Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 135, 193 (2016)	31-May-2016

Q(β^-)=9115.4 *29*; S(n)=4020.4 *30*; S(p)=1622×10^1 *50*; Q(α)=−11610 *SY* 2012Wa38
Estimated uncertainty=300 for Q(α) (2012Wa38).
S(2n)=10785.7 *30*, S(2p)=31260 *500* (syst), Q(β^-n)=2202.3 *29* (2012Wa38).
1981Ru07: ^{79}Zn produced by chemical, thermochromatographic technique and mass separation of fission fragments.
1991Kr15: from mass separation of fragments from ^{238}U(p,X) E=600 MeV.
1997Hu09: ^{238}U(p,F) at 25 MeV.
Isomerism in ^{79}Zn is expected but no evidence found by 1986Ek01.
2010Ho12: ^{9}Be(^{86}Kr,X) E=140 MeV/nucleon; fully-ionized ^{86}Kr beam, A1900 fragment separator at NSCL facility using Bρ-ΔE-Bρ method. After separation, the mixed beam was implanted into the NSCL β-counting system (BCS) consisting of stacks of Si PIN detectors, a double-sided Si strip detector (DSSD) for implantation of ions, and six single-sided Si strip detectors (SSSD) followed by two Si PIN diodes. The identification of each implanted event was made from energy loss, time-of-flight information and magnetic rigidity. The implantation detector measured time and position of ion implantations and β decays. Neutrons were detected with NERO detector. Measured β- and βn-correlated events with ion implants; half-life of ^{79}Zn and delayed-neutron emission probability.
2016Ya02: measured hyperfine structure by collinear laser spectroscopy at ISOLDE-CERN. Deduced spins of ground state and isomer, half-life of isomer, hyperfine structure constants, magnetic and quadrupole moment, isomer shift, configurations.
Additional information 1.
Mass measurements: 2008Ba54, 2008Ha23.
^{80}Cu is a potential beta-delayed neutron emitter to ^{79}Zn daughter nucleus. A preliminary measured value of %β^-n=58 *9* for ^{80}Cu is given by 2014XuZZ, but no decay scheme is known.
Nuclear structure calculations: 2015Ka46, 2012Si08: calculated levels, J, π, shell-model in a large model space.

^{79}Zn Levels

Cross Reference (XREF) Flags

A ^{79}Cu β^- decay (241.0 ms)
B ^{2}H(^{78}Zn,P),(^{78}Zn,pγ)

E(level)[†]	J$^\pi$[#]	T$_{1/2}$	XREF	Comments
0.0	9/2$^+$	0.746 s *42*	AB	%β^-=100; %β^-n=1.7 *5* (2010Ho12,1991Kr15) μ=−1.1866 *10* (2016Ya02) Q=+0.487 *53* (2016Ya02) %β^-n is unweighted average of 2.2 *14* (2010Ho12 from 2109 implants and 19 correlated βn coincidence events), and 1.3 *4* (1991Kr15). Theoretical T$_{1/2}$=1.66 s, %β^-n=0.34 (2003Mo09). Theoretical T$_{1/2}$=7.2 s, %β^-n=2.0 (2016Ma12). J$^\pi$: 9/2 from measurement of hyperfine structure by collinear laser spectroscopy at ISOLDE-CERN, parity from excellent agreement of measured magnetic moment with large-scale shell-model predictions for $\nu g_{9/2}^{-1}$ configuration (2016Ya02). T$_{1/2}$: from 2010Ho12; measurement of time sequence of decay type neutron and β events correlated with the implanted nuclei (of ^{79}Zn) in Si detectors using method of maximum likelihood analysis which required, as input parameters, values of β-detection efficiency, background, half-lives of daughter and granddaughter nuclei and experimental or theoretical values of %β^-n of all the nuclei involved. Others: 0.995 s *19* (from decay curve of neutrons,1991Kr15), 1.0 s *1* (1986Ek01), 2.63 s *9* (1976Ru01), 3.00 s 9 (1974Gr29). In the measurements of 1976Ru01, 1974Gr29 and 1977Al17 the source was probably a mixture of ^{79}Zn and ^{79}Ga, 1991Kr15 report a more precise but much longer half-life than in 2010Ho12. Value from 2010Ho12 is preferred here due to better selectivity of the decay events and implants belonging to

