

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen		NDS 178, 41 (2021).	12-Nov-2021

$Q(\beta^-)=17320$ SY; $S(n)=2650$ SY; $S(p)=17750$ SY; $Q(\alpha)=-14190$ SY [2021Wa16](#)
 $Q(\beta^-)$: other: 16950 590 deduced by evaluators from measured mass excess(⁶⁴V)=-16690 510 ([2020Mi13](#)) and evaluated mass excess(⁶⁴Cr)=-33640 300 ([2021Wa16](#)). Evaluated mass excess(⁶⁴V)=-16320 400 (syst,[2021Wa16](#)).
 Estimated uncertainties: $\Delta Q(\beta^-)=500$, $\Delta S(n)=530$, $\Delta S(p)=640$, $\Delta Q(\alpha)=640$ ([2021Wa16](#)).
 $Q(\beta^-n)=11790$ 410, $S(2n)=7250$ 480, $S(2p)=38210$ 720 (syst,[2021Wa16](#)).
 $Q(\beta^-2n)=8390$ 400 (syst) and $Q(\beta^-3n)=1960$ 400 (syst), deduced by evaluators from evaluated mass excesses of ⁶⁴V, ⁶²Cr and ⁶¹Cr in [2021Wa16](#).
[1997Be70](#): ⁶⁴V produced by ⁹Be(²³⁸U,F), E=750 MeV/nucleon, fragments separator (FRS), identification by time-of-flight. A total of two counts was observed with cross section of 0.3 nb.
[2011Da08](#) (also [2002MaZN](#) thesis): ⁶⁴V produced in the fragmentation of 57.8 MeV/nucleon ⁸⁶Kr beam impinged on 50 mg/cm² thick tantalum target using LISE-2000 spectrometer at GANIL facility. Detector system included a three-element Si-detector telescope containing a double-sided silicon-strip detector (DSSSD) backed by a Si(Li) detector and surrounded by four clover type EXOGAM Ge detectors. Product identified by mass, atomic number, charge, energy loss and time of flight. Measured half-life from timing of β measurement.
[2014Su11](#): ⁶⁴V produced at the NSCL-MSU facility by the fragmentation of a ⁷⁶Ge beam, E=130 MeV/nucleon, impinging on ⁹Be target. Products were selected by the A1900 fragment separator and identified by time of flight and energy loss information, then delivered to β counting system (BCS) surrounded by SeGA Ge array for γ -ray detection. The ⁶⁴V ions were finally stopped in 1 mm thick DSSD which detected β particles. Measured E_γ , (⁶⁴V) γ coincidence, $\beta\gamma$ correlated spectra. Deduced levels, half-life, an isomer in ⁶⁴V.
 Theoretical structure calculations: two primary references in the NSR database at www.nndc.bnl.gov.
[Additional information 1](#).

⁶⁴V Levels

Cross Reference (XREF) Flags

- A ⁹Be(⁷⁶Ge,X γ)
- B ⁹Be(²³⁸U,F γ)

E(level)	J ^{π}	T _{1/2}	XREF	Comments
0	(0,1,2)	15 ms 2	AB	$\% \beta^- = 100$; $\% \beta^- n = ?$; $\% \beta^- 2n = ?$; $\% \beta^- 3n = ?$ Only the β^- decay mode has been observed, thus 100% β^- decay is assigned by inference. In the study of ⁶⁴ V decay to ⁶⁴ Cr, 2014Su11 did not observe any γ ray which could be assigned to ⁶³ Mn, β^-n daughter of ⁶⁴ V, from which $\% \beta^- n$ could be assigned ≈ 0 . However, there could be β^-n decay of ⁶⁴ V to the ground state of ⁶³ Mn. Theoretical T _{1/2} =9.0 ms, $\% \beta^- n = 29$, $\% \beta^- 2n = 2$, $\% \beta^- 3n = 0.0$ (2019Mo01). Theoretical T _{1/2} =18.6 ms, $\% \beta^- n = 12$, $\% \beta^- 2n = 1.7$, $\% \beta^- 3n = 0.1$ (2016Ma12). E(level): the observed activity is assumed to correspond to the g.s. J ^{π} : proposed by 2014Su11 based on non-observation of β feeding of (4 ⁺) state in ⁶⁴ Cr. Other: 2 ⁻ or 7 ⁻ from $\Omega_p = 5/2^-$ and $\Omega_n = 9/2^+$ (2019Mo01 , theory). T _{1/2} : weighted average of 15 ms 2 (2014Su11) and 19 ms 8 (2011Da08). 2014Su11 : β decay curve fitted with known half-lives of ⁶⁴ Cr and ⁶⁴ Mn and a constant background. Contribution from β^-n decay mode was not included due to the absence of any γ rays from β -delayed neutron emission of ⁶⁴ V. 2011Da08 (also 2002MaZN): from time correlation between implantation and β -ray events in the DSSSD; the fitting procedure included five parameters: β -detection efficiency, background rate, mother, daughter and granddaughter half-lives.
81.9 4		571 ns 58	AB	$\%IT = 100$

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ${}^{64}\text{V}$ Levels (continued)

<u>E(level)</u>	<u>J^π</u>	<u>T_{1/2}</u>	<u>XREF</u>	<u>Comments</u>
				E(level): assuming that 81-keV transition feeds the ground state. There seems no experimental verification of this assumption in 2014Su11 , thus the level energy of the isomer is treated as tentative by the evaluator. T _{1/2} : from 82γ(t) in 2021Wi05 . Other: <1 μs from delayed γ rays measured 300 ns after implantation of ${}^{64}\text{V}$ ions (2014Su11), thus T _{1/2} may be greater than 100 ns or so.

γ(${}^{64}\text{V}$)

<u>E_i(level)</u>	<u>E_γ</u>	<u>I_γ</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Mult.</u>	<u>α[†]</u>	<u>Comments</u>
81.9	81.9 4	100	0	(0,1,2)	[E2]	0.820 17	B(E2)(W.u.)=9.7 11 (2021Wi05) E _γ : weighted average of 81.0 7 from (${}^{76}\text{Ge}$,Xγ) (2014Su11) and 82.0 3 from (${}^{238}\text{U}$,Fγ) (2021Wi05). Mult.: E2 multipolarity is assigned by 2021Wi05 , based on Weisskopf estimates for transition probabilities of various multipolarities. Authors mention that M1 admixture is not ruled out. But it is not clear how E1 or E1 with small M2 admixture is ruled out.

[†] 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, GammasLevel Scheme

Intensities: Relative photon branching from each level

