

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	T. D. Johnson, Balraj Singh		NDS 142, 1 (2017)	15-Apr-2017

$Q(\beta^-)=1008$ 8; $S(n)=7034$ 8; $S(p)=6600$ 9; $Q(\alpha)=990$ 16 [2017Wa10](#)

$S(2n)=12905$ 8, $S(2p)=15660$ 60 ([2017Wa10](#)).

Other: $Q(\beta^-)=924$ 10 for measured mass excess(^{189}Re)= -38063 10 ([2013Sh30](#)) and mass excess(^{189}Os)= -38986.7 7 ([2017Wa10](#)).

^{189}Re activity was produced and identified by [1963Cr06](#) in $^{186}\text{W}(\alpha, p)$ and in $\text{Os}(n, p)$, $E=14$ MeV; and by [1963Fl07](#) in

$^{192}\text{Os}(d, n\alpha)$, $E=28$ MeV. Measured β and γ activities and half-life of ^{189}Re activity. Later studies of ^{189}Re decay: [1965Bl06](#), [1973Ho27](#) and [1979Sa18](#).

An activity with $T_{1/2}=4.3$ d 5 was assigned to ^{189}Re ([1969MuZP](#)) in double-neutron capture in ^{187}Re , and followed with β and γ measurements. But no other reports are published about this activity.

An activity of 140 d 20 ([1965Bl06](#), also ≈ 120 d in [1962Bl12](#)) assigned to ^{189}Re was reassigned to 169-d activity of ^{184}Re isomer by [1973Ho27](#).

Other reports of long half-lives of ≈ 150 d or >5 y ([1951Li19](#)) and ≈ 300 d ([1951Tu09](#)) have never been confirmed ([2012Ro36](#) compilation).

[Additional information 1](#).

 ^{189}Re Levels

Band assignments are from [1977Hi06](#) and [2016Re02](#).

Cross Reference (XREF) Flags

- A** ^{189}W β^- decay (11.6 min)
B $^{187}\text{Re}(^{136}\text{Xe}, X\gamma)$
C $^{190}\text{Os}(t, \alpha), (\text{pol } t, \alpha)$

E(level)	J^π	$T_{1/2}$	XREF	Comments
0 ‡	5/2 $^+$	24.3 h 4	A C	$\% \beta^- = 100$ $T_{1/2}$: from 1965Bl06 . Others: 23.4 h 10 (1963Cr06), 24 h (1963Fl07 , 1966BaZY).
125 $^{\#}$ 3	(9/2 $^-$)		BC	
146 ‡ 3	(7/2 $^+$)		C	
260.40 $\&$ 20	3/2 $^+$		A C	E(level): may be doublet with 1/2 $^+$ member of 1/2[411] rotational band.
279 3			C	
303 $^{\#}$ 3	(11/2 $^-$)		BC	
471.0 3			A	
482.4 $\&$ 4	(5/2&7/2) $^+$		C	E(level): doublet containing 5/2 $^+$ and 7/2 $^+$ members of the 1/2[411] rotational band. In the previous evaluation, based on energy summation, a 222 γ line was shown depopulating this level. The β^- measurement by 2009Yu11 could not confirm this γ transition with more reliable coincidence measurements. In $^{190}\text{Os}(t, \alpha)$ it is stated that this level is an unresolved doublet, so this may be a combination of the 471- and 490-keV levels established in β^- decay.
490.1 3			A	
501 3	(3/2 $^+$)		C	
524.0 $^{\#}$ 2	(13/2 $^-$)		B	
599 3	(3/2 $^+$)		C	
640 3	(5/2 $^+$, 3/2 $^-$, 7/2 $^-$)		C	
669.6 $@$ 2	(13/2 $^-$)		B	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{189}Re Levels (continued)					
E(level)	$J^\pi^\dagger$	$T_{1/2}$	XREF	Comments	
670 3	(3/2 ⁺)		C		
697 ^a 3	(7/2 ⁺)		C		
737.8 [#] 2	(15/2 ⁻)		B		
852 3	(5/2 ⁺)		C		
877 3	(9/2 ⁺ , 11/2 ⁻ , 7/2 ⁻)		C		
935.6 [@] 3	(15/2 ⁻)		B		
1017.7 [#] 3	(17/2 ⁻)		B		
1097 3			C		
1149.8 [@] 3	(17/2 ⁻)		B		
1223 3	5/2 ⁺		C		
1247.0 [#] 3	(19/2 ⁻)		B		
1308 3	(5/2 ⁺)		C		
1396 3	(3/2 ⁺ , 5/2 ⁻ , 1/2 ⁻)		C		
1423 3	11/2 ⁻		C	configuration: $\pi 7/2[523]$.	
1440.4 [@] 3	(19/2 ⁻)		B		
1502 10	(11/2 ⁻)		C		
1590.3 [#] 4	(21/2 ⁻)		B		
1632 10			C		
1678.9 [@] 3	(21/2 ⁻)		B		
1692.9 5	(25/2 ⁻)	51 ns 17	B	%IT=100	
				$T_{1/2}$: from $\gamma\gamma(t)$ (2016Re02).	
1770.9 6	(29/2 ⁺)	223 μ s 14	B	%IT=100	
				$T_{1/2}$: from $\gamma(t)$ (2016Re02).	
1916 10			C		
1959 10			C		

