Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, Balraj Singh	NDS 164, 1 (2020)	15-Feb-2020

Q(β^-)=12054 *16*; S(n)=3921 *16*; S(p)=1423×10[1] *13*; Q(α)=−9390 *SY* 2017Wa10
Estimated uncertainty=300 for Q(α) (2017Wa10).
Q(β^-n)=6141 *16*, S(2n)=9157 *16*, S(2p)=30780 *300* (syst) (2017Wa10). Evaluators deduce Q(β^-2n)=2412 *18*.
Q(β^-): Additional information 1.
First identification of ^{98}Rb isotope by 1971Tr02. Later studies of ^{98}Rb decay: 1974Ro15, 1976Ru01, 1978Wo09, 1979En02, 1979Ri09, 1979Pe01, 1980Sc13, 1981En05, 1981Re05, 1981Jo01, 1981Th04, 1986Wa17, 1987PfZX, 1993Ru01, 2011Ni01.
2015Pr03: radioactive Rb isotopes were produced using 500 MeV protons from the TRIUMF cyclotron bombarding a uranium carbide target. The atoms were surface ionized, accelerated to 28 keV, mass separated and then delivered to a gas-filled linear Paul trap. Hyperfine structures were studied by fast-beam collinear laser spectroscopy using TITAN mass trap. Measured optical spectra. Deduced spin, magnetic and electric moments, isotope shifts, changes in mean- square charge radii, and deformation parameters. Authors observed two distinguishable nuclear states from measured optical spectrum but were not able to identify either the ground state or the isomeric state due to the insensitivity of the optical measurements to the excitation energies of the observed states. Evaluators assume the low-spin state with J=0 in 2015Pr03 to correspond to the ground state and the high-spin state with J=(3) to correspond to the isomer.
Mass measurements: 2016Kl04, 2013Ma81 (isomer in ^{98}Rb not detected), 2012Si10, 1986Au02, 1979Ep01.
Theory references: consult the NSR database (www.nndc.bnl.gov/nsr/) for 9 primary references, 2 dealing with nuclear structure calculations and 7 with decay modes and half-lives.
Additional information 2.

^{98}Rb Levels

Cross Reference (XREF) Flags

- A ^{98}Rb IT decay (0.358 μs)
- B ^{99}Kr β^-n decay (37 ms)
- C U(p,X)
- D Coulomb excitation

E(level)†	J^π	$T_{1/2}$	XREF	Comments
0.0	$0^{(-)}$	115 ms *6*	A CD	%β^-=100; %β^-n=14.3 *9*; %β^-2n=0.054 *8* Evaluated rms charge radius=4.434 fm *42* (2013An02). Evaluated δ<r^2>(^{87}Rb,^{98}Rb)=1.855 fm^2 *15* (2013An02). J^π: spin based on a fit with a Voigt profile to the optical spectrum of this state from collinear fast beam laser spectroscopy, which is in agreement to that expected for a single transition typical of J=0 (2015Pr03); parity from systematics of odd-odd Rb nuclei. Atomic-beam measurement by 1981Th04 also suggested J=0. $T_{1/2}$: weighted average of 145 ms *25* (2015Pr03, ion-β correlated decay curve) and 114 ms *5* (1980Sc13, decay curve for 167γ in ^{97}Sr). These values are preferred over many other measurements where the measured half-lives may have corresponded to combined activities of 115 ms and 96 ms. Other measurements from timing of neutrons, β or γ: 102 ms *4* (2011Ni01, (ion)β-correlated decay curve); 127 ms *1* (2003Be05, βn coin); 109 ms *1* (1993Ru01, n-decay); 106 ms *2* (1987PfZX, βn-decay); 106 ms *1* (1986ReZU,1986Wa17, βn-decay); 108 ms *1* (1983Re10, βn-decay, same group as 1986ReZU); 110 ms *20* (1981En05, βn-decay); 100 ms *20* (1979En02, β-decay); 112 ms *4* and 109 ms *12* (1979Pe01, βn-decay); 114 ms *13* (1979Ri09, βn-decay); 108 ms *5* (1978Wo09, $\beta\gamma$-decay); 98 ms *18* (1976AmZW, β-decay); 140 ms *10* (1976Ru01, βn-decay); 106 ms *6* (1974Ro15, βn-decay); 140 ms *8* (1971Tr02, β-decay); 131 ms *31* (1970KlZZ, β-decay). %β^-n: weighted average of 13.0 *10* (1987PfZX), 13.6 *9* (1986ReZU, 1986Wa17, earlier values 13.4 *19* in 1983Re10 and 12.8 *20* in 1980ReZQ), 16.7 *16* (1981En05), 15.8 *26*

