

Adopted Levels

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen <sup>#</sup>		NDS 147, 1 (2018)	30-Nov-2017

$Q(\beta^-)=6390$  50;  $S(n)=4970$  SY;  $S(p)=9950$  SY;  $Q(\alpha)=-2800$  SY [2017Wa10](#)

Estimated uncertainties (syst,[2017Wa10](#)):  $\Delta S(n)=130$ ,  $\Delta S(p)=320$ ,  $\Delta Q(\alpha)=230$ .

$S(2n)=10820$  120,  $S(2p)=21590$  320,  $Q(\beta^-n)=-140$  110 (syst,[2017Wa10](#)).

[2008Os02](#):  $^{164}\text{Eu}$  identified in U(p,X) at E(p)=24 MeV on target of natural uranium in the form of uranium carbide. The fission fragments mass separated as metallic ions and implanted on to a tape transport system. Measured  $\beta$ ,  $\beta\gamma$  coin,  $\gamma\gamma$  coin,  $T_{1/2}$ . The  $^{164}\text{Eu}$  isotope was identified by observing K-x rays of Gd, and five  $\gamma$  rays from its decay, including the 73.3 and 168.8 keV  $\gamma$  rays, which are close in energy to those observed by [2004Jo17](#) and assigned as  $2^+$  to  $0^+$  and  $4^+$  to  $2^+$  transitions in  $^{164}\text{Gd}$ , respectively.

Additional information 1.

[2007Ha57](#) (same group as [2008Os02](#)): source prepared by  $^{238}\text{U}(p,F)$  at E(p)=32 MeV at JAEA facility. Fission products were ionized and separated online using Tokai-ISOL mass separator. Measured  $Q(\beta^-)$  using total absorption gamma-ray spectrometer of BGO detector. Deduced mass excess=-53320 410 ([2007Ha57](#)), value includes systematic predictions in mass evaluations.

[2014Ha38](#), [2010Ha38](#): measured  $Q(\beta^-)$  using total absorption spectrometer of clover Ge detector and  $4\pi$  BGO detectors serving as Compton suppressors at JAEA facility. Measured  $Q(\beta^-)=6393$  keV 50.

[2017Wu04](#):  $^{164}\text{Eu}$  nuclide was produced at the RIBF-RIKEN facility using the  $^9\text{Be}(^{238}\text{U},F)$  reaction at E=345 MeV/nucleon. Two experiments, optimized for the transmission of  $^{158}\text{Nd}$  and  $^{170}\text{Dy}$  ions, were carried out with average beam intensities of 7 pA and 12 pA, respectively. The identification of the nuclide of interest was made in the BigRIPS separator by determining the atomic number and the mass-to-charge ratio of the ion using the TOF-B $\rho$ - $\Delta E$  method. The reaction products were transported through the ZeroDegree spectrometer and implanted into the beta-counting system WAS3ABi that was surrounded by the EURICA array comprising of 84 HPGe detectors. The typical implantation rate was  $\approx 100$  ions/s. Measured (implanted ions)( $\beta^-$ )t, (implanted ions)( $\beta^-$ ) $\gamma$ -t, (implanted ions) $\gamma$ -t correlations, and half-life of the decay of  $^{164}\text{Eu}$ .

[2017Pa25](#):  $^{164}\text{Eu}$  isomer populated in  $^9\text{Be}(^{238}\text{U},F)$ , E=345 MeV/nucleon reaction at RIBF, RIKEN facility using the BigRIPS and ZeroDegree spectrometers for separation and identification of in-flight fission fragments. Delayed gamma rays were detected using EURICA (Euroball-RIKEN Cluster) array, consisting of 84 HPGe crystal. Measured  $E_\gamma$ , delayed  $\gamma$  spectra. Deduced evidence for a micro-second isomer in  $^{164}\text{Eu}$  from the observation of delayed  $\gamma$  rays of 53.7, 89.5, 120.4 and 214 keV from the excited states of  $^{164}\text{Eu}$ , but neither an exact half-life nor the decay scheme could be obtained.

 $^{164}\text{Eu}$  Levels

E(level)	$J^\pi$	$T_{1/2}$	Comments
0	(3)	4.15 s 20	$\% \beta^- = 100$ E(level): the observed $^{164}\text{Eu}$ fragments are assumed to correspond to the g.s. $J^\pi$ : configuration= $\pi 5/2[413]$ or $\pi 5/2[532] \otimes \nu 1/2[521]$ on the basis of systematics of proton orbital in $^{159}\text{Eu}$ and neutron orbital in $^{167}\text{Dy}$ , Gallagher-Moszkowski coupling rules, and possible $\beta$ feeding of the ( $4^+$ ) level in $^{164}\text{Gd}$ . Theoretical calculations by <a href="#">1997Mo25</a> imply $1^+$ to $6^+$ from $\Omega=5/2^+$ proton orbital and $\Omega=7/2^+$ neutron orbital. <a href="#">2017Au03</a> give $0^-$ from systematics. $T_{1/2}$ : from weighted average of 3.80 s 56 ( <a href="#">2017Wu04</a> , from a fit to the (implanted ions) $\beta^-$ -t decay curve using the least-squares and maximum-likelihood methods, including contributions from the parent, daughter and grand-daughter decays, and a constant background); and 4.2 s 2 ( <a href="#">2008Os02</a> , $\gamma$ decay curves, weighted average of four values from decay curves for 73.3 $\gamma$ and 168.8 $\gamma$ ).
0+x			$T_{1/2}$ : in the micro-second domain, based on observation of delayed $\gamma$ rays up to 2 $\mu\text{s}$ following the implantation of $^{164}\text{Eu}$ fragments ( <a href="#">2017Pa25</a> ). Following $\gamma$ rays depopulate the isomer according to $\gamma$ -spectrum shown in Fig. 16 of <a href="#">2017Pa25</a> : 53.7, 89.5, 120.4 and 214 keV.