns	XREF: B(2012).
2072.7 10	(3/2, 5/2, 7/2)	C		J π : from γ (θ) (p,2n γ). However, (p, α), (pol p, α) data indicate 11/2+. In (p,n γ), the authors give 9/2-, 11/2- from excitation, but decay to 5/2- makes the 11/2- assignment very unlikely.
2073.31 23	(7/2+, 9/2+)	G M		XREF: B(2012).
2083.0 5	(3/2-)	BC E		J π : L=(4) in (p,t) from 1/2-.
2095 5	3/2-, 5/2-	B I		J π : From a $\Delta J=^+_1$ d+Q transition to 13/2+ in (α ,2n γ), assumed to be M1+E2 and a γ to 9/2+.
2112.3 4	5/2+	C J M		J π : γ 's to 5/2- and (5/2)+ levels.
2122 5	5/2+, 7/2+	I		J π : from γ excitation function in (p,n γ).
2154.60 18	(9/2-)	J M		XREF: B(2103).
2158.9 [§] 10		C		J π : L=1 in (^3He ,d) and γ to J π =5/2+ 1153 level.
2165 5	7/2, 9/2-	I		XREF: B(2103).
2186.0 3	7/2- [@]	C J M		J π : L=2 from 1/2- in (p,t).
2202 5	7/2-, 9/2-	I		J π : from γ 's to 3/2- and (7/2+, 9/2+) and from (p, α).
2202.17 17	7/2+, 9/2+	B E G M		J π : L=3 in (p,t) from 1/2-.
2209 3	3/2- [@]	J		J π : allowed values from angular distribution and analyzing powers from (p, α) are (9/2-, 11/2+) narrowed by γ to 5/2-.
2210.6 [§] 8	(1/2) [#]	C		E(level): from (p,t).
2216 5	9/2+, 11/2+	I		J π : L=4 in (p,t) from J π =1/2-.
2241.6 7	(7/2, 9/2-)	G		J π : L=4 in (p,t) from 1/2-.
2244.8 [§] 6		C		J π : L=4 in (^3He ,d). If the 1410 γ to 5/2- is from this level, J π is 7/2+; the alternative is that the 7/2-, 9/2- 2202 level is also populated in the ^{87}Zr $\epsilon+\beta+$ decay.
2249 3	9/2- [@]	J		
2256 5	3/2-, 5/2-	I		
2276 3	(9/2- and 7/2+) [@]	J		J π : L=2 in (p,t) from 1/2-.
2277.53 17	7/2-	BC E M		J π : L=3 in (p,t) from 1/2-.
2279.4	(7/2-)	C		
2292.3 10	5/2+, 7/2+	C I		J π : L=3 in (p,t) from J π =1/2-.

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Adopted Levels, Gammas (continued) ^{87}Y Levels (continued)

E(level) [†]	J π	XREF	T _{1/2} [‡]	Comments
2302.61 15	13/2+	D J M		
2314 5	(5/2+, 7/2+)	I		J π : L=3 in (p,t) from 1/2-.
2344.61 17		M		
2353.55 21	(7/2, 9/2, 11/2)	C M		J π : from (p,n γ) excitation function analysis.
2365 3	7/2+	J		J π : J π =15/2- + 7/2+ is assigned from $\sigma(\theta)$ and analyzing power in (p, α)(pol p, α) for the 2365 + 2367 doublet. J π =15/2- is established for the 2367 level giving J π =7/2+ for the 2365 level.
2366.92 15	15/2-	A HIJ LM	≤ 10 ns	XREF: I(2374).
2400.0 3		M		J π : L=8 in (p,t) from 1/2- and dipole γ to 13/2+.
2409 2	3/2+	C E IJ		J π : γ to 9/2+, but no further restrictions.
2428.09 ^c 15	17/2+	A H L	≤ 10 ns	E(level): average of 2407 4 from (^3He ,d), 2413 5 from (p,t), and 2408 3; other: 2408.3 from (p, γ). J π : L=2 in (^3He ,d) and γ to J π =1/2-.
2446 2	(5/2)+	C I		J π : From stretched quadrupole presumed E2 to 13/2+ level established by angular correlations in (α ,2n γ). E(level): Average of 2445 2 from (p, γ) and 2451 5 from (p,t).
2449 3	9/2- [@]	J		J π : L=3 in (p,t) from J π =1/2- and from comparison of primary γ strength in (p, γ) with the γ strength to the 381 level, it follows J π =5/2+.
2479.07 ^b 15	13/2-	A HI L		XREF: I(2486). J π : L=6 in (p,t) from J π =1/2-. ΔJ =+-1 to 11/2+.
2502 2	(5/2+) [#]	C		
2532 2	11/2- [@]	J		
2532 2		C		
2552 2	9/2+	C G I		XREF: I(2544).
2563.7 7	9/2, 11/2+	C G IJ		J π : L=5 in (p,t) from 1/2- and γ to 5/2+.
2572 2	(3/2-) [#]	C		J π : L=5 in (p,t) from 1/2-.
2599 3	9/2- [@]	J		
2602.3 11	(7/2)+	G I		J π : L=3 in (p,t) from 1/2- and log ft =6.8 and log f^{lu}_t =7.4 from (9/2+).
2616 2	(3/2-) [#]	C		
2648.91 ^b 15	(15/2-)	A L		J π : from Δ =1 γ to 13/2- and band structure.
2661 3	7/2+ [@]	J		
2668	(5/2) [#]	C		
2676.06 15	17/2-	A HI L	0.25 ns 10	J π : L=8 in (p,t) from 1/2- and γ angular distribution in (α ,2n γ).
2682 3	11/2+ [@]	J		
2730 4	5/2-, 7/2-	E		J π : L=3 in (^3He ,d).
2737 5	9/2+, 11/2+	I		J π : L=5 in (p,t) from 1/2-.
2747 3	3/2+ [@]	J		
2762	(3/2-) [#]	C		
2801 3	(3/2+ and 11/2+) [@]	J		
2808 5	9/2+, 11/2+	I		J π : L=5 in (p,t) from 1/2-.
2808.4 ^a 8	(13/2-)	L		J π : from γ to (9/2-) level and band structure.
2827.20 ^c 18	21/2+	A H L	0.53 ns 3	J π : from E2 γ to 17/2+ and band structure.
2828 5	(3/2, 5/2)-	I		J π : L=(2) in (p,t) from 1/2-.
2831 3	9/2- [@]	J		
2871 5	11/2-, 13/2-	I		J π : L=6 in (p,t) from 1/2-.
2901 5	3/2-, 5/2-	IJ		J π : L=2 in (p,t) from 1/2-.
2907 4	3/2+, 5/2+	C E		J π : L=2 in (^3He ,d).
2960 3	(5/2+) [@]	J		
2961.47 ^b 18	17/2-	A I L		J π : L=8 in (p,t) from 1/2-; from γ angular distribution in (α ,2n γ), it follows J=17/2.

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Adopted Levels, Gammas (continued)

⁸⁷Y Levels (continued)

E(level) [†]	J π	XREF	T _{1/2} [‡]	Comments
2986.9 3	(19/2+)	A L	<49 ps	J π : from DCO of γ to 21/2+ level. Assigned as 23/2+ in previous evaluation (2009He09), but the assignment of (19/2+) is still consistent with angular distribution and DCO measurements, and fits better with systematics of yrast states of N=48 isotones (see 1998Sc22 for more detailed discussion).
2995.6 3	(17/2)	A		J π : from angular distributions in (α ,2n γ).
2996 2	5/2+	C E I J		XREF: C(2995)I(2997)J(2998).
2996.1 11	(7/2, 9/2, 11/2)	G		J π : L=2 in (³ He,d) and (5/2+) in (p, α).
3038 5	9/2+, 11/2+	I		J π : log ft=6.6, log f ^{Iu} t=6.8 from (9/2)+.
3043 4	3/2+, 5/2+	E		J π : L=5 in (p,t) from 1/2-.
3057 5	(5/2+, 7/2+)	I		J π : L=2 in (³ He,d).
3090 4	3/2+, 5/2+	E		J π : L=(3) in (p,t) from 1/2-.
3093 5	9/2+, 11/2+	I		J π : L=2 in (³ He,d).
3094.4 4	(21/2)	A	<49 ps	J π : L=5 in (p,t) from 1/2-.
				J π : from from γ angular distribution in (α ,2n γ). Assigned 25/2 in previous evaluation (2002He09) and changed due to having re-assigned the daughter state to (19/2+).
3120 3	5/2+, 7/2+	E I		E(level): average of 3120 4 from (³ He,d) and 3121 5 from (p,t).
				J π : L=3 in (p,t) from 1/2-.
3120 10	(13/2-) [@]	J		
3181 5	(13/2+, 15/2+)	I		J π : L=(7) in (p,t) from 1/2-.
3195 4	(1/2+)	E		J π : L=(0) in (³ He,d).
3245 5	9/2+, 11/2+	I		J π : L=5 in (p,t) from J π =1/2-.
3262.9 13	9/2+, 11/2+	G I		XREF: I(3273).
				J π : L=5 in (p,t) from J π =1/2-.
3308 6	3/2+, 5/2+	E J		E(level): average of 3306 4 from (³ He,d) and 3324 10 from (p, α).
				J π : L=2 in (³ He,d).
3351 [§] 2	3/2+, 5/2+	C E		J π : L=2 in (³ He,d).
3402.4 ^b 3	(19/2-)	A L		J π : from γ to (17/2-) and band structure.
3405.2 11	3/2+, 5/2+	E G		J π : L=2 in (³ He,d).
3446.5 3	(19/2-)	A J L		J π : from (D+Q) γ to 17/2- and band placement.
3500	(11/2+) [@]	J		
3552.95 ^c 19	(23/2+)	A L	0.083 ps 21	J π : from D γ to 21/2+ and band placement.
3595.2 4	(21/2, 23/2, 25/2+)	A		J π : from γ to the 21/2+ level and no γ to the 2428 17/2+ level.
3595.3 5	(21/2+)	A	0.5 ns 2	J π : from from γ angular distribution in (α ,2n γ). Assigned 25/2 in earlier evaluation (2009He09) and changed due to having re-assigned the daughter state to (19/2+).
3640 20		J		
3730	(7/2-) [@]	J		
3766.6 ^b 4	(21/2-)	A L		J π : (E2) γ to (17/2-) and band structure.
3840	(11/2-) [@]	J		
3908.8 4	(23/2-)	L		J π : from (D+Q) γ to (21/2-) level and γ to (19/2-).
				and feeding from a $\Delta J=1$ transition from a (25/2-) level itself fed from a (27/2-) bandhead level.
4039.40 ^c 21	(25/2+)	A L	0.17 ps 4	J π : band structure.
4214.1 3	(27/2)	A		J π : from D γ to (25/2) level and band placement.
4555.0 4	(23/2+)	L		J π : from (E2) γ to (19/2+) level $\Delta J=1$ γ to (21/2+) level.
4564.1 3	(23/2-)	L		J π : from stretched (E2) γ to (19/2-).
4609.66 19	25/2+	L	0.12 ps 4	J π : from E2 γ to 21/2+.
5228.2 3	(25/2-)	L		J π : γ from 29/2(-) and $\Delta J=1$ γ to 23/2+.
5288.48 ^c 21	(27/2+)	L	0.10 ps 3	J π : from γ to (25/2+) level, γ to (23/2+), and γ $\Delta J=1$ feeding from (29/2-).
5319.7 4	(25/2-)	L		J π : from (E2) γ to (21/2-) level.
5495.2 4	(25/2+)	L		J π : from $\Delta J=1$ γ to (23/2+) level and band structure.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

⁸⁷Y Levels (continued)

E(level) [†]	J π	XREF	T _{1/2} [‡]	Comments
5759.59 ^d 24	(27/2-)	L	>2.1 ps	J π : from $\Delta J=1$ γ 's to 25/2+ and (25/2-) levels, γ to (23/2-).
5827.1 3	(27/2+)	L		J π : From $\Delta J=1$ γ feeding from (29/2-) and (M1+E2) γ to 25/2+.
5934.50 ^d 24	(29/2-)	L	1.8 ps 4	J π : from M1 γ to (27/2-) level, γ to (25/2-), and band structure.
6535.5 ^d 3	(31/2-)	L	0.18 ps 4	J π : from likely $\Delta J=1$ γ to (29/2-) level and band structure.
7016.6 ^d 3	(33/2-)	L	0.11 ps 3	J π : from likely M1 γ to (31/2-) level.
10537 11	5/2+&	D	23 keV 1	$\Gamma_p=3.44$ keV 20.
10923 11	1/2+&	D	40 keV 2	$\Gamma_p=14.0$ keV 10.
11468 15	3/2+&	D	21 keV 2	$\Gamma_p=1.6$ keV 2.
11739 11	1/2+&	D	33 keV 2	$\Gamma_p=9.5$ keV 5.
11900 11	1/2+&	D	34 keV 2	$\Gamma_p=11.5$ keV 6.
11966 23	(3/2)+&	D	25 keV 8	$\Gamma_p=1.4$ keV 10.
11966 23	(5/2+)&	D	25 keV 8	$\Gamma_p=1.0$ keV 8.
12371 11	3/2+&	D	24 keV 1	$\Gamma_p=5.2$ keV 3.
12661 14	1/2+&	D	44 keV 4	$\Gamma_p=11.9$ keV 7.
12968 15	3/2+&	D		
13076 15	5/2+&	D		

[†] From least-squares fit to γ -ray energies for levels connected by γ 's; for other levels from weighted average of all available reaction values, unless otherwise noted. Where uncertainties on E γ is missing, evaluators assume 1.0 keV.

[‡] From ⁸⁵Rb(α ,2n γ), ⁷⁴Ge(¹⁸O,4n γ), unless indicated otherwise.

[§] From (p, γ), only determined by primary γ spectra.

From comparison of primary γ strength with the γ strength to the 381 level in (p, γ).

@ From (p, α) from angular distribution and analyzing powers.

& From analyzing power and shape of the resonance curve in (p,p') IAR.

a (A): 1/2- ground-state band.

b (B): $\Delta J=1$ band based on 13/2-.

c (C): yrast states, positive parity.

d (D): Other positive parity yrast states.

$\gamma(^{87}\text{Y})$

E(level)	E γ [†]	I γ	Mult. ^{‡§}	δ [§]	α [‡]	Comments
380.82	380.79 7	100	M4		0.256	E γ , Mult.: from IT decay. B(M4)(W.u.)=2.705 12.
793.73	793.7 1	100	(E2)		1.09×10^{-3} 2	Mult.: $\alpha(K)(\text{exp})=1.016 \times 10^{-3}$ 97 gives mult=M1,E2. Placement in level scheme requires $\Delta J=2$. See dataset from (p,n γ). B(E2)(W.u.)>0.0078.
982.89	982.9 1	100	M1, E2			Mult.: $\alpha(K)(\text{exp})=0.55 \times 10^{-3}$ 13 gives mult=M1,E2. See (p,n γ) dataset.
1152.71	771.9 1	100	E2			Mult.: $\alpha(K)(\text{exp})=1.19 \times 10^{-3}$ 33 gives mult=M1,E2. Placement in level scheme requires $\Delta J=2$. See dataset from (p,n γ).
1182.00	1182.1 1	100				
1203.01	409.2 1	9.8 4				
	1203.0 2	100.0 16				
1404.47	1024.0 3	100	E2		5.91×10^{-4}	$\alpha(K)\text{exp} = 0.53 \times 10^{-3}$ 13 from (p,n γ). Mult.: M1,E2 from $\alpha(K)\text{exp}$, but placement in level scheme requires $\Delta J=2$. B(E2)(W.u.)>0.0022. B(E2)(W.u.) calculated assuming Q is E2.
1405.3	1024.0 10	100				
1590.92	1210.0 2	100	D+Q	+1.0 4		B(M1)(W.u.)> 3.7×10^{-7} ; B(E2)(W.u.)>0.00029. B(M1)(W.u.) and B(E2)(W.u.) calculated assuming D+Q is M1+E2.
1608.31	1227.5 1	100				
1623.50	444.0 #	16 #				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Y})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma$	Mult. $^{\ddagger}\S$	$\delta\S$	$\alpha^{\ddagger}$	Comments
1623.50	643.0#	100#				
	829.5 2	100				
1629.94	836.2@ 1	100@	M1, E2			$\alpha(\text{K})_{\text{exp}} = 1.10 \times 10^{-3}$ 20 from (p, γ).
1704.7	501.9#	18#				
	523.3 7	75 13				$I\gamma$: $I\gamma=91$ in (p, γ).
	910.5#	94#				
	1704.5 4	100 18				
1756.08	574.1 1	100 4				
	962.7 2	≈ 36				
1768.2	974.5 5	100				
1801.64	598.1#	16#				
	619.8 2	20 4				
	818.5#	8#				$I\gamma$: $I\gamma=35$ in (p, γ).
	1801.5 2	100 4				
1849	665.2#	67#				
	864.1#	100#				
1979.95	574.0#	123#				$I\gamma$: from (p, γ); not reported in (p,n γ), so placement may be questionable.
	776.9 1	100 4				
	827.3 2	21 3				
	1186.5 3	31 5				
2008.8	1215.1 3	100				
2038.05	633.6 1	100.0 16	M1+E2	+0.37 7	0.00171 3	$\alpha(\text{K})_{\text{exp}} = 1.77 \times 10^{-3}$ 45, from (p,n γ). Mult.: Using δ from 1980Fi06 with the $\alpha(\text{K})_{\text{exp}}$ from 1980Ta13 and comparing with calculations from BrICC yields the M1+E2 multipolarity. B(M1)(W.u.) $>3.6 \times 10^{-6}$; B(E2)(W.u.) >0.00098 . $I\gamma$: from (p,n γ); other: 49 4 from ($^{80}\text{Se}^{(11}\text{B}, 4\text{n}\gamma)$). B(M1)(W.u.) $>1.5 \times 10^{-7}$; B(E2)(W.u.) $>3.9 \times 10^{-6}$.
	1657.2 1	99.3 21	[M1, E2]		3.48×10^{-4} 6	
2072.7	1279.0#	100#				
2073.31	920.6 2					$I\gamma$: Not well determined. (p,n γ), In ^{87}Zr β^+ there is only a weak 921 γ , with the spectrum suggesting roughly half that of the 1692 γ , whereas (p,n γ) shows the 920 γ intensity as slightly less than the 1692 γ . In (p, γ) the 920 γ intensity is a little over 4 times as high as that of the 1692 γ , suggesting, for this case at least, a doublet was observed. In β^+ , the 1279 γ shown deexciting the 2072.7 was not observed, indicating another level close to this energy, as shown here.
	1692.0 15	100 4				
2083.0	880.0#	31#				
	901.3#	97#				
	930.0#&	31#&				
	1100.1#	53#				
	2082.8#	100#				
2112.3	706.3#	55#				
	930.0#&	27#&				
	959.7 4	100				
2154.60	951.7 2	38.8 14				
	1773.5 3	100 4				
2158.9	2158.9#	100#				
2186.0	1392.3 3	100				
2202.17	611.2 2	30 3				$I\gamma$: from (p,n γ); other: 67 17 from ^{87}Zr β^+ decay.
	797.0 7	100 5				$I\gamma$: 100 34 from β^+ .
	1048 1	33 17				$I\gamma$: From β^+ , as not seen in (p,n γ).
	1410.0 15	17 8				$I\gamma$: From β^+ , as not seen in (p,n γ).
	1821.4 2	29.8 20				$I\gamma$: from (p,n γ); other: 50 17 from ^{87}Zr β^+ decay.
2210.6	409.2#	47#				
	2210.4#	100#				
2241.6	633 1	100 50				
	836 1	100 50				

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Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Y})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	I_{γ}	Mult. ^{‡§}	$\delta^{\S}$	$\alpha^{\ddagger}$	Comments
2241.6	1862.0 15	50 25				
2244.8	619.7#	77#				
	1042.6#	100#				
	1451.9#	31#				
2277.53	1075.3 4	80 9				
	1483.8 2	100 14				
	1896.2 3	50 11				
2279.4	1126.9	100				
2292.3	1139.6#	100#				
2302.61	711.4 3					I γ : weak.
	898.6 2					I γ : weak.
	1921.6 2	100				
2344.61	940.0 2	100 11				
	1963.9 2	100 11				
2353.55	746.6#	100#				
	949.4#	47#				
	1559.7 2					E γ : γ 's of 746 and 949 are reported in (p, γ) and 1559 is reported in (p, γ).
2366.92	962.4 1	100	D			δ : =+0.3 7 from 1998Sc22. B(E1)(W.u.)>3.8 $\times 10^{-8}$.
2400.0	2019.2 3	100				
2409	2408.3#	100#				
2428.09	1023.6 1	100	E2		5.91 $\times 10^{-4}$	B(E2)(W.u.)>0.0022.
2479.07	441.1 [@] 5	26 [@] 3	(D+Q)			
	888.2 1	100 5	(D)			
2552	1400.0 15	100 25				
	2172 2	50 25				
2563.7	973 1	50 13				
	1159 1	100 13				
	2183.0 15	38 13				
2602.3	1808.0 15	33 11				
	2222.0 15	100 22				
2648.91	169.9 1	100	D(+Q)	+0.05 2	0.0434 7	Mult.: Supported by directional correlation of oriented states in (^{11}B ,4n γ).
2676.06	27.2 1	<5.9	[M1]		7.79	
	247.9 2	20.0 18	(E1+M2)	+0.19 11	0.010 4	B(E1)(W.u.)<1.4 $\times 10^{-5}$. Transition strengths calculated assuming relative intensity of 3 3 for the 27.2 γ , based on (α ,2n γ). Using this, B(M2)(W.u.)=37 +51-31 which exceeds RUL of 1.
	309.1 1	100 12	M1+E2	+0.20 4	0.00962 20	Mult.: D+Q from (α ,2n γ) angular distribution and E1+M2 for δ =+0.2 4 is eliminated from RUL. δ : from (α ,2n γ); other: -0.08 8 from ^{80}Se (^{11}B ,4n γ). B(M1)(W.u.)=(0.0024 11); B(E2)(W.u.)=(1.1 7).
2808.4	1040.2 [@] 5	100 [@]				
2827.20	399.1 1	100	E2		0.00792	B(E2)(W.u.)=4.6 3.
2961.47	285.4 1	100 6	M1(+E2)	+0.07 28	0.0114 14	
	312.6 3	40 4	(M1+E2)	-0.4 3	0.0102 17	I γ : from ^{80}Se (^{11}B ,4n γ).
2986.9	159.8 [@] 1	100 [@] 5	(M1+E2)	+0.06 2	0.0512 9	E γ : Taken from (α ,2n γ). δ : from (α ,2n γ); other: +0.25 15 from ^{80}Se (^{11}B ,4n γ).
	558.7 [@] 5	35 [@] 4	[M1, E2]		0.00236 10	B(M1)(W.u.)>0.078?; B(E2)(W.u.)>4.1? B(M1)(W.u.)>0.00041; B(E2)(W.u.)>0.092.
2995.6	346.7 2	100				
2996.1	1388.0 15	100 33				
	2615.0 15	100 67				
3094.4	107.5 2	100	D			
3262.9	1857.0 15	100 50				
	2883 2	100 75				
3402.4	440.9 [@] 5	51 [@] 4	(M1)		0.00390	
	726.4 [@] 3	100 [@] 8	(M1+E2)	+0.26 6	1.24 $\times 10^{-3}$	δ : from (α ,2n γ); other: +0.09 11 from ^{80}Se (^{11}B ,4n γ).
3405.2	1203 1	100				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Y})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	I_{γ}	Mult. ^{‡§}	$\delta^{\S}$	$\alpha^{\ddagger}$	Comments
3446.5	770.5@ 3	100@	(D+Q)	-0.19 17	1.08×10^{-3} 2	δ : from ($^{11}\beta, 4n\gamma$).
3552.95	725.8@ 1	100@	D(+Q)	-0.20 22	1.24×10^{-3} 2	δ : from $^{80}\text{Se}(^{11}\text{B}, 4n\gamma)$; other: +0.05 2 from $^{85}\text{Rb}(\alpha, 2n\gamma)$. B(M1)(W.u.)=(0.67 +23-14). B(E2)(W.u.): not calculated due to large uncertainty in mixing ratio.
3595.2	768.0 3	100				
3595.3	608.4 3	100	D+Q	+0.06 3		B(M1)(W.u.)=(1.9×10^{-4} +13-6); B(E2)(W.u.)=(2.1×10^{-3} +15-6).
3766.6	364.1@ 5	100@ 8	D+ (Q)	-0.15 20		
	1090.6@ 5	67@ 8	(E2)		5.12×10^{-4}	
3908.8	142.2@ 5	21@ 6	(D+Q)			
	506.4@ 5	100@ 6	[Q]			
4039.40	486.4@ 1	100@	D(+Q)	-0.16 20		B(M1)(W.u.)=(1.1 +4-3); B(E2)(W.u.)<817.
4214.1	174.7 2	100	D			
4555.0	1568.2@ 5	100@ 14	(E2)		3.50×10^{-4}	
	1727.6@ 5	62@ 19				
4564.1	1011.4@ 5	41@ 17	(D)			
	1117.6@ 3	100@ 7	(E2)		4.86×10^{-4}	
	1161.7@ 5	31@ 4				
4609.66	569.0@ 5	11@ 3				
	1056.8@ 1	100@ 25	D(+Q)	0.04 18		
	1782.4@ 1	83@ 17	E2		3.91×10^{-4}	B(E2)(W.u.)=4.9 21.
5228.2	1189.1@ 5	78@ 11	(D)			
	1319.4@ 5	100@ 11	D(+Q)	0.14 22		
	1675.1@ 5	56@ 6	(D)			δ : From ($^{11}\beta, 4n\gamma$) δ was -0.27 27.
5288.48	678.8@ 1	100@ 18	(D, Q)			
	1249.0@ 5	11.8@ 18	(D, Q)			
	1735.8@ 5	21@ 3				
5319.7	1553.0@ 5	100@	(E2)		3.48×10^{-4}	
5495.2	940.1@ 5	82@ 9	D+Q	-0.8 5		
	1942.2@ 5	100@ 9	D+Q	-0.8 3		
5759.59	264.3@ 5	12.3@ 18	(D)			δ : -0.20 20. Mult.: Although a calculated mixing ratio of -0.20 20 for M2/E1 is reported in ($^{11}\beta, 4n\gamma$), an M2 component is excluded by RUL for larger half-lives reasonably close to 2.1 ps.
	439.7@ 5	14@ 4	D(+Q)	+0.10 10		
	531.5@ 5	9@ 4				
	1195.6@ 3	100@ 7	(E2)		4.26×10^{-4}	B(E2)(W.u.)<2.1.
	1720.0@ 3	95@ 11	(E1+M2)	-0.14 10	5.20×10^{-4}	Mult.: (D+Q) from direction correlation of oriented nuclei in $^{80}\text{Se}(^{11}\text{B}, 4n\gamma)$ and additional support from level scheme placement. B(E1)(W.u.)< 1.3×10^{-5} ?; B(M2)(W.u.)<0.95?
5827.1	331.7@ 5	6.8@ 17				
	1217.4@ 3	100@ 14	(M1+E2)	-1.0 3	4.14×10^{-4}	
	1787.8@ 5	44@ 7				
5934.50	107.5@ 5	38@ 4	(D)			
	174.9@ 1	100@ 6	D+Q	-0.20 12		
	615.0@ 5	21@ 4				
	646.0@ 3	80@ 6	(D)			Mult., δ : reported as E1+M2 with $\delta=-0.5(4)$, but this δ gives BM2W=4.E+2 +6-4 which is too large and δ must be essentially zero.
	706.3@ 5	44@ 5				
6535.5	601.0@ 1	100@	(D+Q)	+0.14 14		B(M1)(W.u.)=(0.55 13); B(E2)(W.u.)=(30 +70-3)0.
7016.6	481.1@ 1	100@	(D+Q)	-0.10 15		B(M1)(W.u.)=(1.8 5); B(E2)(W.u.)=(90 +260-9)0.