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Adopted Levels, Gammas (continued)

^{98}Rb Levels (continued)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
				(1979Pe01), 18.4 *29* (1979Ri09), 19 *3* (1974Ro15, original value of 13.3 *21* in 1974Ro15 renormalized by 1981Jo01), %β⁻2n: from β⁻n/β⁻2n=267 *33* (1981Re05) and %β⁻n=14.3 *9*. 1981Re05 give %β⁻2n=0.060 *9* based on %β⁻n=16.1 *13*. Other: <0.1 (1974Ro15). %β⁻n and %β⁻2n are combined for the decays of g.s. and isomer. β⁻n compilations: 1993Ru01, 1984Ma39, 1983En03, 1982Ru01, 1981Jo01, 1979RuZQ, 1975Iz03, 1989BrZI. $\Delta<r^2>(^{98}Rb,^{87}Rb)$=1.821 fm² *15* (1981Th04). $\delta<r^2>(^{87}Rb,^{98}Rb)$=+2.063 fm² *9*(stat) *93*(syst); $\delta<\beta_2^2>$=+0.174 for $\delta\nu(^{87}Rb,^{98}Rb)$=−910.5 MHz *53* (2015Pr03, hyperfine structure measurements). The sources of ^{98}Rb used for many of the studies cited above for half-life and decay modes most likely contained small admixture of 96 ms isomer also. On the basis of $T_{1/2}$ of 167γ (in ^{97}Sr from ^{98}Rb β⁻n decay), it is assumed here that predominant β⁻n decay is from the 115-ms activity. It is possible that the 141γ (in ^{97}Sr) is from β⁻n decay of the 96-ms isomer, but $T_{1/2}$ of 141γ is not known.
50.2 *3*		<0.7‡ ns	D	
113.8 *2*	(2⁻)	1.18 ns *35*	D	Jπ: Coulomb excitation from J=0(⁻) g.s. 2016Cl03 propose same parity for g.s., 114 and 432 levels. $T_{1/2}$: from RDDS analysis, and scaled upwards by a factor of 1.4, as estimated from a comparison of lifetime determined by 2016Cl03 in Coulomb excitation using a similar analysis for the first 2⁺ state in ^{98}Sr and the corresponding value in literature.
123.8 *5*	(1,2⁻)		A	Jπ: 123.8γ to 0(⁻) g.s.
144.9 *15*		<0.7‡ ns	D	
178.3 *5*		0.358 μs *7*	A	%IT=100 $T_{1/2}$: from (implant)γ(t) in ^{98} IT decay (2012Ka36). Other: : 0.70 μs *+6−5* (2009Fo05, implant-γ(t)).
244.0 *20*		<0.7‡ ns	D	
258.4 *2*	(2⁻)		D	Jπ: Coulomb excited state from 0(⁻) g.s.
≈270	(3⁺)	96 ms *3*	C	%β⁻=100; %β⁻n=14.3 *9*; %β⁻2n=0.054 *8* (1981Re05) μ=+1.785 *1* (2015Pr03) Q=+1.431 *32* (2015Pr03) E(level): from βγ data and Q(β⁻) measurement (1982Pa24,1988GrZX). 2017Au03 suggest E(level)=73 *26*. Jπ: spin tentatively assigned by 2015Pr03 from hyperfine structure measurements, where J=4 was not ruled out; 2002Lh01 also tentatively proposed 3⁺ with possible configuration=π3/2[431]⊗ν3/2[411]. $T_{1/2}$: weighted average of 90 ms *10* (2015Pr03, ion-β correlated decay curve) and 96 ms *3* (1980Sc13, decay curve for 289γ and 433γ in ^{98}Sr). See numerous other half-life measurements in comments for the g.s., where these values may be for combined activity of g.s. and the isomer. $<\beta_2>^2$=+0.126, extracted from the quadrupole moment (2015Pr03). $\delta<r^2>(^{87}Rb,^{98}Rb)$=+2.084 fm² *9*(stat) *93*(syst); $\delta<\beta_2^2>$=+0.177 for $\delta\nu(^{87}Rb,^{98}Rb)$=−922.5 MHz *53* (2015Pr03). μ,Q: deduced from measured hyperfine parameters relative to known values of ^{87}Rb (2015Pr03). Uncertainties are statistical only. %β⁻n and %β⁻2n are combined for the decays of g.s. and isomer. See the details of the measurements in comments for the g.s.
432.1 *6*	(1⁻,2⁻)		D	Jπ: 2016Cl03 in Coulomb excitation propose 1 or 2, based on 432γ to the g.s. The authors also propose same parity for g.s., 114 and 432 levels.
636.8 *15*			D	

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Adopted Levels, Gammas (continued)

^{98}Rb Levels (continued)

† From a least-squares fit to γ-ray energies, unless otherwise stated.
‡ Estimated from Doppler correction for 50.2-, 94.7-, and 99.1-keV γ rays in Coulomb excitation (2016Cl03).

