^{65}Fe β^- decay (0.805 s) 2019Ol02,2009Pa16

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 202,59 (2025)	25-Feb-2025

Parent: ^{65}Fe: E=0; J^π=(1/2$^-$); $T_{1/2}$=0.805 s *10*; Q(β^-)=7967 *6*; %β^- decay=100

^{65}Fe-J^π,$T_{1/2}$: From Adopted Levels of ^{65}Fe. Adopted $T_{1/2}$ is taken from 2019Ol02 in this dataset. Other: 0.81 s *5* (2009Pa16).

^{65}Fe-Q(β^-): From 2021Wa16.

Adapted from the XUNDL dataset for 2009Pa16 compiled by by B. Karamy and B. Singh (McMaster), also including some data received from D. Pauwels in an email reply to B. Singh on May 12, 2009; and the XUNDL dataset for 2019Ol02 compiled by E.A. McCutchan (NNDC,BNL) on December 20, 2020.

2019Ol02: ^{65}Fe source was from the decay of ^{65}Mn produced by ^{238}U(p,F) with 1.4 MeV proton from the pulsed CERN Proton Synchrotron Booster on an UC_x target. Fission products thermally released from the target were ionized by the ISOLDE Resonance Ionization Laser Ion Source (RILIS), mass separated and implanted on a thin aluminum foil surrounded by a fast plastic scintillator for detecting β particles and two truncated-cone shaped $LaBr_3$(Ce) crystals and two HPGe detectors for detecting γ rays. Measured Eγ, Iγ, $\beta\gamma\gamma$-coin, $\beta\gamma$(t), $\beta\gamma\gamma$(t). Deduced levels, J, π, $T_{1/2}$, β-decay branching ratios, log *ft*. Comparisons with shell-model calculations with the LNPS interaction. Even though a saturated mixed source of ^{65}Fe g.s. and isomer was used, the decay scheme of ^{65}Fe g.s. β decay can be constructed based on $\gamma\gamma$-coin gating on 883γ and γ singles which are only seen in the decay of ^{65}Fe ground state.

2009Pa16: ^{65}Fe source was produced by ^{238}U(p,F) with 30 MeV proton from the LISOL facility of the Cyclotron Research Center (CRC) at Louvain-La-Neuve (Belgium) on a 10 mg/cm^2 ^{238}U target inside a gas catcher for stopping and thermalizing the recoiling fission products. Ions leaving the gas are transported through a SextuPole Ion Guide (SPIG), accelerated, mass separated, and implanted into a detection tape surrounded by three thin plastic ΔE detectors for detecting β particles and two MINIBALL clusters for detecting γ rays. Measured Eγ, Iγ, $\beta\gamma\gamma$-coin, γ(t). Deduced levels, J, π, parent $T_{1/2}$, β-decay branching ratios, log *ft*. 2009Pa16 also study ^{65}Fe decay using ^{65}Fe source produced in deep inelastic reaction ^{238}U(^{64}Ni,Xγ) with E=430 ^{64}Ni beam at ANL and measuring $\beta\gamma\gamma\gamma$-coin.

2005GaZR (thesis): ^{65}Fe source is from the decay of ^{65}Mn produced by fragmentation of a 61.8 MeV/nucleon ^{76}Ge beam on a ^{58}Ni target at GANIL. Measured Eγ, Iγ. Deduced levels, J, π, decay branching ratios, log *ft*. Report 7 transitions.

The decay scheme is considered incomplete by the evaluator due to possible missing levels in a large energy gap of about 5.5 MeV between the highest observed level at E=2470 keV and Q-value=7967 keV *6*, mainly because of possible unobserved γ rays from those levels.

^{65}Co Levels

E(level)[†‡]	J^π[#]	$T_{1/2}$[@]	Comments
0.0	(7/2)$^-$	1.16[#] s *3*	
882.69 *7*	(3/2$^-$)	4 ps *4*	
1095.34 *8*	(1/2$^-$)	1.250 ns *20*	
1222.76 *7*	(3/2$^-$)	55 ps *6*	
1557.47 *7*	(3/2$^-$,5/2,7/2$^-$)		
1948.20 *12*			
1959.13 *8*	(3/2$^-$)	<90 ps	J^π: (1/2$^-$,3/2$^-$) in 2009Pa16 and 2019Ol02.
1996.52 *6*	(3/2$^-$)	<90 ps	
2183.83 *11*	(1/2$^-$,3/2$^-$)	<160 ps	
2276.07 *12*			
2470.12 *12*	(3/2$^-$,5/2,7/2$^-$)		

† Additional information 1.

