Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109,1103 (2008)	1-Mar-2008

Q(β^-)=−6.46×10^3 *8*; S(n)=9.32×10^3 *8*; S(p)=3.2×10^2 *8*; Q(α)=5.46×10^3 *5* 2012Wa38
Note: Current evaluation has used the following Q record −6410 syst 9260 syst 280 syst 5510 syst 2003Au03.
Uncertainty in Q(β^-), S(n), S(p) and Q(α) is 90, 90, 90 and 70, respectively (2003Au03).
Q(α): 2003Au03 deduce Q(α) from Eα in ^{166}Re α-decay (1992Me10 and 1996Pa01) assuming an E(level)=150 *50* to g.s. transition. If, instead, it were a g.s. to g.s. transition, those two measurements would imply Q(α)=5657 *16*.
Assignment: ^{93}Nb(^{84}Kr,α7n), ^{89}Y(^{84}Kr,7n), E=5.1 to 5.5 MeV/u and 5.8 to 6.4 MeV/u, excit (1978Sc26); ^{141}Pr(^{32}S,pxn), E=204 MeV, excit (1992Me10).

^{166}Re Levels

Cross Reference (XREF) Flags

A ^{170}Ir α decay (0.87 s)
B ^{170}Ir α decay (811 ms)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0	‡	2.25[#] s *21*	A	%α<24; %ε+%β^+>76 %α: Both α decay and ε decay have been observed, but the branching has not been measured. Based on a comparison of excitation function data for the various nuclides they studied, 1978Sc26 estimate 30≤%α(^{166}Re)≤100. However, based on T$_{1/2}$ and assuming r$_0$(^{162}Ta)=1.562 *3* (unweighted average of r$_0$=1.567 *24* (^{160}Hf), 1.556 *16* (^{162}W), 1.563 *11* (^{164}W) from 1998Ak04), %α<24 for HF>1 if a g.s. to g.s. transition is assumed and %α<6 if Q(α)=5510 *70* from 2003Au03; further, if this is an unhindered decay, HF<4 would imply %α>6 or >1.35 respectively, for these two Q(α) possibilities. The evaluator adopts an upper limit of 24 for %α, implying %ε+%β^+>76 since p decay is not expected (S(p)>0 from 2003Au03). The much higher estimate of %α in 1978Sc26 might Be unreliable due to the similarity of both Eα and T$_{1/2}$ for the ^{166}Re and ^{165}Re decays.
0.0+x			B	E(level): it is not known whether this is the g.s. or an excited state.
0.0+y	(3$^-$)		A	E(level): this may or may not Be the g.s.; if it is, y=0. However, a comparison of Eα from low-spin ^{170}Ir α decay with Q(α) from systematics (2003Au03) suggests that it is not. J$^\pi$: α decay is possibly unhindered (HF=4.4 *18*) from (3$^-$) low-spin isomer in ^{170}Ir.
53+x			B	E(level): an alternative value of 69+x is possible because the order of the 53γ and the 69γ has not been established. π probably opposite to π(0+x) level based on (E1) 53γ to 0.0+x level.
65+x			B	π probably same as π(0+x) level based on (E1) 110γ from 175+x level.
75+x			B	E(level): 70+x 14 from energy difference between possible α group feeding this level and the 6121α feeding the 0+x level. π probably same as π(0+x) level based on (M1) 75γ to 0.0+x level.
122+x			B	E(level): 117+x 12 from energy difference between possible α group feeding this level and the 6121α feeding the 0+x level. π probably opposite to π(0+x) level based on (E1) 122γ to 0.0+x level.
175+x			B	E(level): 174+x 14 from energy difference between possible α group feeding this level and the 6121α feeding the 0+x level. π probably opposite to π(0+x) level based on (E1) 175γ to 0.0+x level.

[†] From Eγ, except as noted.

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Adopted Levels, Gammas (continued)

^{166}Re Levels (continued)

‡ The lowest-energy orbitals available for the 75th proton are probably 1/2[411] ($d_{3/2}$) and 9/2[514] ($h_{11/2}$) based on possible $J^\pi=(1/2^+)$ and $(9/2^-)$ for the g.s. of ^{165}Re and ^{167}Re, respectively; the lowest-energy neutron orbital available to the 91st neutron is probably 5/2[523] ($f_{7/2}$) based on $J^\pi=(5/2^-)$ for the g.s. of the isotone ^{165}W (1995Hi02). If the deformation is large enough for the Gallagher-Moszkowski rule to Be valid, low-lying 3^- and 7^+ states might Be expected, but no low-lying isomeric excited state has been identified in ^{166}Re as yet. ε decay to ^{166}W indicates an intensity imbalance at each of the 2^+, 4^+ and 6^+ levels observed so far; this is probably the result of a very incomplete decay scheme, so this provides no useful indication of J^π(g.s.) for ^{166}Re. The possibility that the 0+x or the 0+y level is, in fact, the g.s. cannot Be ruled out.