$\gamma(^{98}Rb)$

E_i(level)	J_i^π	E_γ †	I_γ	E_f	J_f^π	Mult.	Comments
50.2		50.2 *3*	100	0.0	$0^{(-)}$		
113.8	(2^-)	113.8# *2*	100	0.0	$0^{(-)}$	[E2]	B(E2)(W.u.)=9.4×10^2 *+38−22*
123.8	$(1,2^-)$	123.8‡ *5*	100	0.0	$0^{(-)}$		
144.9		94.7 *14*	100	50.2			
178.3		(54.5‡)		123.8	$(1,2^-)$		E_γ: from level-energy difference.
		178.3‡ *5*	100 *5*	0.0	$0^{(-)}$		
244.0		99.1 *13*	100	144.9			
258.4	(2^-)	258.4 *2*	100	0.0	$0^{(-)}$		
432.1	$(1^-,2^-)$	318.3 *8*	100 *38*	113.8	(2^-)		
		432.1# *8*		0.0	$0^{(-)}$		there is a γ transition of 433 from 6^+ to 4^+ in ^{98}Sr, but 2016Cl03 find inconsistency in the yields of this line at forward and backward angles, suggesting the presence of another line, possibly belonging to ^{98}Rb.
636.8		378.4 *14*	100	258.4	(2^-)		

† From Coulomb excitation, unless otherwise stated.
‡ From ^{98}Rb IT decay (0.358 μs).
# The γ transition to the g.s. should have some E2 admixture, as the level is directly populated in Coulomb excitation.

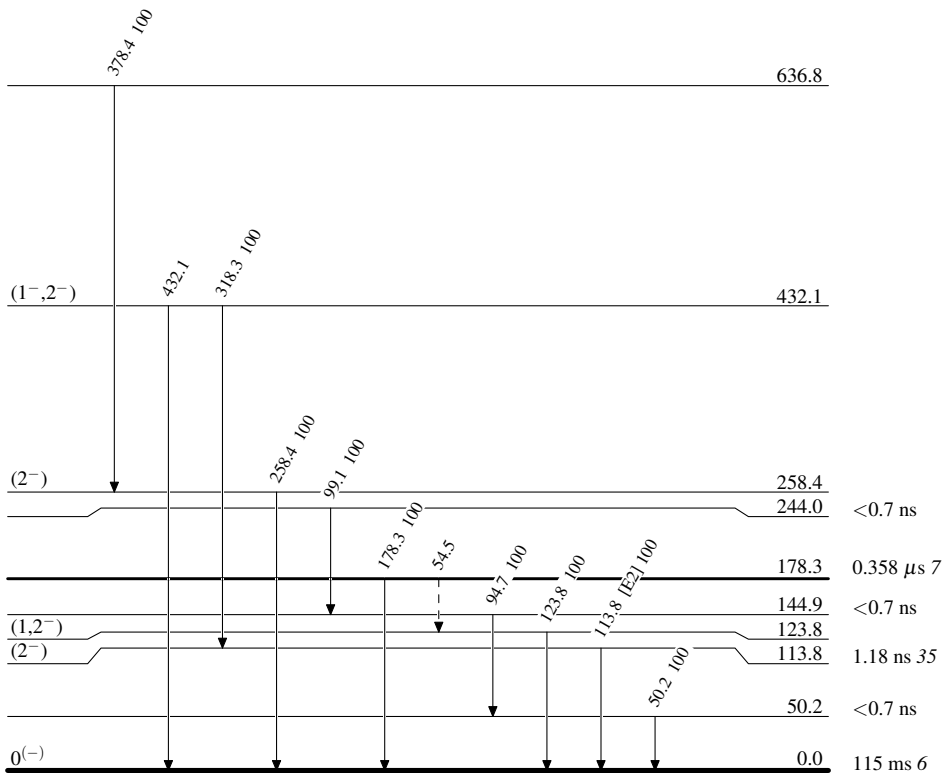
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)



$^{98}_{37}Rb_{61}$