## Adopted Levels, Gammas

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | F. G. Kondev | NDS 159, 1 (2019) | 30-Aug-2019 |

Q($\beta^-$)=−1166 *3*; S(n)=6375.6 *10*; S(p)=6787.4 *8*; Q($\alpha$)=2245.7 *14* 2017Wa10

### $^{177}$Hf Levels

Cross Reference (XREF) Flags

| | | | | | |
|---|---|---|---|---|---|
| A | $^{177}$Hf IT decay (1.09 s) | F | $^{176}$Yb($\alpha$,3n$\gamma$) | K | $^{178}$Hf($^3$He,$\alpha$),(d,t) |
| B | $^{177}$Hf IT decay (51.4 min) | G | Coulomb excitation | L | $^{177}$Hf(n,n′$\gamma$) |
| C | $^{177}$Lu $\beta^-$ decay (6.6443 d) | H | $^{176}$Hf(n,$\gamma$) E=thermal | M | $^{176}$Yb($^9$Be,xn$\gamma$) |
| D | $^{177}$Lu $\beta^-$ decay (160.4 d) | I | $^{177}$Hf($\gamma$,$\gamma'$):Mossbauer | | |
| E | $^{177}$Ta $\varepsilon$ decay | J | $^{176}$Hf(d,p), $^{178}$Hf(d,t) | | |

| E(level)† | Jπ | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 0.0@ | 7/2− | stable | ABCDEFGHIJKLM | $\mu$=+0.7935 *6*; Q=+3.37 *3*<br>Jπ: J=7/2, laser-rf resonance spectroscopy (1995Ji15). $\pi$ from $\mu$ and L=(3) in $^{176}$Hf(d,p) (1968Ri07); band assignment.<br>$\mu$: Using atomic beam technique (1973Bu07,1973Bu25,2014StZZ).<br>Q: Using hyperfine structure of muonic x-rays technique (1984Ta04,2016St14).<br>$\Delta<r^2>(^{178}Hf,^{177}Hf)$=−0.061 (1999Le11), $\Delta<r^2>(^{177}Hf,^{178}Hf)$=+0.047 *2* (1994An14) and +0.044 *4* (1997Zh36). Others: 1994Ji07, 1994Zi04, 1996Zh35, 1999Bo32.<br>configuration: *ν* 7/2[514] Nilsson configuration. The assignment is supported by the observed in-band properties, such as alignment and $g_K$-$g_R$ values, comparison between the measured $\mu$ with Nilsson model predictions and systematics of similar structures in neighboring nuclei. |
| 112.9498@ *4* | 9/2− | 0.541 ns *14* | A CDEFGHIJKLM | $\mu$=1.03 *3*; Q=1.30 *2*<br>Jπ: 112.9498$\gamma$ M1+E2 to 7/2−; L=5 in $^{176}$Hf(d,p) (1968Ri07); band assignment.<br>$T_{1/2}$: Weighted average (external uncertainty) of 0.583 ns *6* (1991De24,1992De53), 0.5295 ns *30* (1996Al20) and 0.545 ns *6* (2013Do24). Others: 0.52 ns *2* (1963Li05), 0.52 ns *4* (1961Ha38), 0.52 ns *3* (1962Bi05), 0.53 ns *6* (1961Ha21), 0.42 ns *3* (1962Be46), 0.43 ns *4* (1963Wi07), 0.50 ns *5* (1965Ro17), 0.523 ns *25* (1968Ra25), 0.490 ns *15* (1972Ho54), 0.70 ns *15* (1982Ko08), 0.32 ns *3* (1961We11), 0.59 *3* from B(E2)↑=1.92 *10* (1961Ha21) and $\delta$=−4.77 *19*.<br>$\mu$: Using integral perturbed angular correlations technique (1996Al20,2014StZZ).<br>Q: Using hyperfine structure of muonic x-rays technique (1984Ta04,2016St14). |
| 249.6744@ *4* | 11/2− | 107 ps *10* | A CDEFG IJ LM | $\mu$=+1.5 *5*<br>Jπ: 136.7245$\gamma$ M1+E2 to 9/2−, 249.6742$\gamma$ E2 to 7/2−; band assignment.<br>$T_{1/2}$: Weighted average of 107 ps *11* in Coulomb excitation and 106 ps *21* in $^{177}$Hf($\gamma$,$\gamma'$):Mossbauer.<br>$\mu$: Using integral perturbed angular correlations technique (1968Br15,2014StZZ). |
| 321.3162& *4* | 9/2+ | 0.665 ns *16* | A CDEF JKLM | $\mu$=−0.73 *9*<br>Jπ: 71.64$\gamma$ E1+M2 to 11/2− and 321.27$\gamma$ E1+M2 to 7/2−; band |

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**Adopted Levels, Gammas (continued)**

$^{177}$Hf Levels (continued)