‡ From a least-squares fit to γ-ray energies.

\# From Adopted Levels.

@ From $\beta\gamma$(t) or $\beta\gamma\gamma$(t) (883 and 1223 levels only) in 2019Ol02, with the limit deduced from lack of a delayed component in $\beta\gamma$(t), unless otherwise noted. Values are adopted in Adopted Levels.

^{65}Fe β^- decay (0.805 s) 2019Ol02,2009Pa16 (continued)

β^- radiations

av Eβ: Additional information 2.

E(decay)	E(level)	I$\beta^{-\dagger\ddagger}$	Log *ft*	Comments
(5497 *6*)	2470.12	1.29	5.98	av Eβ=2489.1 *29* Iβ^-: 1.3 *1* (2019Ol02).
(5691 *6*)	2276.07	0.49	6.5	av Eβ=2583.4 *29* Iβ^-: 0.5 *1* (2019Ol02).
(5783 *6*)	2183.83	11.1	5.1	av Eβ=2628.1 *29* Iβ^-: 11.2 *7* (2019Ol02), 10 *2* (2009Pa16).
(5971 *6*)	1996.52	36.3	4.69	av Eβ=2719.0 *29* Iβ^-: 35 *2* (2019Ol02), 40 *6* (2009Pa16).
(6008 *6*)	1959.13	22.3	4.91	av Eβ=2737.5 *29* Iβ^-: 24 *1* (2019Ol02), 20 *3* (2009Pa16).
(6019 *6*)	1948.20	0.55	6.5	av Eβ=2742.8 *29* Iβ^-: 0.6 *1* (2019Ol02).
(6410 *6*)	1557.47	0.92	6.4	av Eβ=2933.0 *29* Iβ^-: 0.9 *2* (2019Ol02).
(6744 *6*)	1222.76	17.8	5.2	av Eβ=3095.5 *29* Iβ^-: 18 *3* (2019Ol02), 18 *5* (2009Pa16).
(6872 *6*)	1095.34	2.5	6.1	av Eβ=3157.8 *29* Iβ^-: 2.8 *6* (2019Ol02), <3 (2009Pa16).
(7084 *6*)	882.69	7	5.9	av Eβ=3261.1 *29* Iβ^-: 5 *5* (2019Ol02), 12 *3* (2009Pa16).

† From γ+ce intensity balance at each level. All β feedings should be considered as upper limits and thus associated log *ft* values as lower limits, due to possible missing γ rays in this incomplete decay scheme. Original values from 2019Ol02 and 2009Pa16 deduced in the same way by the authors are given under comments.

‡ Absolute intensity per 100 decays.

$\gamma(^{65}Co)$

Iγ normalization: 0.613 *31* from Σ[%I(γ+ce to g.s.)]=100. Due to possible missing unobserved transitions to g.s. in this incomplete decay scheme, this value should be considered as an upper limit. 2019Ol02 use intensity balance of entire A=65 decay chain to determine that β feeding to ground state is <0.3%. 2009Pa16 give a normalization factor of 0.20 *6*, which the evaluator could not reproduce from the level scheme given by 2009Pa16.

