^{162}Eu IT decay 2018Ha19,2020Or03,2021Wa04

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 195,1 (2024)	19-Sep-2023

Parent: ^{162}Eu: E=158.4 *24*; $J^{\pi}=(3^-)$; %IT decay=?

2020Or03 compiled for XUNDL database by E.A. McCutchan (NNDC,BNL).

2020Or03, 2018Ha19, 2019KoZX: ^{162}Eu produced from CARIBU source facility consisting of ≈1 Ci ^{252}Cf inside large volume gas catcher. Ions extracted in charge state 2^+, mass separated, and collected in an rf quadrupole cooler/buncher. Beam purification using multireflection time-of-flight mass separator (δ-tof). Measured cyclotron frequencies using Canadian Penning Trap (CPT) with phase-imaging ion-cyclotron-resonance (PI-ICR) technique. 2020Or03: deduced masses and excitation energies of isomers. 2018Ha19: deduced atomic masses and $T_{1/2}$ of isomer.

2020Vi04, 2018Vi02: ^{162}Eu produced by E=25 MeV, 10-15 μA proton-induced fission on 15 mg/cm^2 ^{nat}U target at JYFLTRAP double Penning trap mass spectrometer located at the Ion-Guide Isotope Separator On-Line (IGISOL) facility in the JYFL Accelerator Laboratory. Thermalized ions extracted out of gas cell by employing a sextupole ion guide and differential pumping are reaccelerated and decontaminated by passing through a dipole magnet. Mass measurements by (TOF-ICR) technique and cyclotron frequencies by (PI-ICR) technique. Deduced excitation energies of isomers.

2021Wa04: 50 MeV proton beam on UCx target at the Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL. Induced fission fragments selected by two-stage dipole magnet separator implanted in moving tape and displaced ≈50 cm to measuring low background station of four HPGe detectors for γ decay and two plastic scintillators for β decay. Measured $\beta\gamma$, $\beta\gamma\gamma$, γ(t) and K_α(t) spectra. Deduced common level scheme of ^{162}Eu β^- g.s. and 158.4 isomer decays. Performed Projected Shell Model calculations. See ^{162}Eu β^- decay dataset.

The existence of g.s. and 158.4 isomeric state was established by two precise independent Penning trap atomic mass measurements done by 2020Or03 and 2020Vi04, with $T_{1/2}$ values associated with the two states: 11.0 s *10* (weighted average of 10.6 s *10* (1987Gr12) and 11.8 s *14* (2017Wu04)) for the g.s., and 15.0 s *5* (2018Ha19) for the isomer.

However, a new $T_{1/2}$ measurement done by 2021Wa04 using the decay curves of five γ rays plus the K_α x rays from ^{162}Eu β^- decay found all six $T_{1/2}$ fit values rather closely distributed around their weighted value of 11.8 s *2*, including the 12.3 s *6* value measured from 205γ(t)+330γ(t) decay and counted by 2021Wa04 as best candidate for $T_{1/2}$ of the isomeric state. Based on their measurement, 2021Wa04 concluded that either $T_{1/2}$'s of g.s. and isomeric states are very close, or that the isomeric state is not seen in the data of this experiment. Consequently their ^{162}Eu β^- decay level scheme (see the decay dataset with this name at ^{162}Gd in this evalution) corresponds most likely to both g.s. and isomer decays (unless only g.s. of ^{162}Eu was populated, which is difficult to prove with the existing data).

It is difficult to assess the data of 2018Ha19 and 2021Wa04. One can observe that the decay curve of 2018Ha19 (Fig. 3(b), corresponding to 165γ+254γ decay) spans a larger interval of counts than the decay curve of 2021Wa04 (Fig. 7(b), corresponding to 165γ decay) which would favor the overall conclusions of 2018Ha19. However, all six measured $T_{1/2}$ values of 2021Wa04 consistent with an undifferentiated value makes judicious the assessment done by 2021Wa04 that most likely one cannot separate at this stage the β decay schemes of ^{162}Eu g.s. and isomeric state.

^{162}Eu Levels

E(level)	J^{π}†‡	$T_{1/2}$†	Comments
0.0	(6^+)	11.4 s *6*	%β^-=100 $T_{1/2}$: Unweighted average of 10.6 s *10* (1987Gr12), 11.8 s *14* (2017Wu04) and 11.78 s *16* (2021Wa04), based on the assumption that all values are from the decay of ^{162}Eu β^- g.s. However, not knowing that the $T_{1/2}$ of the 158.5 isomer ^{162}Eu β^- significantly differs from this value, the adopted $T_{1/2}$ for g.s. is highly hypothetical. 1987Gr12 (see also, 1990An31, 1988GrZY and 1987An03 (preliminary value), all by the same authors): measured the decay of the Gd K x-rays in an isotope-separated source from the spontaneous fission of ^{252}Cf. 2017Wu04: see description in ^{162}Sm Adopted Levels. 2021Wa04: weighted average of the following values: 12.3 *6* (205γ(t) and 330γ(t)), 12.0 *2* (165γ(t)), 11.6 *4* (254γ(t)), 11.7 *12* (863γ(t)), 10.8 *5* (72γ(t)) and 11.6 *3* (K_α(t)). Other: ≈6 s from 1986Ma12 (based on tentative assignment from isotope-separated source from neutron-induced fission of ^{235}U).
158.4 *24*	(3^-)		%β^-=?; %IT=? E(level): Weighted average of 160.2 *24* (2020Or03) and 156.0 *28* (2020Vi04, quoted as weighted

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^{162}Eu IT decay 2018Ha19,2020Or03,2021Wa04 (continued)

^{162}Eu Levels (continued)

E(level)	J^{π}[†][‡]	$T_{1/2}$[†]	Comments
			of 155.9 *30* and 156.8 *94*). $T_{1/2}$: 15.0 s *5* adopted by 2018Ha19 for this isomeric state from fit of summed background-subtracted time spectrum produced by gating on the 165γ+254γ is contradictied by 12.0 s *2* from 165γ decay and 11.6 s *4* from 254γ decay, rather associated with ^{162}Eu g.s. β^- decay.

† Adopted values.

‡ Adopted values proposed by 2021Wa16 (in order to explain the relatively strong β feeding of the 2^+, 3^+, 4^+, 6^+ and 6^- levels) to be: 6^+, ν5/2[413]$\otimes\nu$7/2[633] for g.s. and 3^-, ν5/2[413]$\otimes\nu$1/2[521] for 158.4 isomer, respectively, by comparing with neghboring nuclei (see 2021Wa04 for the list of them). 2018Ha19 proposed (1^+), π5/2[413]ν7/2[633] for g.s. and (6^+), π5/2[413]ν7/2[633] for isomer assuming that they separated the β decay of the isomer based on $T_{1/2}$, which was contradicted by 2021Wa04 $T_{1/2}$ measurements.