[†] From $^{190}\text{Os}(\text{pol } t, \alpha)$ experimental analyzing power and angular distributions fit with DWBA for low-spin ($J \leq 9/2$) states. For high-spin ($J > 9/2$) states, the assignments are based on multiplicities of γ transitions from $\gamma\gamma(\theta)$ and conversion coefficients deduced from intensity balance arguments, and band structures (2016Re02).

[‡] Band(A): $\pi 5/2[402]$.

[#] Band(B): $\pi 9/2[514]$.

[@] Band(C): $\pi 9/2[514] \otimes 2^+$ of γ band.

[&] Band(D): $\pi 1/2[411]$.

^a Band(E): $\pi 7/2[404]$.

 $\gamma(^{189}\text{Re})$

$E_i(\text{level})$	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult. [†]	$\delta^\dagger$	$\alpha^\ddagger$
260.40	3/2 ⁺	260.4 2	100	0	5/2 ⁺	[M1+E2]		0.24 11
303	(11/2 ⁻)	177.5		125	(9/2 ⁻)	(M1+E2)	0.22 8	0.988 24
471.0		210.6 2	100	260.40	3/2 ⁺			
490.1		229.7 2	100	260.40	3/2 ⁺			
524.0	(13/2 ⁻)	221.6		303	(11/2 ⁻)	(M1+E2)	0.35 8	0.511 17
		399.1		125	(9/2 ⁻)			
669.6	(13/2 ⁻)	146		524.0	(13/2 ⁻)			
		367.0		303	(11/2 ⁻)			
		544.6		125	(9/2 ⁻)			
737.8	(15/2 ⁻)	213.8		524.0	(13/2 ⁻)	(M1+E2)	0.20 10	0.589 18
		435.1		303	(11/2 ⁻)			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

$\gamma(^{189}\text{Re})$ (continued)								
$E_i(\text{level})$	J_i^π	E_γ	E_f	J_f^π	Mult. [†]	$\delta^\dagger$	$\alpha^\ddagger$	Comments
935.6	(15/2 ⁻)	198	737.8	(15/2 ⁻)				
		265.9	669.6	(13/2 ⁻)				
		411.6	524.0	(13/2 ⁻)				
		633	303	(11/2 ⁻)				
1017.7	(17/2 ⁻)	279.8	737.8	(15/2 ⁻)	(M1+E2)	0.3 2	0.273 22	
		493.7	524.0	(13/2 ⁻)				
1149.8	(17/2 ⁻)	132	1017.7	(17/2 ⁻)				
		214.2	935.6	(15/2 ⁻)				
		412.0	737.8	(15/2 ⁻)				
		480.2	669.6	(13/2 ⁻)				
		626	524.0	(13/2 ⁻)				
1247.0	(19/2 ⁻)	229.3	1017.7	(17/2 ⁻)	(M1+E2)	0.2 +2-1	0.49 3	
		509.3	737.8	(15/2 ⁻)				
1440.4	(19/2 ⁻)	194	1247.0	(19/2 ⁻)				
		290.7	1149.8	(17/2 ⁻)				
		422.7	1017.7	(17/2 ⁻)				
		504.7	935.6	(15/2 ⁻)				
		703	737.8	(15/2 ⁻)				
1590.3	(21/2 ⁻)	343.3	1247.0	(19/2 ⁻)				
		572.6	1017.7	(17/2 ⁻)				
1678.9	(21/2 ⁻)	89	1590.3	(21/2 ⁻)				
		238.5	1440.4	(19/2 ⁻)				
		431.9	1247.0	(19/2 ⁻)				
		529.1	1149.8	(17/2 ⁻)				
		661.2	1017.7	(17/2 ⁻)				
1692.9	(25/2 ⁻)	(14.0)	1678.9	(21/2 ⁻)				E_γ : from level-energy difference.
		102.6	1590.3	(21/2 ⁻)				
1770.9	(29/2 ⁺)	78.0	1692.9	(25/2 ⁻)	(M2)		118.4	B(M2)(W.u.)=0.0123 12 Mult.: from conversion coefficient deduced from K-x ray intensity and photon intensity.