E_γ [‡]	I_γ [‡#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α [†]	Comments
127.3 *1*	2.2 *2*	1222.76	(3/2⁻)	1095.34	(1/2⁻)	[M1]	0.02147 *30*	α(K)=0.01926 *27*; α(L)=0.001924 *27*; α(M)=0.000268 *4* α(N)=1.171×10^{-5} *17* %Iγ=1.3 E_γ,I_γ: others: 127.6 *3* with Iγ=3.4 *12* (2009Pa16); 127.7 *5* with Iγ=2 *1* (2009Pa16, ^{65}Fe from deep inelastic).
212.7 *1*	12.1 *9*	1095.34	(1/2⁻)	882.69	(3/2⁻)	[M1,E2]	0.018 *12*	α(K)=0.016 *11*; α(L)=0.0016 *11*; α(M)=2.3×10^{-4} *15* α(N)=9 %Iγ=7.4 E_γ: others: 212.5 *2* (2009Pa16); 212.0 *2* with Iγ=6 *2* (2009Pa16, ^{65}Fe from deep inelastic). I_γ: weighted average of 11.1 *13* (2009Pa16) and 12.5 *9* (2019Ol02).
340.10 *6*	48 *2*	1222.76	(3/2⁻)	882.69	(3/2⁻)	[M1,E2]	0.0037 *18*	α(K)=0.0033 *16*; α(L)=3.2×10^{-4} *16*; α(M)=4.5×10^{-5} *22* α(N)=1.9×10^{-6} *9* %Iγ=29 E_γ: weighted average of 340.07 *6* (2009Pa16) and 340.2 *1* (2019Ol02). Others: 339.7 *2* with Iγ=40 *3* (2009Pa16, ^{65}Fe from deep inelastic); 340 *2* with Iγ=28 (2005GaZR); 340.0 *3* assigned to ^{65}Ni by 1988Bo06.
439.1 *1*	1.7 *1*	1996.52	(3/2⁻)	1557.47	(3/2⁻,5/2,7/2⁻)			%Iγ=1.0
626.4 *2*	0.4 *1*	2183.83	(1/2⁻,3/2⁻)	1557.47	(3/2⁻,5/2,7/2⁻)			%Iγ=0.25
674.9 *1*	1.3 *1*	1557.47	(3/2⁻,5/2,7/2⁻)	882.69	(3/2⁻)			%Iγ=0.8
736.4 *1*	24 *2*	1959.13	(3/2⁻)	1222.76	(3/2⁻)			%Iγ=15 E_γ: others: 736.1 *10* (2009Pa16); 736.1 *2* with Iγ=20 *1* (2009Pa16, ^{65}Fe from deep inelastic); 738 *2* with Iγ=20 (2005GaZR). I_γ: weighted average of 22 *2* (2009Pa16) and 26 *2* (2019Ol02).
773.8 *1*	4.6 *3*	1996.52	(3/2⁻)	1222.76	(3/2⁻)			%Iγ=2.8 E_γ,I_γ: others: 774.0 *10* with Iγ=6 *4* (2009Pa16); 773.8 *5* with Iγ=4 *2* (2009Pa16, ^{65}Fe from deep inelastic).
863.9 *1*	1.4 *1*	1959.13	(3/2⁻)	1095.34	(1/2⁻)			%Iγ=0.86 E_γ,I_γ: others: 864.0 *10* with Iγ=1.8 *10* (2009Pa16); 863.8 *5* with Iγ=3 *1* (2009Pa16, ^{65}Fe from deep inelastic).

$^{65}_{27}Co_{38}$-3

$\gamma(^{65}$Co) (continued)

