

**Adopted Levels**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Jun Chen and Ameenah R. Farhan		NDS 194,3 (2024)	8-Jan-2024

$Q(\beta^-)=11321.4$  17;  $S(n)=4582.7$  12;  $S(p)=14030$  syst;  $Q(\alpha)=-13110$  syst    [2021Wa16](#)  
 Estimated uncertainties ([2021Wa16](#)): 200 for S(p), 300 for Q(α).  
 $Q(\beta^-n)=3506.0$  22,  $S(2n)=11118$  6,  $S(2p)=32020$  400 (syst) ([2021Wa16](#)).  
[Additional information 1](#).  
 Isotope produced and identified in mass-separated fission products from <sup>235</sup>U(n,F) ([1987Ar21](#), [1987LuZX](#), [1990Wi12](#), [1991Kr15](#)).  
 Mass measurements: [2022Gi08](#) (mass excess=-51011.4 20, JYFL), [2017We16](#) (mass excess=-50981.55 89, CERN).  
 Other measurements:  
[2005Va19](#) (also thesis: [2002VaZX](#)): <sup>76</sup>Cu produced by <sup>238</sup>U(n,F) and <sup>238</sup>U(p,F) at ISOLDE-CERN facility using resonance ionization laser spectroscopy. Measured E<sub>γ</sub>, I<sub>γ</sub>, γγ, βγ, timing of βγ and γγ coin spectra. [2005Va19](#) searched for an isomer of 1.27 s proposed in [1990Wi12](#), but no evidence was found.  
[2009Wi03](#) (also [2008Wi01](#),[2009Gr06](#)): measured delayed %β<sup>-</sup>n. <sup>76</sup>Cu isotope produced in the reaction <sup>238</sup>U(p,F) with a 50 MeV beam provided by the HRIBF facility at ORNL RIB facility. The radioactive beams were extracted and mass separated. Detected decay products with a Micro-channel plate detector, an ionization chamber and a moving tape collector. Measured γ, β, γγ and βγ coin with two plastic β-detectors and γ-rays with four clover Germanium detectors.  
[2010Ho12](#): <sup>9</sup>Be(<sup>86</sup>Kr,X) E=140 MeV/nucleon; fully-ionized <sup>86</sup>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 <sup>76</sup>Cu and delayed-neutron emission probability. A total of 277 implants were detected, and three correlated βn coincidences were observed.  
[2020De21](#), [2017De30](#): <sup>76</sup>Cu produced in 1.4-GeV proton bombardment of UC<sub>x</sub> target using HRS mass separator, ISCOOL gas-filled segmented linear Paul trap, and RILIS at ISOLDE-CERN facility. Cu isotopes were selectively ionized by the RILIS laser ion source, accelerated to 30 keV for mass separation with high-resolution mass separator (HRS), and injected into ISCOOL gas-filled linear Paul trap. Measured hyperfine spectra and isotope shifts using Collinear Resonance Ionization spectroscopy (CRIS). Deduced hyperfine structure parameters, magnetic dipole moment and electric quadrupole moment.  
 Mass measurements: [2017We16](#), [2007Gu09](#) (also [2005Gu36](#)).  
 Theoretical calculations: four primary references for structure and three for decay characteristics retrieved from the NSR database ([www.nndc.bnl.gov/nsr/](http://www.nndc.bnl.gov/nsr/)) are listed in this dataset under 'document' records.