[†] Weighted average of values from $\epsilon+\beta^+$ decay, (p,n γ), and (p,2n γ) or (α ,2n γ), or one of these measurements, unless indicated otherwise.

[‡] For calculation of reduced transition probabilities and the related α , the assignments of stretched Q are taken to be E2.

[§] From (α ,2n γ), unless indicated otherwise.

From (p, γ); these values do not have uncertainties and the energies are quoted here to the nearest 0.1 keV.

@ From $^{80}\text{Se}(^{11}\text{B}, 4n\gamma)$.

& Multiply placed; undivided intensity given.

Adopted Levels, Gammas (continued)

^{87}Y IT Decay (13.37 h) 1984Pr01,1966Sa16

Parent ^{87}Y : $E=380.82$ 7; $J\pi=9/2+$; $T_{1/2}=13.37$ h 3; %IT decay=98.43 10.

^{87}Y -%IT decay: calculated from measured $I_{\beta^+}=0.75$ 5 and theoretical ϵ/β^+ ratio for decay to ^{87}Sr .

This state also decays by electron capture.

 ^{87}Y Levels

E(level)	$J\pi$	$T_{1/2}$	Comments
0.0	1/2-	79.8 h 3	$J\pi, T_{1/2}$: from ^{87}Y Adopted Levels.
380.79 7	9/2+	13.37 h 3	%IT=98.43 10; % ϵ +% β^+ =1.57 10. $J\pi, T_{1/2}$: from ^{87}Y Adopted Levels.

 $\gamma(^{87}\text{Y})$

E_γ	E(level)	$I_\gamma^\dagger$	Mult.	α	Comments
380.79 7	380.79	79.3	M4	0.256	$\alpha(K)\text{exp}=0.207$ 4 (1966Sa16). $B(M4)(\text{W.u.})=2.705$ 12. E_γ : from ^{87}Y Adopted γ 's. $\alpha(K)\text{exp}$: deduced from theoretical $\alpha_K=0.181$ 3 for the 388 M4 γ in ^{87}Sr and the measured ratio $I_{\text{ce}_K(381)}/I_{\text{ce}_K(388)}=1.135$ 19 (1966Sa16).

† For absolute intensity per 100 decays, multiply by 0.9843 10.

Decay Scheme

Intensity: $I(\gamma+\text{ce})$ per
100 parent decays
%IT=98.43 10

^{87}Zr β^+ Decay 1971AwZZ,1989Sh39

Parent ^{87}Zr : $E=0.0$; $J\pi=(9/2)+$; $T_{1/2}=1.68$ h 1; $Q(\text{g.s.})=3672$ 4; % β^+ decay=100.

1989Sh39: produced by proton-induced spallation and measured absolute γ intensities.

1971AwZZ: produced by $^{86}\text{Sr}(^3\text{He},2n)$ followed by chemical separation. Measured γ singles and $\gamma\gamma$ coincidences; more accurate coincidences were reported by same authors (1973KaZD).

1971Ar18: produced by irradiation of yttrium and niobium with 120 and 660-MeV protons, respectively, followed by chemical separation. Measured γ 's. Report 15 γ 's.

1965Ba48: produced by (α,n) and measured β^+ and γ spectra. They report β^+ to ground state and isomeric level and no γ rays.

1964Aw02: produced by $(p,3n)$ and report two γ rays.

1963Bu06: produced by (p,pn) and report one γ ray.

 ^{87}Y Levels

E(level) †	$J\pi^\ddagger$	$T_{1/2}^\S$	Comments
0.0	1/2-	79.8 h 3	
380.79 7	9/2+	13.37 h 3	%IT=98.43 16; % ϵ +% β^+ =1.57 16.
794 1	5/2-		
1153 1	5/2+		

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$^{87}\text{Zr } \beta^+ \text{ Decay } 1971\text{AwZZ}, 1989\text{Sh39 (continued)}$ **$^{87}\text{Y Levels (continued)}$**

$E(\text{level})^\dagger$	$J\pi^\ddagger$	Comments
1405 1	(7/2+, 9/2+, 13/2+)	$J\pi$: Previously (7/2+, 9/2+), however as the logft value is still consistent with 13/2+, it is not clear that this level can be unambiguously differentiated from the 13/2+ 1405 level in the Adopted Set.
1590 1	11/2+	
1608 1	(7/2+, 9/2+)	
2073 1	(7/2+, 9/2+)	
2202 1	7/2+, 9/2+	
2241 1	(7/2, 9/2-)	
2553 2	(9/2)+	
2564 1	9/2, 11/2+	
2602 2	7/2+	
2996 2	(7/2, 9/2, 11/2)	
3263 2	9/2+, 11/2+	
3405 2	3/2+, 5/2+	

 † From least-squares fit to γ energies. ‡ From ^{87}Y Adopted Levels. $§$ From ^{87}Y Adopted Levels. **β^+, ϵ Data**

$E\epsilon$	$E(\text{level})$	$I\beta^+^\ddagger$	$I\epsilon^\ddagger$	$\text{Log } ft$	$I(\epsilon+\beta^+)^\ddagger$	Comments
(267 5)	3405		0.14 3	5.46 10	0.14 3	No feeding to this level is expected from (9/2)+. This indicates there may be another level very close to 3405 keV with a different $J\pi$, or there is unobserved β^+ feeding to a higher level which subsequently feeds into this one.
(409 5)	3263		0.11 5	5.95 20	0.11 5	
(676 5)	2996		0.17 7	6.21 18	0.17 7	
(1070 5)	2602		0.34 7	6.32 9	0.34 7	
(1108 5)	2564		0.42 5	6.26 6	0.42 5	
(1119 5)	2553		0.17 4	6.66 11	0.17 4	
(1431 5)	2241	0.0024 9	0.14 5	6.97 16	0.14 5	
(1470 5)	2202	0.0074 19	0.30 8	6.65 12	0.31 8	
(1599 5)	2073	0.0016 8	0.026 13	7.78 22	0.028 14	
(2064 5)	1608	0.869 22	1.79 4	6.173 11	2.66 6	
(2082 5)	1590	0.24 2	0.46 5	6.77 5	0.70 7	
(2267 5)	1405	0.13 5	0.15 5	7.33 16	0.28 10	
(2519 5)	1153	0.04 3	0.02 2	8.2 4	0.06 5	No feeding is expected from (9/2)+. This indicates there may be another level very close to 1153 keV with a different $J\pi$, or there is unobserved β^+ feeding to a higher level which subsequently feeds into this one.
(2878 5)	794	0.13 5	0.041 17	9.29 ^{1u} 18	0.17 7	
(3291 4)	380.79	80.45 19	13.87 14	5.692 5	94.32 15	$E\epsilon$: measured $E(\beta^+)$ are 2260 40 (1965Ba48) and 2280 50 (1971AwZZ).

 ‡ Absolute intensity per 100 decays. **$\gamma(^{87}\text{Y})$**

Coincidence data are from 1971AwZZ.

I_γ normalization: from 1989Sh39 from relative intensities of parent and daughter γ rays during decay and growth (no details). This value conflicts with $I_\gamma(\text{norm})=0.010$ based on $I_e+I_{\beta^+}=98.0$ 6 to the 381 level, by 1984Pr01 from the ratio of I_γ of 381 and 485 from ^{87}Sr , and γ intensity balance.

$E\gamma^\ddagger$	$E(\text{level})$	$I\gamma^\ddagger§$	Mult. ‡	α	Comments
(380.79 7)	380.79		M4	0.256 4	$E\gamma$: not measured here, from ^{87}Y Adopted γ 's. B(M4)(W.u.)=2.76 15.

Continued on next page (footnotes at end of table)

⁸⁷Zr β⁺ Decay 1971AwZZ,1989Sh39 (continued)

γ(⁸⁷Y) (continued)

E _γ [†]	E(level)	I _γ ^{‡§}	Comments
611 1	2202	4 1	
633 1	2241	2 1	
772 1	1153	8 1	
794 1	794	10 2	
797 1	2202	6 2	
836 1	2241	2 1	
(921)	2073		A weak 921 keV was observed but not placed in 1971AwZZ. From the spectra shown, it seems the 921γ has about half the intensity of the 1692 γ. Comparison with data from the ⁸⁷ Sr(p,nγ) reaction (1980Ta13) indicates that this may be the same transition depopulating the (7/2+,9.2+) level at 2073.
973 1	2564	4 1	
1024 1	1405	28 2	
1048 1	2202	2 1	
1159 1	2564	8 1	
1203 1	3405	5 1	
1210 1	1590	32.9 10	I _γ from 1989Sh39.
^x 1216 1		3 2	
1227 1	1608	100	
1388.0 15	2996	3 1	
1400.0 15	2553	4 1	
1410.0 15	2202	1.0 5	
^x 1657 2		3 1	
1692.0 15	2073	1.0 5	
1808.0 15	2602	3 1	
1821.0 15	2202	3 1	
1857.0 15	3263	2 1	
1862 2	2241	1.0 5	
2172 2	2553	2 1	
2183.0 15	2564	3 1	
2222.0 15	2602	9 2	
2615.0 15	2996	3 2	
2883 2	3263	2.0 15	

[†] From 1971AwZZ, unless otherwise noted; for another less extensive set, see 1971Ar18.

[‡] From ⁸⁷Y Adopted γ's.

[§] For absolute intensity per 100 decays, multiply by 0.0280 4.

^x γ ray not placed in level scheme.

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays

$^{80}\text{Se}(^{11}\text{B}, 4n\gamma)$ 1998Sc22E=45 MeV. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$, $\gamma\gamma(\theta)(\text{DCO})$ and lifetimes using OSIRIS CUBE detector array with six detectors. ^{87}Y Levels

E(level)	$J\pi^\dagger$	$T_{1/2}^\ddagger$	Comments
0.0§	1/2-		
380.81@ 10	9/2+		
793.5§ 3	5/2-		
1404.41@ 14	13/2+		
1590.71 14	11/2+		
1629.3 6			$J\pi$: assigned (1/2-, 3/2-) in Adopted Levels.
1768.0§ 6	(9/2-)		
2008.4 6			$J\pi$: assigned (7/2) in Adopted Levels.
2037.7 4	(11/2+)		$J\pi$: from Adopted Levels. Assigned (11/2-) in 1998Sc22, although no DCO ratios were obtained for populating or depopulating transitions, and the authors do not discuss on what experimental basis this assignment was made.
2366.72 17	15/2-		
2428.02@ 17	(17/2+)		$J\pi$: Band placement.
2478.9# 3	(13/2)-		$J\pi$: from Adopted Levels.
2648.8# 3	(15/2-)		
2675.82 19	17/2-		$J\pi$: Consistent with definitive assignment in Adopted Levels from additional strong arguments.
2808.2§ 8	(13/2-)		
2827.02@ 20	(21/2+)		
2961.2# 3	17/2-		$J\pi$: Agrees with Adopted Levels which has additional strong arguments.
2986.8 3	(19/2+)		
3402.2# 3	(19/2-)		
3446.3 3	(19/2-)		
3552.77@ 21	(23/2+)	0.083 ps 21	$J\pi$: From R(DCO) and band placement.
3766.4# 4	(21/2-)		
3908.6 4	(23/2-)		
4039.23@ 22	(25/2+)	0.17 ps 4	$J\pi$: band placement.
4554.9 4	(23/2+)		
4563.9 3	(23/2-)		
4609.49 21	25/2+	0.12 ps 4	$J\pi$: From stretched Q (assumed to be E2) to 21/2+.
5228.0 3	(25/2-)		
5288.30@ 23	(27/2+)	0.10 ps 3	
5319.5 4	(25/2-)		
5495.1 4	(25/2+)		
5759.4& 3	(27/2-)	>2.1 ps	
5826.9 3	(27/2+)		$J\pi$: Originally assigned 27/2(+) in 1998Sc22. However as the authors note, the B(E1) strength for the 108 transition feeding the level from the 5935 state with (29/2-) exceeds RUL. No other experimental information is sufficient to adopt a definite value for parity.
5934.3& 3	(29/2-)	1.8 ps 4	$J\pi$: As the authors note, if a positive parity, this would result in excessively large B(M2)(W.u.) values for the $\Delta J=2$ 615 and 706 transitions.
6535.3& 3	(31/2-)	0.18 ps 4	$J\pi$: Supported by DCO and shell model calculations. See 1998Sc22.
7016.4& 3	(33/2-)	0.11 ps 3	$J\pi$: Supported by DCO and shell model calculations. See 1998Sc22.

† Based on multiple order of γ transitions deduced from directional correlations of de-exciting oriented states (DCO) ratios; Additional supporting are noted along with any differences from assignments in Adopted Levels.

‡ From DSAM.

§ (A): 1/2- decoupled ground-state band.

(B): $\Delta J=1$ band based on 13/2-.

@ (C): Yrast states, positive parity.

& (D): Other positive parity yrast states.

 $\gamma(^{87}\text{Y})$ DCO ratios are for gating on $\Delta J=2$ transitions, unless otherwise stated.

$E\gamma^\dagger$	E(level)	$I\gamma^\ddagger$	Mult.§	δ	α	Comments
27.0 5	2675.82					

Continued on next page (footnotes at end of table)

$^{80}\text{Se}(^{11}\text{B}, 4n\gamma)$ 1998Sc22 (continued) $\gamma(^{87}\text{Y})$ (continued)

$E\gamma^{\dagger}$	E(level)	$I\gamma^{\ddagger}$	Mult. [§]	δ	α	Comments
107.5 5	5934.3	4.0 [#] 4	(D)			DCO=0.24 6. Mult.: DCO suggests mult=dipole and placement in the level scheme requires $\Delta\pi$ =yes; however, this leads to B(E1)(W.u.)=0.02, which exceeds the RUL of 0.01. This was noted in 1998Sc22.
142.2 5	3908.6	0.7 [#] 2	(D,Q)			DCO=0.68 26.
159.8 3	2986.8	6.0 3	(M1+E2)	+0.25 15	0.059 12	Mult.: $T_{1/2}$ in Adopted Levels for 2986 is used so that RUL can rule out E1+M2. DCO=0.59 3.
169.9 1	2648.8	13.3 [#] 6	D(+Q)	-0.15 25		DCO=0.59 6.
174.9 1	5934.3	10.4 [#] 6	D+Q	-0.20 12		DCO=0.59 3, 0.92 7 ($\Delta J=1$ gated).
247.9 5	2675.82	3.4 [#] 3	(E1+M2)	+0.19 11	0.010 4	DCO=0.97 5. Mult.: R(DCO) gives mult=Q and RUL eliminates E1+M2.
264.3 5	5759.4	0.7 [#] 1	(D)			DCO=0.64 7. δ : -0.20 20. Mult.: Although a calculated mixing ratio of -0.20 20 for M2/E1 is reported, an M2 component is excluded by RUL for larger half-lives reasonably close to 2.1 ps.
285.4 3	2961.2	5.5 3	(M1+E2)	+0.07 28	0.0114 14	Mult.: D+Q from R(DCO) and then γ to 17/2- gives (M1+E2). DCO=0.96 7, 1.42 12 ($\Delta J=1$ gated).
309.1 1	2675.82	17 [#] 2	(M1+E2)	-0.08 8	0.00932 22	DCO=0.62 2, 0.90 3 ($\Delta J=1$ gated). Mult.: D+Q from R(DCO). If the adopted δ of +0.20 4 is used E1+M2 is eliminated from RUL.
312.3 5	2961.2	2.2 [#] 2	(D+Q)	-0.4 3		DCO=0.52 8.
331.7 5	5826.9	0.4 [#] 1				
364.1 5	3766.4	3.9 3	D(+Q)	-0.15 20		DCO=0.61 6.
380.8 1	380.81	234 10	M4		0.256	Mult.: From Adopted Levels.
399.0 1	2827.02	100 2	E2		0.00793	DCO=1.01 2. Mult.: Stretched Q from DCO, assumed by evaluators to be E2.
439.7 5	5759.4	0.8 [#] 2	D(+Q)	+0.10 10		DCO=0.73 4 Corresponds to the 439.7+440.9+441.1 apparently unresolved triplet, 1988Sc22.
440.9 5	3402.2	3.8 [#] 3	(D,Q)			Mult.: Given as only (M1) in 1998Sc22.
441.1 5	2478.9	3.0 [#] 3	[E1]		0.00177 13	
481.1 1	7016.4	14 [#] @ 2	(D+Q)	-0.10 15		DCO=0.65 10.
486.4 1	4039.23	41 [#] @ 3	D(+Q)	-0.16 20	0.00312 12	DCO=0.60 6.
506.4 5	3908.6	3.3 [#] 2	[Q]			
531.5 5	5759.4	0.5 [#] 2				
558.7 5	2986.8	2.1 [#] 2	[M1, E2]			
569.0 5	4609.49	1.3 [#] 3				
601.0 1	6535.3	29 [#] @ 2	(D+Q)	+0.14 14		DCO=0.76 6.
615.0 5	5934.3	2.2 [#] 4				
633.3 5	2037.7	4.7 [#] 5				
646.0 3	5934.3	8.3 [#] 6	D+Q	-0.5 4		DCO=0.53 6.
678.8 1	5288.30	11 [#] @ 2	(D,Q)			DCO=0.32 2. The DCO ratio was smaller than the theoretical results and so no mixing ratio was derived (1998Sc22).
706.3 5	5934.3	4.6 5				
725.8 1	3552.77	59 [#] @ 5	D(+Q)	-0.20 22		DCO=0.59 6.
726.4 3	3402.2	7.5 6	D(+Q)	+0.09 11		DCO=0.70 5 ($\Delta J=1$ gated).
770.5 3	3446.3	6.2 7	(D+Q)	-0.19 17		DCO=0.58 5.
793.5 3	793.5	6.6 4				
835.8 5	1629.3	1.0 [#] 1				
888.2 1	2478.9	11.7 6	(D)			
940.1 5	5495.1	0.9 [#] 1	D+Q	-0.8 5		DCO=0.52 6.
962.3 1	2366.72	18.2 9	D			δ : $\delta(Q/D)=+0.03$ 7. DCO=0.65 2.
974.5 5	1768.0	0.7 1				
1011.4 5	4563.9	2.4 10	(D)			DCO=0.9 5.

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$^{80}\text{Se}(^{11}\text{B},4n\gamma)$ 1998Sc22 (continued) $\gamma(^{87}\text{Y})$ (continued)

$E\gamma^\dagger$	E(level)	$I\gamma^\ddagger$	Mult.§	δ	α	Comments
1023.6 1	1404.41	159 19				DCO=1.01 4 (combined value from a doublet). I γ : From the value of the 1024 peak with the component from the 1024 γ transition from the 2428 level subtracted out.
	2428.02	129# 7	[E2]		5.91 $\times 10^{-4}$	DCO=1.01 4 Combined value from doublet.
1040.2 5	2808.2	0.3# 1				
1056.8 1	4609.49	12#@ 3	D(+Q)	0.04 18		DCO=0.70 8.
1090.6 5	3766.4	2.6# 3	(E2)		5.12 $\times 10^{-4}$	DCO=1.49 20 ($\Delta J=1$ gated).
1117.6 3	4563.9	5.9 4	E2		4.86 $\times 10^{-4}$	DCO=1.02 7, 1.40 10 ($\Delta J=1$ gated). Mult.: Evaluators assume Q most likely E2.
1161.7 5	4563.9	1.8 2				
1189.1 5	5228.0	1.4 2	(D)			DCO=0.87 18.
1195.6 3	5759.4	5.7# 4	(E2)		4.26 $\times 10^{-4}$	DCO=1.45 13 ($\Delta J=1$ gated). Mult.: Supports the tentative $\pi=-$ assignment, as $\pi=+$ results in an M2 of over 130 W.u., excluded by RUL.
1209.9 1	1590.71	26.6 12				
1214.9 5	2008.4	0.9# 1				
1217.4 3	5826.9	5.9# 8	(M1+E2)	-1.0 3		DCO=0.45 4.
1249.0 5	5288.30	1.3# 2	(D,Q)			DCO=0.21 4. The DCO ratio was smaller then theoretical results and so no mixing ratio was derived (1998Sc22).
1319.4 5	5228.0	1.8# 2	D(+Q)	0.14 22		DCO=0.75 11, 1.17 16 ($\Delta J=1$ gated).
1553.0 5	5319.5	3.5#@ 5	(E2)		3.48 $\times 10^{-4}$	DCO=1.37 15 ($\Delta J=1$ gated).
1568.2 5	4554.9	2.1 3	(E2)		3.50 $\times 10^{-4}$	DCO=1.99 23.
1656.8 5	2037.7	2.3 2				
1675.1 5	5228.0	1.0 1	(D+Q)	-0.27 27		DCO=0.56 9.
1720.0 3	5759.4	5.4 6	(E1+M2)	-0.14 10	5.20 $\times 10^{-4}$	DCO=0.61 3. Mult.: (D+Q) from DCO and additional support from level scheme placement.
1727.6 5	4554.9	1.3 4				
1735.8 5	5288.30	2.3# 3				
1782.4 1	4609.49	10#@ 2	E2		3.91 $\times 10^{-4}$	DCO=1.03 13.
1787.8 5	5826.9	2.6 4				
1942.2 5	5495.1	1.1 1	D+Q	-0.8 3		DCO=0.43 6.

† Authors state that $\Delta(E\gamma)=0.1$ to 0.5 keV. Evaluators assign 0.1 keV for $I\gamma>10\%$, 0.3 keV for $I\gamma=5-10\%$ and 0.5 keV for $I\gamma<5\%$.

‡ These relative values represent A_0 in $\gamma(\theta)$ distributions, deduced from singles spectra at $\theta=45^\circ$ and 90° .

§ DCO values given are the ratios $W(90^\circ,45^\circ,90^\circ)/W(45^\circ,90^\circ,90^\circ)$.

From $\gamma\gamma$ coincidence spectra.

@ Corrected for Doppler-shifted portion of the intensity.

Level Scheme

Intensities: relative I_γ

⁸⁷Y₄₈

⁸⁰Se(11B,any) 1998Sc22 (continued)

⁸⁴Sr(α,p) 1977Me16

E(α)=18 MeV, FWHM=20 keV, θ=7°–142° in 7.5° steps and DWBA analysis of p(θ).

The authors assume that the reaction proceeds by triton cluster transfer with two neutrons coupled to J^π=0+ and use the same proton configuration as in the (³He,d) work of 1971Ma11 in order to compare the strengths in both reactions. The agreement is good for most of the low-lying levels, except for the 1f_{5/2} transfer to the 801 level, which is more than two times stronger than that found in (³He,d).

⁸⁷Y Levels

E(level)	Jπ [†]	L [‡]	S [§]	E(level)	Jπ [†]	L [‡]	S [§]	E(level)	Jπ [†]	L [‡]	S [§]
0.0	(1/2-)	1	1.15	1321# 8				2012 8			
388 8	(9/2+)	4	6.23	1403 8				2103 8	(3/2-)	(1)@	0.26
801 8	(5/2-)	3	2.60	1504# 8	(3/2-)		0.10	2201 8	(9/2+)	(4)	0.92
981 8	(3/2-)	1	0.72	1618 8	(9/2+)	4	1.58	2282 8	(5/2-)	3	0.02
1157 8	(5/2+)	2	0.24	1757 8							
1203 8				1851 8	(3/2-)	1	0.24				

[†] Value assumed for extraction of S.

[‡] The authors take L values from the (³He,d) work of 1971Ma11.

[§] The results were normalized arbitrarily by requiring that the ground-state strength is equal to the ground-state strength in (³He,d).

Weakly excited levels.

@ Poor fit. The dip expected at 60°–70° is not observed.

⁸⁵Rb(α,2nγ), ⁷⁴Ge(¹⁸O,4nγ) 1980Fi06,1986Wa25,1988Ko08

1980Fi06: ⁸⁵Rb(α,2nγ), E=24.1–36.1 MeV, measured γ spectrum, n-γ coincidences, γγ coincidences, γ(θ), and excitation functions.

1986Wa25: ⁷⁴Ge(¹⁸O,4nγ), E=40–80 MeV, measured γγ coincidences and measured lifetimes by recoil-distance method.

1988Ko08: ⁸⁵Rb(α,2nγ), E=27 MeV, measured lifetimes by generalized centroid-shift method.

⁸⁷Y Levels

Scheme is from 1980Fi06.

E(level)	Jπ [†]	T _{1/2} [‡]	Comments
0.0	1/2-§		
380.80 10	9/2+§	13.37 h 3	T _{1/2} : From Adopted Levels.
793.60 10	5/2-§	≤10 ns	
1404.4 4	13/2+§	≤10 ns	
1590.61 15	11/2+§	≤10 ns	
1623.11 23	(5/2, 7/2)§		
2037.7 4	(15/2+)	≤10 ns	
2207.6 4			E(level): Based on subsequent measurements, it seems likely that the 170 keV γ depopulating this level is the same as that depopulating the 2649 keV level and therefore this level is not included in the Adopted Levels.
2366.8 3	15/2-	≤10 ns	
2428.0 4	17/2+§	≤10 ns	
2478.81 25	13/2-		
2648.7 3	15/2(-)		
2675.9 3	17/2-	0.25 ns@ 10	
2827.1 4	(21/2+)	0.53 ns# 3	T _{1/2} : other: 0.75 ns 10 (1988Ko08). Jπ: Definitive in Adopted Levels.
2961.3 3	17/2-		
2986.9 4	(23/2+)	<49 ps#	T _{1/2} : other: <0.1 ns (1988Ko08). Jπ: assignment in Adopted Levels is (19/2+) and decay includes γ to (17/2+) level.
2995.4 4	(17/2)		
3094.4 5	(25/2)	<49 ps#	T _{1/2} : other: <0.1 ns (1988Ko08). Jπ: (21/2) in Adopted Levels.
3401.6 4	(19/2-)§		
3447?	(21/2-)		Jπ: (19/2-) in Adopted Levels.
3553.4 5	(23/2+)		Jπ: Definitive in Adopted Levels.

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⁸⁵Rb($\alpha, 2n\gamma$), ⁷⁴Ge(¹⁸O, $4n\gamma$) 1980Fi06, 1986Wa25, 1988Ko08 (continued)

⁸⁷Y Levels (continued)

E(level)	J $\pi^{\dagger}$	T _{1/2} [‡]	Comments
3595.1 5	(21/2, 23/2, 25/2+) [§]		
3595.3 5	(25/2+)	0.5 ns@ 2	J π : (21/2+) in Adopted Levels.
3765.8 4	(21/2)		J π : (21/2-) in Adopted Levels.
4040.2 5	(25/2)		J π : 25/2+ in Adopted Levels.
4214.9 5	(27/2)		J π : Based on angular distribution and placement in cascade.

[†] From γ angular distributions and excitation in ($\alpha, 2n\gamma$) (1980Fi06), unless indicated otherwise.

[‡] From delayed coincidences (1980Fi06) from general statement that all values are ≤ 10 ns, unless indicated otherwise.

[§] From Adopted Levels.

[#] From 1986Wa25.

[@] From 1988Ko08.

