

Adopted Levels, Gammas

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	31-Aug-2021

Q(β^-)=-8640 30; S(n)=10941 24; S(p)=-457 23; Q(α)=7268.2 27 2021Wa16

Q(ϵ)=7779 25, Q(ϵp)=4980 40, S(2n)=19824 23, S(2p)=2198 22 (2021Wa16).

¹⁸⁹Bi identified by 1973Ga08 and 1974Le02 in ¹⁵⁹Tb(⁴⁰Ar,X) E=300 MeV reaction. Later decay studies of ¹⁸⁹Bi: 1984ScZQ, 1985Co06, 1993An19, 1995Ba75, 1997Wa05, 2001An11, 2003Ke08.

2017Ba12 (also 2017Mo44): measured hyperfine structure using in-source laser spectroscopy with 1-GeV proton beam from the PNPI, Gatchina synchrocyclotron incident on a 40 g/cm² uranium monocarbide target. Deduced magnetic moment and mean-square charge radius of the g.s. of ¹⁸⁹Bi.

Theoretical calculations: consult NSR database at www.nndc.bnl.gov/nsr/ for 24 primary references for α decay of ¹⁸⁹Bi and ^{189m}Bi, and one reference for nuclear structure.

Additional information 1.

¹⁸⁹Bi Levels

Cross Reference (XREF) Flags

- A ¹⁹³At α decay (28 ms)
- B ¹⁹³At α decay (21 ms)
- C ¹⁹³At α decay (27 ms)
- D ¹⁰⁹Ag(⁸²Kr,2n γ),(⁸³Kr,3n γ)

E(level) [†]	J π [‡]	T _{1/2}	XREF	Comments
0.0	(9/2 ⁻)	688 ms 5	ABCD	% α ≈100 (1997Wa05) μ =3.72 29 (2017Ba12,2019StZV) μ : from in-source laser spectroscopy (2017Ba12). Uncertainties of 0.28 (statistical) and 0.07 (systematic) combined in quadrature by evaluator. Measured $\delta\langle r^2 \rangle$ (¹⁸⁹ Bi, ²⁰⁹ Bi)=-0.792 fm ² 44(stat) 55(syst) (2017Ba12). J π : M1 γ from (7/2 ⁻); $\pi h_{9/2}$ state. T _{1/2} : from α -decay (2007DoZW, Fig. 3, based on measured values of 689 ms 2 for decay curve for 6672 α and 681 ms 8 for 7107 α). Other measurements: 580 ms 25 (2003Ke08); 667 ms 13 (2002Hu14); 728 ms 40, ≈1000 ms, 1.4 s +10-8 (1997Wa05), 680 ms 30 (1984ScZQ), <1.5 s (1973Ga08). Weighted average of all the values, except the low value from 2003Ke08 is 686 ms 5, close to the adopted value here from 2007DoZW.
99.6 5	(7/2 ⁻)	<10 ns	AB	J π : favored α decay from (7/2 ⁻) parent. T _{1/2} : from $\alpha\gamma$ (t) (2003Ke08).
184 8	(1/2 ⁺)	5.0 ms 1	A	% α =83 5 (2003Ke08); %IT=17 5 (2003Ke08) Other % α =50-100 (1985Co06). E(level): average of values from ¹⁹³ At α -decay: 187 9 (2003Ke08), 182 8 (1997Wa05). Others: 190 40 (1995Ba75), 220 30 (1993An19), 92 7 (1985Co06). J π : favored α decay from (1/2 ⁺) parent; s _{1/2} state. T _{1/2} : from 7287 α decay curve (1999An52 and 2007DoZW, same value obtained in the two independent measurements). Other measurements: 4.6 ms +8-6 (2003Ke08), 5.2 ms 6 (1997Wa05), 4.8 ms 5 (1997An09), 7.0 ms 20 (1995Ba75,1997Wa05), 4 ms 2 (1993An19), ≈5 ms (1984ScZQ) and 5.4 ms 2 (2007DoZW, from 7107 α). The uncertainty of 0.2 ms in 1995Ba75 was a misprint, it should have been 2.0 ms as explained in 1997Wa05, a later paper by the same group as 1995Ba75. Weighted average of all the values listed above also gives 5.0 ms 1, same as that from 1999An52 and 2007DoZW.
357.6 5	(13/2 ⁺)	886 ns 32	CD	%IT=100 E(level): from ^{193m} At α decay (2003Ke08). π 1i _{13/2} proton state.

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Adopted Levels, Gammas (continued)

¹⁸⁹Bi Levels (continued)

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>XREF</u>	<u>Comments</u>
			J ^π : M2 γ to (9/2 ⁻) (2001An11). Favored α decay from (13/2 ⁺) parent. T _{1/2} : weighted average of 888 ns 32 (2007DoZW, recoils-α-γ correlation decay curve); and 880 ns 50 (2002Hu14, recoil-α-γ(t) in ¹⁰⁹ Ag(⁸² Kr,2nγ), ⁸³ Kr,3nγ), note that units of ms in Fig. 2 and text of 2004Hu15 are misprints). Others: ≈550 ns (2003Ke08, αγ(t) in ¹⁹³ At, 27-ms, (13/2 ⁺) α decay); ≥360 ns 120 (2001An11, recoil-α-γ(t) in ¹⁴² Nd(⁵² Cr,p4nγ),E=239-307 MeV reaction).
778 [#] 1	(17/2 ⁺)	D	
1091 [#] 2	(21/2 ⁺)	D	
1466 [#] 2	(25/2 ⁺)	D	
1912 [#] 2	(29/2 ⁺)	D	
2422 [#] 2	(33/2 ⁺)	D	
2973 [#] 3	(37/2 ⁺)	D	

† From E_γ data, assuming 1 keV uncertainty when not stated.
‡ From systematics of neighboring nuclides, except when noted otherwise.
Band(A): πi_{13/2} intruder orbital band.