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Adopted Levels, Gammas (continued)

^{79}Zn Levels (continued)

E(level)[†]	J^{π}[#]	$T_{1/2}$	XREF	Comments
				^{79}Zn activity. 2010Ho12 attribute the difference to the existence of a possible isomer in ^{79}Zn whose contribution will depend on the reaction used to produce the source. Weighted average of the two widely results is not meaningful. The unweighted average of the two values is 0.87 s *12*. μ,Q: from measurement of hyperfine structure by collinear laser spectroscopy at ISOLDE-CERN (2016Ya02).
983 *3*	$5/2^+$		B	J^{π}: L(d,p)=2; γ to $9/2^+$.
110×10^1 *15*	$1/2^+$	≥200 ms	B	%IT=?; $\%\beta^-$=? $\mu=-1.0180$ *12* (2016Ya02) Measured isomer shift $\delta\nu(^{79}Zn,^{79m}Zn)$=61.3 MHz *31* (2016Ya02) which gives difference in charge radii i.e. $<r^2>(^{79}Zn),^{79m}Zn)= +0.204$ fm^2 *6*(stat) *36*(syst) (2016Ya02). μ: from measurement of hyperfine structure by collinear laser spectroscopy at ISOLDE-CERN (2016Ya02). J^{π}: 1/2 from measurement of hyperfine structure by collinear laser spectroscopy at ISOLDE-CERN. Large negative value of magnetic moment is consistent only with contribution from $\nu(3s^1_{1/2}1g^{-2}_{9/2})$ with some mixing of $\nu 2d^1_{3/2}$ orbital, giving a positive parity for the 1/2 isomer (2016Ya02). Also L(d,p)=(0) gives $(1/2^+)$. $T_{1/2}$: estimated by 2016Ya02 from no significant change observed in the intensity ratio of the most intense peaks in the hyperfine spectra for the ground state and isomer with different accumulation times. Authors also mention in the text half-life of a few hundred ms, as for the ground state. Proposed configuration=$\nu(3s_{1/2}1g^{-2}_{9/2})$ with some mixing of $\nu(1g^{-2}_{9/2}2d^1_{3/2})$ configuration, a 2h-1p intruder configuration (2016Ya02). Authors note that muti-particle-multi-hole such as 4h-3p configurations cannot be excluded as these can also give a magnetic moment in agreement with the experimental value.
1336[‡] *1*	(1/2,3/2)		B	J^{π}: prompt 236γ to $1/2^+$ is expected to be dipole; feeding from higher states favors positive parity.
1424 *4*	$3/2^+,5/2^+$		B	J^{π}: L(d,p)=2.
2312? *4*			B	
2521[‡] *3*			B	
3195[‡] *4*			B	
3198? *6*			B	
3304? *5*			B	

† From Eγ data.

‡ Uncertainty is relative with respect to the uncertainty in Eγ from this level, assuming fixed energy of 1100 keV for the $(1/2^+)$ isomer. Absolute uncertainty is 150 keV as for 1100 level.

As proposed by 2015Or01 based on γ-gated proton angular distributions, DWBA analysis and shell-model predictions, unless otherwise stated.

$\gamma(^{79}Zn)$

E_i(level)	J^{π}_i	E_{γ}	E_f	J^{π}_f	Mult.
983	$5/2^+$	983 *3*	0.0	$9/2^+$	
1336	(1/2,3/2)	236 *1*	110×10^1	$1/2^+$	(D)
1424	$3/2^+,5/2^+$	441 *1*	983	$5/2^+$	
2312?		888[†] *3*	1424	$3/2^+,5/2^+$	
2521		1185 *3*	1336	(1/2,3/2)	

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Adopted Levels, Gammas (continued)

$\gamma(^{79}Zn)$ (continued)

E_i(level)	J_i^π	E_γ	E_f	J_f^π
3195		1859 *4*	1336	(1/2,3/2)
3198?		1774† *4*	1424	$3/2^+,5/2^+$
3304?		2321† *4*	983	$5/2^+$

† Placement of transition in the level scheme is uncertain.