Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 158, 1 (2019)	16-May-2019

Q(β^-)=6606.0 *27*; S(n)=7275.8 *24*; S(p)=12050.3 *30*; Q(α)=−1113×10^1 *14* 2017Wa10
S(2n)=12418.9 *24*, S(2p)=29200 *470*, Q(β^-n)=1086.7 *29* (2017Wa10).
Other measurements:
1983Ru06: production and identification in W(^{76}Ge,X) E=9 MeV/nucleon followed by mass separation. Other: ^{238}U(p,F) E=30 MeV (2002Kr13, 2002Kr10).
2007Gu09, 2007Ra27: measured mass.
2009Fl03, 2010Vi07: ^{73}Cu was produced at ISOLDE facility in U(p,F) reaction. Resonance Ionization laser ion source (RILIS) used to laser ionize the atoms. Measured hyperfine structure. Deduced spin, magnetic dipole and electric quadrupole moment of the ground state. Collinear and in-source laser spectroscopic technique Authors state that quadrupole moments can be deduced from these measurements and will be discussed in a forthcoming paper. Comparison with large-scale shell-model calculations.
2016Bi08: ^{73}Cu isotope produced in U(p,X), E=1.4 GeV reaction at the CERN-ISOLDE facility, followed by selective ionization using RILIS laser ion source, accelerated to 30 keV and injected into a gas-filled linear Paul trap. Measured isotope shift with respect to ^{65}Cu using the collinear laser spectroscopy setup. Comparison with droplet model predictions.
2017De30: ^{73}Cu produced in 1.4-GeV proton bombardment of UC$_x$ target using HRS mass separator, ISCOOL gas-filled segmented linear Paul trap, and RILIS at ISOLDE-CERN facility. Measured hyperfine spectra, hyperfine structure parameters, magnetic dipole moment and electric quadrupole moment by Collinear Resonance Ionization Spectroscopy (CRIS). See also previous measurements at the same laboratory by 2009Fl03 and 2010Vi07.
2017Yu05: ^{9}Be(^{86}Kr,X), E=64 MeV/nucleon; analyzed available data; deduced S(n) and S(2n).
^{74}Ni is expected to decay by β^-n mode to ^{73}Cu, but no details are available.
Additional information 1.

^{73}Cu Levels

Cross Reference (XREF) Flags

A ^{73}Ni β^- decay (0.84 s)
B Coulomb excitation
C ^{238}U(^{76}Ge,Xγ)

E(level)	J$^{\pi}$ †	T$_{1/2}$	XREF	Comments
0.0	3/2$^-$	4.2 s *3*	ABC	%β^-=100; %β^-n=? μ=+1.7425 *9* (2017De30) Q=−0.23 *2* (2017De30) Theoretical T$_{1/2}$=2.92 s, %β^-n=0 (2019Mo01). Theoretical T$_{1/2}$=294 s, %β^-n=0.7 (2016Ma12). δ<r^2>(^{65}Cu,^{73}Cu)=0.523 fm^2 *15*(stat) *58*(syst) (2016Bi08); the systematic uncertainty for isotope shift resulted from those in the atomic factors. J$^{\pi}$: spin from hyperfine structure measurement in 2009Fl03 and 2010Vi07, parity from comparison of level energies, g factors and quadrupole moments with shell-model calculations. Dominant πp$_{3/2}$ configuration for odd-A Cu isotopes, with some νg$^4_{9/2}$ admixture for ^{73}Cu as suggested by 2001Fr21. See also 2017Ne04 review article. T$_{1/2}$: weighted average of 4.4 s *3* (1998Hu20) and 3.9 s *3* (1983Ru06). μ: measured relative to that for ^{65}Cu g.s.=+2.3817 *3*. Previous measurements: μ=+1.7426 *8* (2009Fl03,2010Vi07); also listed in 2014StZZ. Q: value of −0.200 *10* in 2010Vi07 is re-evaluated to −0.210 *10* by 2016St14.
135.4 *1*	(1/2)$^-$		B	
166.07 *10*	(5/2)$^-$		ABC	J$^{\pi}$: possible πf$_{5/2}$ configuration.
961.21 *20*	(7/2)$^-$	2.6 ps *3*	AB	T$_{1/2}$: deduced by the evaluator from experimental B(E2)(W.u.)=14.9 *18* in Coulomb excitation (2008St04).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{73}Cu Levels (continued)

E(level)	J^{π}†	$T_{1/2}$	XREF	Comments
				Configuration=$\pi 2p_{3/2}\otimes 2^+$ in ^{70,72}Ni proposed earlier is consistent with B(E2) values (2008St04). J^{π}: possible $\pi p_{3/2}\otimes(2^+$ in ^{72}Ni).
1010.14 *15*	(7/2⁻)		A	J^{π}: possible $\pi f_{7/2}^{-1}$.
1297.96 *22*	(7/2⁻)	15 ps *8*	A C	$T_{1/2}$: from recoil-distance Doppler-shift (RDDS) method (2015Sa09) in ^{238}U(^{76}Ge,Xγ). J^{π}: possible $\pi f_{5/2}\otimes(2^+$ in ^{72}Ni).
1489.04 *18*	(9/2⁻)		A	J^{π}: possible member of $\pi f_{7/2}^{-1}$ configuration.
1708.8? *7*			A	
2161.6 *14*	(7/2⁺)‡		A	
2386.0 *6*	(9/2⁺,11/2⁺)‡		A	

† Except for the ground state, all other assignments (from 2001Fr21) are tentative, based on shell-model predictions, and comparisons with the structure of neighboring nuclides. π=− for 135, 166 and 961 levels is from direct excitation from 3/2⁻ ground state in Coulomb excitation.