γ(¹⁸⁹Bi)

<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_γ</u>	<u>I_γ</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Mult.</u>	<u>δ</u>	<u>α[†]</u>	<u>I_(γ+ce)</u>	<u>Comments</u>
99.6	(7/2 ⁻)	99.6 5	100	0.0	(9/2 ⁻)	M1(+E2)	<0.6	9.8 5		α(K)=7.3 11; α(L)=1.9 5; α(M)=0.47 13 α(N)=0.120 31; α(O)=0.024 6; α(P)=0.0025 4 B(M1)(W.u.)>0.00015 E _γ : from ^{193m} At decay (2003Ke08). Mult.: from α(K)exp=8.7 20 (2003Ke08).
184	(1/2 ⁺)	(84 8)		99.6	(7/2 ⁻)	[E3]		55×10 ¹ 27	100	B(E3)(W.u.)=1.3 5 E _γ : from level-energy difference.
357.6	(13/2 ⁺)	357.6 5	100	0.0	(9/2 ⁻)	M2		0.969		α(K)=0.738; α(L)=0.175; α(M)=0.0429; α(N)=0.01105 B(M2)(W.u.)=0.092 3 Mult.: from α(K)exp=0.9 1 (2001An11, from number of K-x rays and γ rays in the decay of 357.6-keV isomer, populated in ¹⁴² Nd(⁵² Cr,p4nγ)). E _γ : from ^{193m} At α decay (2003Ke08). Other: E _γ =357 (2001An11, from recoils-α-g correlation in ¹⁴² Nd(⁵² Cr,p4nγ), identified by the 357γ-transition having the same excitation function as the 6672 keV α-line from decay of ¹⁸⁹ Bi, and in coincidence with Bi K-x rays).

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Adopted Levels, Gammas (continued) $\gamma(^{189}\text{Bi})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ	E_f	J_f^π
778	(17/2 ⁺)	420	357.6	(13/2 ⁺)
1091	(21/2 ⁺)	313	778	(17/2 ⁺)
1466	(25/2 ⁺)	375	1091	(21/2 ⁺)
1912	(29/2 ⁺)	446	1466	(25/2 ⁺)
2422	(33/2 ⁺)	510	1912	(29/2 ⁺)
2973	(37/2 ⁺)	551	2422	(33/2 ⁺)

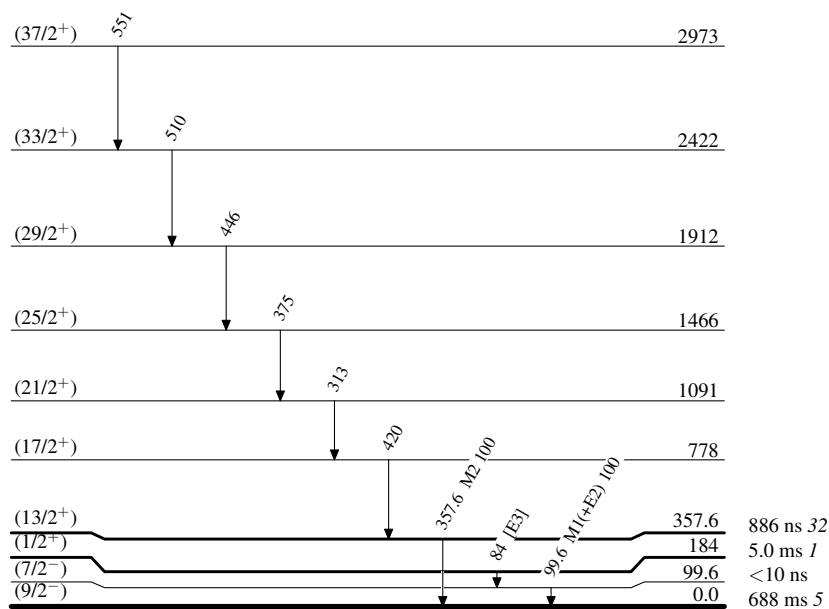
[†] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ -ray energies, assigned multiplicities, and mixing ratios, unless otherwise specified.

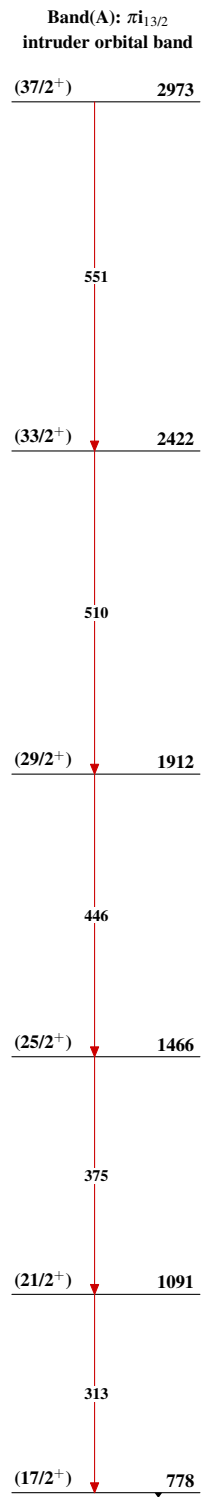
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

----- \rightarrow γ Decay (Uncertain) $^{189}\text{Bi}_{106}$

Adopted Levels, Gammas $^{189}_{83}\text{Bi}_{106}$