 $\gamma(^{87}\text{Y})$

E $\gamma^{\dagger}$	E(level)	I $\gamma^{\ddagger}$	Mult. [#]	$\delta^{\#}$	Comments
27.2 1	2675.9	≤ 2.4 [§]	(M1)		Mult.: A ₂ =-0.44 11, A ₄ =+0.02 15, from Table 3, 1980Fi06 implying mult=dipole, and M1 from level structure.
107.5 2	3094.4		D		Mult.: A ₂ =-0.28 3, A ₄ =+0.01 5, from Table 3, 1980Fi06.
159.8 1	2986.9	20 2	D+Q	+0.06 2	Mult.: A ₂ =-0.15 3, A ₄ =+0.07 4, from Table 2, 1980Fi06.
169.9& 1	2207.6	≤ 19 ^{&}			I γ : from I γ (169) $\leq$ I γ (633), the following γ .
	2648.7	50& 11	D+Q	+0.05 2	I γ : from measured I γ (169)=59 6 and I γ (169)=9 9 deexciting the 2207 level.
					Mult.: A ₂ =-0.15 2, A ₄ =+0.09 3, from Table 2, 1980Fi06, but unresolved doublet.
174.7 2	4214.9		D		Mult.: A ₂ =-0.21 8, A ₄ =-0.02 10.
247.9 2	2675.9	8.2 [§] 16			E γ : this placement is considered as questionable by 1980Fi06 because of possible ⁸⁶ Y impurities; however, it is confirmed by 1988Ko08, because at the E α value at which they have measured ⁸⁶ Y is practically not produced.
					I γ : Could be a doublet.
					Mult.: A ₂ =+0.14 2, A ₄ =-0.02 3, from Table 3, 1980Fi06.
285.4 1	2961.3	18 2	D		
309.1 1	2675.9	41 [§] 5	M1+E2	+0.20 4	Mult.: A ₂ =-0.44 2, A ₄ =+0.07 3, from Table 2, 1980Fi06. Angular distributions give D+Q and RUL eliminates E1+M2.
312.6 3	2961.3	7.2 51			Mult.: A ₂ =-0.52 11, A ₄ =0, from Table 3, 1980Fi06.
					I γ : Calculated using branching ratio of 0.29 3 from (¹¹ B, $4n\gamma$).
346.7 2	2995.4				Mult.: A ₂ =-0.36 9, A ₄ =-0.08 12, from Table 3, 1980Fi06.
364.2 2	3765.8				Mult.: A ₂ =-0.14 6, A ₄ =0, from Table 3, 1980Fi06.
380.8 1	380.80		M4		Mult.: from ^{87m} Y isomeric decay.
399.1 1	2827.1	100	Q		Mult.: A ₂ =+0.34 2, A ₄ =-0.07 2, from Table 2, 1980Fi06.
440.3 2	3401.6				E γ : Unresolved doublet.
					Mult.: A ₂ =+1.07 7, A ₄ =0, from Table 3, 1980Fi06.
486.8 2	4040.2		D		Mult.: A ₂ =-0.74 7, A ₄ =+0.15 8, from Table 3, 1980Fi06.
608.4 3	3595.3	≤ 5	D+Q	+0.06 3	Mult.: A ₂ =-0.15 7, A ₄ =0, from Table 2, 1980Fi06.
633.3 2	2037.7	17 2	D+Q	+0.37 7	Mult.: A ₂ =-0.58 3, A ₄ =+0.02 4, from Table 2 1980Fi06.
725.7 3	3401.6	25 3	D+Q	+0.26 6	Mult.: A ₂ =-0.51 3, A ₄ =0, from Table 2, 1980Fi06.
726.3 3	3553.4	29 3	D+Q	+0.05 2	Mult.: A ₂ =-0.34 2, A ₄ =0, from Table 2, 1980Fi06.
768.0 3	3595.1	<48			Mult.: A ₂ =-0.06 2, A ₄ =-0.02 4, from Table 2, 1980Fi06, but unresolved doublet.
					I γ : Unresolved doublet with 771 γ from 3447.
771.0 ^a 3	3447?	<32	Q		Mult.: A ₂ =+0.28 6, A ₄ =0.02, from Table 2, 1980Fi06, but unresolved doublet.
					I γ : Unresolved doublet with 768 γ from 3595 level.
793.6 1	793.60	121 13	Q		Mult.: A ₂ =+0.26 2, A ₄ =+0.03 3, from Table 2, 1980Fi06.
(829.5 2)	1623.11				E γ : from adopted levels.
					Mult.: A ₂ =+1.10 10, A ₄ =+0.25 10 from Table 1, 1980Fi06, but authors state that contaminant peaks add unknown systematic error.
888.2 1	2478.81	56 6	D		Mult.: A ₂ =-0.20 2, A ₄ =+0.06 3, from Table 2, 1980Fi06.
962.4 1	2366.8	82 9	D		Mult.: A ₂ =-0.18 2, A ₄ =+0.02 3, from Table 2, 1980Fi06.
1023.6 [@] 1	1404.4	648 [@] 71	Q		

Continued on next page (footnotes at end of table)

⁸⁵Rb(α,2nγ), ⁷⁴Ge(¹⁸O,4nγ) 1980Fi06,1986Wa25,1988Ko08 (continued)

γ(⁸⁷Y) (continued)

E _γ [†]	E(level)	I _γ [‡]	Mult. [#]	δ [#]	Comments
1023.6@ 1	2428.0	648@ 71	Q		Mult.: A ₂ =+0.28 2, A ₄ =-0.03 3, from Table 2, 1980Fi06, but unresolved doublet.
1209.8 1	1590.61	108 12	D+Q	+1.0 4	Mult.: A ₂ =-0.92 2, A ₄ =+0.31 3, from Table 2, 1980Fi06.

[†] From 1980Fi06.

[‡] Relative I_γ measured at E=24.6 MeV in (α,2nγ) (1980Fi06).

[§] From (¹¹B,4nγ) I_γ(247.9)/I_γ(309.1)=0.20 3 and as the 247.9γ in 1980Fi06 may be a doublet, I_γ(27.2)/I_γ(247.9) ≤ 0.24.

[#] From γ angular distribution (1980Fi06) at E=24.6 MeV, unless otherwise noted.

@ Multiply placed; undivided intensity given.

& Multiply placed; intensity suitably divided.

a Placement of transition in the level scheme is uncertain.

Level Scheme

& Multiply placed; undivided intensity given

@ Multiply placed; intensity suitably divided

Intensities: relative I_γ

⁸⁶Sr(p,γ) IAR 1972PaYW

E=4.55 MeV to = 5.1 MeV, measured excitation functions, determined Γ_γ for transitions from the S(p)+4800 level.

⁸⁷Y Levels

E(level) [†]	Jπ [‡]
793.73	5/2-
982.89	3/2-

Continued on next page (footnotes at end of table)

⁸⁶Sr(p,γ) IAR 1972PaYW (continued)

⁸⁷Y Levels (continued)

E(level) [†]	Jπ [‡]
1203.01	(5/2)-
S(p)+4800§ 15	5/2+

[†] Nominal values from Adopted Levels, unless indicated otherwise.

[‡] From Adopted Levels.

§ Resonance energy in lab coordinates.

γ(⁸⁷Y)

E(level)	E _γ [†]	I _γ [‡]	Mult.	Comments
S(p)+4800	9327	7 2	(E1)	B(E1)(W.u.)=0.006 3.
	9547	13 3	(E1)	B(E1)(W.u.)=0.011 3.
	9735	7 2	(E1)	B(E1)(W.u.)=0.006 2.

[†] Calculated from level-energy differences.

[‡] Γ_γ in eV.

Level Scheme

Intensities: Γ_γ in eV for each transition

⁸⁶Sr(p,γ) 1975NoZT,1969Ir01,1976PiZM

1975NoZT: E_p=4.3 MeV and 4.8 MeV, anti-Compton pair spectrometer.

1969Ir01: E_p=3930 keV, FWHM=2 keV, pair spectrometer, measured primary γ spectra, report 5 primary γ's.

1976PiZM: E_p=2.8-3.8 MeV, determined primary γ strengths.

Other: 1979Sz06: E_p=2-3 MeV, determined primary γ strengths.

⁸⁷Y Levels

E(level)	Jπ [†]	Comments
0.0	1/2-	
380.9	9/2+	
793.6	5/2-	
982.6	3/2-	
1152.5	5/2+	
1181.5	3/2-	
1202.7	5/2-	
1405.1	(7/2+, 9/2+) [#]	
1590.8	11/2+	
1607.8	(7/2+, 9/2+)	
1625.6	(5/2, 7/2)	
1629.4	(1/2-, 3/2-) [#]	

Continued on next page (footnotes at end of table)

$^{86}\text{Sr}(\text{p},\gamma)$ 1975NoZT,1969Ir01,1976PiZM (continued) ^{87}Y Levels (continued)

E(level)	$J\pi^\dagger$	Comments
1704.3	(5/2-)	
1755.4	(5/2, 7/2-)#	
1801.0	(1/2-, 3/2, 5/2-)	$J\pi$: other: from comparison of primary γ strength with the γ strength to the 381 level, it follows $J^\pi=5/2+, 7/2-$, (1976PiZM).
1846.7	(1/2+, 5/2-)#	$J\pi$: 1/2- in Adopted Levels.
1979.2	(7/2, 9/2)-	
2072.7	(3/2, 5/2, 7/2)	
2073.31	(7/2+, 9/2+)	
2082.7	(3/2)-	
2111.4	5/2+	
2158.9		
2185 $\S$ 2	7/2-	
2210.4	(1/2)#	
2245.4		
2279.4	(7/2-)	
2292.1	5/2+, 7/2+	$J\pi$: other: from comparison of primary γ strength with the γ strength to the 381 level, it follows $J^\pi=5/2-$ (1976PiZM).
2354.5	(7/2, 9/2, 11/2)	
2376.9?		
2408.3	3/2+	
2440 $\ddagger$	(5/2)+#	
2445 $\S$ 2	(5/2)+	
2507 $\ddagger$	(5/2)+#	
2532 $\S$ 2		
2551 $\S$ 2	9/2+	
2572? $\S$ 2		
2579 $\ddagger$	(3/2-)#	E(level): Could be the 2581 level observed in 1975NoZT.
2618 $\ddagger$	(3/2-)#	E(level): Could be the 2616 level observed in 1975NoZT.
2668 $\ddagger$	(5/2)#	
2762 $\ddagger$	(3/2-)#	
2908 $\S$ 2	3/2+, 5/2+	
2995 $\S$ 2	(5/2+)	E(level): Could correspond to the 2995.6 keV (17/2+), 2996 keV 5/2+, or 2996.1 keV (7/2,9/2,11/2) levels in the Adopted Levels. Evaluators assume the 5/2+ assignment at these higher energies is more likely.
3351 $\S$ 2	3/2+, 5/2+	
9644 3		E(level): proton capture level at $E_p=3930$ keV.

 † From ^{87}Y Adopted Levels, unless otherwise noted. ‡ Only from 1976PiZM and only level energies reported. $\S$ From 1975NoZT, no γ 's are given. Evaluator adopts $\Delta(E)=2$ keV as these are values from the γ -ray energies determined with an accuracy of 1-2 keV from the pair spectra (1975NoZT).# From comparison of γ strengths to the γ strength to low lying levels (1976PiZM). $\gamma(^{87}\text{Y})$

E(level)	$E_\gamma^\ddagger$	$I_\gamma^\dagger$	Comments
380.9	380.86	100	
793.6	793.59	100	
982.6	982.58	100	
1152.5	771.57	100	
1181.5	1181.51	100	
1202.7	409.25	9	E_γ : The authors place the 409 γ tentatively from the 1202, 1509, and 2210 levels. The branching from the 1202 levels agrees with that from (p,n γ) so the evaluator assigns all the intensity to this placement. Also, the placement from the 1509 level is not confirmed in other reactions populating this level.
	1202.60	100	
1405.1	1024.11	100	
1590.8	1209.9	100	
1607.8	1226.9	100	
1625.6	444.0	56	
	642.98	100	

Continued on next page (footnotes at end of table)

$^{86}\text{Sr}(\text{p},\gamma)$ 1975NoZT,1969Ir01,1976PiZM (continued) $\gamma(^{87}\text{Y})$ (continued)

E(level)	$E\gamma^\ddagger$	$I\gamma^\dagger$	Comments
1625.6	831.97	100	
1629.4	835.80	100	
1704.3	501.9	18	
	522.70	91	
	910.48	94	
	1704.2	100	
1755.4	552.85	48	
	574.01	100	E γ : The authors place the 574 γ tentatively from the 1756 and the 1979 levels. In (p,n γ) the 574 γ is placed only from the 1756 level with branching that agrees with that from (p, γ).
	961.6	37	
1801.0	598.1	16	
	619.7#	35	
	818.52	8	
	1801.0	100	
1846.7	665.16	67	
	864.12	100	
1979.2	776.5	81	
	826.9	12	
2072.7	1279.0	100	E γ : The 1279 γ was originally placed by the authors as deexciting the same 2073.31 level as the 920.29 γ and 1691.7 γ . However, as the 1279 γ was not observed in β^+ decay or (p,n γ), it is likely originating from a different level as shown by the evaluators here.
2073.31	920.29	100	I γ : The spectrum from ^{87}Zr β^+ decay suggests the 920 γ has roughly half the intensity of the 1692 γ . The (p,n γ) data show the 920 γ with intensity slightly less than the 1692 γ . Therefore, it is very likely that this is a doublet, a large part of which is unplaced.
	1691.7	22	
2082.7	880.0	31	
	901.3	97	
	930.0#	31	
	1100.1	53	
	2082.8	100	
2111.4	706.27	55	
	930.0#	27	
	958.9	100	
2158.9	2158.9	100	
2210.4	2210.4	100	
2245.4	619.7#	77	
	1042.63	100	
	1451.9	31	
2279.4	1126.9	100	
2292.1	1139.6	100	
2354.5	746.6	100	
	949.4	47	
2376.9?	672.6@	100	
2408.3	2408.3	100	
9644	8457 $\frac{\S}{6}$	90 $\frac{\S}{6}$	
	8658 $\frac{\S}{6}$	58 $\frac{\S}{6}$	
	8852 $\frac{\S}{6}$	52 $\frac{\S}{6}$	
	9267 $\frac{\S}{6}$	14 $\frac{\S}{6}$	
	9644 $\frac{\S}{6}$	100 $\frac{\S}{6}$	

† Relative photon branches from each level are from 1975NoZT, unless noted otherwise.

‡ See the (p, γ) dataset for energies from an unpublished source quoted to higher precision, but without uncertainties.

$\frac{\S}{6}$ Primary γ 's observed by 1969Ir01 at $E_p=3930$ keV.

Multiply placed.

@ Placement of transition in the level scheme is uncertain.

$^{86}\text{Sr}(p,\gamma)$ 1975NoZT,1969Ir01,1976PiZM (continued)

Level Scheme

Intensities: relative photon branching from each level

* Multiply placed

$^{87}_{39}\text{Y}_{48}$

⁸⁶Sr(p,p'),(pol p,p') IAR 1977Ki06,1972Me19

1977Ki06: E_p=4.5–7 MeV, FWHM = 35 keV, θ = 30°–160°. Used polarized and unpolarized beams, measured excitation functions and on-resonance σ(θ) to ⁸⁶Sr ground state and first-excited 2+ level for all strong IAR between E_p=4.5 and 7 MeV. Measured analyzing powers, inelastic spin-flip cross sections and asymmetries for d-wave resonances by use of polarized beam and detection of p-γ coincidences. Analysis of results by means of IAR theories and statistical models. Deduced total and partial widths, spectroscopic amplitudes.

1972Me19: E_p=4.5–7.5 MeV, measured σ(E) and σ(θ). Deduced IAR parameters, spectroscopic factors.

For p-γ correlation measurements: see 1974Cu04. Also: 1975KiZK, 1976KiZH, 1975VaYH.

⁸⁷Y Levels

Γ_p: from 1977Ki06; other: 1972Me19.

E(level) [†]	Jπ [‡]	T _{1/2} [§]	L [#]	(2J+1)S(p,p) [@]	Comments
S(p)+4808 11	5/2+	23 keV 1	2	2.72	Γ _p =3.44 keV 20.
S(p)+5198 11	1/2+	40 keV 2	0	0.58	Γ _p =14.0 keV 10.
S(p)+5750& 15	3/2+	21.0 keV 15		0.29	Γ _p =1.6 keV 2.
S(p)+6024 11	1/2+	34 keV 2	0	0.32	Γ _p =11.5 keV 6.
S(p)+6187 11	1/2+	33 keV 2	0	0.25	Γ _p =9.5 keV 5.
S(p)+6252 23	(3/2+ and 5/2+)	25 keV 8	2	≈ 0.2	Γ _p : Γ(p)=1.4 10 keV for J ^π =3/2+ and Γ(p)=1.0 keV 8 for J ^π =5/2+.
					E(level): unresolved doublet; see ⁸⁶ Sr(d,p).
S(p)+6663 11	3/2+	24 keV 1	2	0.54	Γ _p =5.2 keV 3.
					L: from 1975VaYH.
S(p)+6957 14	1/2+	44 keV 4	0	0.25	Γ _p =11.9 keV 7.
S(p)+7267 ^a 15	3/2+		2		
S(p)+7377 ^a 15	5/2+		2		

[†] Weighted average from 1977Ki06 and 1972Me19, unless indicated otherwise. Energies are in lab coordinates. S_p=5784.1 keV 11.

[‡] From polarized-beam experiments (1977Ki06,1975VaYH); these assignments have been adopted.

[§] From 1977Ki06; other: 1972Me19.

[#] Derived from the shape of the resonance curve at 90° and 125° (1972Me19).

[@] From IAR elastic scattering (1977Ki06); other: 1972Me19.

& From 1977Ki06 only.

^a From 1972Me19. See also 1975VaYH.

⁸⁶Sr(³He,d), (d,n) 1971Ma11,1976Ho11

1971Ma11: (³He,d), E(³He)=20 MeV, FWHM=25 keV, θ=10°–70°. DWBA analysis of angular distributions.

1976Ho11: (d,n) E_d=12 MeV, θ=5°–55°, observed ground state and first three excited levels. DWBA analysis of angular distributions.

Data are from 1971Ma11, unless otherwise noted.

⁸⁷Y Levels

E(level)	Jπ [†]	L	(2J+1)C ² S [‡]	Comments
0.0	1/2-	1	1.15	
380 4	9/2+	4	7.19	
793 4	5/2-	3	1.15	
982 4	3/2-	1	0.54	
1155 4	5/2+	2	0.32	
1400 [§] 4				E(level): Possibly the (7/2+,9/2+) 1405 keV level in the Adopted Levels.
1605 4	9/2+	4	0.53	Jπ: assigned (7/2+,9/2+) in Adopted Levels for level at 1608.3.
1848 4	3/2-	1	0.07	Jπ: Assigned 1/2- in Adopted Levels.
				(2J+1)C ² S: The authors give (2J+1)C ² S=0.07 for 2p _{1/2} .
2085 4	3/2-	1	0.09	
2203 4	9/2+	4	0.79	Jπ: assigned 7/2+,9/2+ in Adopted Levels for level at 2202.15.
2278 4	5/2-	3	0.14	Jπ: assigned (7/2-) in Adopted Levels.
2407 4	5/2+	2	0.03	Jπ: assigned 3/2+ in Adopted Levels.
2730 4	5/2-	3	0.16	Jπ: assigned 5/2-,7/2- in Adopted Levels.
2907 4	5/2+	2	0.12	Jπ: assigned 3/2+,5/2+ in Adopted Levels.
2995 4	5/2+	2	0.11	
3043 4	5/2+	2	0.20	Jπ: assigned 3/2+,5/2+ in Adopted Levels.
3090 4	5/2+	2	0.25	Jπ: assigned 3/2+,5/2+ in Adopted Levels.

Continued on next page (footnotes at end of table)

$^{86}\text{Sr}(^3\text{He,d}), (\text{d,n})$ 1971Ma11,1976Ho11 (continued) **^{87}Y Levels (continued)**

E(level)	$J\pi^\dagger$	L	$(2J+1)C^2S^\ddagger$	Comments
3120 § # 4				$J\pi$: assigned (13/2-) in Adopted Levels.
3195 4	1/2+	(0)	(0.04)	
3306 4	5/2+	2	0.11	$J\pi$: assigned 3/2+,5/2+ in Adopted Levels.
3353 4	5/2+	2	0.16	$J\pi$: assigned 3/2+,5/2+ in Adopted Levels.
3406 4	5/2+	2	0.09	$J\pi$: assigned 3/2+,5/2+ in Adopted Levels.

† Assignments are those assumed for extraction of S. Assignments which differ in the Adopted Levels are noted.

‡ Spectroscopic factors were determined from measured absolute cross sections and finite-range nonlocal DWBA calculations (1971Ma11). Those of 1976Ho11 are in fair agreement.

§ Weak level not fitted by any L-value. It is assumed by the authors to be populated by non-direct processes.

The value 3150 given in the author's Fig. 4 is a misprint. The correct value of 3120 is given in the text and in the spectrum of Fig. 1. No entry for this level is given in the authors' table.

 $^{87}\text{Sr}(\text{p},n\gamma)$ 1980Ta13

E_p = from 2.9 to 5.3 MeV in 50-keV steps; measured γ -ray excitation functions, angular distributions, and conversion electrons.

 ^{87}Y Levels

E(level) †	$J\pi^\ddagger$	Comments
0.0	1/2-	
380.9 1	9/2+	
793.9 1	5/2-	
982.9 1	3/2-	
1153.0 2	5/2+	
1182.1 1	3/2-	$J\pi$: assignment in Adopted Levels is (3/2)-.
1203.2 1	5/2-	$J\pi$: assignment in Adopted Levels is (5/2)-.
1405.2 2	(11/2+, 13/2+)	$J\pi$: assignment in Adopted Levels is (13/2+).
1591.5 2	(11/2+)	$J\pi$: assignment in Adopted Levels is 11/2+.
1608.7 2	(9/2+)	$J\pi$: assignment in Adopted Levels is (7/2+,9/2+).
1630.1 2	7/2-	$J\pi$: assignment in Adopted Levels is (1/2-,3/2-).
1704.7 4	3/2+	$J\pi$: assignment in Adopted Levels is (5/2-).
1756.2 2	5/2-	$J\pi$: assignment in Adopted Levels is (5/2-,7/2-).
1801.7 2	5/2-	$J\pi$: assignment in Adopted Levels is (1/2-,3/2,5/2-).
1980.1 2	7/2-	$J\pi$: assignment in Adopted Levels is (7/2,9/2)-.
2009.2 2	(9/2-, 11/2-)	$J\pi$: assignment in Adopted Levels is (7/2).
2038.6 2	(11/2, 13/2)	$J\pi$: assignment in Adopted Levels is (15/2+).
2073.4 2	(7/2+, 9/2+)	
2112.7 5	5/2+	
2154.8 2	(9/2, 11/2)-	$J\pi$: assignment in Adopted Levels is (9/2-).
2186.2 3	(5/2, 7/2, 9/2)	$J\pi$: assignment in Adopted Levels is 7/2-.
2202.6 2	$\geq 7/2$	$J\pi$: assignment in Adopted Levels is 7/2+,9/2+.
2277.7 2	(7/2, 9/2)	$J\pi$: assignment in Adopted Levels is (7/2-).
2302.2 2	$\geq 7/2$	$J\pi$: assignment in Adopted Levels is 13/2+.
2345.1 2	$\geq 9/2$	
2353.6 2	(7/2, 9/2, 11/2)	
2367.9 3	$\geq 9/2$	$J\pi$: assignment in Adopted Levels is 15/2-.
2400.4 4	$\geq 9/2$	

† From least-squares fit to γ -ray energies.

‡ Assignments are from this work based on γ excitation functions and angular distributions, except those for levels below 1170 keV which are from ^{87}Y Adopted Levels. Differences from Adopted Levels are noted.

$^{87}\text{Sr}(\text{p},\text{n}\gamma)$ 1980Ta13 (continued) $\gamma(^{87}\text{Y})$

E_γ	E(level)	$I_\gamma^\dagger$	Mult.#	Comments
380.9 1	380.9			
409.2 1	1203.2	4.38 15		
523.3 7	1704.7	1.28 22		
552.6 2	1756.2	2.31 22		
574.1 1	1756.2	5.54 23		
611.2 2	2202.6	3.0 3		
619.8 2	1801.7	1.21 22		
633.6 1	2038.6	11.17 18	(M1, E2)	$\alpha(\text{K})_{\text{exp}} = 1.77 \times 10^{-3}$ 45. Mult.: D,Q, but since $J\pi$ from the Adopted Levels is (15/2+) and this γ decays to a (13/2+), E1 can be ruled out leaving M1,E2.
711.4 3	2302.2	‡		
771.9 1	1153.0	31.8 4	E2	$\alpha(\text{K})_{\text{exp}} = 1.19 \times 10^{-3}$ 33. Mult.: M1, E2, but placement in the level scheme requires $\Delta J=2$, so M1 is ruled out.
776.9 1	1980.1	10.3 4		
793.9 1	793.9	100	E2	$\alpha(\text{K})_{\text{exp}} = 1.016 \times 10^{-3}$ 97. Mult.: M1, E2, but placement in the level scheme requires $\Delta J=2$, so M1 is ruled out.
797.0 7	2202.6	10.0 5		
827.3 2	1980.1	2.2 3		
836.2 1	1630.1	28.5 4	M1, E2	$\alpha(\text{K})_{\text{exp}} = 1.10 \times 10^{-3}$ 20.
898.6 2	2302.2	‡		
920.6 2	2073.4	5.71 20		
940.0 2	2345.1	3.6 4		
951.7 2	2154.8	6.36 22		
959.7 4	2112.7	3.67 22		
962.7 2	1756.2	≈ 2.0 §		
	2367.9	≈ 5.2 §		
982.9 1	982.9	22.7 5	M1, E2	$\alpha(\text{K})_{\text{exp}} = 0.55 \times 10^{-3}$ 13.
1024.3 1	1405.2	89.0 6	M1, E2	$\alpha(\text{K})_{\text{exp}} = 0.53 \times 10^{-3}$ 13. Mult.: $A_2 = +0.107$ 25, $A_4 = +0.015$ 33.
1075.3 4	2277.7	2.23 25		
1182.1 1	1182.1	14.9 5		
1186.5 3	1980.1	3.2 5		
1203.1 1	1203.2	44.8 7		
1210.3 1	1591.5	44.6 8		$A_2 = -0.130$ 25, $A_4 = +0.018$ 34.
1215.3 1	2009.2	29.9 8		
1227.5 1	1608.7	38.1 7		
1392.3 3	2186.2	2.0 4		
1483.8 2	2277.7	2.8 4		
1559.7 2	2353.6	3.3 4		
1657.2 1	2038.6	11.09 23		
1692.0 2	2073.4	6.01 21		
1704.5 4	1704.7	1.7 3		
1773.5 3	2154.8	16.4 7		
1801.5 2	1801.7	6.10 23		
1821.4 2	2202.6	2.98 20		
1896.2 3	2277.7	1.4 3		
1921.6 2	2302.2	7.8 4		
1963.9 2	2345.1	3.6 4		
2019.2 3	2400.4	1.31 25		

† Relative photon intensity at 5.2 MeV.

‡ Intensity is given as "weak".

§ 1980Ta13 report $I_\gamma = 7.24$ 24 for the 962.7 γ doubly placed from the 1756 and 2367 levels. From $I_\gamma(963)/(I_\gamma(552\gamma + 574\gamma)) = 0.25$ for placement from the 1756 level in (p, γ), assuming that the 2367 is not populated in that reaction, one gets $I_\gamma = 2.0$ and 5.2 for placements from the 1756 and 2367 levels respectively in (p, $\text{n}\gamma$).

From this work.

$^{88}\text{Sr}(\text{p},2\text{n}\gamma)$ 1980Fi06 (continued) $\gamma(^{87}\text{Y})$ (continued)

E_γ		E(level)	I_γ	Mult. [†]	Comments
399.1	1	2827.3	≤ 5		E_γ : this placement is by the evaluators and is based on the ^{87}Y Adopted γ 's. Because this γ is very weak in this reaction no unique assignment can be made on the basis of the observed coincidences.
793.6	2	793.6	260	50	$A_2=+0.54$ 3, $A_4=+0.09$ 3 Although authors note that contaminant peaks add an unknown systematic error.
829.5	2	1623.2	75	11	$A_2=+1.10$ 10, $A_4=+0.25$ 10 Although authors note that contaminant peaks add an unknown systematic error.
888.2	2	2479.0	32	4	(D) $A_2=-0.11$ 6, $A_4=-0.02$ 7.
962.4	1	2366.9	86	17	
1023.6 [‡]	1	1404.5	290 [‡]	32	
		2428.2	290 [‡]	32	
^x 1188.8	2		37	4	
1202.5	2	1202.6	66	8	(Q) $A_2=+0.12$ 2, $A_4=-0.04$ 3.
1209.8	1	1590.7	100		(D+Q) $A_2=-0.88$ 3, $A_4=+0.04$ 4.
1214.3	2	2008.0	26	3	$A_2=+0.08$ 8, $A_4=0$.
^x 1227.0	2		68	9	

[†] From γ angular distribution.[‡] Multiply placed; undivided intensity given.^x γ ray not placed in level scheme.

