^{186}Re IT decay (2.0×10^5 y) 1972Se06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. C. Batchelder and A. M. Hurst, M. S. Basunia	NDS 183, 1 (2022)	1-Mar-2022

Parent: ^{186}Re: E=148.2 *5*; $J^\pi=(8^+)$; $T_{1/2}=2.0\times10^5$ y; %IT decay=100.0

^{186}Re-%IT decay: assuming no β^- or ε decay from isomeric state. β^- decay could feed only the 869 level in ^{186}Os, and 1972Se06 place a limit of ≈10% on such a branch based on their failure to observe the E2 435γ known to deexcite that level. Q(ε) to J≥6 levels in ^{186}W is negative. Also, the observed ratio of I(γ+ce) deexciting the 2^+ levels in the ε and β^- decay daughters is the same for both the g.s. decay and the isomer decay.

1972Se06: sources from ^{185}Re(n,γ), chemically purified and aged 0, 4 or 20 years; 4-year old source thicknesses 0.25 and ≈0.025 mg/cm^2; three Ge(Li) detector systems (8 cc, 0.5 cc with FWHM=330 eV at 14 keV, 20 cc detectors), windowless Si(Li) detector with FWHM≈1 keV at 130 keV; measured $T_{1/2}$, Eγ, Iγ, E(ce), I(ce), x-ray intensities for isomer, and γ and x-ray intensities for ^{186}Re (3.7185 d) decay.

The decay scheme is that of 1972Se06. A possible, unobserved E=1.93 *50* E5 transition connecting the isomer to the known $(3)^-$ 146 keV level, postulated in 1988Fi06 to explain a small excess in K x-ray intensity, has not been adopted; 1972Se06 concluded that the observed I(K x ray) could be explained adequately on the basis of conversion of the 99γ alone.

^{186}Re Levels

E(level)†	J^π†	$T_{1/2}$	Comments
0.0	1^-	3.7185 d *5*	
59.010 *3*	2^-		
99.361 *3*	3^-	25.5 ns *25*	
148.2 *5*	(8^+)	2.0×10^5 y	%IT=100 E(level): Other: 149 keV *7* deduced from Eγ (1972Se06). J^π: Deduced configuration $K^\pi=8^+$, $\pi5/2[402]\otimes\nu11/2[615]$ (1972Se06). $T_{1/2}$: From mass spectrometry and average absolute photon intensity measurements in 1972Se06; uncertainty not stated. Secondary datum: 1.7×10^5 y from consistency check that measured equilibrium β^- activity using a proportional counter, corrected for β^- self-absorption and photon background (1972Se06).

† From Adopted Levels.

$\gamma(^{186}Re)$

Iγ normalization: Assuming Σ(I(γ+ce) to g.s.)=100; consistent with Iγ normalization=0.889 *23* based on Σ(I(γ+ce) from 99 level)=100.

In the table below, the quoted x-ray energies are taken from Table 2 of 1972Se06 and the intensities are taken from Table 4 of 1972Se06. The average energy is reported for unresolved contributions from Re Kβ_1 + W Kβ_2, Re Kβ_2 + Os Kβ_1, and Re Lγ x rays.

Measured K and L X-ray intensities in ^{186m}Re per 137-keV γ observed in ^{186}Os following β^- decay of ^{186g}Re.

x ray	energy (keV)	I_x
Re Kα_1	61.13	0.070 *6*
Re Kα_2	59.71	0.030 *12*
Re Kβ_1 + W Kβ_2	69.20	0.063 *2*
Re Kβ_2 + Os Kβ_1	71.31	0.074 *3*
Re Lα	8.67	1.80 *1*
Re Lβ	10.07	2.73 *2*
Re Lγ	12.03	0.42 *3*

Continued on next page (footnotes at end of table)

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$\gamma(^{186}Re)$ (continued)

