

$^{77}\text{Cu}$   $\beta^-$ -n decay (469.8 ms) 2009II01,2009Pa35,2012Ko29

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

Parent:  $^{77}\text{Cu}$ :  $E=0$ ;  $J^\pi=5/2^-$ ;  $T_{1/2}=469.8$  ms 20;  $Q(\beta^-n)=5368.9$  19;  $\% \beta^-n$  decay=30.1 20

$^{77}\text{Cu}$ - $J^\pi, T_{1/2}$ : From  $^{77}\text{Cu}$  Adopted Levels in the ENSDF database (Sept 2020 update).

$^{77}\text{Cu}$ - $Q(\beta^-n)$ : From 2021Wa16.

$^{77}\text{Cu}$ - $\% \beta^-n$  decay:  $\% \beta^-n=30.1$  20 from  $^{77}\text{Cu}$  Adopted Levels, where the value is based on measurements by 2018Ra27, 2010Ho12 and 2009II01.

2009II01: two experiments were performed using the Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL. In the first experiment, the Cu ions were accelerated to 225 MeV and measured  $\beta$ -delayed neutron emission probabilities. In the second experiment, the low-energy ions (200 keV) were sent to Low-energy Radioactive Ion Beam Spectroscopy Station (LeRIBSS). For both measurements using four clover Ge detectors and two plastic  $\beta$  detectors around beam pipe. Measured  $E_\gamma$ ,  $I_\gamma$ ,  $\beta\gamma$ -,  $\gamma\gamma$ -coin, absolute branching ratios in  $^{77}\text{Cu}$   $\beta$  decay and 772.4-keV ( $1/2^-$ ) isomer in  $^{77}\text{Zn}$ , half-life of  $^{77}\text{Cu}$  g.s.

2009Pa35:  $^{77}\text{Cu}$  produced in the fission of uranium (target=uranium carbide) by spallation neutrons which were produced by 1 GeV protons hitting a tantalum target. The  $^{77}\text{Cu}$  nuclei were selected by Resonant Ionization Laser Ion Source (RILIS) and General Purpose mass separator (GPS) at the CERN-ISOLDE facility. The separated  $^{77}\text{Cu}$  nuclei at a typical energy of 60 keV were implanted on a tape surrounded by three E- $\Delta E$  plastic detectors for  $\beta$ -particle detection and two HPGe detectors. Measured  $\gamma$ ,  $\beta$ ,  $\beta\gamma$  coin,  $\beta\beta$  coin,  $\gamma\gamma$  coin and delayed-neutron events. The neutrons were detected with the Mainz neutron long counter. Major contribution to  $\gamma$ -ray and  $\beta$  spectra are from  $^{77}\text{Ga}$  decay as indicated by a comparison of 'laser-on' and 'laser-off' spectra. In both the spectra, lines from  $^{77}\text{Ga}$  are quite prominent. The decay scheme of  $^{77}\text{Ga}$  is poorly known, By subtraction procedures, 2009Pa35 obtained a spectrum which mainly contained lines from  $^{77}\text{Cu}$  activity.

2012Ko29:  $^{77}\text{Cu}$  produced in  $^{238}\text{U}(p,F), E=54$  MeV at HRIBF-ORNL facility, followed by online separation of fragments using two stages of mass separation. The Cu isotopes were accelerated to about 3 MeV/nucleon in the tandem accelerator and transmitted to the measuring decay station. Measured  $\beta$  and  $\gamma$  radiations using two plastic detectors for  $\beta$  radiation and four Ge clover detectors for  $\gamma$  radiation. Deduced partial  $\beta^-n$  branches to the g.s., first  $2^+$  and ( $4^+$ ) states from  $\beta$  and  $\gamma$  data.

1991Kr15: measured  $T_{1/2}(^{77}\text{Cu}$  g.s.) by n(t)  $T_{1/2}(^{77}\text{Cu})=0.469$  s 8 (1991Kr15).  $\% \beta^-n$  is unknown.

 $^{76}\text{Zn}$  Levels

<u>E(level)<sup>†</sup></u>	<u><math>J^\pi</math><sup>‡</sup></u>	<u><math>T_{1/2}</math><sup>‡</sup></u>
0.0	$0^+$	5.7 s 3
598.56 5	$2^+$	25.4 ps +37-29
1296.28 9	( $4^+$ )	10.4 ps +25-22

<sup>†</sup> From  $E_\gamma$  data.

<sup>‡</sup> From the Adopted Levels.

 $\gamma(^{76}\text{Zn})$ 

$I_\gamma$  normalization: Deduced from  $I(\gamma$  to g.s.)+ $I(\beta^-n$  to g.s.)=100 through this decay branch.

<u><math>E_\gamma</math><sup>†</sup></u>	<u><math>I_\gamma</math><sup>†‡</sup></u>	<u><math>E_i</math>(level)</u>	<u><math>J_i^\pi</math></u>	<u><math>E_f</math></u>	<u><math>J_f^\pi</math></u>	<u>Comments</u>
598.56 5	100.2 9	598.56	$2^+$	0.0	$0^+$	$\%I_\gamma=19.3$ 20
697.72 8	2.89 11	1296.28	( $4^+$ )	598.56	$2^+$	$\%I_\gamma=0.56$ 6

<sup>†</sup> From 2009II01.

<sup>‡</sup> For absolute intensity per 100 decays, multiply by 0.193 20.

$^{77}\text{Cu}$   $\beta^-n$  decay (469.8 ms) 2009I101,2009Pa35,2012Ko29 (continued)Delayed Neutrons ( $^{76}\text{Zn}$ )

$E(^{76}\text{Zn})$	$I(n)^{\dagger\ddagger}$
0.0	11 1
598.56	19 1
1296.28	0.55 4

$^{\dagger}$  Measured by 2012Ko29.

$^{\ddagger}$  Absolute intensity per 100 decays.

 $^{77}\text{Cu}$   $\beta^-n$  decay (469.8 ms) 2009I101,2009Pa35,2012Ko29Decay Scheme

Intensities:  $I_{\gamma}$  per 100 parent decays