Level Scheme

Intensities: relative I_γ
& Multiply placed; undivided intensity
given

$^{89}\text{Y}(\text{p},\text{t})$ 1976Oe02,1975Co11 $J^\pi(^{89}\text{Y})=1/2^-$.1976Oe02: $E_p=42$ MeV, FWHM=17 keV, $\theta=10^\circ-50^\circ$. Internal energy calibration by means of known level energiesdetermined in previous γ -ray measurements in ^{87}Y . Uncertainty in energy is estimated to be 5 keV for all levels.1975Co11: $E_p=27.8$ MeV, FWHM=35-60 keV, $\theta=9^\circ-50^\circ$.1973Pe01: $E_p=27$ MeV, FWHM=90 keV, $\theta=10^\circ-90^\circ$.1973Mo11: $E_p=49.5$ MeV, FWHM=75 keV, $\theta=5^\circ-45^\circ$. Uncertainty in level energies is ≈ 30 keV. Report 8 levels and 6 L values.

Unless noted otherwise, results presented here are from 1976Oe02.

$^{89}\text{Y}(\text{p},\text{t})$ 1976Oe02,1975Co11 (continued) ^{87}Y Levels

E(level)	$L^\dagger$	$\sigma(\mu\text{b}/\text{sr})^\ddagger$	Comments
0.0	0	87.9	Observed by 1973Mo11 only and the relative intensity in their spectrum is approximately 1% of that of the ground state.
380 30			
793 5	2	1.3	
980 5	2	8.4	
1177 5	2	16.5	
1205 5	2	37.0	
1609 5	2	0.85	
1641 5	0	2.1	
1719 5	2	1.5	
1814 5	2	3.1	
1857 5	0	3.0	
1991 5	4	14.2	
2021 5	(4)	1.3	
2095 5	2	1.5	
2122 5	3	4.3	
2165 5	4	19.5	
2202 5	4	3.1	
2216 5	5	4.5	
2256 5	2	3.9	
2287 5	3	19.2	
2314 5	(3)	(6.1)	
2374 5	8	4.1	
2413 5	(3)	1.0	
2451 5	3	5.1	
2486 5	6	3.1	
2544 5	5	4.9	
2563 5	5	38.8	
2601 5	3	8.6	
2675 5	8	3.1	
2737 5	5	13.6	
2808 5	5	6.0	
2828 5	(2)	6.2	
2871 5	6	2.3	
2901 5	2	4.4	
2958 5	8	1.5	
2997 5	3	11.9	
3038 5	5	7.2	
3057 5	(3)	8.8	
3093 5	5	2.9	
3121 5	3	5.7	
3181 5	(7)	5.1	
3245 5	5	4.8	
3273 5	5	4.7	

† L-values deduced from DWBA analysis of angular distribution. The neutrons were assumed to be picked up from a $1g_{9/2}$ configuration for L=0, 2, 4, and 8 transfers, and from a $1f_{5/2}, 1g_{9/2}$ configuration for L=3, 5 and 7 transfers, respectively.

‡ Sum of cross sections at all angles measured (1976Oe02).

$^{90}\text{Zr}(\text{p},\alpha)$, (pol p, α) 1998Gu07,1973MuZC,1975Pe02

1965Fu09: $E_p=22.5$ MeV, FWHM=250–300 keV and $E_p=20.2$ MeV, FWHM=110 keV, $\theta=30^\circ\text{--}50^\circ$; observe levels at 0 and 380 keV.

1973MuZC: $E_p=16.6$ MeV, FWHM=40 keV, $\theta=8^\circ\text{--}170^\circ$, measured cross sections were not accurate enough for DWBA analysis.

1975Pe02: $E_p=22.8$ MeV, FWHM=70 keV, $\theta=10^\circ\text{--}120^\circ$, DWBA analysis of $\sigma(\theta)$.

1998Gu07: $E_p=22$ MeV, FWHM=12 keV, $\theta=5^\circ\text{--}65^\circ$ and polarization; measured differential cross sections and analyzing powers.

 ^{87}Y Levels

E(level) [†]	$J\pi^{\ddagger}$	$\sigma^{\S}$	Comments
0.0	1/2–	56.0	
379.3	9/2+	13.3	
793.3	5/2–	119.0	
981.3	3/2–	143.8	
1151.3	5/2+	2.3	
1182.3	3/2–	2.9	$J\pi$: 5/2– ruled out from angular distribution and analyzing power, Fig. 3 from 1998Gu07.
1201.3	5/2–	15.0	$J\pi$: 3/2– ruled out from angular distribution and analyzing power, Fig. 4 from 1998Gu07.
1401.3	13/2+	6.6	
1607.3	(5/2+, 3/2–)	1.8	$J\pi$: assignment in Adopted Levels is 3/2–.
1629.3	5/2+	4.9	$J\pi$: assignment in Adopted Levels is (1/2–, 3/2–).
1704.3	3/2–	1.1	$J\pi$: assignment in Adopted Levels is (5/2–).
1757.3	5/2+	1.7	$J\pi$: assignment in Adopted Levels is (5/2, 7/2–). $J\pi$: other: (5/2–) (1975Pe02).
1802.3	5/2–	8.8	$J\pi$: assignment in Adopted Levels is (1/2–, 3/2, 5/2–).
1846.3	1/2–	4.0	$J\pi$: other: (3/2–) (1975Pe02).
1979.3	7/2–	63.8	$J\pi$: assignment in Adopted Levels is (7/2, 9/2)–. $J\pi$: other: (9/2–) (1975Pe02).
2006.3	11/2+	20.6	$J\pi$: assignment in Adopted Levels is (7/2).
2113.3	5/2+	14.4	
2153.3	(9/2–, 11/2+)	15.5	$J\pi$: assignment in Adopted Levels is (9/2–).
2184.3	7/2–	25.3	E(level), $J\pi$: other: 1975Pe01 report a level at 2170 with $J^\pi=(7/2\text{--})$.
2209.3	3/2–	12.5	
2249.3	9/2–	2.9	
2276.3	7/2+ and 9/2–	52.2	$J\pi$: assignments in Adopted Levels are (7/2+) and (9/2–). E(level), $J\pi$: other: 1975Pe01 report a level at 2270 with $J^\pi=(9/2\text{+})$.
2302.3	13/2+	14.6	
2365.3	15/2– and 7/2+	7.5	
2408.3	3/2–	18.4	$J\pi$: other: (15/2–) (1975Pe02); assignment in Adopted Levels is (3/2)+.
2449.3	9/2–	10.7	
2531.3	11/2–	19.0	
2562.3	11/2+	56.0	
2599.3	9/2–	37.4	E(level), $J\pi$: other: 1975Pe01 report a level at 2630 with $J^\pi=(13/2\text{--})$.
2661.3	7/2+	8.9	
2682.3	11/2+	7.7	
2747.3	3/2+	31.1	
2801.3	11/2+ and 3/2+	12.7	
2831.3	9/2–	10.9	
2903.3	(3/2–, 5/2+)	25.5	$J\pi$: assignment in Adopted Levels is (3/2–, 5/2–).
2960@	(13/2–)		
2998.3	5/2+	39.1	
3120@	(13/2–)		
3324#			
3450@			$J\pi$: likely 3446.5 in Adopted Levels with (19/2–).
3500@	(11/2+)		
3640#			
3730@	(7/2–)		
3840@	(11/2–)		

[†] From 1998Gu07 with the uncertainties from a general statement, unless indicated otherwise.

[‡] Deduced by 1998Gu07 from angular distributions and analyzing powers. The assignments of 1975Pe02 that differ are noted. The assignments in Adopted Levels that do not include those given here are also noted.

[§] From 1998Gu07, integrated cross section from 5° to 65° in μb .

From 1973MuZC only.

@ From 1975Pe02 only.

Adopted Levels, Gammas

Q(β⁻)=-5473 8; S(n)=9449 6; S(p)=7352 15; Q(α)=-4974 8 2012Wa38.

Q(β⁻n)=-18285 7, Q(εcp)=-2112 4.

Mass excess from 2008We10: -79341.4 53 keV, from 2012Ka13: -79343.9 50 keV, using ⁹⁷Mo as reference (jyfltrap).

For model calculations of level energies and configurations, see 1985Ox01.

; Systematics of 1-qp configurations, 2010Ro27.

Other recent theory and calculations:2010Ro27,2006Es02.

⁸⁷Zr Levels

Cross Reference (XREF) Flags

A (HI,xnγ)
B ⁸⁷Nb β⁺ Decay (2.6 min)
C ⁸⁷Nb β⁺ Decay (3.75 min)
D ⁸⁷Zr IT Decay (14.0 s)
E ⁹⁰Zr(³He,⁶He)

E(level) [†]	Jπ [‡]	XREF	T _{1/2} [§]	Comments
0.0	9/2+	ABCDE	1.68 h 1	%ε+%β ⁺ =100. Jπ: from logft=5.7 allows Jπ=9/2+, 7/2+, or 11/2+. A logft=8.10 to a 5/2- level rules out 11/2+. logft=6.77 to the 11/2+ 1591.3 level rules out 7/2+. Collinear laser spectroscopy of cool bunched ion beams was performed on ⁸⁷ Zr providing information on mean-square charge radii, magnetic moments, and extracted quadrupole moments for the ground state. In addition, these measurements provide additional arguments for the 9/2+ assignment for the ground state based on Zr systematics of strong prolate deformations for N < 50 (2002Fo12). T _{1/2} : from 1984Pr01. However, their measured results of 1.684 1 and 1.667 6 would give an average of about 1.682 3. So, the authors seem to have chosen to increase their final uncertainty. Other: 1.69 h 2 (1989Sh39). μ=-0.895 9; Q=+0.423 48 (2002Fo12,2003Th03). μ,Q: from collinear LASER spectroscopy. β ₂ =0.10 1 from 2002Fo12. Mean square charge radius around 18.7 fm ² corresponding to β ₂ between 0.1 and 0.2 (2002Ca47) from LASER spectroscopy. The 9/2, as opposed to 7/2, spin assignment is consistent with the larger quadrupole moment. See 2002Fo12 for more detail.
200.91 12	7/2+	ABCDE	2.44 ns 10	Jπ: See 335 level.
335.84 19	1/2-	A CDE	14.0 s 2	%IT=100. μ=+0.642 7 (2002Fo12). μ: from collinear LASER spectroscopy. Jπ: Uniquely established using collinear laser spectroscopy, see 2002Fo12. E3γ from the 335 level to the 200 level and M1+E2γ from the 200 level to the gs, establishes π(335 level)=- and Jπ(200 level)=7/2+. T _{1/2} : from isomeric decay. %IT: no ε decay from this level has been observed. Jπ: from logft=5.8 from (9/2+) and ΔJ=1 transition to 9/2+ based on angular distribution measurement.
470.63 12	(7/2+)	AB		
523.7 23		B		
589.3 17		B		
801.50 15	(7/2)	AB		
817.45 22		B E		
931.53 24		A		
1061 15		E		
1069.42 19	(13/2)+	A	<49 ps	
1087.37 15	(9/2)	AB		
1124.88 20	(11/2+)	A		
1284.0 23		B		
1287.5 23		B		
1505.5 23		B		
1656.9 3	(11/2+)	A		
1669 4		B		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁸⁷Zr Levels (continued)

E(level) [†]	Jπ [‡]	XREF	T _{1/2} [§]	Comments
1691.3 3	(13/2)	A		
1749 4		B		
1884.4 3	(7/2+, 9/2+, 11/2+)	B		Jπ: from logft=4.6 for ε decay from (9/2+) ⁸⁷ Nb.
1911 4		B		
1919.6 23		B		
1949 3		B		
2059.2 23		B		
2069.3 23		B		
2073.72 25	(13/2-)	A	2.97 ns 20	
2125 15		E		
2201.9 3	(17/2)+	A	<35 ps	
2245.3 23		B		
2287 15		E		
2312.5 4	(17/2-)	A	2.74 ns 9	
2354.3 7		B		
2467.1 4	(17/2-)	A	11 ps 3	
2598.2 23		B		
2894.1	(21/2)+	A	71 ps 7	
2986.1 4	(19/2-)	A		
3053.3 23		B		
3236.8	(19/2-)	A	3.0 ps 6	
3365.9 8	(21/2-)	A	<3 ps	
3380.4 15	(23/2)	A	<0.2 ps	
3447.0 23		B		
3942.7	(25/2)	A	0.15 ps 5	
4056.8	(25/2+)	A		
4128.7	(25/2)	A	0.80 ps 20	
4333.1	(25/2-)	A	6.9 ps 14	
4530.2	(27/2)	A	0.44 ps 10	
4618.6	(27/2-)	A		
5054.8	(29/2+)	A		
5074.3 16	(27/2-)	A	0.5 ps 2	
5507.6	(29/2+)	A		
5529.3	(29/2-)	A		
5689.9	(29/2-)	A		
5803.2	(31/2+)	A		
6212.6	(31/2-)	A		
6234.3	(33/2+)	A		
6268.8	(31/2-)	A		
6573.7	(35/2+)	A		
6840.1	(33/2-)	A		
7451.9	(35/2-)	A		
7476.8	(37/2+)	A		
8777.6	(39/2-)	A		
10091.6	(43/2+)	A		

[†] From least-squares fit to γ-ray energies.

[‡] From (HI,xnγ), unless indicated otherwise. Based on excitation functions, γ(θ), and, for quadrupole transitions, RUL.

[§] From (HI,xnγ) using Doppler shift attenuation, or recoil distance techniques.

⁸⁷Zr

E(level)	Eγ [†]	Iγ [†]	Mult. [‡]	δ	α [§]	Comments
200.91	201.02 [#] 14	100	M1+E2	-0.35	0.0370	δ: δ=-0.35 or -2.6 from (HI,xnγ), but α(exp) determined in isomeric decay deviates from α for δ=-2.6 by more than one standard deviation.
335.84	134.93 [#] 15	100	E3		2.67	B(M1)(W.u.)=0.00095 4; B(E2)(W.u.)=3.25 14. Mult.: from α(exp) deduced in isomeric decay.
470.63	470.63 [#] 12	100	(D+Q)			B(E3)(W.u.)=0.0646 13.
523.7	322.8 23	100				δ: δ=-0.04 or δ=-8 from (HI,xnγ).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Zr})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$	Mult. [‡]	δ	$\alpha^{\S}$	Comments
589.3	388.7 23	100				
801.50	600.9 2	100@ 16				
	801.2 2	42@ 13	(D)			
817.45	616.5@ 2	100				
931.53	460.9 2	100				
1069.42	1069.4 2	100	E2		5.76×10^{-4}	B(E2)(W.u.)>0.36.
1087.37	886.4@ 2	100				
	1087.4 2	17				
1124.88	1124.9 2	100	D+Q			
1284.0	466.5@ 23	100				
1287.5	470.0@ 23	100				
1505.5	1304.6@ 23	100				
1656.9	569 1	75				
	1456 1	50	(E2)		3.67×10^{-4}	
	1657 1	100	(M1+E2)		3.68×10^{-4}	
1669	381.3@ 23	100				
1691.3	567	100				
	621.9 2	75	(D)			
1749	461.7@ 23	100				
1884.4	797.0@ 23	14				
	1066.8@ 3	100 11				
	1083.0@ 7	6 3				
	1295.4@ 23	5				
	1683.6@ 7	41 4				
	1884.5@ 7	89 8				
1911	242.4@ 23	100				
1919.6	1718.7@ 23	100				
1949	1360.1@ 23	100				
2059.2	1858.3@ 23	100				
2069.3	1868.4@ 23	100				
2073.72	416.8 2	79	D			
	949.0	16	[D]			
	1004.3 2	100	(D)			
2201.9	1132.5 2	100	E2		5.09×10^{-4}	B(E2)(W.u.)>0.38.
2245.3	2044.4@ 23	100				
2312.5	110.6 10	58	(D)			
	238.8 2	100	E2		0.0478	B(E2)(W.u.)=7.0 3.
2354.3	2153.4@ 7	100				
2467.1	154.7 2	100	(M1+E2)	0.5 25	0.09 12	B(M1)(W.u.)=(0.4 +8-4); B(E2)(W.u.)=(5.×10 ³ +38-5).
2598.2	2397.3@ 23	100				
2894.1	692.2	100	E2		1.67×10^{-3}	B(E2)(W.u.)=2.19 22.
2986.1	521.9	30	(D)			
	675.8 2	100	(D)			
3053.3	2852.3@ 23	100				
3236.8	924.8	100	(M1+E2)	0.50 25	7.98×10^{-4}	B(M1)(W.u.)=(0.0074 21); B(E2)(W.u.)=(2.4 20).
3365.9	129.7		(D+Q)			
	378.2	88	(D+Q)			
	900.0	100	(E2)		8.60×10^{-4}	B(E2)(W.u.)>7.4.
3380.4	486.4	100				
3447.0	3246.0 23					
3942.7	562.4	100	(D)			
	1048.5					
4056.8	1162.7	100				
4128.7	748.4	100	(D)			
4333.1	967.2	100	(E2)		7.25×10^{-4}	B(E2)(W.u.)=4.2 9.
4530.2	401.8	33				
	587.3	100	(D)			
	1149.7					
4618.6	285.6	100				
5054.8	524.5					
	1112.3					
5074.3	741.0	100	(D)			
5507.6	977.4					

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Zr})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$	E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$	E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$
5507.6	1378.7		6212.6	683.4	100	7451.9	1183.0	
5529.3	455.0		6234.3	431.0		7476.8	903.0	
	910.8			1179.5			1242.7	
	1196.1		6268.8	578.8	100	8777.6	1325.7	100
5689.9	615.6	100	6573.7	339.3	100	10091.6	1314.0	100
5803.2	295.4		6840.1	627.5	100			
	1273.0		7451.9	611.9				

† From (HI,xn γ), unless indicated otherwise.

‡ From (HI,xn γ) and adopted parities, unless indicated otherwise.

§ Value is given only where needed for BE2W or BM1W calculation.

$^{\#}$ Weighted average from (HI,xn γ) and $\varepsilon+\beta^+$ decay (2.6 m).

$^{\circ}$ From $\varepsilon+\beta^+$ decay (2.6 m).

 ^{87}Zr IT Decay (14.0 s) 1972Tu03,1974Vo03,1977Ko05

Parent ^{87}Zr : E=335.84 19; $J\pi=(1/2)^-;$ $T_{1/2}=14.0$ s 2; %IT decay=100.

1972Tu03: produced by $^{89}\text{Y}(\text{p},3\text{n})$; measured γ singles, $\gamma\gamma$ coincidences.

1974Vo03: produced by spallation by 660 MeV p on Ag target.

1977Ko05: produced by $^{58}\text{Ni}(^{32}\text{S},3\text{p})$.

 ^{87}Zr Levels

E(level)	$J\pi^{\dagger}$	$T_{1/2}$	Comments
0.0	9/2+		
200.91 12	7/2+		
335.84 19	1/2-	14.0 s 2	$T_{1/2}$: from 1972Tu03, $\gamma(\text{t})$.

† From ^{87}Zr Adopted Levels.

 $\gamma(^{87}\text{Zr})$

The decay curves of the 135- and 201-keV γ 's show a half-life of 14 s.

$E_{\gamma}^{\dagger}$	E(level)	$I_{\gamma}^{\ddagger\S}$	Mult. ‡	$\delta^{\ddagger}$	α	Comments
134.93 15	335.84	27.2 3	E3		2.67 4	$\alpha(\text{exp})=2.64$ 16. Mult.: from $\alpha(\text{exp})$. B(E3)(W.u.)=0.0643 15.
201.02 14	200.91	96.4	M1+E2	-0.35	0.0370	Mult., δ : from Adopted Levels.

† From Adopted Levels.

‡ Given $I_{\gamma}(135\gamma)/I_{\gamma}(201\gamma)=0.285$ 8 from 1972To03, mult(201 γ)=M1+E2 with $\delta=-0.35$ or -2.6 from $\gamma(0)$ in (HI,xn γ), the requirement of an intensity balance at the 201 level, and I_{γ} normalization to $I_{\gamma}(1+\alpha)=100$ for each transition, one gets $\alpha(135\gamma)(\text{exp})=2.79$ 11 or 2.64 11 for the two values of δ , either of which establishes mult=E3 with $\alpha=2.67$ 4 and thus $I_{\gamma}(135\gamma)=27.2$ 3. One then has $I_{\gamma}(201\gamma)=95.8$ 31 which gives $\alpha(201\gamma)(\text{exp})=0.044$ 33 from which one gets $\delta<2$, eliminating the larger solution. With $\alpha(201\gamma)=0.037$ for $\delta=-0.35$ one gets $I_{\gamma}(201\gamma)=96.4$ with an uncertainty depending on that for δ , unspecified by the authors. For an uncertainty of 30%, one gets $I_{\gamma}=96.4$ 4.

§ Absolute intensity per 100 decays.

⁸⁷Zr IT Decay (14.0 s) 1972Tu03,1974Vo03,1977Ko05 (continued)

Decay Scheme

Intensities: I(γ+ε) per
100 parent decays
%IT=100

⁸⁷Nb β⁺ Decay (3.75 min) 1974Vo03,1986CoZQ,1977Ko05

Parent ⁸⁷Nb: E=0.0; Jπ=(1/2-); T_{1/2}=3.75 min 9; Q(g.s.)=5473 8; %β⁺ decay=100.

Although the strongest decay branch has probably been reported, since the decay energy is over 5 MeV and only levels below 350 keV have been observed, higher energy states should be expected.

1974Vo03: spallation by 660-MeV protons on silver and chemical separation; measured: γ singles and γγ coincidences with parent activity separated by T_{1/2} for each γ ray.

1986CoZQ: ⁵⁸Ni(³²S,3p), E(³²S)=110 MeV; measured γ singles and γγ coincidences.

1977Ko05: ⁵⁸Ni(³²S,n2p)⁸⁷Mo and ⁵⁸Ni(³²S,3p)⁸⁷Nb, E=111 MeV; measured γ singles and γγ coincidences.

1971Do01: ⁵⁸Ni(³²S,3p), E(³²S)=90-100 MeV; measured γ singles.

1972Tu03: ⁹⁰Zr(p,4n); measured γ singles and γγ coincidences.

⁸⁷Zr Levels

E(level)	Jπ [†]
0.0	9/2+
201.2 2	7/2+
336.4 3	1/2-

[†] From ⁸⁷Zr Adopted Levels.

β⁺,ε Data

Eε	E(level)	Iβ ⁺	Iε	Log ft	I(ε+β ⁺)
(5137 8)	336.4	96.90 4	3.10 4	5.344 11	100

γ(⁸⁷Zr)

Coin from 1972Tu03.

I_γ normalization: see comment for I_γ.

Eγ [†]	E(level)	Iγ [‡] #	Mult.§	δ§	α	Comments
135.2 3	336.4	27.2 6	E3		2.66 5	α: α(K)exp=2.02 12 and K/L+M=3.02 3 from a β ⁺ study in 1991Mi15. This confirms the E3 character.
201.2 2	201.2	96.4	(M1+E2)	-0.35	0.0370	α: α(K)exp=0.049 5 and K/L+M=7.07 36 from a β ⁺ study in 1991Mi15. From this, the authors infer δ=0.72 10. A re-analysis yields δ=0.4 4.

[†] Weighted average from 1974Vo03, 1977Ko05, and 1972Tu03.

[‡] From I_γ(1+α)=100 for each γ ray. This gives I_γ(135)/I_γ(201)=0.282, which compares favorably to the measured value of 0.285 8 (1972Tu03); others: 0.20 5 (1971Do01) and 0.27 3 (1974Vo03). No significant ε feeding is expected to the ground state and the 201 level since they would be unique 3rd forbidden and 3rd forbidden, respectively, with expected logft values of ≈ 21 and ≈ 17 (1998Si17), compared to the allowed transition to the 335 level.

Footnotes continued on next page

⁸⁷Nb β⁺ Decay (3.75 min) 1974Vo03,1986CoZQ,1977Ko05 (continued)

γ(⁸⁷Zr) (continued)

§ From Adopted Levels.

Absolute intensity per 100 decays.

⁸⁷Nb β⁺ Decay (2.6 min) 1986CoZQ,1974Vo03,1977Ko05

Parent ⁸⁷Nb: E=3.84 14; Jπ=(9/2+); T_{1/2}=2.6 min 1; Q(g.s.)=5473 8; %β⁺ decay=100.

Although there are five studies of this decay, of the 35 γ's reported here, only 11 are reported by more than one author. Therefore, this activity needs additional study.

1986CoZQ: ⁵⁸Ni(³²S,3p), E(³²S)=110 MeV measured γ spectra and γγ coincidences. Data taken from authors' decay scheme drawing.

1974Vo03: spallation by 660-MeV protons on silver with chemical separation; measured γ spectra and decay for each γ, γγ coincidences.

1977Ko05: ⁵⁸Ni(³²S,n2p)⁸⁷Mo and ⁵⁸Ni(³²S,3p)⁸⁷Nb, E(³²S)=111 MeV; measured γ spectra and γγ coincidences.

1971Do01: ⁵⁸Ni(³²S,3p), E(³²S)=90-100 MeV; measured γ spectra.

1972Tu03: ⁹⁰Zr(p,4n); measured γ spectra and γγ coincidences.

⁸⁷Zr Levels

E(level) [†]	Jπ [‡]	Comments
0.0	9/2+	
201.01 19	7/2+	
470.58 16	(7/2+)	
523.8? § 23		
589.3 § 17		
801.1 4	(7/2)	
817.54 25		
1087.9 12	(9/2)	
1284.0 § 24		
1287.5 § 24		
1505.6 § 23		
1669 § 4		
1749 § 4		
1884.4 3	(7/2+, 9/2+, 11/2+)	Jπ: From logft.
1911? § 4		
1919.7 § 23		
1949? § 3		
2059.3 § 23		
2069.4 § 23		
2245.4 § 23		
2354.4 8		
2598.3 § 23		
3053.4 § 23		
3447.1 § 23		

Footnotes continued on next page

⁸⁷Nb β⁺ Decay (2.6 min) 1986CoZQ,1974Vo03,1977Ko05 (continued)

⁸⁷Zr Levels (continued)

† From least-squares fit to γ-ray energies.

‡ From ⁸⁷Zr Adopted Levels.

§ Observed only by 1986CoZQ, not uniquely assigned to this decay.

β⁺,ε Data

Eε	E(level)	Iβ ^{†‡}	Iε ^{†‡}	Log ft	I(ε+β ⁺) ^{†‡}
(3592 8)	1884.4	27	3.6	4.8	31
(5006 8)	470.58	21	0.75	5.8	22
(5276 8)	201.01	5	0.1	6.6	5
(5477 8)	0.0	36	0.91	5.8	37

† The total branching intensities are from γ-ray intensity balances and are based on a 37% branch to the ground state, as reported by 1982De43. Branches less than 5% are not reported here since this scheme is very approximate. The β⁺ and ε intensities are theoretical values from the LOGFT code.

‡ Absolute intensity per 100 decays.

γ(⁸⁷Zr)

Coin from 1986CoZQ.

Iγ normalization, I(γ+ce) normalization: from 1982De43 and considered to be approximate.