E_γ [†]	I_γ [‡ b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ [#]	α [a]	$I_{(\gamma+ce)}$ [c]	Comments
40.350 *3*	5.68 *4*	99.361	3^-	59.010	2^-	M1+E2	0.145 *6*	17.7 *5*		α(L)=13.6 *4*; α(M)=3.21 *9* α(N)=0.773 *22*; α(O)=0.1233 *32*; α(P)=0.00653 *9* E_γ: 40.29 from 1972Se06. δ: adopted value; weighted average of 0.146 *6* from intensity balance through 59-keV level (1972Se06) and 0.124 *+33−45* in (n,γ) E=thermal (1969La11).
48.84[&] *50*		148.2	(8^+)	99.361	3^-	(E5)[@]		4.8×10^6 *4*	100	ce(L)/(γ+ce)=0.51 *4*; ce(M)/(γ+ce)=0.38 *4* ce(N)/(γ+ce)=0.098 *11*; ce(O)/(γ+ce)=0.0102 *12*; ce(P)/(γ+ce)=7.7×10^{-6} *8* α(L)=2.48×10^6 *19*; α(M)=1.82×10^6 *16* α(N)=4.7×10^5 *4*; α(O)=4.9×10^4 *4*; α(P)=36.8 *26*
59.009 *4*	20.1 *2*	59.010	2^-	0.0	1^-	M1+E2	0.042 *10*	4.21 *7*		α(L)=3.25 *5*; α(M)=0.744 *12* α(N)=0.1804 *30*; α(O)=0.0302 *5*; α(P)=0.002171 *30* E_γ: 58.98 from 1972Se06. I_γ: weighted average of 20.2 *1* and 19.8 *2* (1972Se06).
99.362 *4*	1.21 *5*	99.361	3^-	0.0	1^-	E2		4.23 *6*		α(K)=0.848 *12*; α(L)=2.55 *4*; α(M)=0.650 *9* α(N)=0.1543 *22*; α(O)=0.02198 *31*; α(P)=7.86×10^{-5} *11* E_γ: 99.33 from 1972Se06.

[†] From adopted gammas, unless noted otherwise.
[‡] From 1972Se06, relative to I(137γ, ^{186}Os)=10.0 *1*, except as noted.
[#] From adopted gammas, except as noted.
[@] L2/L3≈0.6, L1<<L2 from authors′ analysis of Re L_α x ray and L_β x ray intensity data; L/M≈1 from I(ce) excess (cf. relative I(ce) in (n,γ)) near 40ce(M) and 59ce(L) peaks (1972Se06). E5 theory (2008Ki07) is consistent, giving L1:L2:L3:M=0.3:12.5:12.1:18.2 at 48.84 keV: L2/L3≈1, L1/L2≈0.02, and L/M≈1. M5 theory gives L1:L2:L3:M=5.5:0.9:86.7:49.6 for same γ: L2/L3≈0.01, L1/L2≈6, and L/M≈2 ; also, no 8^- level is known or expected in adjacent odd-odd isotopes. Multipolarities with L<5 are eliminated because the reduced transition probability would be less than 6×10^{-6}.
[&] Eγ deduced according to energy-level difference from precision measurement of (8^+) isomer in 2015Ma60.
[a] Additional information 1.
[b] For absolute intensity per 100 decays, multiply by 0.901 *15*.
[c] Absolute intensity per 100 decays.

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Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

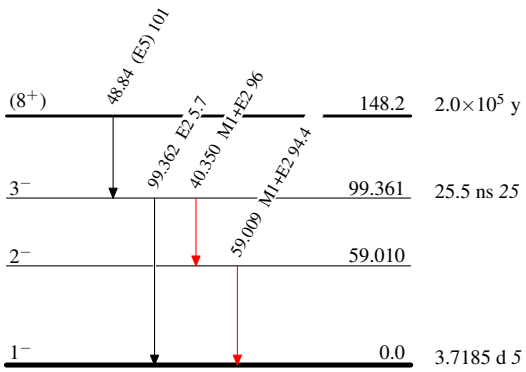
%IT=100.0

Legend

$I_\gamma < 2\%\times I_\gamma^{max}$

$I_\gamma < 10\%\times I_\gamma^{max}$

$I_\gamma > 10\%\times I_\gamma^{max}$



$^{186}_{75}Re_{111}$