E_γ ‡	I_γ ‡#	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α †	Comments
882.65 *15*	100 *7*	882.69	(3/2$^-$)	0.0	(7/2)$^-$	[E2]	0.000296 *4*	α(K)=0.000267 *4*; α(L)=2.59×10^{-5} *4*; α(M)=3.60×10^{-6} *5* α(N)=1.599×10^{-7} *22* %Iγ=61 E_γ: unweighted average of 882.50 *9* (2009Pa16) and 882.8 *1* (2019Ol02). Others: 883.3 *2* with Iγ=100 (2009Pa16, ^{65}Fe from deep inelastic); 882 *2* with Iγ=100 (2005GaZR); 882.6 *5* assigned to ^{65}Ni by 1988Bo06.
901.2 *1*	0.9 *1*	1996.52	(3/2$^-$)	1095.34	(1/2$^-$)			%Iγ=0.55
960.8 *3*	14 *2*	2183.83	(1/2$^-$,3/2$^-$)	1222.76	(3/2$^-$)			%Iγ=8.6 E_γ: unweighted average of 960.5 *2* (2009Pa16) and 961.1 *1* (2019Ol02). Others: 961.4 *2* with Iγ=13 *3* (2009Pa16, ^{65}Fe from deep inelastic); 961 *2* (2005GaZR). I_γ: weighted average of 9 *3* (2009Pa16) and 14 *1* (2019Ol02). Other: 12 (2005GaZR).
1053.3 *1*	0.8 *1*	2276.07		1222.76	(3/2$^-$)			%Iγ=0.49
1065.5 *1*	0.9 *1*	1948.20		882.69	(3/2$^-$)			%Iγ=0.55
1076.3 *1*	10.6 *11*	1959.13	(3/2$^-$)	882.69	(3/2$^-$)			%Iγ=6.5 E_γ: others: 1076.2 *3* (2009Pa16), 1077 *2* (2005GaZR). I_γ: weighted average of 8.3 *18* (2009Pa16) and 11.1 *8* (2019Ol02). Other: 39 from 2005GaZR is discrepant.
1088.5 *1*	3.7 *3*	2183.83	(1/2$^-$,3/2$^-$)	1095.34	(1/2$^-$)			%Iγ=2.3 E_γ,I_γ: others: 1088.7 *6* with Iγ=3.9 *13* (2009Pa16); 1089.1 *2* with Iγ=8 *3* (2009Pa16, ^{65}Fe from deep inelastic).
1113.7 *1*	14 *1*	1996.52	(3/2$^-$)	882.69	(3/2$^-$)			%Iγ=8.6 E_γ,I_γ: other: 1113.5 *3* with Iγ=15 *2* (2009Pa16).
1222.8 *1*	22 *2*	1222.76	(3/2$^-$)	0.0	(7/2)$^-$	[E2]	0.0001496 *21*	α(K)=0.0001234 *17*; α(L)=1.189×10^{-5} *17*; α(M)=1.658×10^{-6} *23* α(N)=7.40×10^{-8} *10*; α(IPF)=1.258×10^{-5} *18* %Iγ=13 E_γ: others: 1222.7 *2* (2009Pa16); 1222 *2* (2005GaZR). I_γ: weighted average of 23 *3* (2009Pa16) and 21 *2* (2019Ol02). Other: 12 (2005GaZR).
1557.4 *1*	2.3 *2*	1557.47	(3/2$^-$,5/2,7/2$^-$)	0.0	(7/2)$^-$			%Iγ=1.4
1587.4 *1*	1.6 *1*	2470.12	(3/2$^-$,5/2,7/2$^-$)	882.69	(3/2$^-$)			%Iγ=0.98
1958.8 *5*	0.4 *1*	1959.13	(3/2$^-$)	0.0	(7/2)$^-$			%Iγ=0.25 I_γ: from the level scheme in FIG.4 of 2019Ol02. The value of 0.1 *1* in TABLE I of 2019Ol02 is likely a misprint. Authors′ B(E2)(W.u.) value for this γ in TABLE III is consistent with Iγ=0.4 but not 0.1.
1996.5 *1*	38 *4*	1996.52	(3/2$^-$)	0.0	(7/2)$^-$			%Iγ=23 E_γ: others: 1996.6 *4* (2009Pa16); 1993 *2* (2005GaZR).

$^{65}_{27}Co_{38}$-4

$\gamma(^{65}$Co) (continued)

E_γ [‡]	I_γ [‡#]	E_i(level)	J_i^π	E_f	J_f^π	Comments
						I_γ: weighted average of 44 *4* (2009Pa16) and 35 *3* (2019Ol02). Other: 18 from 2005GaZR is discrepant. Additional information 3.
2470.4 *5*	0.5 *1*	2470.12	$(3/2^-,5/2,7/2^-)$	0.0	$(7/2)^-$	%Iγ=0.31

† Additional information 4.

‡ From 2019Ol02, unless otherwise noted. Values reported in 2009Pa16 are from the measurement using ^{65}Fe source from ^{238}U(p,F); values from the decay of ^{65}Fe source produced in deep inelastic reaction ^{238}U(^{64}Ni,Xγ) in 2009Pa16 are given under comments as noted where available and these values were communicated to B. Singh in an e-mail reply from D. Pauwels (first author of 2009Pa16) on May 12, 2009.

\# For absolute intensity per 100 decays, multiply by 0.613.

$^{65}_{27}$Co$_{38}$-5

^{65}Fe β^- decay (0.805 s) 2019Ol02,2009Pa16

Decay Scheme

Intensities: I_γ per 100 parent decays