Eγ ^{†‡}	E(level)	Iγ ^{§a}	Mult.	δ	α	Comments
201.0# 2	201.01	100 4	M1+E2	-0.35	0.0370	Iγ: weighted average of 100 6 (1974Vo03) and 100.0 44 (1972Tu03). Mult.,δ: from Adopted γ's.
242.4@ 23	1911?	2@				
^x 269.0& 10		≈6&				
322.8@ 23	523.8?	2@				
381.3@ 23	1669	@				
388.7@ 23	589.3	@				
461.7@ 23	1749	2@				
466.5@ 23	1284.0	2@				
470.0@ 23	1287.5	7@				
470.6# 2	470.58	69 4				Iγ: Weighted average of 74.0 44 (1974Vo03), 71.7 40 (1972Tu03), and 60 5 (1982DeZQ), and 67 (1986CoZQ), normalized to this value in 1977K05; other: 72 4 (1972Tu03).
600.0 5	801.1	9.5 15				
616.6 2	817.54	31 3				Eγ: this placement is from 1977Ko05, 1974Vo03 place this transition from the 1087 level.
797.0@ 23	1884.4	5@				
801.0 6	801.1	4.0 12				Iγ: from 1974Vo03; others: 8.4 21 (1977Ko05), 4 1 (1982De43), and 7 (1986CoZQ).
887.0 15	1087.9	7.2 22				
^x 983.0& 15		4.8& 14				
1066.8 5	1884.4	37 4				Eγ: this placement is from 1986CoZQ, 1974Vo03 place this transition from the 2153 level.
1083.0 7	1884.4	7 2				
^x 1168.0& 15		3.6& 11				
^x 1285.0& 14		4.0& 12				
1295.4@ 23	1884.4	2@				
1304.6@ 23	1505.6	5@				
1360.1@ 23	1949?	2@				
^x 1559.0& 15		3.0& 9				

Continued on next page (footnotes at end of table)

87Nb β⁺ Decay (2.6 min) 1986CoZQ,1974Vo03,1977Ko05 (continued)γ(87Zr) (continued)

$E\gamma^{\dagger\dagger}$	E(level)	$I\gamma^{\S a}$	Comments
1683.2 3	1884.4	2.4 10	Eγ: Adopted 1683.2 3 (1974Vo03); others: 1686.0 7 (1977Ko05) and is discrepant, 1682.7 (1982De43), and 1684.1 23 (1986CoZQ). Iγ: Weighted average of 4.2 21 (1977Ko05) and 2 1 (1982De43); others 15.2 5 (1974Vo03) and 2 (1986CoZQ), but with no uncertainties given. The evaluators have opted for a lower intensity values since at least 3 values have consistently low values, whereas the larger value may be due to impurities. Note that the $I\gamma(1683)/(I\gamma(1067\gamma + 1884\gamma))$ branching is 0.26 6 from 1982De43, 0.21 3 from 1974Vo03, 0.09 5 from 1977Ko05, and 0.06 from 1986CoZQ.
1718.7@ 23	1919.7	2@	
1858.3@ 23	2059.3	2@	
1868.4@ 23	2069.4	2@	
1884.2 3	1884.4	33 3	
2044.4@ 23	2245.4	2@	
2153.3 7	2354.4	3.8 11	Iγ: from 1974Vo03; other: 12 (1986CoZQ).
2397.3@ 23	2598.3	2@	
2852.3@ 23	3053.4	2@	
3246.0@ 23	3447.1	2@	

[†] Average of values from 1974Vo03 and 1977Ko05, unless indicated otherwise.

[‡] 914.2 γ was reported by 1974Vo03, but this transition has been reassigned by 1977Ka05 to ⁸⁶Nb decay.

[§] Average of data from 1974Vo03, 1977Ko05, and 1982De43, unless indicated otherwise. The values of 1974Vo03 and 1982De43 were normalized to $I\gamma(201)=100$. The data of 1977Ko05 were normalized to $I\gamma(470.8\gamma)=69$, based on a weighted average from 1974Vo03, 1986CoZQ, and 1972Tu03. When they were used, the values of 1986CoZQ were normalized to $I\gamma(616)=31$, since they also included the 3.75-minute activity; no uncertainties are given by 1986CoZQ.

Average of values from 1974Vo03, 1977Ko05, 1972Tu03, and 1971Do01.

@ Only from 1986CoZQ.

& Only from 1974Vo03.

^a For absolute intensity per 100 decays, multiply by 0.3.

^x γ ray not placed in level scheme.

Decay Scheme

Intensities: relative $I\gamma$

$^{90}\text{Zr}(^3\text{He},^6\text{He})$ 1978Pa11E(^3He)=70 MeV, split-pole spectrograph and time-of-flight spectroscopy of ^6He . ^{87}Zr Levels

E(level)
0.0
211 10
332 10
825 13
1061 15
2125 15
2287 15

(HI,xn γ)1978Ar19: $^{86}\text{Sr}(\alpha,3n\gamma)$, $E_\alpha=21$ MeV and 51 MeV. Measured $\gamma\gamma$ coincidences and γ angular distribution; levels to 5100 keV. Level lifetimes measured by $\gamma(t)$ between beam pulses.1978Ki06: $^{84}\text{Sr}(\alpha,n\gamma)$, $E_\alpha=16.8$ MeV. Measured $\gamma\gamma$ coincidences and γ angular distribution.1986Wa25: $^{74}\text{Ge}(^{18}\text{O},5n\gamma)$, $E(^{18}\text{O})=60$ MeV, measured lifetimes using recoil-distance method.1999Zh18: $^{59}\text{Co}(^{32}\text{S},3pn\gamma)$, $E(^{32}\text{S})=118$ MeV. Measured γ singles, $\gamma\gamma$ coincidences, $\gamma\gamma(\theta)$ DCO with array of seven Ge detectors each with Compton suppression. ^{87}Zr Levels

E(level)	$J\pi^\dagger$	$T_{1/2}^\ddagger$	Comments
0.0	$9/2+^@$		
200.8 2	$7/2+^@$	2.44 ns & 10	
335.6 2	$1/2-^@$		
470.7 2	$(7/2+)$		
801.4 2	$(7/2+)$		
931.6# 3			
1069.4 2	$(13/2)+$	<49 ps	$T_{1/2}$: also, 2.73 ns (1978Ar19), but probably from decay of 2312 level.
1087.3 2	$(9/2+)$		
1124.88 20	$(11/2+)$		
1657 1	$(11/2+)$		
1691.3 3	$(13/2+)$		
2073.7 3	$(13/2-)$	2.97 ns & 20	
2201.9 3	$(17/2)+$	<35 ps	$T_{1/2}$: also 2.73 ns (1978Ar19), but probably from decay of 2312 level.
2312.5 4	$(17/2-)$	2.74 ns 9	$T_{1/2}$: average of 2.73 ns 7 and 2.94 ns 20 from 1978Ar19 and 2.1 ns 4 from 1986Wa25.
2467.2 4	$(17/2-)$	11 ps 3	
2617?			
2894.1 11	$(21/2+)$	71 ps 7	
2988.8 7	$(19/2-)$		
3237.3 9	$(19/2-)$	3.0 ps 6	
3367.1 8	$(21/2-)$	<3 ps	
3380.4 13	$(23/2+)$	<0.2 ps &	
3942.7 13	$(25/2+)$	0.15 ps & 5	
4056.8§ 15	$(25/2+)$		
4128.7 15	$(25/2+)$	0.80 ps & 20	
4334.3 13	$(25/2-)$	6.9 ps 14	
4530.2 14	$(27/2+)$	0.44 ps & 10	
4619.7§ 15	$(27/2-)$		
5054.8§ 15	$(29/2+)$		
5075.4 15	$(27/2-)$	0.5 ps & 2	
5507.6§ 15	$(29/2+)$		
5530.4§ 15	$(29/2-)$		
5691.0§ 17	$(29/2-)$		
5803.2§ 16	$(31/2+)$		
6213.7§ 17	$(31/2-)$		
6234.3§ 16	$(33/2+)$		
6269.9§ 19	$(31/2-)$		
6573.6§ 19	$(35/2+)$		

Continued on next page (footnotes at end of table)

(II,xnγ) (continued)

⁸⁷Zr Levels (continued)

E(level)	Jπ [†]
6841.2 § 19	(33/2-)
7453.0 § 19	(35/2-)
7476.8 ? § 18	(37/2+)
8778.7 § 22	(39/2-)
10092.7 § 24	(43/2-)

[†] For levels reported by 1978Ar19, deduced on the basis of excitation functions and γ(θ) and, for quadrupole transitions, from RUL. From 1999Zh18 for other levels, unless noted as "From Adopted Levels".

[‡] From 1986Wa25, unless indicated otherwise.

§ Reported only by 1999Zh18.

Reported only by 1978Ki06.

@ From Adopted Levels.

& From 1978Ar19, γ(t) between beam pulses.

γ(⁸⁷Zr)

Coin from 1978Ki06 and 1978Ar19.

Eγ [†]	E(level)	Iγ [‡]	Mult.§	δ	α	Comments
110.6 10	2312.5	15	(D)			Mult.: A ₂ =+0.42 2, A ₄ =+0.03 3 (1978Ar19). Mult.: From γ(θ). Tentative Jπ assignment is consistent with E1.
129.7	3367.1		(D+Q)			
134.8 2	335.6	1.3				
154.7 2	2467.2	15	(M1+E2)		0.09 4	Mult.: A ₂ =+0.42 1, A ₄ =+0.02 2 (1978Ar19). Eγ: From 1978Ar19; states that this is a doublet partly belonging to ⁸⁷ Y.
*169.7						
200.9 2	200.8	12.9	M1+E2@	-0.35	0.0371	Mult.: A ₂ =+0.17 2, A ₄ =-0.02 4 (1978Ar19). δ: -0.35 or -2.6 from (II,xnγ) (1978Ar19), but α(exp) determined in isomeric decay deviates from α for δ=-2.6 by more than one standard deviation.
238.8 2	2312.5	26	E2		0.0478	Mult.: A ₂ =+0.30 2, A ₄ =-0.14 3 (1978Ar19).
285.6	4619.7					
295.4	5803.2					
339.3	6573.6					
378.2	3367.1	7	(D+Q)			Mult.: A ₂ =-0.30 2, A ₄ =0 (1978Ar19).
401.8	4530.2	3				
415 ^a	2617?	9				Eγ,Iγ: reported only by 1978Ar19. A ₂ =+0.2 1, A ₄ =0 (1978Ar19).
416.8 2	2073.7	15	D			Mult.: A ₂ =-0.34 12, A ₄ =0 (1978Ar19). Mult.: from γ(θ), mult is definitely not Q. From tentative JPI likely E1.
431.0	6234.3					
455.0	5530.4					
460.9 2	931.6					Eγ: observed only by 1978Ki06.
470.7 2	470.7	3	(D+Q)			Mult.: A ₂ =-0.06 2, A ₄ =0 (1978Ar19). δ: δ(E2/M1)=-0.04 or -8 (1978Ar19).
486.4	3380.4	26	(D)			Mult.: A ₂ =-0.34 4, A ₄ =0 (1978Ar19) But possible doublet with γ from ⁸⁷ Y.
521.9	2988.8	3	(D)			Mult.: A ₂ =-0.35 20, A ₄ =0 (1978Ar19).
524.5	5054.8					
562.4	3942.7	11	(D)			Mult.: A ₂ =-0.15 11, A ₄ =0 (1978Ar19).
567	1691.3	4				
569 1	1657	6				
578.8	6269.9					
587.3	4530.2	9	(D)			
600.9 2	801.4	3				A ₂ =+0.08 13, A ₄ =0 (1978Ar19).
611.9	7453.0					
615.6	5691.0					
621.9 2	1691.3	3	(D) [#]			Mult.: A ₂ =+0.45 5, A ₄ =0 (1978Ar19).
627.5	6841.2					

Continued on next page (footnotes at end of table)

(HI,xn γ) (continued) $\gamma(^{87}\text{Zr})$ (continued)

$E_{\gamma}^{\dagger}$	E(level)	$I_{\gamma}^{\ddagger}$	Mult. [§]	α	Comments
675.8	2988.8	10	(D)		E γ : Used the unweighted average of 1978Ar19 and 1999Zh18 as the 673.4 γ from 1978Ki06 is not only discrepant, but unplaced by the authors. Mult.: $A_2=-0.16$ 10, $A_4=0$ (1978Ar19).
683.4	6213.7				
692.2	2894.1	34	E2	1.67×10^{-3}	Mult.: $A_2=+0.34$ 3, $A_4=-0.11$ 5 (1978Ar19).
741.0	5075.4	8	(D)		Mult.: $A_2=-0.4$ 1, $A_4=0$ (1978Ar19).
748.4	4128.7	7	(D)		Mult.: $A_2=-0.5$ 2, $A_4=0$ (1978Ar19).
770.6 ^a	3237.3	4	(D)		Mult.: $A_2=-0.9$ 2, $A_4=0$ (1978Ar19).
801.2 2	801.4	1.6	(D)		I γ : from I γ (801)=6 and I γ (601)=11 from 1978Ki06, 1978Ar19 give I γ (600) <4. Mult.: $A_2=-0.2$ 2, $A_4=0$ (1978Ar19). $A_2=-0.36$ 9, $A_4=0$ (1978Ar19).
886.4 2	1087.3	12			Mult.: $A_2=+0.4$ 2, $A_4=-0.2$ 3 (1978Ar19).
900.0	3367.1	8	(E2) [@]	8.60×10^{-4}	
903.0 ^a	7476.8?				
910.8	5530.4				
924.8	3237.3	8	(M1+E2) [@]	7.98×10^{-4}	Mult.: $A_2=+0.34$ 10, $A_4=0$ (1978Ar19).
949.0	2073.7	3	[D]		Mult.: $A_2=-0.6$ 4, $A_4=0$ (1978Ar19).
967.2	4334.3	12	(E2)	7.25×10^{-4}	Mult.: $A_2=+0.26$ 10, $A_4=-0.35$ 15 (1978Ar19).
977.4	5507.6				
1004.3 2	2073.7	19	(D)		
1048.5	3942.7				
1069.4 2	1069.4	100	E2 [@]	5.76×10^{-4}	Mult.: $A_2=+0.38$ 3, $A_4=-0.04$ 5 (1978Ar19). Mult.: Stretched Q from angular distribution and M2 excluded by RUL.
1087.4 2	1087.3	2			
1112.3	5054.8				
1124.9 2	1124.88	7	D+Q ^{&}		Mult.: $A_2=-0.65$ 22, $A_4=+0.44$ 21 (1978Ar19).
1132.5 2	2201.9	67	E2	5.09×10^{-4}	Mult.: $A_2=+0.28$ 3, $A_4=-0.11$ 5 (1978Ar19).
1149.7	4530.2				
1162.7	4056.8				
1179.5	6234.3				
1183.0	7453.0				
1196.1	5530.4				
1242.7 ^a	7476.8?				
1273.0	5803.2				
1314.0	10092.7				
1325.7	8778.7				
1378.7	5507.6				
1456 1	1657	4	(E2)	3.67×10^{-4}	Mult.: $A_2=+0.19$ 18, $A_4=0$ (1978Ar19).
1657 1	1657	8	(M1+E2) ^{&}	3.68×10^{-4}	Mult.: $A_2=-0.56$ 22, $A_4=0$ (1978Ar19).

[†] From 1978Ki06 if an uncertainty is given; otherwise from an unweighted average of the values from 1978Ar19 and 1999Zh18, neither of whom give uncertainties.

[‡] From 1978Ar19, measured in $^{86}\text{Sr}(\alpha, 3n\gamma)$ at $E_{\alpha}=51$ MeV.

[§] From $\gamma(0)$ (1978Ar19).

[#] $\gamma(0)$ allows a small δ .

[@] From $\gamma(0)$ and RUL.

[&] $\gamma(0)$ gives $\Delta J=-1$ with large δ .

^a Placement of transition in the level scheme is uncertain.

^x γ ray not placed in level scheme.

Level Scheme

Intensities: relative I(γ+ce)

(Hf,xm) (continued)

⁸⁷Zr
₄₇

Adopted Levels, Gammas

Q(β⁻)=-6988 7; S(n)=12812 9; S(p)=3194 8; Q(α)=-4094 20 2012Wa38.

Q(β⁻n)=-17834 8, Q(εcp)=-1879 16 2012Au05.

Mass measurement using the JYFLTRAP trap mass spectrometer yields mass excess -73873.0 65 keV using ⁹⁸Mo as a reference 2012Ka13.

Mass measurement using the Canadian Penning trap mass spectrometer yields 86.920675 28 u, with mass excess -73891 26 keV, 2011Fa10.

Other mass measurement using the JYFLTRAP Penning trap reported a mass excess of -73868 7 keV, but possible contributions from an isomeric state were not taken into account (2006Ka48).

With the exception of the 400-keV level, these data are from the ⁵⁸Ni(³²S,3pγ) studies.

For model calculations of level energies, electromagnetic moments, and decay probabilities see 2000Ga57.

Recent theory and calculations: 2004La18.

⁸⁷Nb Levels

See 2003Pa09 for configurations of non-superdeformed bands. B(M1) transitions strengths are calculated for these cases since the δ has only a small effect.

Cross Reference (XREF) Flags

A ⁵⁸Ni(³²S,3pγ), ⁴⁰Ca(⁵⁰Cr,3pγ)

B ⁸⁷Mo β⁺ Decay

E(level) [†]	Jπ [‡]	XREF	T _{1/2} [‡]	Comments
0.0 ^h	(1/2)-	AB	3.7 min 1	%ε+%β ⁺ =100. Jπ: Consistent with logft of 5.34 to (1/2)- level of ⁸⁷ Zr and systematics of niobium isotopes, see e.g., ⁹³ Nb. T _{1/2} : weighted average of 3.5 2 (1971Do01), 3.9 2 (1972Tu03), and 3.7 1 (1974Vo03).
3.9 ⁿ 1	(9/2)+	AB	2.6 min 1	E(level): From 1991Ju05 ⁵⁸ Ni(³² S,3pγ). %ε+%β ⁺ =100. Jπ: from systematics of odd-A niobium isotopes, see e.g., ⁹³ Nb. Consistent with logft of 5.6 to (9/2)+ level of ⁸⁷ Zr (1991Mi15). T _{1/2} : from 2.6 1 (1972Tu03) and 2.6 1 (1974Vo03).
200.2 ^d 4	(3/2-)	A		
266.9 ^o 2	(7/2)+	A		T _{1/2} : effective half-life, not corrected for feeding, is 67 ps 9 (1991Ju05).
334.0 ^h 1	(5/2-)	AB	28 ns 2	T _{1/2} : from γ-n(t) between beam pulses (1995Ka06).
400.76 13	(9/2, 7/2, 5/2)+	B		
784.5 ⁿ 2	(13/2)+	A	1.8 ps 3	T _{1/2} : From 1991Ju05.
839.8 ^d 2	(7/2-)	A		T _{1/2} : effective half-life, not corrected for feeding is 44 ps 15 (1991Ju05).
995.4 2	(11/2+)	A		
1051.5 ^o 2	(11/2)+	A		
1168.6 ^h 1	(9/2-)	A		
1603.5 ^d 1	(11/2-)	A		T _{1/2} : effective half-life, not corrected for feeding, is 21 ps 7 (1991Ju05).
1737.1 ⁿ 2	(17/2)+	A	0.69 ps 21	T _{1/2} : from 1991Ju05.
1954.4 ^o 2	(15/2)+	A	23 ps 18	T _{1/2} : from 1991Ju05.
1976.6 ^h 2	(13/2-)	A		T _{1/2} : effective half-life, not corrected for feeding, is 37 ps 9 (1991Ju05).
2114.5 2	(15/2+)	A		
2277.2 ^d 2	(15/2-)	A		T _{1/2} : Effective half-life, not corrected for feeding, is 11.1 ps 14 (1991Ju05).
2307.8 3	(15/2+)	A		
2412.4 ^g 2	(17/2-)	A	58 ps 5	g=+0.82 10. T _{1/2} : from 1991Ju05, although the different feeding due to the revised level scheme may impact the half-life somewhat. g-factor from 1995We03 by impad method.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁸⁷Nb Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
2490.8 ¹ 2	(21/2)+	A	13.9 ps 7	g=+0.38 11. g-factor from +0.41 13 (1995We03) by impad method and +0.36 11 (1999Te02 as well as 1998Ju02 and 1998Te06 by the same authors) by the recoil distance transient field method. Changes in the level scheme imply a new feeding pattern which leads to a possible small change where which should be addressed. T _{1/2} : from 1991Ju05 and may be slightly impacted by revised level scheme.
2581.2 2	(17/2-)	A		
2861.20 ⁿ 19	(21/2)+	A	0.8 ps 5	g=-0.6 11. T _{1/2} : from 1991Ju05. g-factor from 1999Te02 by recoil distance transient field method.
2905.6 ^c 2	(19/2-)	A		
2988.2 2	(19/2-)	A		
3219.0 ^g 2	(21/2-)	A	0.55 ps 14	T _{1/2} : From 1991Ju05.
3219.7 ^m 2	(23/2+)	A	0.55 ps 14	T _{1/2} : From 1991Ju05. g=+1.4 7. g-factor from 1999Te02 by recoil distance transient field method.
3445.9 ¹ 2	(25/2)+	A	1.7 ps 1	T _{1/2} : From 1991Ju05. g=+0.22 15. g-factor from 1999Te02 by recoil distance transient field method.
3741.9 ⁿ 2	(25/2+)	A		g=+0.04 22. g-factor from 1999Te02 by recoil distance transient field method.
3781.2 ^c 4	(23/2-)	A		
3869.0 2	(25/2+)	A		
4130.7 ^g 2	(25/2-)	A	2.1 ps 3	g=+0.51 39. g-factor from 1999Te02 by recoil distance transient field method.
4285.8 ^e 4	(25/2-)	A		
4301.1 ^m 2	(27/2+)	A		
4591.7 ¹ 2	(29/2)+	A		T _{1/2} : Effective half-life, not corrected for feeding is 0.62 ps 21 (1991Ju05).
4779.1 ^c 4	(27/2-)	A		
4939.8 ⁿ 2	(29/2)+	A		
5009.7 ^g 3	(29/2-)	A	3.5 ps 3	g=+0.53 11. T _{1/2} : from 1991Ju05. g-factor from 1999Te02 by the recoil distance transient method.
5301.5 ^e 5	(29/2-)	A		
5592.4 ^f 3	(31/2-)	A		T _{1/2} : Effective half-life, not corrected for feeding is 0.62 ps 14 (1991Ju05).
5620.29 ^m 20	(31/2+)	A		
5776.3 ^c 4	(31/2-)	A	0.28 ps 9	
5841.0 ¹ 2	(33/2)+	A	0.29 ps +9-6	
6039.2 ^g 2	(33/2-)	A	0.24 ps 4	
6196.9 4	(33/2+)	A		
6367.2 ⁿ 3	(33/2)+	A		
6393.1 3	(33/2-)	A		
6443.6 ^e 4	(33/2-)	A		
6539.6 4	(33/2+)	A		
6744.7 ^f 3	(35/2-)	A	0.33 ps 5	
6810.3 ^m 3	(35/2+)	A	0.44 ps 6	
6973.5 ^c 5	(35/2-)	A	0.31 ps +16-8	
7139.7 ¹ 3	(37/2)+	A	0.30 ps 4	
7225.6 ^g 3	(37/2-)	A	0.58 ps 9	
7618.8 3	(37/2+)	A	0.33 ps +7-5	
7647.2 ^e 4	(37/2-)	A	0.26 ps +12-9	
7942.2 ⁿ 6	(37/2+)	A		
8061.7 ^m 3	(39/2+)	A	0.49 ps 8	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁸⁷Nb Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
8254 f 1	(39/2-)	A	0.46 ps 7	
8365 .5 c 5	(39/2-)	A		T _{1/2} : effective half-life, not corrected for side feeding is 0.36 ps +7-6.
8432 .3 j 4	(41/2+)	A	0.40 ps 6	
8535 g 1	(41/2-)	A	0.33 ps 5	
8571 .5 l 6	(41/2+)	A	0.64 ps +14-10	
8873 .5 5	(41/2+)	A		
8934 .5 e 5	(41/2-)	A	0.152 ps 28	
9014 .5 5	(41/2+)	A		
9514 .3 m 5	(43/2+)	A	0.062 ps +28-21	
9575 .3 n 8	(41/2+)	A		
9843 .4 f 5	(43/2-)	A	0.28 ps +5-4	
9888 .3 c 7	(43/2-)	A		
9997 j 2	(45/2+)	A	0.222 ps 35	
10236 .6 g 7	(45/2-)	A	0.34 ps 5	
10459 .7 e 6	(45/2-)	A	0.090 ps 21	
11023 .8 8	(45/2+)	A		
11186 .7 m 7	(47/2+)	A	0.07 ps +7-3	
11545 .0 c 8	(47/2-)	A		
11579 .7 f 7	(47/2-)	A		T _{1/2} : effective half-life, not corrected for side feeding is 0.194 ps +35-28.
11948 j 2	(49/2+)	A		T _{1/2} : effective half-life, not corrected for side feeding is 0.028 ps +35-21.
12017 .2 e 7	(49/2-)	A	0.152 ps 21	
12492 .4 12	(49/2+)	A		
13119 .7 m 9	(51/2+)	A	0.028 ps +35-21	
13258 .7 k 9	(51/2+)	A		
13476 .1 c 10	(51/2-)	A		
13577 .8 f 8	(51/2-)	A		
13752 .4 i 16	(53/2+)	A		
13880 e 3	(53/2-)	A	0.083 ps 14	
14201 .5 j 16	(53/2+)	A		
14590 .2 9	(53/2-)	A		
15329 .3 m 10	(55/2+)	A	0.021 ps +21-7	
15672 .1 c 11	(55/2-)	A		
15867 .2 i 17	(57/2+)	A		
16187 .6 e 22	(57/2-)	A		T _{1/2} : effective half-life, not corrected for side feeding is 0.12 ps +27-6.
17927 .8 m 11	(59/2+)	A		
18260 .1 i 17	(61/2+)	A		
18894 .5 e 23	(61/2-)	A		
x@	J	A		
1250+x@	J+2	A		
2679+x@	J+4	A		
4251+x@	J+6	A		
5970+x@	J+8	A		
7849+x@	J+10	A		
9894+x@	J+12	A		
12110+x@	J+14	A		
14505+x@	J+16	A		
17090+x@	J+18	A		
y&	J ₁	A		
1492+y&	J ₁ +2	A		
1870+y ^a	J ₁ +2	A		
3134+y&	J ₁ +4	A		
3378+y ^a	J ₁ +4	A		
4924+y&	J ₁ +6	A		
5035+y ^a	J ₁ +6	A		
6795+y ^a	J ₁ +8	A		
6916+y&	J ₁ +8	A		
8759+y ^a	J ₁ +10	A		
8994+y&	J ₁ +10	A		
10876+y&	J ₁ +12	A		

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Adopted Levels, Gammas (continued)
⁸⁷Nb Levels (continued)

E(level) [†]	Jπ [§]	XREF	E(level) [†]	Jπ [§]	XREF
11170+y&	J ₁ +12	A	z ^b	J ₂	A
13150+y&	J ₁ +14	A	1697+z ^b	J ₂ +2	A
13438+y&	J ₁ +14	A	3563+z ^b	J ₂ +4	A
15582+y ^a	J ₁ +16	A	5604+z ^b	J ₂ +6	A
15831+y&	J ₁ +16	A	7815+z ^b	J ₂ +8	A
18169+y ^a	J ₁ +18	A	10199+z ^b	J ₂ +10	A
18374+y&	J ₁ +18	A	12736+z ^b	J ₂ +12	A

[†] From least-squares fit to γ -ray energies. When no uncertainties were reported, they were estimated to be 0.5 keV for fitting purposes.

[‡] From measurements in ⁵⁸Ni(³²S,3p γ), 2003Pa09, unless otherwise noted.

[§] Suggested from ⁵⁸Ni(³²S,3p γ) DCO measurements. with support from band placement. Exceptions are noted.

For the superdeformed bands, the spins are from 1997La02.

@ (A): SD-1 band.