Weighted average of 2.23 s *27* from 252γ(t) and 2.28 s *34* from 424γ(t) in ε decay (1992Me10). Other data: 2.2 s *4* (1978Sc26, for Eα=5495 *10*); 1.9 s *11* (1992Me10, for Eα=5501 *13*; however, A=165 contribution cannot Be ruled out); the Eα=5506 *10*, 2.4 s *6* line assigned by 1981Ho10 to ^{165}Re has $T_{1/2}$ and Eα consistent with those for ^{166}Re (to which 1978Sc26 assign their 5495 *10* line and 1982De11 assign their 5527 *4* line) but 1996Pa01 confirm its assignment to ^{165}Re. $T_{1/2}$=2.8 s *3* (1984Sc06, for Eα=5372 *10*) was assigned by those authors to ^{166}Re, but neither 1992Me10 nor 1996Pa01 see this line so the evaluator presumes it to have been misassigned. Note that the assignment of this $T_{1/2}$ to the ^{166}Re g.s. here is at variance with the assumption in 2003Wa32 that the observed ^{166}Re α decay takes place from an excited state, unless both states have comparable $T_{1/2}$.

$\gamma(^{166}Re)$

E_i(level)	E_γ †	E_f	Mult. ‡	α #	Comments
53+x	53 @	0.0+x	(E1)	0.410	See comments on 53γ from 175+x level.
65+x	(65)	0.0+x	[M1]	3.12	E_γ,Mult.: γ expected to form a cascade with 110γ to 0+x level in ^{170}Ir α decay (811 ms); may Be a highly-converted transition because transition is not evident in relevant α-γ coin spectrum, so 2007Ha45 suggest M1 multipolarity, consistent with level scheme.
75+x	75	0.0+x	(M1)	11.75	Mult.: suggested in ^{170}Ir α decay (811 ms) based on 6053α-γ coin spectrum which includes significant I(K x ray) attributed to internal conversion of the 75γ; analogous to authors′ observations for known M1 92γ from ^{171}Re α decay.
122+x	(47)	75+x			E_γ: highly tentative; however, observation of 2007α-75γ coin (2007Ha45) suggests the existence of a transition connecting the 122+x and 75+x levels and such a transition may Be too highly converted to Be seen in α-γ coincidence spectrum. Level scheme implies $\Delta\pi$=(yes), suggesting a multipolarity of M2 or higher.
	69	53+x	[M1]	2.62	
	122	0.0+x	(E1)	0.229	Mult.: since I(75γ)/I(Kα x ray) in ^{170}Ir α decay (811 ms) is approximately the same in spectra gated by the 6053α and by the 6007α, 2007Ha45 conclude that the 122γ is probably E1 since it provides no significant contribution to K x ray peak′s intensity via internal conversion.
175+x	53 @&	122+x	[M1,E2]	40 *40*	This second placement of 53γ is suggested by energy difference between 175γ and 122γ that deexcite the same level.
					Mult.: assumed, based on level scheme; however, I(53γ)/I(122γ) in ^{170}Ir α decay (811 ms) is approximately the same in the spectra gated by 5951α or by the 6007α (2007Ha45). Authors favor M1 multipolarity for this component and E1 for the other.
	110	65+x	(E1)	0.300	Mult.: based on an argument similar to that used by 2007Ha45 to assign multipolarity to 122γ.
	175	0.0+x	(E1)	0.0906	Mult.: based on an argument similar to that used by 2007Ha45 to assign multipolarity to 122γ.

† From ^{170}Ir α decay (811 ms); uncertainties unstated by authors.

‡ Very tentative values from arguments based on γ and K x ray intensities in α-γ coin spectra in ^{170}Ir α decay (811 ms), except

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Adopted Levels, Gammas (continued)

$\gamma(^{166}Re)$ (continued)

as noted.

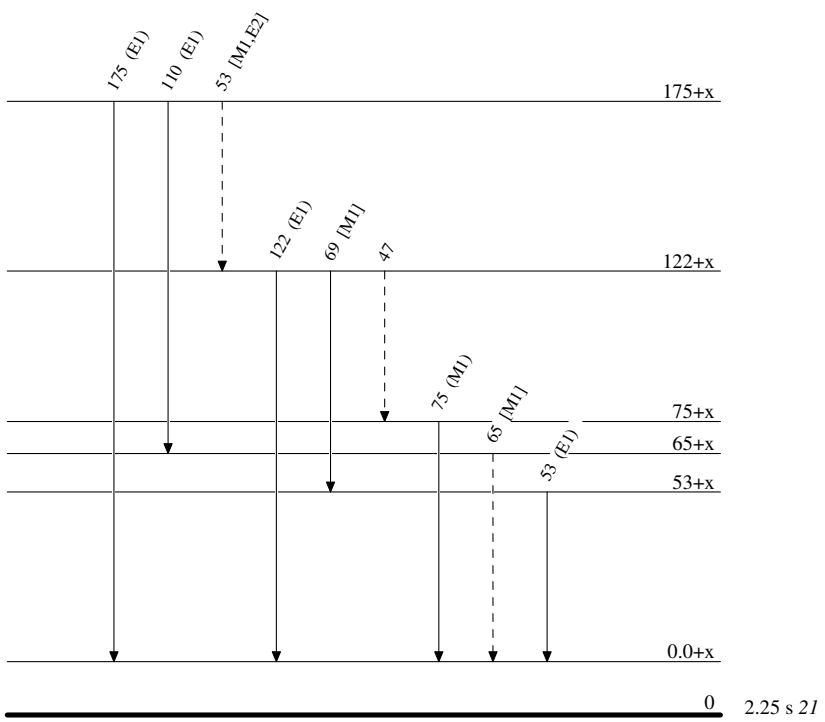
[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

[@] Multiply placed.

[&] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme



$^{166}_{75}Re_{91}$