[†] From $^{187}\text{Re}(^{136}\text{Xe}, X\gamma)$ and $^{192}\text{Os}(^{136}\text{Xe}, X\gamma)$ $\gamma\gamma(\theta)$ data.

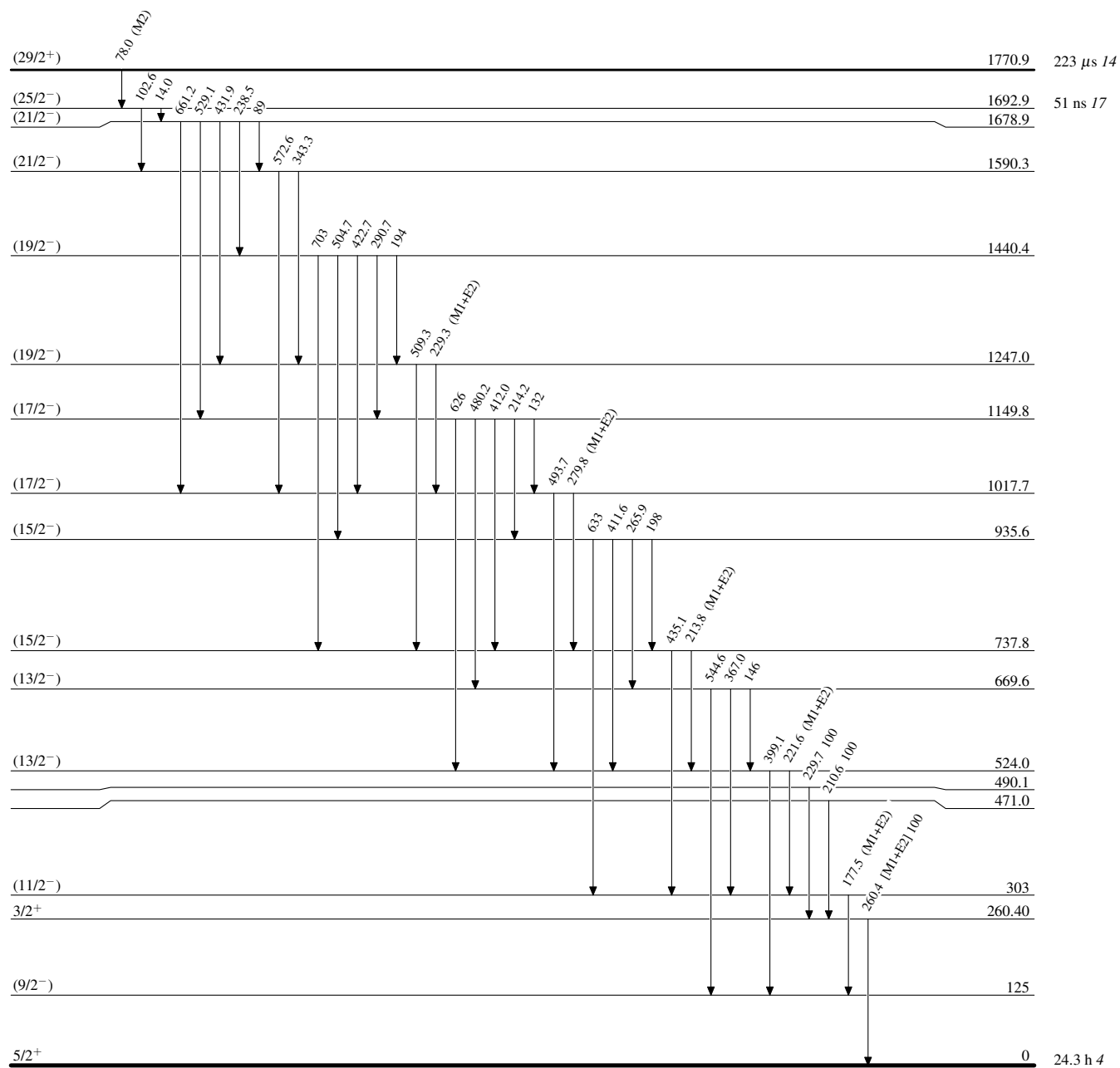
[‡] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

-----► γ Decay (Uncertain)

Adopted Levels, Gammas