& (B): SD-2 band.

a (C): SD-3 band.

b (D): SD-4 band.

c (E): Band based on (19/2-).

d (F): Band based on (3/2-).

e (G): Band based on (25/2-).

f (H): Band based on (31/2-).

g (I): Band based on (17/2-).

h (J): g.s. band.

i (K): Band based on (53/2+).

j (L): Band based on (41/2+).

k (M): Band based on (51/2+).

l (N): Band based on (21/2+).

m (O): Band based on (23/2+).

n (P): Band based on (9/2+).

o (Q): Band based on 7/2(+).

 $\gamma(^{87}\text{Nb})$

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. [§]	$\alpha^{\textcircled{a}}$	Comments
200.2	200.1 5	100.0			
266.9	263.0 1	100.0	M1	0.01690	
334.0	67.0 3	7.4 9	[E1]	0.383 8	
	334.0 1	100.3	(E2)	0.01613	B(E2)(W.u.)=0.191 16.
400.76	133.9& 1	16& 8			
	396.8& 1	100& 14			
784.5	780.7 1	100.0	E2	1.31×10 ⁻³	B(E2)(W.u.)=48 8.
839.8	505.8 1	100.7	(M1)	0.00343	I γ : From branching ratios from ⁴⁰ Ca(⁵⁰ Cr,3p) in 1991Ju05. Mult.: deduced from angular distribution (1991Mi15).
	639.5 7	<14	(E2)	0.00222	I γ : From branching ratios from ⁴⁰ Ca(⁵⁰ Cr,3p) in 1991Ju05.
	835.8 1	79.7			I γ : From branching ratios from ⁴⁰ Ca(⁵⁰ Cr,3p) in 1991Ju05.
995.4	991.5 1	100.0	(E2)	7.36×10 ⁻⁴	
1051.5	267.0 1	26.4			
	784.5 1	100.4	(E2)	1.30×10 ⁻³	
	1047.6 1	32.12	(E2)	6.48×10 ⁻⁴	
1168.6	834.7 1	100	(E2)	1.11×10 ⁻³	
	1164.8 3				
1603.5	434.9 1	35.2 22	(M1+E2)		I γ : From 1991Mi15, ³² .
	763.7 1	100.3	(E2)	1.39×10 ⁻³	
1737.1	952.5 1	100	(E2)	8.07×10 ⁻⁴	B(E2)(W.u.)=45 +19-10.
1954.4	903.0 1	100.10	(E2)	9.16×10 ⁻⁴	B(E2)(W.u.)=1.0 +38-5.
	959.0 1	42.9	(E2)	7.94×10 ⁻⁴	B(E2)(W.u.)=0.3 +13-2.
	1169.9 1	31.3	(M1+E2)	5.30×10 ⁻⁴	
1976.6	808.0 1	100.0			
2114.5	1063.0 1	100.0			
2277.2	300.6 1	77.16	(M1+E2)		
	673.6 1	100.21	(E2)	0.00192	

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Adopted Levels, Gammas (continued)

 $\gamma(^{87}\text{Nb})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult. \$ $\dagger$	$\alpha^{\oplus}$	Comments
2277.2	1492.9 2	80 9	(E1+M2)		
2307.8	1312.4				
	1523.4				
2412.4	104.6 3		(E1)	0.1051	
	135.2 1	100 24	(M1)	0.0969	Mult.: Consistent with RUL.
	297.9 3	18 4	(E1)	0.00527	B(M1)(W.u.)=(0.057 16).
	435.6 ^a 1		[E2]	0.00682	B(E1)(W.u.)=1.5 $\times 10^{-5}$ 5.
	458.0 1	53 6	(E1)	0.00185 16	B(E1)(W.u.)=(1.23 $\times 10^{-5}$ 23).
	675.2 1	83 17	[E1]	6.92 $\times 10^{-4}$	B(E1)(W.u.)=6.1 $\times 10^{-6}$ 16.
2490.8	753.7 1	100.0	(E2)	1.43 $\times 10^{-3}$	B(E2)(W.u.)=7.3 6.
2581.2	168.9 1	100.0			
2861.20	370.0 2	100 10	[M1]	0.00729 12	Mult.: M1 or E1 consistent with RUL.
	1123.9 2	51 6	(E2)	5.56 $\times 10^{-4}$	B(M1)(W.u.)=(0.36 +59-14).
2905.6	324.5 1	100 10	(M1+E2)		B(E2)(W.u.)=6 +11-3.
	628.9	50 10	(E2)	0.00231	
2988.2	575.8 1	100			
3219.0	230.8 1	14.0 23	[M1]	0.0236	Mult.: E1 or M1 from RULs. M1 from level scheme placement.
	313.4 1	41 4	[M1]	0.01093	B(M1)(W.u.)=0.28 +10-5.
	637.9 3	4.0 20			Mult.: M1 or E1 consistent with RUL.
	806.4 1	100 20	(E2)	1.21 $\times 10^{-3}$	B(M1)(W.u.)=0.33 +12-7.
3219.7	358.1 2	6.3 23	(M1+E2)		B(E2)(W.u.)=83 +28-17.
	729.0 1	100 12	(M1+E2)		
3445.9	226.3 1	100 11	[M1]	0.0250	Mult.: E1 or M1 consistent with RUL.
	955.2 1	77 17	(E2)	8.02 $\times 10^{-4}$	B(M1)(W.u.)=(0.61 11).
3741.9	522.1 1	7 4	(M1+E2)	0.00320	B(E2)(W.u.)=7.9 20.
	880.7 1	100 10	(E2)	9.77 $\times 10^{-4}$	
3781.2	875.5 3	100.0	(E2)	9.85 $\times 10^{-4}$	
3869.0	1378.2 1	100.0	(E2)	4.05 $\times 10^{-4}$	
4130.7	911.8 1	100.0	(E2)	8.96 $\times 10^{-4}$	B(E2)(W.u.)=19 3.
4285.8	154.4 5	8 8			
	1067 1	100 10	(E2)	6.24 $\times 10^{-4}$	
4301.1	559.1 1	100 10	(M1+E2)	0.00270	
	855.5 1	87 9	(M1+E2)	1.04 $\times 10^{-3}$	
	1080.5 3	20 5	(E2)	6.05 $\times 10^{-4}$	
4591.7	290.9 1	24.3 24	(M1+E2)	0.01330 23	
	1145.6 1	100 10	(E2)	5.34 $\times 10^{-4}$	
4779.1	493.3 1	80 9	[M1+E2]	0.00363 6	
	997 1	100 21	[E2]	7.25 $\times 10^{-4}$	
4939.8	1197.8 1	100.0	(E2)	4.88 $\times 10^{-4}$	
5009.7	879.0 1	100.0	(E2)	9.75 $\times 10^{-4}$	B(E2)(W.u.)=13.4 12.
5301.5	521.8 8	14 3	(M1+E2)		
	1016 1	100 10	(E2)	6.95 $\times 10^{-4}$	
	1172 1				
5592.4	582.8 1	100.0	(M1+E2)		
5620.29	680.7 2	100 21	(M1+E2)		
	1028 1	55 21			
	1319.2 1	61 7	(E2)	4.24 $\times 10^{-4}$	
5776.3	475.0 4	100 11	[M1]		Mult.: M1 or E1 consistent with RUL.
	997.1 1	78 16	[E2]	7.25 $\times 10^{-4}$	B(E2)(W.u.)=39 +17-10.
5841.0	220.9 2	4.7 16	(M1)		Mult.: E1 or M1 consistent with RUL.
	1249.4 1	100 11	(E2)	4.58 $\times 10^{-4}$	B(E2)(W.u.)=27 7.
6039.2	447.0 4	100 11	(M1)	0.00459	Mult.: Only E1 excluded from RUL.
	1029.4 1	10 4	(E2)	6.75 $\times 10^{-4}$	B(M1)(W.u.)=(0.94 20).
6196.9	1605.1 3	100.0			B(E2)(W.u.)=8 4.
6367.2	747.5 3	15 9	[M1+E2]		
	1426.7 3	100 20	(E2)	3.94 $\times 10^{-4}$	
6393.1	800.5 5	100.0	(M1+E2)		

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Adopted Levels, Gammas (continued)
 $\gamma(^{87}\text{Nb})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\dagger}$	Mult.§#	$\alpha^{\oplus}$	Comments
6443.6	666.9	11 6			
	1141.9	100 10			
6539.6	172.0	100 71			
	342.7	71 36			
	1598.7	64 36			
6744.7	351.6 1	22.3 23	(M1)	0.00825	Mult.: E1 or M1 consistent with RUL allowed for M1. B(M1)(W.u.)=(0.20 4).
	705.5 1	100 10	(M1+E2)	1.59×10^{-3}	B(M1)(W.u.)=(0.112 22).
	1152.4 1	46 5	(E2)	5.28×10^{-4}	B(E2)(W.u.)=10.1 20.
6810.3	269.1	42 8	[M1]	0.01608	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.59 15); B(E2)(W.u.)=(90 +100-9)0.
	969.2 1	100 10	(M1+E2)	7.87×10^{-4}	B(M1)(W.u.)=(0.030 6).
	1188.6	37 7	[E2]	4.97×10^{-4}	B(E2)(W.u.)=4.9 12.
6973.5	529.9 3	67 7	[M1]		Mult.: E1 or M1 consistent with RUL.
	1196.2	100 50	(E2)	4.91×10^{-4}	B(E2)(W.u.)=19 +7-6.
7139.7	329.2 1	38 4	[M1]	0.00968	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.56 13).
	1298.8 1	100 20	(E2)	4.33×10^{-4}	B(E2)(W.u.)=16 5.
7225.6	480.9 1	100 11	(M1)	0.00387	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.28 6).
	1186.4 1	20 4	(E2)	5.00×10^{-4}	B(E2)(W.u.)=3.0 10.
7618.8	808.5 3	100 20	(M1+E2)		
	1777.6 3	81 8	(E2)	4.19×10^{-4}	B(E2)(W.u.)=1.9 +4-3.
7647.2	422.2	16 9	(M1+E2)		
	673.4	60 13	[M1+E2]		
	902.4	100 20	(M1+E2)		
	1203.3	90 50	[E2]	4.86×10^{-4}	B(E2)(W.u.)=11 +6-3.
	1253.7	33 17	(E2)	4.55×10^{-4}	B(E2)(W.u.)=3.4 +18-11.
7942.2	1575.0	100.0	[E2]	3.88×10^{-4}	
8061.7	442.9 1	44 5	[M1]	0.00471	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.16 4).
	1251.2	100 20	[E2]	4.56×10^{-4}	B(E2)(W.u.)=11 4.
8254	1028 1	8 4	(M1+E2)	6.93×10^{-4}	B(M1)(W.u.)=(0.0032 18).
	1510 1	100 10	[E2]	3.86×10^{-4}	B(E2)(W.u.)=6.4 14.
8365.5	718.2	60 12	[M1+E2]	1.52×10^{-3}	
	1392 1	100 10	(E2)	4.01×10^{-4}	B(E2)(W.u.)=8.2 +18-20.
8432.3	370 1	63 13	(M1)	0.00728	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.42 12).
	1292.8 3	100 10	(E2)	4.36×10^{-4}	B(E2)(W.u.)=10.5 22.
8535	282 1	77 7	[M1]	0.01428	Mult.: Only M1 allowed from RUL with small E2 admixture. B(M1)(W.u.)=(1.3 3).
	1310 1	100 11	[E2]	4.28×10^{-4}	B(E2)(W.u.)=10.9 22.
8571.5	140 ^a				
	1431.8	100	[E2]	3.93×10^{-4}	
8873.5	441.6	100.0			
8934.5	399.3	32 6	[M1]	0.00603	Mult.: E1 or M1 consistent with RUL. B(M1)(W.u.)=0.38 11.
	568.9	56 6	[M1]	0.00260	M E1 or M1 consistent with RUL. B(M1)(W.u.)=(0.23 6).
	1287.1	100 21	(E2)	4.38×10^{-4}	B(E2)(W.u.)=24 8.
9014.5	952.7				
9514.3	499.6	40 9	[M1]		
	641.1	13 7	[M1+E2]		
	1452.3	100 10	(E2)	3.90×10^{-4}	B(E2)(W.u.)=40 +21-12.
9575.3	1633.0	100.0	[E2]	3.94×10^{-4}	
9843.4	908.8		[M1+E2]	9.04×10^{-4}	
	1308.1	61 22	[M1+E2]	4.41×10^{-4}	B(M1)(W.u.)=0.013 6.
	1590.1	100 22	[E2]	3.90×10^{-4}	B(E2)(W.u.)=5.4 +18-19.
9888.3	953.8	100 30	[M1+E2]		
	1522.2	27 7	(E2)	3.86×10^{-4}	
9997	1565 1	100.0	(E2)	3.88×10^{-4}	B(E2)(W.u.)=11.8 19.
10236.6	1301.9	59 12	[E2]	4.31×10^{-4}	B(E2)(W.u.)=7.2 21.
	1701.2	100 10	(E2)	4.04×10^{-4}	B(E2)(W.u.)=3.2 7.

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Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Nb})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\dagger}$	Mult. §#	$\alpha^{\oplus}$	Comments
10459.7	223				
	616.3	100 16	[M1]		
	1525.1	70 40	(E2)	3.86×10^{-4}	
11023.8	2452.3	100.0			
11186.7	1672.4	100.0	(E2)	4.00×10^{-4}	B(E2)(W.u.)=27 +19-13.
11545.0	1656.7	100.00	[E2]	3.97×10^{-4}	
11579.7	1736.3	100.0	[E2]	4.11×10^{-4}	
11948	1951.1	100.0	(E2)	4.67×10^{-4}	
12017.2	437.6		(M1+E2)	0.00485	
	1557.6	79 8	(E2)	3.87×10^{-4}	B(E2)(W.u.)=7.8 16.
	1778.2	100 10	(E2)	4.20×10^{-4}	B(E2)(W.u.)=5.1 10.
12492.4	2495.1	100.0			
13119.7	1933.0	100.0	[E2]	4.60×10^{-4}	B(E2)(W.u.)=33 +98-18.
13258.7	2072.0	100.0			
13476.1	1931.0	100.0	[E2]	4.60×10^{-4}	
13577.8	1998.1	100.00			
13752.4	1263 ^a				
	1804.1				
13880	1862.2	100	(E2)	4.40×10^{-4}	B(E2)(W.u.)=13.3 23.
14201.5	2253.1	100.0			
14590.2	2573.0	100.0			
15329.3	2071 ^a		[E2]	5.05×10^{-4}	
	2209.6		[E2]	5.54×10^{-4}	
15672.1	2196.0	100.0			
15867.2	2114.7	100.0			
16187.6	2308.4	100.0	[E2]	5.91×10^{-4}	
17927.8	2598.4	100.0	(E2)	7.03×10^{-4}	
18260.1	2392.9	100.0			
18894.5	2706.8	100.0	[E2]	7.46×10^{-4}	
1250+x	997	$\frac{1}{2}$			
	1250	$\frac{1}{2}$			
	1362	$\frac{1}{2}$			
	1382	$\frac{1}{2}$			
2679+x	1421	$\frac{1}{2}$			This transition is shown (1997La02) to feed a level deexciting by a 2225 γ .
	1429	$\frac{1}{2}$			
4251+x	1572	100 $\frac{1}{2}$			
5970+x	1719	100 $\frac{1}{2}$			
7849+x	1879	100 $\frac{1}{2}$			
9894+x	2045	100 $\frac{1}{2}$			
12110+x	2216	100 $\frac{1}{2}$			
14505+x	2395	100 $\frac{1}{2}$			
17090+x	2585	100 $\frac{1}{2}$			
1492+y	1492	100 $\frac{1}{2}$			
3134+y	1642	100 $\frac{1}{2}$			
3378+y	1508	100 $\frac{1}{2}$			
4924+y	1790	100 $\frac{1}{2}$			
5035+y	1657	100 $\frac{1}{2}$			
6795+y	1760	$\frac{1}{2}$	(E2)	4.15×10^{-4}	Mult.: from R(DCO)=0.94 12 (1997La02).
	1871	$\frac{1}{2}$	(E2)	4.42×10^{-4}	Mult.: from R(DCO)=0.97 17 (1997La02).
6916+y	1881	$\frac{1}{2}$	(E2)	4.45×10^{-4}	Mult.: from R(DCO)=0.89 13 (1997La02).
	1992	$\frac{1}{2}$	(E2)	4.79×10^{-4}	Mult.: from R(DCO)=1.06 16 (1997La02).
8759+y	1964	100 $\frac{1}{2}$			
8994+y	2078	100 $\frac{1}{2}$			
10876+y	2117	100 $\frac{1}{2}$			
11170+y	2176	100 $\frac{1}{2}$			
13150+y	2274	100 $\frac{1}{2}$			
13438+y	2268	100 $\frac{1}{2}$			
15582+y	2432	100 $\frac{1}{2}$			
15831+y	2393	100 $\frac{1}{2}$			
18169+y	2587	100 $\frac{1}{2}$			
18374+y	2543	100 $\frac{1}{2}$			
1697+z	1697	100 $\frac{1}{2}$			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Nb})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$
3563+z	1866	100 ‡
5604+z	2041	100 ‡
7815+z	2211	100 ‡
10199+z	2384	100 ‡
12736+z	2537	100 ‡

† From $^{58}\text{Ni}(^{32}\text{S},3p\gamma)$, unless indicated otherwise. Uncertainties estimated by the evaluators to be 0.3 keV.

‡ Experimental results not available.

§ From $^{58}\text{Ni}(^{32}\text{S},3p\gamma)$, DCO (directional correlation of oriented nuclei) ratios, with additional support from from angular distributions in some cases. See the $(^{32}\text{S},3p\gamma)$ dataset for more details. The exception is for the 263 γ which is from the ^{87}Mo $\varepsilon+\beta+$ decay. The transitions that are determined to be quadrupole are presumed to be E2 rather than M2. When half lives are known and additional support can be obtained by comparing with Recommended Upper Limits (RUL), that is mentioned.

$^\#$ In cases of mixed multipolarity, transition strengths were calculated assuming negligible mixing ratios of around 0.1, as they are usually small in this nuclei. In 2003Pa09, they were assumed to be 0.

$^\@$ Value is given when needed for transition strengths.

$^\&$ From ^{87}Mo $\varepsilon+\beta+$ decay.

$^\text{a}$ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)

Bands for ⁸⁷Nb

⁸⁷Nb
₄₆

Adopted Levels, Gammas (continued)

Bands for 87Nb

⁸⁷Mo β⁺ Decay 1991Mi15,1977Ko05,1982De43

Parent ⁸⁷Mo: E=0.0; Jπ=7/2⁺; T_{1/2}=14.02 s 26; Q(g.s.)=6988 7; %β⁺ decay=100.

1997Hu07: ⁵⁸Ni(³²S,2pn), E(³²S)=170 MeV; measured half-life and proton-γ coincidences.

1991Mi15: ⁵⁸Ni(³²S,2pn), E(³²S)=105 MeV; measured γ singles, γγ and βγ coincidences, half-lives of the γ's, and conversion electrons.

1983Ha06: ⁵⁸Ni(³²S,2pn), E(³²S)=122 MeV; measured delayed protons and proton-γ coincidences and ⁸⁷Mo half-life.

1982De43: ⁵⁸Ni(³²S,2pn), βγ coincidences with 263 γ with T_{1/2}=15 s 2, measured E_β.

1977Ko05: ⁵⁸Ni(³²S,2pn), E(³²S)=111 MeV, observed 263-keV γ with T_{1/2}=14.1 s 2 and 397 γ with T_{1/2}=12.4 s 5.

Decay scheme is from 1991Mi15.

Since this decay has a Q value of over 6 MeV and the only observed levels are below 0.5 MeV, the scheme is clearly incomplete. Therefore, the ε intensities are upper limits and logft values are lower limits.

Some of the levels in the ⁸⁷Nb daughter decay by the emission of protons to levels in ⁸⁶Zr. From proton-752 γ (the 2⁺ to ground state γ) coincidences, 1983Ha06 deduce 15% 8 of the decays produce this γ ray. From proton-752 γ coincidences, 1997Hu07 deduce the feeding of the 2⁺, 4⁺, and 6⁺ levels in ⁸⁶Zr to be 11% 6, 2% 1, and 2% 1, respectively.

Decay scheme is from 1991Mi15, using level energies from the Adopted Levels.

⁸⁷Nb Levels

E(level)	Jπ [†]
0	(1/2) ⁻
4.0 5	(9/2) ⁺
267.0 5	(7/2) ⁺
334.0 4	(5/2) ⁻
400.8 5	(9/2, 7/2, 5/2) ⁺

[†] From ⁸⁷Nb Adopted Levels.

β⁺,ε Data

Since this decay has a Q value of over 6 MeV and the only observed levels are below 0.5 MeV, the scheme is clearly incomplete. Therefore, the ε intensities are upper limits and logft values are lower limits.

Eε	E(level)	Iβ [†]	Iε [†]	Log ft	I(ε+β ⁺) [†]	Comments
(6587 7)	400.8	24	0.34	5.4	24	
(6654 7)	334.0	3	0.04	6.3	3	
(6721 7)	267.0	51	0.69	5.1	52	Eε: The end-point of the positron spectrum in coincidence with the 263-keV γ ray was measured to be 5.3 3 MeV (1991Mi15).
(6984 7)	4.0	20	0.23	5.6	20	

[†] Absolute intensity per 100 decays.

γ(⁸⁷Nb)

Iγ normalization: the absolute intensities, and thereby the ε branch intensities, were determined from the intensity of the 511-keV annihilation radiation (1991Mi15).

Eγ [†]	E(level)	Iγ ^{†‡}	Mult.	α	Comments
67.0 3	334.0	0.7 6			
133.9 1	400.8	6 3			
263.0 1	267.0	100 1	M1	0.01705	α(K)exp=0.016 3.
334.0 4	334.0	4 3			
396.8 1	400.8	37 5			

[†] From 1991Mi15. Other: 1982De43.

[‡] For absolute intensity per 100 decays, multiply by 0.55.

⁸⁷Mo β⁺ Decay 1991Mi15,1977Ko05,1982De43 (continued)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09

2003Pa09: ⁵⁸Ni(³²S,3pγ) E(³²S)=135 MeV. Measured E_γ, I_γ, γγ, γγ(θ)(DCO) lifetimes with DSAM using the GAMMASPHERE comprised of 36 Compton-suppressed HPGe detectors in conjunction with the Microball composed of 95 CsI (TI) scintillators. In a second experiment for lifetime measurements, 95 HPGe detectors were used.

1986CoZQ: ⁵⁸Ni(³²S,3pγ) E(³²S)=100–120 MeV, measured excitation functions, γγ coincidences, and γ angular distributions.

1991Mi15: ⁵⁸Ni(³²S,3pγ) E(³²S)=103 MeV, measured γ singles, γγ-charged particle coincidences, and γ angular distributions. No uncertainties are given for the E_γ.

1991Ju05: ⁵⁸Ni(³²S,3pγ) E(³²S)=108 MeV and ⁴⁰Ca(⁵⁰Cr,3pγ) E(⁵⁰Cr)=170 MeV, γ singles, γγ coincidences, DCO ratios, γ angular distributions, and lifetimes by recoil distance Doppler shift method.

1995Ka06: ⁵⁸Ni(³⁶Ar,α3nγ) E(³⁶Ar)=149 MeV, measured one level lifetime by γ-n(t).

1995We03: ⁵⁸Ni(³²S,3pγ) E(³²S)=110 MeV, measured g-factors by IMPAD method.

1997La02 (also 1996LaZZ): ⁵⁸Ni(³²S,3pγ) E(³²S)=135 MeV. Measured E_γ, γγ and γγ(θ) coincidences and deduced DCO ratios and lifetimes by centroid-shift method using GAMMASPHERE array and charged-particle microball. Deduced SD bands. Intensity measurements not reported.

1997We04: ⁵⁸Ni(³²S,3pγ) E(³²S)=95–105 MeV and ⁵⁸Ni(³⁵Cl,2pα) E(³⁵Cl)=124 MeV, measured γγ coincidences, γ(θ), excitation functions, DCO ratios with 5 Compton-suppressed Ge detectors.

Scheme is from 2003Pa09 with additions as noted; the scheme is similar to that of 1991Ju05 with some rearrangements, which is similar to that of 1991Mi15, 1997We04, but less extensive.

⁸⁷Nb Levels

See 2003Pa09 for configurations of non-superdeformed bands.

E(level) ^{†‡§}	Jπ [#]	T _{1/2} [@]	Comments
0.0 ^l	(1/2)–		Jπ: from Adopted Levels.
1.9 ^r 2	(9/2)+		Jπ: from Adopted Levels.
199.6 ^h 4	(3/2)–		
264.9 ^s 2	(7/2)+		T _{1/2} : effective half-life, not corrected for feeding, is 67 ps 9 (1991Ju05).
332.9 ^l 1	(5/2)–	28.4 ns 2	R(DCO)=1.18 13 1997We04.
			T _{1/2} : From 1995Ka06.
781.9 ^r 1	(13/2)+	1.8 ps 4	T _{1/2} : From 1991Ju05.
838.1 ^h 1	(7/2)–		T _{1/2} : effective half-life, not corrected for feeding is 44 ps 15 (1991Ju05).
993.3 2	(11/2)+		
1049.2 ^s 1	(11/2)+		
1167.1 ^l 2	(9/2)–		
1601.8 ^h 2	(11/2)–		T _{1/2} : effective half-life, not corrected for feeding, is 21 ps 7 (1991Ju05).
1734.7 ^r 2	(17/2)+	0.69 ps 21	T _{1/2} : from 1991Ju05.
1952.1 ^s 1	(15/2)+	23 ps 18	T _{1/2} : from 1991Ju05.
1974.8 ^l 2	(13/2)–		Angular distribution measurements from 1991Ju05 consistent with ΔJ=2 for a stretched E2.
			T _{1/2} : effective half-life, not corrected for feeding, is 37 ps 9 (1991Ju05).
2112.2 2	(15/2+)		
2275.2 ^h 2	(15/2)–		
2305.5 3	(15/2+)		T _{1/2} : Effective half-life, not corrected for feeding, is 11.1 ps 14 (1991Ju05).