<sup>76</sup>Cu Levels

E(level)	J <sup>π</sup>	T <sub>1/2</sub>	Comments
0	3 <sup>(-)</sup>	637 ms 7	$\% \beta^- = 100$ ; $\% \beta^- n = 7.2$ 5 ( <a href="#">2009Wi03</a> ) $\mu = -1.0907$ 15 ( <a href="#">2017De30</a> , <a href="#">2019StZV</a> ) $Q = +0.36$ 2 ( <a href="#">2017De30</a> , <a href="#">2021StZZ</a> ) $\delta \langle r^2 \rangle (^{65}\text{Cu}, ^{76}\text{Cu}) = +0.58$ fm <sup>2</sup> 2(stat) 10(syst) ( <a href="#">2020De21</a> ). Isotope shift $\delta \nu(^{65}\text{Cu}, ^{76}\text{Cu}) = -4848$ MHz 5 ( <a href="#">2020De21</a> ). $\% \beta^- n$ : from <a href="#">2009Wi03</a> , weighted average of two measurements giving 7.3 6 and 7.0 6; the first is from comparison of relative intensities of the most intense γ rays in <sup>76</sup> Zn and <sup>75</sup> Zn; second is from comparison of absolute intensities of most intense γ rays from nuclei in β <sup>-</sup> n branch to the number of ions deposited. This value is considered as composite for the 638-ms and 1.27-s activities. Previous value was 7 1 in <a href="#">2008Wi01</a> . Other %β <sup>-</sup> n measured values: <7.2 ( <a href="#">2010Ho12</a> ), 2.2 5 ( <a href="#">2000KoZH</a> ), 3 2 ( <a href="#">1986ReZR</a> ). Measured %β <sup>-</sup> decay=88 3 which populates <sup>76</sup> Zn ( <a href="#">2009Wi03</a> ). J <sup>π</sup> : spin from hyperfine structure in <a href="#">2017De30</a> , negative parity from comparison with shell-model calculations. T <sub>1/2</sub> : weighted average of 599 ms 18 ( <a href="#">2010Ho12</a> ), 653 ms 24 ( <a href="#">2005Va19</a> ), 641 ms 6 ( <a href="#">1991Kr15</a> ), 570 ms 60 (697γ(t), <a href="#">1990Wi12</a> ), and 637 ms 20 ( <a href="#">2022Si25</a> ). Others: 647 ms 5 ( <a href="#">2000KoZH</a> ), 0.61 s 10 ( <a href="#">1986ReZR</a> ), 0.35 s 8 (697γ(t), <a href="#">1987LuZX</a> ).

Continued on next page (footnotes at end of table)

**Adopted Levels (continued)** $^{76}\text{Cu}$  Levels (continued)

<u>E(level)</u>	<u>T<sub>1/2</sub></u>	<u>Comments</u>
		<a href="#">Additional information 2.</a>
		$\mu, Q$ : from hyperfine structure measurement using Collinear Resonance Ionization Spectroscopy (CRIS) ( <a href="#">2017De30</a> ). Measured value of $\mu = -1.0895$ 15 is re-evaluated to $\mu = -1.0907$ 15 by <a href="#">2019StZV</a> . Measured value of $Q = +0.34$ 2 is re-evaluated to $Q = +0.36$ 2 by <a href="#">2021StZZ</a> . <a href="#">2017De30</a> compared measured $\mu$ and $Q$ with shell-model calculations using A3DA-m and PFSDG-U interactions.
0+x?	1.27 s 30	$\% \beta^- = ?$ $T_{1/2}$ : from 599 $\gamma$ (t), apparent $T_{1/2}$ ( $^{76}\text{Cu}$ isomer) = 0.84 s 6; but after subtraction of 698 $\gamma$ contribution, $T_{1/2}$ ( $^{76}\text{Cu}$ isomer) = 1.27 s 30 ( <a href="#">1990Wi12</a> ) which is assigned to a second, longer-lived isomer in <a href="#">1990Wi12</a> . This isomer was not confirmed by <a href="#">2005Va19</a> in their resonance ionization laser spectroscopy; and the decay curves for 599 $\gamma$ and 698 $\gamma$ showed no time differences. <a href="#">2009Wi03</a> (same first author as in <a href="#">1990Wi12</a> ) mentioned disagreement about the existence of the isomer citing <a href="#">1990Wi12</a> and <a href="#">2005Va19</a> papers, and appeared to have considered only one activity for $^{76}\text{Cu}$ . <a href="#">2010Ho12</a> do not discuss the isomer in $^{76}\text{Cu}$ . Its existence is considered as highly uncertain by the evaluators. $J^\pi$ : 1,2,3 proposed by <a href="#">1990Wi12</a> based on decay mode and expected shell-model considerations.