‡ Possible member of $\pi p_{3/2}(\nu p_{1/2}^{-1}\otimes\nu g_{9/2}^{5})_{5-}$ multiplet.

γ(^{73}Cu)

E_i(level)	J_i^{π}	E_{γ}†	I_{γ}†	E_f	J_f^{π}	Mult.	α‡	Comments
135.4	(1/2)⁻	135.4 *1*	100	0.0	3/2⁻	[M1+E2]	0.11 *9*	α(K)=0.10 *8*; α(L)=0.011 *9*; α(M)=0.0015 *12* α(N)=4.E−5 *3* E_{γ}: from Coulomb excitation.
166.07	(5/2)⁻	166.1 *1*	100	0.0	3/2⁻	[M1+E2]	0.05 *4*	α(K)=0.05 *4*; α(L)=0.005 *4*; α(M)=0.0007 *5* α(N)=1.9×10⁻⁵ *14*
961.21	(7/2)⁻	961.2 *2*	100	0.0	3/2⁻	[E2]	0.000294 *5*	α=0.000294 *5*; α(K)=0.000264 *4*; α(L)=2.62×10⁻⁵ *4*; α(M)=3.68×10⁻⁶ *6* α(N)=1.116×10⁻⁷ *16* B(E2)(W.u.)=14.6 *+19−15*
1010.14	(7/2⁻)	844.2 *2*	73 *8*	166.07	(5/2)⁻			
		1010.0 *2*	100 *10*	0.0	3/2⁻			
1297.96	(7/2⁻)	1131.9 *2*	100	166.07	(5/2)⁻	[M1+E2]	0.000189 *14*	α=0.000189 *14*; α(K)=0.000168 *12*; α(L)=1.66×10⁻⁵ *12*; α(M)=2.33×10⁻⁶ *17* α(N)=7.1×10⁻⁸ *5*; α(IPF)=1.8×10⁻⁶ *4*
1489.04	(9/2⁻)	478.9 *1*	100	1010.14	(7/2⁻)			
1708.8?		1542.2 *10*	100	166.07	(5/2)⁻			
2161.6	(7/2⁺)	1995.5 *14*	100	166.07	(5/2)⁻			
2386.0	(9/2⁺,11/2⁺)	676.9 *7*	100 *22*	1708.8?				
		1088.2 *6*	76 *22*	1297.96	(7/2⁻)			

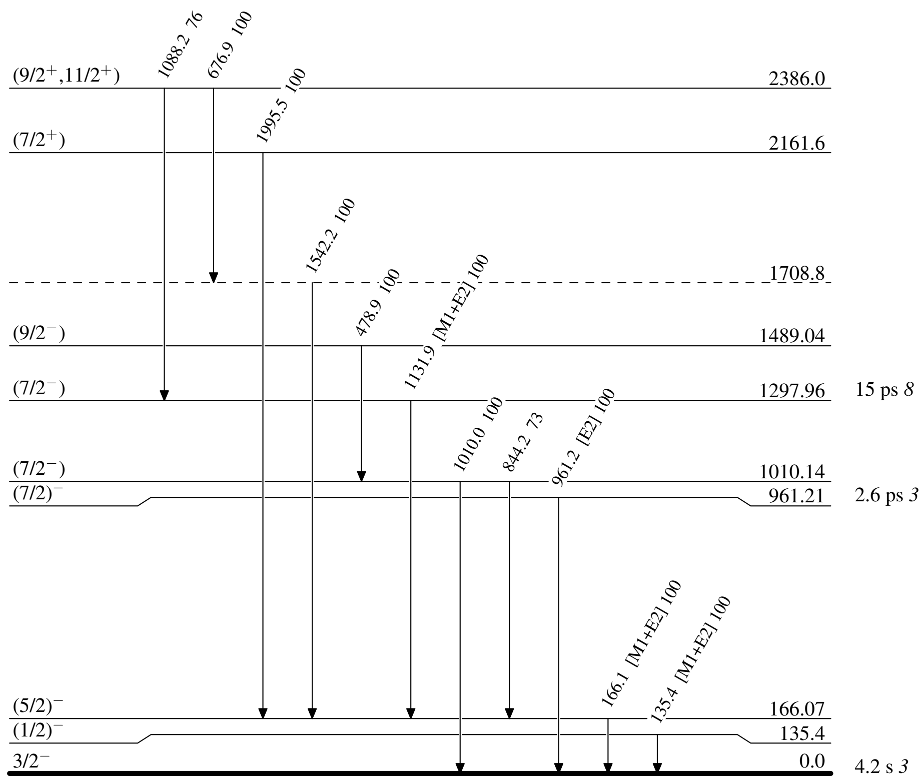
† From ^{73}Ni β⁻ decay, unless otherwise noted.

‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{73}_{29}Cu_{44}$