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

⁸⁷Nb Levels (continued)

E(level) ^{†‡§}	Jπ [#]	T _{1/2} [@]	Comments
2410.2 ^k 2	(17/2-)	58 ps 5	g=+0.82 10. g: from 1995We03. Since the level scheme has been slightly changed in 2003Pa09 as compared to 1995We03, the feeding pattern of this level has changed which impacts the calculations for the g-factor. This should be revisited experimentally. T _{1/2} : from 1991Ju05, although the different feeding due to the revised level scheme may impact the half-life somewhat.
2488.4 ^p 2	(21/2)+	13.9 ps 7	g=+0.41 13. g: from 1995We03 may be slightly impacted by revised level scheme. T _{1/2} : from 1991Ju05 and may be slightly impacted by revised level scheme.
2579.0 2	(17/2-)		
2858.7 ^r 2	(21/2)+	0.8 ps 5	T _{1/2} : from 1991Ju05.
2903.4 ^g 2	(19/2-)		
2986.0 2	(19/2-)		Jπ: Consistent with DCO for 1066 feeding transition.
3216.7 ^k 2	(21/2-)&	1.6 ps 3	T _{1/2} : From 1991Ju05.
3217.3 ^q 2	(23/2+)	0.55 ps 14	T _{1/2} : from 1991Ju05.
3444.6 ^p 16	(25/2)+	1.66 ps 14	T _{1/2} : from 1991Ju05.
3739.4 ^r 2	(25/2+)		Iγ(521)=4.9 4, Iγ(879)=6.3 6, Iγ(1251)=2.5 3 (1991Ju05) ; Evaluator notes a significant discrepancy in branching ratios between 2003Pa09 and 1991Ju05.
3779.0 ^g 4	(23/2-)&		
3866.6 2	(25/2+)		
4128.5 ^k 2	(25/2-)&	2.1 ps 3	
4283.5 ⁱ 4	(25/2-)&		
4298.5 ^q 2	(27/2+)&		
4589.2 ^p 2	(29/2)+		T _{1/2} : Effective half-life, not corrected for feeding is 0.62 ps 21 (1991Ju05).
4776.8 ^g 4	(27/2-) ^a		
4937.3 ^r 2	(29/2+)&		
5007.5 ^k 2	(29/2-)	3.5 ps 3	T _{1/2} : from 1991Ju05.
5299.2 ⁱ 5	(29/2-)		Jπ: based on DCOs of feeding 475 transition and depopulating γ.
5590.2 ^j 3	(31/2-)		T _{1/2} : Effective half-life, not corrected for feeding is 0.62 ps 14 (1991Ju05).
5617.7 ^q 2	(31/2+)		
5774.0 ^g 4	(31/2-) ^a	0.28 ps 9	
5838.6 ^p 2	(33/2)+	0.29 ps +9-6	
6037.0 ^k 3	(33/2-)	0.24 ps 4	
6194.4 4	(33/2+)		
6364.7 ^r 3	(33/2+)&		
6390.9 3	(33/2-)		
6441.3 ⁱ 4	(33/2-) ^a		
6537.1 4	(33/2+)		
6742.5 ^j 3	(35/2-)	0.33 ps 5	
6807.8 ^q 3	(35/2+)	0.44 ps 6	
6971.3 ^g 5	35/2-&	0.31 ps +16-8	
7137.2 ^p 3	(37/2)+	0.30 ps 4	
7223.4 ^k 3	(37/2-)&	0.58 ps 9	
7616.7 3	(37/2+)	0.33 ps +7-5	
7644.9 ⁱ 4	(37/2-)&	0.26 ps +12-9	
7939.7 ^r 6	(37/2+) ^a		
8059.6 ^q 3	(39/2+)&	0.49 ps 8	
8251.4 ^j 6	(39/2-)&	0.46 ps 7	
8363.4 ^g 5	(39/2-)&		T _{1/2} : effective half-life, not corrected for side feeding is 0.36 ps +7-6.
8429.9 ⁿ 4	(41/2)+	0.40 ps 6	
8533.2 ^k 6	(41/2-)&	0.33 ps 5	
8569.0 ^p 6	(41/2+) ^a	0.64 ps +14-10	
8871.2 5	(41/2+)		
8932.4 ⁱ 5	(41/2-)&	0.152 ps 28	
9012.4 5	(41/2+)		Jπ: Feeding from (43/2+) and into (39/2+) both presumed to be Δ1.
9512.1 ^q 5	(43/2+)&	0.062 ps +28-21	
9572.7 ^r 8	(41/2+) ^a		
9811.3? ^b 11	(43/2-)		Jπ: Tentative Assignment made assuming this level extended a band structure (1991Ju05), not confirmed in 2003Pa09.
9841.3 ^j 6	(43/2-) ^a	0.28 ps +5-4	
9886.2 ^g 7	(43/2-) ^a		
9994.9 ⁿ 11	(45/2+)	0.222 ps 35	

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

⁸⁷Nb Levels (continued)

E(level) ^{†‡§}	Jπ [#]	T _{1/2} [@]	Comments
10234.5 ^k 7	(45/2-)&	0.34 ps 5	
10457.5 ⁱ 6	(45/2-)&	0.090 ps 21	
11021.3 8	(45/2+)		Jπ: Assuming stretched E2 for the 2452 keV line, although needs experimental verification.
11184.5 7	(47/2+)&	0.07 ps +7-3	
11542.9 ^g 9	(47/2-) ^a		
11577.6 ^j 7	(47/2-) ^a		T _{1/2} : effective half-life, not corrected for side feeding is 0.194 ps +35-28.
11945.9 ⁿ 15	(49/2+)&		T _{1/2} : effective half-life, not corrected for side feeding is 0.028 ps +35-21.
12015.1 ⁱ 7	(49/2-)&	0.152 ps 21	
12490.0 2	(49/2+)		Jπ: Assuming stretched E2 for populating and depopulating transitions, but no experimental verification.
13117.5 ^q 9	(51/2+) ^a	0.028 ps +35-21	
13256.5 ^o 9	(51/2+)		Jπ: Band placement.
13473.9 ^g 10	(51/2-) ^a		
13575.7 ^j 9	(51/2-) ^a		
13750.0 ^m 16	(53/2+)		Jπ: Assuming stretched E2 for the 1263 and 1804 keV depopulating transitions.
13877.1 ⁱ 22	(53/2-)&	0.083 ps 14	
14199.1 ⁿ 16	(53/2+) ^a		
14588.1 9	(53/2-)		Jπ: Assuming stretched E2 populating (49/2-).
14860? 1	(53/2-)		Jπ: Assuming stretched E2 for the 2846 depopulating transition.
15327.2 ^q 10	(55/2+)	0.021 ps +21-7	Jπ: band placement.
15670.0 ^g 11	(55/2-) ^a		
15864.8 ^m 17	(57/2+)		Jπ: Assuming stretched E2 for the 2115 depopulating transition.
15927.0? ^o 8	(55/2+)		Jπ: Assuming stretched E2 for the 2674 depopulating transition.
15938 ^j 1	(55/2-)		Jπ: Supported by tentative band placement.
16185.5 ⁱ 22	(57/2-) ^a		T _{1/2} : effective half-life, not corrected for side feeding is 0.12 ps +27-6.
17925.6 ^q 11	(59/2+)&		T _{1/2} : effective half-life, not corrected for side feeding is 0.028 ps +63-28.
18257.7 ^m 17	(61/2+)&		
18839.1? ^o 9	(59/2+)		Jπ: Supported by tentative band placement.
18892.4 ⁱ 23	(61/2-) ^a		
x ^c	J		Jπ: =(35/2) from 1997La02.
1250+x ^c	J+2		
1258+x			
2679+x ^c	J+4		
4251+x ^c	J+6		
5970+x ^c	J+8		
7849+x ^c	J+10		
9894+x ^c	J+12		
12110+x ^c	J+14		
14505+x ^c	J+16		
17090+x ^c	J+18		
y ^d	J ₁		Jπ: = (41/2) from 1997La02.
1492+y ^d	J ₁ +2		
1870+y ^e	J ₁ +2		
3134+y ^d	J ₁ +4		
3378+y ^e	J ₁ +4		
4924+y ^d	J ₁ +6		
5035+y ^e	J ₁ +6		
6795+y ^e	J ₁ +8		
6916+y ^d	J ₁ +8		
8759+y ^e	J ₁ +10		
8994+y ^d	J ₁ +10		
10876+y ^d	J ₁ +12		
11170+y ^d	J ₁ +12		
13150+y ^d	J ₁ +14		
13438+y ^d	J ₁ +14		
15582+y ^e	J ₁ +16		
15831+y ^d	J ₁ +16		
18169+y ^e	J ₁ +18		
18374+y ^d	J ₁ +18		
z ^f	J ₂		Jπ: = (39/2) from 1997La02.
1697+z ^f	J ₂ +2		
3563+z ^f	J ₂ +4		

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

⁸⁷Nb Levels (continued)

E(level) ^{†‡§}	Jπ [#]
5604+z ^f	J ₂ +6
7815+z ^f	J ₂ +8
10199+z ^f	J ₂ +10
12736+z ^f	J ₂ +12

[†] From least-squares fit to Eγ's (by evaluators).

[‡] Note that 1991Ju05 report a tentative level at 6299 fed by a 675 γ transition from the (33/2-) level at 6973 and depopulated by a tentative 997 γ transition. Similarly, a level at 2694 from 1991Ju05 were deexcited by 282 and 717 γ transitions which have alternate placements in 1993Pa09.

[§] Note a 5553 level was assigned in 1997We04, depopulated by 963.7 and 1253.7 γ transitions. A 1253.7 γ transition was placed from the 7644.5 level in 2003Pa09, and it seems unlikely that this level would have been missed in both 2003Pa09 and 1991Ju05, and so is not included here. A level at 7151 keV was also assigned in 1997We04, depopulated by a 408.7γ. As it also unlikely this level would have been missed in 1991Ju05 and 2003Pa09, it is not included here.

[#] From DCO ratios (2003Pa09) when available. Good agreement with comparisons (1991Ju05) of γ(θ) distributions with theoretical results obtained from a model with compound nucleus alignment. These assignments have been included in the Adopted Levels.

@ From 2003Pa09, unless otherwise noted.

& Supported by DCO ratios and band placement.

a Suggested by band placement.

b From 1991Ju05.

c (A): SD-1 band (1997La02). percent feeding=2.0 2. Q(intrinsic)=5.2 +11-8.

d (B): SD-2 band (1997La02). percent feeding=1.9 2. Q(intrinsic)=5.0 +7-10.

e (C): SD-3 band (1997La02). percent feeding=3.2 3. Q(intrinsic)=5.3 +12-10.

f (D): SD-4 band (1997La02). percent feeding=1.3 3.

g (E): Band based on (19/2-).

h (F): Band based on (3/2-).

i (G): Band based on (25/2-).

j (H): Band based on (31/2-).

k (I): Band based on (17/2-).

l (J): g.s. band.

m (K): Band based on (53/2+).

n (L): Band based on (41/2+).

o (M): Band based on (51/2+).

p (N): Band based on (21/2+).

q (O): Band based on (23/2+).

r (P): Band based on (9/2+).

s (Q): Band based on 7/2(+).

γ(⁸⁷Nb)

E(level)	Eγ [†]	Iγ [‡]	Mult.§#	α	Comments
199.6	200.1 5	3.0 6			DCO=0.56 +8-7.
264.9	263.0 1	8.4 8	M1	0.01690	DCO=0.65 4. Angular distribution A ₂ =-0.17 1, A ₄ =+0.04 1, 1991Ju05. Mult.: established in 1991Mi15 fixing Δ' π.
332.9	67.0 3	0.43 4	[E1]		Iγ: From branching ratio found from ⁸⁷ Mo β ⁺ decay, (1991Mi15). Eγ: From 1991Mi15.
	334.0 1	5.8 6	(E2)	0.01613	DCO=1.03 6. Other: R(DCO)=1.18 13 1997We04.
					Angular distribution A ₂ =+0.15 1, A ₄ =-0.01 2, 1991Ju05.
781.9	780.7 1	100 10	E2	1.31×10 ⁻³	B(E2)(W.u.)=0.21 4. DCO=0.97 1. Other: R(DCO)=1.09 2 from 1997We04.
					Angular distribution A ₂ =+0.13 1, A ₄ =-0.09 1, 1991Ju05.
838.1	505.8 1	16.1 16	(M1+E2)		B(E2)(W.u.)=48 8. DCO=0.62 3.
	573.1 1	<2			Angular distribution A ₂ =-0.48 1, A ₄ =+0.17 2, 1991Ju05.
	639.5 7	<2	(E2)	0.00222	Eγ: Reported only in 1991Ju05. Mult.: from R(DCO)=1.22 11 (1991Ju05).
	835.8 1				Eγ: Reported only in 1991Ju05. DCO=0.87 4 (1991Ju05).

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⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

γ(⁸⁷Nb) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult.§#	α	Comments
993.3	991.5 1	4.3 4	(E2)	7.36×10 ⁻⁴	DCO=0.90 1. Appears to be the 992 keV γ seen in 1991Ju05, and assigned to the 1954 keV level, except the 1063 keV γ should not be in coincidence as in 1993Pa05. However, the γ energy is taken from 1991Ju05.
1049.2	267.0 1	2.1 8	(M1+E2)		Iγ: Deduced from branching ratios in 1991Ju05.
	784.5 1	8.3 26	E2	1.30×10 ⁻³	Angular distribution A ₂ =-0.40 9, A ₄ =+0.13 11, 1991Ju05. DCO=0.88 +9-8. Other: R(DCO)=1.15 14 (1997We04). Angular distribution A ₂ =+0.26 2, A ₄ =-0.09 3, 1991Ju05.
1167.1	1047.6 1	2.7 5	(E2)	6.48×10 ⁻⁴	DCO=1.16 +20-17.
	834.7 1	18.8 19	(E2)	1.11×10 ⁻³	DCO=0.97 3. Other: R(DCO)=0.86 10 (1997We04).
1601.8	1164.8@ 3				
	434.9 1	8.2 8	(M1+E2)		DCO=0.82 4.
	763.7 1	23.1 23	E2	1.39×10 ⁻³	DCO=1.05 +7-6. Angular distribution A ₂ =+0.32 1, A ₄ =-0.08 2, 1991Ju05. other: R(DCO)=1.24 14 (1997We04).
1734.7	952.5 1	71 14	E2	8.07×10 ⁻⁴	DCO=1.02 +3-2. other: R(DCO)=1.08 1 (1991Ju05) and 0.90 5 (1997We04). Angular distribution A ₂ =+0.24 1, A ₄ =-0.06 2, 1991Ju05.
1952.1	903.0 1	20.4 20	E2	9.16×10 ⁻⁴	DCO=0.87 8. other: R(DCO)=1.18 13 (1991Ju05). Angular distribution A ₂ =0.28 3, A ₄ =-0.10 3, 1991Ju05.
	959.0 1	8.6 18	(E2)	7.94×10 ⁻⁴	Was assigned to a 962.9 keV level in 1991Ju05. DCO=0.99 +15-13.
1974.8	1169.9 1	6.4 6	(M1+E2)	5.30×10 ⁻⁴	DCO=0.58 5.
2112.2	808.0 1	2.0 6	E2		Angular distribution A ₂ =+0.31 2, A ₄ =-0.11 3, 1991Ju05.
	1063.0 1	4.0 4			Was assigned to the 2411 keV level in 1991Ju05. DCO=0.62 +9-8.
2275.2	300.6 1	3.4 7	(M1+E2)		DCO=0.59 +4-9.
	673.6 1	4.4 9	E2	0.00192	DCO=0.97 +5-4. other: R(DCO)=1.09 3 (1995Ju05). Angular distribution A ₂ =+0.27 1, A ₄ =-0.07 1, 1991Ju05.
					Eγ: Branching comparing 1991Ju05 with 2003Pa09 suggests multiple placement.
2305.5	1492.9 2	3.5 4	(E1+M2)	3.90×10 ⁻⁴ 7	DCO=0.52 +7-16.
	1312.4&				
	1523.4&				
2410.2	104.6 3		(E1)	0.1051	
	135.2 1	30 7	(M1+E2)	0.0969	DCO=0.50 +16-13.
	297.9 3	5.4 11	(E1)	0.00527	DCO=0.65 3. Eγ: likely the 297.9 γ seen in 1991Ju05 depopulating the earlier proposed 1349 keV level as several coincidences match.
	435.6 1		[E2]	0.00682	DCO=0.59 3.
	458.0 1	15.8 16	(E1+M2)	0.00185 14	Angular distribution A ₂ =-0.26 1, A ₄ =0.05 1, 1991Ju05.
	675.2 1	25 5	[E1]	6.92×10 ⁻⁴	DCO=1.08 +11-10.
2488.4	753.7 1	59 6	E2	1.43×10 ⁻³	DCO=1.09 3. other: R(DCO)=1.06 1 (1995Ju05) and 0.97 4 (1997We04). Angular distribution A ₂ =0.30 1, A ₄ =-0.10 3, 1991Ju05.
2579.0	168.9 1	5.0 10			Since this appears to be the 169 γ assigned to the 2905 19/2 in 1991Ju05, this γ energy is used. DCO=1.10 12.
2858.7	370.0 2	15.2 15	(M1)	0.00729	DCO=0.60 3.
	1123.9 2	7.8 8	(E2)	5.56×10 ⁻⁴	DCO=0.99 7. other: R(DCO)=1.04 4 (1991Ju05) and 0.97 12 (1997We04). Angular distribution A ₂ =+0.61 7, A ₄ =-0.21 7, 1991Ju05.
2903.4	324.5 1	17.9 18	(M1+E2)		DCO=0.46 2.
					324 γ assigned to the 2736.6 level in 1991Ju05.

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

γ(⁸⁷Nb) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult.§#	α	Comments
2903.4	628.2 1	9.0 18	(E2)	0.00231	DCO=1.05 +10-9. Other: R(DCO)=1.13 4 (1991Ju05).
2986.0	575.8 1	4.4 4			
3216.7	230.8 1	4.9 8	[M1]	0.0236	DCO=0.82 27.
	313.4 1	14.2 14	[M1]	0.01093	DCO=0.51 3. Angular distribution A ₂ =-0.39 2, A ₄ =+0.05 12, 1991Ju05. B(M1)(W.u.)=0.11 3. DCO=0.62 3. DCO=0.95 3. Other: R(DCO)=1.10 13 (1997We04). Angular distribution A ₂ =+0.34 1, A ₄ =-0.11 2, 1991Ju05.
	637.9 3	1.4 7			
	806.4 1	35 7	E2	1.21×10 ⁻³	
3217.3	358.1 2	1.7 6	(M1+E2)	0.00791 12	
	729.0 1	27 3	(M1+E2)	1.48×10 ⁻³	DCO=0.49 2. Angular distribution A ₂ =-0.46 1, A ₄ =+0.10 1, 1991Ju05.
3444.6	226.3 1	23.5 24	[M1]	0.0250	DCO=0.47 2. Angular distribution A ₂ =-0.36 1, A ₄ =+0.06 1, 1991Ju05. DCO=0.94 2. Other: R(DCO)=1.08 1 (1995Ju05) and 1.19 13 (1997We04). Angular distribution A ₂ =0.23 1, A ₄ =-0.05 4, 1991Ju05. Mult.: supported by DCO and angular distribution.
	955.2 1	18 4	E2	8.02×10 ⁻⁴	DCO=0.51 4. Angular distribution A ₂ =-0.41 2, A ₄ =+0.13 2, 1991Ju05. DCO=0.88 +7-6. Angular distribution A ₂ =+0.37 3, A ₄ =-0.13 3, 1991Ju05. DCO=1.00 +10-11. uncertainty of +0.01 for the DCO ratio quoted by 2003Pa09 seems to be a misprint. Evaluator increased this to +0.10.
3739.4	522.1 1	1.8 9	(M1+E2)		
	880.7 1	24.3 24	(E2)	9.77×10 ⁻⁴	
3779.0	875.5 3	9 8	(E2)	9.85×10 ⁻⁴	
3866.6	1378.2 1	4.1 4	(E2)	4.05×10 ⁻⁴	DCO=1.11 +9-8. Angular distribution A ₂ =+0.182, A ₄ =-0.03 3, 1991Ju05. DCO=0.96 3. Other: R(DCO)=1.04 3 (1995Ju05) and 0.95 11 (1997We04). Angular distribution A ₂ =+0.24 1, A ₄ =-0.07 2, 1991Ju05. DCO=0.38 +8-7. DCO=1.22 +11-10. DCO=0.49 3. DCO=0.46 3. DCO=0.95 5. DCO=0.55 5.
4128.5	911.8 1	54 5	(E2)	8.96×10 ⁻⁴	
4283.5	154.1 5	1.2 11			
	1067 1	15.2 15	(E2)	6.24×10 ⁻⁴	
4298.5	559.1 1	8.9 9	(M1+E2)		
	855.0 1	7.7 8	(M1+E2)	1.04×10 ⁻³	
	1080.5 3	1.8 4	(E2)	6.05×10 ⁻⁴	
4589.2	290.9 1	10.2 10	(M1+E2)		
	1145.6 1	42 4	(E2)	5.34×10 ⁻⁴	Eγ: Possibly the 293.9 depopulating a 2988 keV level shown in 1991Ju05. Comparing branching ratios from intensities for the 291γ and 1145γ transitions obtained from (⁵⁰ Cr,3pγ), the result is comparable to (³² S,3pγ), although for the same reaction 1991Ju05 is about half of that in 2003Pa09. Angular distribution A ₂ =-0.58 4, A ₄ =+0.15 5, 1991Ju05. DCO=1.03 5. Other: R(DCO)=1.14 3 (1995Ju05) and 0.90 (11) (1997We04). Angular distribution A ₂ =0.33 2, A ₄ =-0.08 2, 1991Ju05. Eγ: Assigned to 2905 keV level in 1991Ju05. The 493γ and 997γ branching agrees with 2003Pa09 for placement from the 4776.8 keV level. DCO=0.9 3. Eγ: Assigned to 6300 keV level in 1991Ju05. DCO=1.16 +8-7. Other: R(DCO)=1.04 5 (1995Ju05). DCO=1.09 3. Other: R(DCO)=1.06 3 (1991Ju05). Angular distribution A ₂ =+0.30 1, A ₄ =-0.011 2, 1991Ju05. Eγ: Assigned to a 6300 keV level in 1991Ju05. DCO=0.32 +21-9. DCO=1.04 6.
4776.8	493.3 1	4.7 5	[M1+E2]		
	997 1	5.9 12	[E2]	7.25×10 ⁻⁴	
4937.3	1197.8 1	17 4	(E2)	4.88×10 ⁻⁴	
5007.5	879.0 1	34 7	E2	9.75×10 ⁻⁴	
5299.2	521.8 8	2.4 5	(M1+E2)		
	1016 1	17.0 17	(E2)	6.95×10 ⁻⁴	
	1172 [@] 1				
5590.2	582.8 1	35 4	(M1+E2)		DCO=0.54 2. Angular distribution A ₂ =-0.31 1, A ₄ =+0.09 1, 1991Ju05.

Continued on next page (footnotes at end of table)

$^{58}\text{Ni}(^{32}\text{S},3\text{p}\gamma), ^{40}\text{Ca}(^{50}\text{Cr},3\text{p}\gamma)$ 2003Pa09 (continued) $\gamma(^{87}\text{Nb})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\ddagger}$	Mult.§#	α	Comments
5617.7	680.7 2 1028 1 1319.2 1	4.4 9 2.4 9 2.7 3	(M1+E2) (E2)	 4.24×10^{-4}	DCO=0.46 4. DCO=1.04 5. DCO=0.74 +8-7.
5774.0	475.0 4 997.1 1	3.7 4 2.9 6	(M1+E2) [E2]	 7.25×10^{-4}	E γ : Assigned to a 6300 keV level in 1991Ju05.
5838.6	220.9 2	1.8 6	(M1)	0.0270	Mult.: M1 or E1 from RULs and DCO. M1 from level scheme placement.
	1249.4 1	38 4	E2	4.58×10^{-4}	DCO=0.37 +7-6. Mult.: from R(DCO). DCO=0.99 +5-4. Other: R(DCO)=1.10 3 (1991Ju05). Angular distribution $A_2=+0.25$ 2, $A_4=-0.09$ 2, 1991Ju05. DCO=0.57 2.
6037.0	447.0 4	15.6 16	(M1+E2)	0.00459	Angular distribution $A_2=0.-39$ 2, $A_4=+0.08$ 3, 1991Ju05. DCO=0.96 +11-10. DCO=0.56 7.
	1029.4 1 1605.1 3	1.6 6 1.7 6	(E2)	6.75×10^{-4}	DCO=1.00 +29-16.
6194.4					E γ : Used value from 2003Pa09 as 1991Ju05 has no uncertainties here either.
6364.7	747.5 3 1426.7 3	0.9 5 6.0 12	[M1+E2] (E2)	1.39×10^{-3} 3.94×10^{-4}	DCO=0.58 3. Angular distribution $A_2=-0.11$ 2, $A_4=-0.00$ 3, 1991Ju05.
6390.9	800.5 5	6.3 6	(M1+E2)	1.20×10^{-3}	
	666.9& 1141.9&	0.8 4 7.3 7			
6537.1	172.0& 342.7& 1598.7&	1.4 10 1.0 5 0.9 5			
6742.5	351.6 1 705.5 1 1152.4 1	4.0 4 17.9 18 8.3 8	(M1) (M1+E2) (E2)	0.00825 1.59×10^{-3} 5.28×10^{-4}	DCO=0.64 3. DCO=0.51 2. DCO=0.97 5.
6807.8	269.1& 969.2 1	4.7 9 11.3 11	(M1) (M1+E2)	0.01608 7.87×10^{-4}	DCO=0.48 4. DCO=0.62 +7-6.
	1188.6&	4.2 8	[E2]	4.97×10^{-4}	
6971.3	529.9 3 1196 2	3.2 3 4.8 24	[M1] (E2)	0.00307 4.91×10^{-4}	DCO=0.99 5. Other: R(DCO)=1.01 8 (1991Ju05).
7137.2	329.2 1 1298.8 1	4.4 4 11.7 23	(M1) (E2)	0.00968 4.33×10^{-4}	DCO=0.52 4. DCO=1.02 +9-8.
7223.4	480.9 1 1186.4 1	16.5 17 3.3 7	(M1+E2) (E2)	0.00387 5.00×10^{-4}	DCO=0.54 2. DCO=0.99 6.
7616.7	809.5 3 1777.6 3	8.5 17 6.9 7	(M1+E2) (E2)	1.17×10^{-3} 4.19×10^{-4}	DCO=0.55 5. DCO=0.95 7.
					Other: R(DCO)=1.18 9 (1991Ju05).
7644.9	422.2& 673.4& 902.4&	0.9 5 3.3 7 5.5 11	(M1+E2) [M1+E2] (M1+E2)	0.00529 1.76×10^{-3} 9.18×10^{-4}	DCO=0.59 26. DCO=0.64 +13-11.
	1203.3& 1253.7&	4.8 24 1.8 9	[E2] (E2)	4.86×10^{-4} 4.55×10^{-4}	DCO=0.94 +8-7.
7939.7	1575.0&	4.0 8	[E2]	3.88×10^{-4}	
8059.6	442.9 1 1251.2&	4.8 5 10.9 22	(M1+E2) [E2]	0.00471 4.56×10^{-4}	DCO=0.47 4.
8251.4	1028 1 1510 1	1.8 8 21.5 22	(M1+E2) [E2]	6.93×10^{-4} 3.86×10^{-4}	DCO=0.58 3.
8363.4	718.2& 1392 1	3.1 6 5.2 5	[M1+E2] (E2)	1.52×10^{-3} 4.01×10^{-4}	DCO=1.02 +18-15.
8429.9	370 1 1292.8 3	6.9 14 10.9 11	(M1) (E2)	0.00728 4.36×10^{-4}	DCO=0.58 3. DCO=1.10 +9-3.
8533.2	282 1 1310 1	4.3 4 5.6 6	(M1) [E2]	0.01428 4.28×10^{-4}	DCO=0.47 +7-6. DCO=0.74 +8-7.
8569.0	140 ^a 1431.8&				
		3.4 7	[E2]	3.93×10^{-4}	
8871.2	441.6&	0.5 3			
8932.4	399.3&	2.2 4	[M1]	0.00603	

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,3pγ),⁴⁰Ca(⁵⁰Cr,3pγ) 2003Pa09 (continued)

γ(⁸⁷Nb) (continued)

E(level)	E _γ [†]	I _γ [‡]	Mult.§#	α	Comments
8932.4	568.9&	3.8 4	(M1+E2)	0.00260	DCO=0.47 +9-8.
	1287.1&	6.8 14	(E2)	4.38×10 ⁻⁴	DCO=1.20 +25-20.
9012.4	952.7&				
9512.1	499.6&	2.8 6	[M1+E2]	0.00352	
	641.1&	0.9 5	[M1+E2]	0.00197	
	1452.3&	7.0 7	(E2)	3.90×10 ⁻⁴	DCO=1.10 5.
9572.7	1633.0&	2.0 6	[E2]	3.94×10 ⁻⁴	
9811.3?	1278@				E _γ : Not in the Table 2 of 1991Ju05, but is shown as tentative in the level scheme.
	1560@ 2				
9841.3	908.8&		[M1+E2]	9.04×10 ⁻⁴	
	1308.1&	1.7 6	[M1+E2]	4.41×10 ⁻⁴	
	1590.1&	2.8 6	[E2]	3.90×10 ⁻⁴	
9886.2	953.8&	8.9 27	[M1+E2]	8.14×10 ⁻⁴	
	1522 2	2.4 6	(E2)	3.86×10 ⁻⁴	
9994.9	1565 1	10.1 10	(E2)	3.88×10 ⁻⁴	DCO=1.03 4.
10234.5	1301.9&	4.8 10	[E2]	4.31×10 ⁻⁴	
	1701 2	8.2 8	(E2)	4.04×10 ⁻⁴	DCO=0.84 +12-10.
10457.5	223&				
	616.3&	2.6 4	[M1]	0.00216	Mult.: E1 or M1 from RUL.
	1525.1&	1.8 9	(E2)	3.86×10 ⁻⁴	DCO=0.95 +13-12.
11021.3	2452.3&	1.4 5			
11184.5	1672.4&	4.4 4	(E2)	4.00×10 ⁻⁴	DCO=1.01 6.
11542.9	1656.7&	6.1 6	[E2]	3.97×10 ⁻⁴	
11577.6	1736.3&	2.4 8	[E2]	4.11×10 ⁻⁴	
11945.9	1951 1	6.3 6	(E2)	4.67×10 ⁻⁴	DCO=1.04 7.
12015.1	437.6&		(M1+E2)	0.00485	DCO=0.48 +12-10.
	1557.6&	5.8 6	(E2)	3.87×10 ⁻⁴	DCO=0.93 +11-10.
	1778 2	7.3 7	(E2)	4.20×10 ⁻⁴	DCO=1.19 +25-21.
12490.0	2495.1&	0.3 2			
13117.5	1933.0&	4.8 5	[E2]	4.60×10 ⁻⁴	
13256.5	2072.0&	1.4 7	[E2]		
13473.9	1931.0&	3.9 4	[E2]	4.60×10 ⁻⁴	
13575.7	1998.1&	2.3 10			
13750.0	1263a				
	1804.1&	0.8 4			
13877.1	1862 2	5.7 6	(E2)	4.40×10 ⁻⁴	DCO=0.98 +9-8.
14199.1	2253.1&	1.3 6			
14588.1	2573.0&	1.9 9			
14860?	2846&a				
15327.2	2071&a		[E2]	5.05×10 ⁻⁴	
	2209.6&	2.7 9	[E2]	5.54×10 ⁻⁴	
15670.0	2196.0&	1.4 7			
15864.8	2114.7&				
15927.0?	2674.0&a				
15938	2364&a		[E2]	6.13×10 ⁻⁴	
16185.5	2308.4&	3.1 6	[E2]	5.91×10 ⁻⁴	
17925.6	2598.4&	2.3 5	(E2)	7.03×10 ⁻⁴	DCO=0.95 +16-14.
18257.7	2392.9&	0.5 3			DCO=0.90 +10-9.
18839.1?	2912&a				
18892.4	2706.8&	1.5 8	[E2]	7.46×10 ⁻⁴	
1250+x	997				
	1250				
	1362				
	1382				
1258+x	2225				
2679+x	1421				This transition is shown (1997La02) to feed the level deexciting by a 2225 γ.
	1429				
4251+x	1572				
5970+x	1719				
7849+x	1879				
9894+x	2045				

Continued on next page (footnotes at end of table)

$^{58}\text{Ni}(^{32}\text{S},3\text{p}\gamma), ^{40}\text{Ca}(^{50}\text{Cr},3\text{p}\gamma)$ 2003Pa09 (continued) $\gamma(^{87}\text{Nb})$ (continued)

E(level)	$E\gamma^\dagger$	Mult.§#	α	Comments
12110+x	2216			
14505+x	2395			
17090+x	2585			
1492+y	1492			
3134+y	1642			
3378+y	1508			
4924+y	1790			
5035+y	1657			
6795+y	1760	(E2)	4.15×10^{-4}	Mult.: From R(DCO)=0.94 12 (1997La02).
	1871	(E2)	4.42×10^{-4}	Mult.: From R(DCO)=0.97 17 (1997La02).
6916+y	1881	(E2)	4.45×10^{-4}	Mult.: From R(DCO)=0.89 13 (1997La02).
	1992	(E2)	4.79×10^{-4}	Mult.: From R(DCO)=1.06 16 (1997La02).
8759+y	1964			
8994+y	2078			
10876+y	2117			
11170+y	2176			
13150+y	2274			
13438+y	2268			
15582+y	2432			
15831+y	2393			
18169+y	2587			
18374+y	2543			
1697+z	1697			
3563+z	1866			
5604+z	2041			
7815+z	2211			
10199+z	2384			
12736+z	2537			

[†] For SD bands, values are from 1997La02. For other levels, from 1991Ju05, when available. Exceptions noted; when values are from 2003Pa09, an uncertainty of 0.5 keV is assumed for fitting the levels. Note that for fitting the energy levels a χ^2 of 7.3 is obtained compared to the critical value 1.42, so the fit is not very good. One of the main contributors to the χ^2 is the 780.7 γ transition. If the 779.9 value from 2003Pa09 is used with the assumed uncertainty of 0.5 keV this is brought down to 2.5.

[‡] From 2003Pa09 for $^{58}\text{Ni}(^{32}\text{S},3\text{p})$ at 135 MeV, unless otherwise noted. Other: see 1991Ju05 and 1997We04.

[§] Based on R(DCO)s unless otherwise noted. Where both DCO ratios and angular distributions show stretched quadrupole (DCO=1), E2 was assumed. A DCO between 0.35 and 0.55 indicates a dipole character, assuming either E1 or M1, and based on systematics, is assumed to have a small to negligible mixing ratio (2003Pa09). Level scheme placement indicates either E1 or M1.

[#] For SD-1, SD-2 and SD-3 bands, $\gamma\gamma(\theta)$ (DCO) results (1997La02) give $\Delta J=2$, quadrupole for all the strong transitions and these are presumed to be E2 rather than M2.

[@] From 1991Ju05.

[&] From 2003Pa09.

^a Placement of transition in the level scheme is uncertain.

$^{58}\text{Ni}(^{32}\text{S},3\text{p}\gamma), ^{40}\text{Ca}(^{50}\text{Cr},3\text{p}\gamma)$ 2003Pa09 (continued)

Level Scheme

 Intensities: relative I(γ +ce)

 $^{87}_{41}\text{Nb}_{46}$

Adopted Levels, Gammas

$Q(\beta^-) = -9195.5$; $S(n) = 10846.5$; $S(p) = 5041.6$; $Q(\alpha) = -3399.7$ 2012Wa38.

$Q(\beta^-n) = -2.37 \times 10^4.3$ (syst.), $Q(\epsilon p) = 3795.5$ (syst.) 2012Wa38.

Mass measurement: 2011Ha08 (SHIPTRAP Penning trap, GSI Darmstadt) Measured mass excess = -66882.8 ± 39 keV.

Mass measurement: 2011Fa10 (Canadian Penning trap mass spectrometer) Measured mass excess = -66887.1 ± 41 keV.

 ^{87}Mo Levels

Cross Reference (XREF) Flags

A $^{58}\text{Ni}(^{32}\text{S}, 2p\text{n}\gamma)$, $^{40}\text{Ca}(^{50}\text{Cr}, 2p\text{n}\gamma)$

E(level)	$J\pi^\dagger$	XREF	$T_{1/2}^\ddagger$	Comments
0.0§	(7/2+)	A	14.1 s 3	$\%e + \% \beta^+ = 100$; $\% \beta^+ p = 15.8$. From 1997Hu07: Branching ratio percentages for β^- -delayed proton decay populating the first 2+, 4+, and 6+ states in ^{86}Zr are 11.6, 2.1, and 2.1. $J\pi$: from systematics of N=45 isotones. $T_{1/2}$: weighted average of 14.6 15 (1977Ko05), 15.2 (1982De43), 13.3 4 (1983Ha06), and 14.5 3 and 14.2 10 (1991Mi15) all from $\gamma(t)$ measurements in ^{87}Mo decay.
31.56§ 6	(9/2+)	A		
786.52§ 19	(11/2+)	A		
864.54§ 9	(13/2+)	A	14 ps 4	
1773.00§ 14	(15/2+)	A		
1863.57§ 10	(17/2+)	A	14 ps 4	
1969.83# 14	(15/2)	A		
2283.70# 12	(17/2)	A		
2695.98# 13	(19/2)	A		
2742.17§ 12	(21/2+)	A	1.2 ps 5	
2963.3 16	(21/2+)	A		
3134.98# 13	(21/2)	A		
3382.62§ 13	(23/2+)	A		
3600.34§ 13	(25/2+)	A	1.1 ps 5	
3618.75# 14	(23/2)	A		
4161.35# 16	(25/2)	A		
4384.82§ 17	(27/2+)	A		
4550.72§ 16	(29/2+)	A		
4713.09# 18	(27/2)	A		
5253.77# 20	(29/2)	A		
5302.51§ 21	(31/2+)	A		
5670.12§ 19	(33/2+)	A	0.46 ps 7	
5857.67# 23	(31/2)	A		
6368.35# 23	(33/2)	A		
6945.82§ 21	(37/2+)	A	0.24 ps 7	
8354.95§ 24	(41/2+)	A	<0.3 ps	
10004.4§ 3	(45/2+)	A		
11838.4§ 7	(49/2+)	A		

† From γ -ray multiplicities, decay patterns, and expected band structure as deduced in $^{58}\text{Ni}(^{32}\text{S}, 2p\text{n})$ and $^{40}\text{Ca}(^{50}\text{Cr}, 2p\text{n})$ study (1991Wi15).

‡ From recoil distance Doppler shift method and Doppler-shifted line-shape data (1991Wi15), unless noted otherwise.

§ (A): yrast band based on ground state.

(B): second band.

 $\gamma(^{87}\text{Mo})$

E(level)	$E\gamma^\dagger$	I_γ	Mult. ‡	δ	α	Comments
31.56	31.55 6	100	M1+E2	0.27 +18-13	13.6 48	α : Symmetrized from $\alpha(\text{exp}) = 11.5 + 69-31$ from intensity balance in $^{58}\text{Ni}(^{32}\text{S}, 2p\text{n})$. Mult., δ : From $\alpha(\text{exp})$.
786.52	755.3 4 787.1 4					
864.54	832.95 6	100	E2		$1.19 \times 10^{-3} \pm 2$	B(E2)(W.u.) = $4.4 + 18-10$.
1773.00	907.7 2 986.7 2					

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{87}\text{Mo})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma$	Mult. ‡	α	Comments
1863.57	999.12 6	100	E2	7.74×10^{-4} 11	B(E2)(W.u.)=1.8 +7-4.
1969.83	1104.1 3	100			
2283.70	313.76 9	13.0 22	D		
	420.22 6	42 3			
	510.54 11	100 20	(D)		
2695.98	412.23 7	100 8	D		
	832.7§ 5	2 2			
2742.17	878.60 6	100	E2	1.05×10^{-3} 2	B(E2)(W.u.)=39 +28-11.
2963.3	1099.7 1	100			
3134.98	439.05 9	54 7			
	851.34 8	100 9	E2	1.13×10^{-3} 2	
3382.62	640.51 7	100	D		
3600.34	217.78 7	22 3	D(+Q)		
	858.11 6	100 6	E2	1.11×10^{-3} 2	B(E2)(W.u.)=40 +33-13.
3618.75	483.81 8	50 12			
	922.63 9	100 19			
4161.35	542.27 20	52 19			$I\gamma$: Doublet with a 540 keV transition in ^{84}Zr , 1991Wi15.
	1026.49 11	100 20			
4384.82	784.46 14	100			
4550.72	165.87 15	24 4	D		
	950.39 11	100 9	E2	8.69×10^{-4} 13	
4713.09	551.72 20	72 26			
	1094.28 15	100 38			
5253.77	540.57 20	75 28			$I\gamma$: Doublet with a 540 keV transition in ^{84}Zr , 1991Wi15.
	1092.48 15	100 41			
5302.51	751.9 8	100			
5670.12	367.61 9	23 3	D(+Q)		
	1119.39 9	100 5	(E2)	6.01×10^{-4} 9	B(E2)(W.u.)=25 5.
5857.67	1144.57 15	100			
6368.35	1114.57 12	100			
6945.82	1275.69 9	100	(E2)	4.74×10^{-4} 7	B(E2)(W.u.)=30 +13-6.
8354.95	1409.12 11	100	(E2)	4.23×10^{-4} 6	
10004.4	1649.41 11	100			
11838.4	1834.0 6	100			

 † Unplaced γ 's are not included here; see $^{58}\text{Ni}(^{32}\text{S}, 2\text{pn})$ and $^{40}\text{Ca}(^{50}\text{Cr}, 2\text{pn})$ data. ‡ Assigned by evaluator from angular distributions and authors' comments in $^{58}\text{Ni}(^{32}\text{S}, 2\text{pn})$ and $^{40}\text{Ca}(^{50}\text{Cr}, 2\text{pn})$ study (1991Wi15).

§ Placement of transition in the level scheme is uncertain.

⁵⁸Ni(³²S,2pnγ), ⁴⁰Ca(⁵⁰Cr,2pnγ) 1991Wi15

⁵⁸Ni(³²S,2pnγ) with E(³²S)=110 MeV and ⁴⁰Ca(⁵⁰Cr,2pn) with E(⁵⁰Ca)=170 MeV. Measured γγ and nγγ coincidences with five Compton-suppressed Ge detectors, one neutron detector, and four charged-particle telescopes as well as a twenty Ge detector array. Level lifetimes were measured with the recoil-distance Doppler-shift and Doppler-shifted line-shape methods. Angular distributions are given for 14 γ's.

1993IDZY: ⁵⁸Ni(³²S,2pnγ) with E(³²S)=110–125 MeV Experiment done at NORDBALL with a Si Ball and a Neutron wall with 15 Compton-suppressed Ge detectors. These were preliminary results with analysis in progress. As the proposed level scheme is largely in agreement with 1991WI15 with the addition of a few new levels, it is included in this dataset. Where there are discrepancies, data from 1991WI15 is presented. Several other levels are indicated in the report which appear to conflict with the published data and are not shown. Since the report from 1993IDZY indicates that these results are tentative, they are not included in the adopted set. Clearly, more work needs to be done on this isotope to clarify the situation.

⁸⁷Mo Levels

E(level) ^{†‡}	Jπ [§]	T _{1/2}	Comments
0 [#]	(7/2+)	14.02 s 26	
31.56 [#] 6	(9/2+)		
786.52 [#] 19	(11/2+)		
847 ^{&}			Jπ: Proposed as (9/2-) 1993IdZY based on systematics.
864.54 [#] 9	(13/2+)	14 ps 4	
1469 ^{&}			Jπ: Proposed as (11/2-) in 1993IdZY based on systematics.
1773.00 [#] 14	(15/2+)		
1863.57 [#] 10	(17/2+)	14 ps 4	
1969.83 [@] 14	(15/2)		Jπ: proposed as (13/2-) in 1993IdZY The evaluator notes that the presence of the 1123 transition does appear to make this proposal somewhat more likely assuming the proposed (9/2-) assignment for the 847 keV level. Based as that is on preliminary report data, the older adopted Jπ is kept.
2283.70 [@] 11	(17/2)		
2695.98 [@] 13	(19/2)		
2742.17 [#] 12	(21/2+)	1.2 ps 5	
2770 ^{&}			
2963.3 16	(21/2+)		
3134.97 [@] 13	(21/2)		
3200 ^{&}			
3382.62 [#] 13	(23/2+)		
3600.33 [#] 13	(25/2+)	1.1 ps 5	
3618.75 [@] 14	(23/2)		
3780 ^{&}			
3919 ^{&}			
4161.34 [@] 15	(25/2)		
4384.82 [#] 17	(27/2+)		
4550.72 [#] 16	(29/2+)		
4713.09 [@] 17	(27/2)		
5253.77 [@] 19	(29/2)		
5302.51 [#] 21	(31/2+)		
5670.12 [#] 19	(33/2+)	0.46 ps 7	
5857.66 [@] 23	(31/2)		
6368.35 [@] 23	(33/2)		
6945.82 [#] 21	(37/2+)	0.24 ps 7	
8354.95 [#] 23	(41/2+)	<0.3 ps	
10004.4 [#] 3	(45/2+)		
11838.4 [#] 7	(49/2+)		

[†] From least-squares fit to γ energies not using Eγ data of 1993IDZY as this was a secondary reference.

[‡] Taken from 1991Wi15, unless otherwise noted.

[§] From γ-ray multiplicities, decay patterns, and expected band structure.

[#] (A): yrast band based on ground state.

[@] (B): second band, probably negative parity.

[&] From 1993IdZY.

^γ(⁸⁷Mo)

Continued on next page (footnotes at end of table)

$^{58}\text{Ni}(^{32}\text{S},2\text{pn}\gamma), ^{40}\text{Ca}(^{50}\text{Cr},2\text{pn}\gamma)$ 1991Wi15 (continued) $\gamma(^{87}\text{Mo})$ (continued)

$E_{\gamma}^{\pm\delta}$	E(level)	I_{γ}	Mult. [†]	δ	α	Comments
31.55 6	31.56	180	M1+E2	0.27 +18-13	13.6 48	α : Symmetrized from α ; $\alpha(\text{exp})=11.5 +69-31$ from intensity balance in $^{58}\text{Ni}(^{32}\text{S},2\text{pn})$. Mult., δ : From $\alpha(\text{exp})$. I_{γ} : uncertainty given as +120-90. Mult., δ : from $\alpha(\text{exp})$ of 11.5 +69-31 calculated from intensity balance in $^{58}\text{Ni}(^{32}\text{S},2\text{pn})$. A small mixture of E2, $\delta=0.05 +12-4$, is allowed. Angular distribution: $A_2=-0.47$ 10, $A_4=+0.21$ 18.
165.87 15	4550.72	36 6	D			Angular distribution: $A_2=-0.38$ 7, $A_4=-0.07$ 10.
217.78 7	3600.33	48 6	D(+Q)			
^x 221.6 3						
^x 274.6 3						
^x 290.5 3						
313.76 9	2283.70	35 6	D			Angular distribution: $A_2=-0.27$ 5, $A_4=-0.01$ 7.
367.61 9	5670.12	41 5	D(+Q)			Angular distribution: $A_2=-0.41$ 7, $A_4=+0.05$ 11.
412.23 7	2695.98	219 16	D			Angular distribution: $A_2=-0.57$ 3, $A_4=0.00$ 4.
420.22 6	2283.70	114 7				Angular distribution: $A_2=+0.46$ 5, $A_4=-0.10$ 8 consistent with $\Delta J=0$ (1991Wi15).
439.05 9	3134.97	96 12				
483.81 8	3618.75	52 12				
^x 490.9 3						
501#	1969.83					
504#	3200					E γ : Likely the unplaced 504.3 3 keV transtion seen reported in 1991Wi15.
510.54 11	2283.70	270 54	(D)			Angular distribution: $A_2=-0.10$ 5, $A_4=-0.06$ 6.
540.57 20	5253.77	55 20				I_{γ} : Doublet with a 540 keV transition in ^{84}Zr , 1991Wi15.
542.27 20	4161.34	55 20				I_{γ} : Doublet with a 540 keV transition in ^{84}Zr , 1991Wi15.
551.72 20	4713.09	58 21				
580#	3780					E γ : Likely the unplaced 580.4 3 keV transition seen in 1991Wi15.
622#	1469					
640.51 7	3382.62	63 8	D			Angular distribution: $A_2=-0.43$ 6, $A_4=+0.15$ 9.
751.9 8	5302.51	40 20				
755.3 4	786.52					
784.46 14	4384.82	40 20				
787.1 4	786.52					
800#	2770					
815#	847					E γ : Likely the 814.5 3 keV transition reported in 1991Wi15.
832.7@ 5	2695.98	5 5				
832.95 6	864.54	1000	E2		1.19×10^{-3} 2	Angular distribution: $A_2=+0.39$ 2, $A_4=-0.13$ 3.
^x 842.5 3						
851.34 8	3134.97	179 16	E2		1.13×10^{-3} 2	Angular distribution: $A_2=+0.5$ 1, $A_4=-0.17$ 13.
858.11 6	3600.33	216 12	E2		1.11×10^{-3} 2	Angular distribution: $A_2=+0.39$ 5, $A_4=-0.16$ 7.
878.60 6	2742.17	501 21	E2		1.05×10^{-3}	Angular distribution: $A_2=+0.39$ 3, $A_4=-0.17$ 4.
907.7 2	1773.00					E γ : level energy difference is 908.45 11. E The significant deviation of the energy level E and contribution to a large chi-square fit to the E level energies suggest a larger uncertainty than given.
922.63 9	3618.75	103 19				
950.39 11	4550.72	148 13	E2		8.69×10^{-4} 13	Angular distribution: $A_2=+0.29$ 7, $A_4=+0.06$ 11.
986.7 2	1773.00					
999.12 6	1863.57	669 25	E2		7.74×10^{-4} 2	Angular distribution: $A_2=+0.34$ 2, $A_4=-0.13$ 3.
1026.49 11	4161.34	106 21				
^x 1048.8 5						
1092.48 15	5253.77	73 30				
1094.28 15	4713.09	80 30				

Continued on next page (footnotes at end of table)

⁵⁸Ni(³²S,2pnγ),⁴⁰Ca(⁵⁰Cr,2pnγ) 1991Wi15 (continued)

γ(⁸⁷Mo) (continued)

Eγ ^{‡§}	E(level)	I _γ	Mult. [†]	α	Comments
1099.7 1	2963.3	65 8			Eγ: In Table 1 of 1991Wi15, this γ transition was shown depopulating a level at 3842 keV and feeding a 17/2+ level. However, this would feed the 2743 keV level at 21/2+. On the other hand, their level scheme shows this transition to come from the 2963 keV level, and this is in agreement with the level scheme shown in 1993IdZY.
1104.1 3	1969.83	22 6			Eγ: level energy difference is 1105.28 11. E The significant deviation of the energy level E and contribution to a large chi-square fit to the E level energies suggest a larger uncertainty than given.
1114.57 12	6368.35	61 20			
1119.39 9	5670.12	179 9	(E2)	6.01×10 ⁻⁴ 9	
1123#	1969.83				
1144.57 15	5857.66	70 35			
1176#	3919				
1275.69 9	6945.82	52 13	(E2)	4.74×10 ⁻⁴ 7	
1409.12 11	8354.95	39 17	(E2)	4.23×10 ⁻⁴ 6	
1649.41 11	10004.4	22 10			
1834.0 6	11838.4	15 10			

[†] Assigned by evaluator from angular distributions and authors' comments (1991WI15). Quadrupole transitions are assumed by the evaluator to be E2 rather than M2.

[‡] From 1991Wi15 unless otherwise noted.

[§] Uncertainties assumed to be 1 keV if unavailable.

From 1993IdZY.

@ Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

$^{58}\text{Ni}(^{32}\text{S},2\text{pn}\gamma), ^{40}\text{Ca}(^{50}\text{Cr},2\text{pn}\gamma)$ 1991Wi15 (continued)

Level Scheme

 Intensities: relative I_γ

Adopted Levels, Gammas

Q(β⁻)=-11800 SY; S(n)=14500 SY; S(p)=869 6; Q(α)=-1.7×10³ 3 2012Wa38.

Uncertainty associated with Q(β⁻) is ΔQ(β⁻)=400; for S(n) ΔS(n)=300 and Q(εp)=4154 7 (systematics) 2012Wa38.

Mass measurement: 2011Ha08 (shiptrap Penning trap, GSI Darmstadt). Measured mass excess=-57690.0.8 42 keV. More mass calculations at 2012Ji07.

⁸⁷Tc Levels

Cross Reference (XREF) Flags

A ⁵⁸Ni(³²S,2npγ)

B ⁹Be(¹⁰⁷Ag,Xγ)

E(level)	Jπ [†]	XREF	T _{1/2}	Comments
0.0 [‡]	(9/2+)	A	2.2 s 2	%ε+%β ⁺ =100. T _{1/2} : from 2001Ki13; also given by the same authors as 2.4 2 (2000StZU), 1.9 2 (2000WeZY) and 1.9 +3-2 (2000WeZZ). %ε+%β ⁺ : assumed by evaluator since Q(α) is negative.
712.0 [‡] 10	(13/2+)	A		
1599.0 [‡] 15	(17/2+)	A		
0+x		B		
7+x?		B		
71+x	(7/2+)	B	647 ns 24	%IT=100. T _{1/2} : measured in 2009Ga40 from decay timing of 64γ and 70γ. Other: ≈0.7 ns (2007Re18).

[†] From systematics of N=44 odd-Z nuclei, namely, ⁸¹Rb, ⁸³Y, and ⁸⁵Nb.

[‡] (A): possible g.s. band.

γ(⁸⁷Tc)

E(level)	Eγ	Mult.
712.0	712	[E2]
1599.0	887	[E2]
71+x	64 [†]	
	71 [†]	

[†] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)

 Bands for ^{87}Tc

(A)

 $(17/2+)$

887

 $(13/2+)$

712

 $(9/2+)$
 $^{87}_{43}\text{Tc}_{44}$

⁹Be(¹⁰⁷Ag,Xγ) 2009Ga40,2007Re18

Search for long-lived isomers.

Fragmentation of ¹⁰⁷Ag beam at E=750 MeV. Particle identification through fragment recoil separator. Search for isomers using the RISING (Rare ISotope INvestigations at GSI) array of 15 seven-element cluster Ge detectors. The detectors were placed in three angular rings at 51°, 90°, and 129° with respect to the secondary beam axis.

Measured delayed γ-ray spectra.

⁸⁷Tc Levels

The isomeric ratio is defined as $R = N_{\text{isomer}} / (N_{\text{ions}}(\text{fragment})\gamma)$, N_{isomer} =number of ions observed in the isomeric state, N_{ions} =total number of ions of that nuclear species, F =correction factor for in-flight losses, g =correction factor for finite measuring time period.

E(level)	Jπ	T _{1/2}	Comments
0+x			
7+x?			
71+x	(7/2+)	647 ns 24	%IT=100. Jπ: Inferred from assuming hindered M1 and E1 transitions from the decay of an 7/2+ oblate shape to 5/2+ and 5/2- prolate shapes and comparison with systematics (2009Ga40). T _{1/2} : measured in 2009Ga40 from decay timing of 64γ and 70γ. Other: =700 ns (2007Re18). R=11 5 (2009Ga40).

γ(⁸⁷Tc)

Eγ	E(level)
64†‡	71+x
71†‡	71+x

† The 64- and 70-keV γ rays are not in mutual coincidence and so it is deduced that both γ rays deexcite the isomer.

‡ Placement of transition in the level scheme is uncertain.

Level Scheme

⁵⁸Ni(³²S,2npγ) 1991Ru06

Produced by ⁵⁸Ni(³²S,2np) with E(³²S)=110 MeV and ⁴⁰Ca(⁵⁰Cr,2np) with E(⁵⁰Cr)=170 MeV. Used array of 19 Compton-suppressed Ge detectors to measure γγ-recoil-mass coincidences.

⁸⁷Tc Levels

E(level)	Jπ†
0.0	(9/2+)
712.0 10	(13/2+)
1599.0 15	(17/2+)

† From systematics of N=44 odd-Z nuclei, namely, ⁸¹Rb, ⁸³Y, and ⁸⁵Nb.

⁵⁸Ni(³²S,2npγ) 1991Ru06 (continued)

γ(⁸⁷Tc)

<u>Eγ</u>	<u>E(level)</u>
^x 431	
712	712.0
887	1599.0

^x γ ray not placed in level scheme.

Level Scheme

Adopted Levels

$S(p)=1900$ SY; $Q(\alpha)=-1700$ SY 2012Wa38.

The uncertainties to be associated with these estimated Q values are as follows: for $S(p)$, 500 and for $Q(\alpha)$, 600.

$Q(\epsilon p)=10900$ 400 (systematics), 2012Wa38.

Produced by $\text{Ni}(^{112}\text{Sn},x)$ with beam energy of 58 and 63 MeV per nucleon. Projectile fragments studied with LISE3 spectrometer (1995Le14, 1995Ry03 by the same authors).

Some recent nuclear structure theory, calculations: 1997He24.

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