| E(level)† | Jπ | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| | | | | assignment.<br>$T_{1/2}$: Weighted average of 0.63 ns *5* (1961Ha38), 0.69 ns *3* (1962Be46), 0.65 ns *6* (1965Ro17), 0.65 ns *3* (1968Ra25), and 0.67 ns *3* (1973GoYH). Others: 0.728 ns *22* (2011Zh56), 0.52 ns *3* (1961We11) and 0.50 ns *15* (1960Va12).<br>$\mu$: Using integral perturbed angular correlations technique (1969Hu06,2014StZZ).<br>configuration: $\nu$ 9/2[624] Nilsson configuration. The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values, comparison between the measured $\mu$ with Nilsson model predictions and systematics of similar structures in neighboring nuclei. |
| 375‡ | | | J | |
| 390‡ | | | J | |
| 409.4085@ *5* | 13/2⁻ | | A D FG LM | Jπ: 159.7341γ M1+E2 to 11/2⁻; 296.4584γ E2 to 9/2⁻; band assignment. |
| 426.6752& *4* | 11/2⁺ | 40 ps *3* | A DEF J LM | XREF: J(432).<br>Jπ: 105.3589γ M1+E2 to 9/2⁺, 177.0007γ to 11/2⁻, 313.7250γ E1+M2 to 9/2⁻; band assignment.<br>$T_{1/2}$: From 105γ-128γ(Δt) and centroid-shift analysis in 2011Zh56. |
| 459‡ | | | J | |
| 508.13[a] *5* | 5/2⁻ | | E H J LM | XREF: J(504).<br>Jπ: 508.1γ M1+E2 to 7/2⁻, 395.2γ E2 to 9/2⁻.<br>configuration: $\nu$ 5/2[512] Nilsson configuration. The assignment is supported by the deduced $C_{j,l}$ coefficients in $^{176}$Hf(d,p),$^{178}$Hf(d,t). |
| 555.1779& *4* | 13/2⁺ | | A D F JKLM | XREF: J(556).<br>Jπ: 128.5027γ M1+E2 to 11/2⁺, 233.8615γ E2 to the 9/2⁺ level; band assignment. |
| 560‡[b] | 1/2⁻ | | J M | Jπ: L(d,p)=1 and the assigned configuration.<br>configuration: $\nu$1/2[521] Nilsson configuration. The assignment is supported by the observed in-band properties, such as alignment and large signature splittings, $\sigma$ exp/$\sigma$ DWBA in $^{176}$Hf(d,p),$^{178}$Hf(d,t), and systematics of similar structures in neighboring nuclei. |
| 567?‡[c] | (1/2⁻) | | J M | Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07) and the assigned configuration.<br>configuration: $\nu$1/2[510] Nilsson configuration. The assignment is supported by the observed in-band properties, such as alignment and large signature splittings, and systematics of similar structures in neighboring nuclei. |
| 591.3179@ *7* | 15/2⁻ | | A D FG LM | Jπ: 181.9093γ to 13/2⁻; 341.6432γ E2 to 11/2⁻; band assignment. |
| 604.49[a] *5* | 7/2⁻ | | E JKLM | XREF: J(610)K(605).<br>Jπ: L(d,p)=3; 96.3γ M1+E2 to 5/2⁻ and 354.9γ E2 to 11/2⁻; band assignment. |
| 607‡[c] | (3/2⁻) | | J M | Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07) and the assigned configuration. |
| 623.0[b] *7* | (3/2⁻) | | H J M | Jπ: 623.0γ to 7/2⁻; band assignment. |
| 652‡[b] | (5/2⁻) | | J M | Additional information 1.<br>Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07); band assignment. |
| 665‡[c] | (5/2)⁻ | | J M | Additional information 2.<br>Jπ: L(d,p)=3; band assignment. |
| 703‡[c] | (7/2)⁻ | | J | Jπ: L(d,p)=3; band assignment. |
| 708.4622& *5* | 15/2⁺ | | A D F M | Jπ: 153.2842γ M1+E2 to 13/2⁺, 281.7868γ E2 to 11/2⁺; band assignment. |
| 727.1[a] *7* | 9/2⁻ | | M | Jπ: 123.1γ to 7/2⁻, 218.5γ to 5/2⁻; band assignment. |

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**Adopted Levels, Gammas (continued)**

$^{177}$Hf Levels (continued)

| E(level)† | Jπ | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 739‡ | (1/2⁻,3/2⁻) | | J | Jπ: L(d,p)=(1). |
| 745.91d 5 | (7/2)⁺ | | E L | Jπ: 319.3γ to 11/2⁺, 745.9γ E1 to 7/2⁻; band assignment and proposed configuration.<br>configuration: ν7/2[633] Nilsson configuration. |
| 780‡ | (7/2)⁻ | | J | Jπ: L(d,p)=3. |
| 794.4394@ 9 | 17/2⁻ | | A D FG M | Jπ: 203.0γ to 15/2⁻, 385.0304γ E2 to 13/2⁻; band assignment. |
| 805.75e 7 | 3/2⁻ | | E J | XREF: J(804).<br>Jπ: L(d,p)=1; 297.7γ M1+E2 to 5/2⁻ and 805.7γ to 7/2⁻.<br>configuration: ν3/2[512] Nilsson configuration. The assignment is supported by the deduced $C_{j,l}$ coefficients ($^{176}$Hf(d,p), $^{178}$Hf(d,t)). |
| 839.1b 8 | (7/2⁻) | | M | Jπ: 216.1γ to (3/2⁻); band assignment. |
| 841.5c 3 | (9/2⁻) | | J M | XREF: J(839).<br>Jπ: 176.5γ to (5/2⁻); band assignment. |
| 845.6b 3 | (9/2⁻) | | M | Jπ: 193.6γ to (5/2⁻); band assignment. |
| 847.41d 5 | 9/2⁺ | | E JKL | XREF: J(851)K(848).<br>Jπ: 420.8γ M1+E2 to 11/2⁺, 847.4γ E1 to 7/2⁻; band assignment. |
| 872.96e 6 | (5/2)⁻ | | E J | XREF: J(878).<br>Jπ: L(d,p)=3; band assignment. |
| 882.8611& 5 | 17/2⁺ | | A D F M | Jπ: 174.3988γ M1+E2 to 15/2⁺, 327.6829γ E2 to 13/2⁺; band assignment. |
| 919‡ | (1/2⁻,3/2⁻) | | J | Jπ: L(d,p)=(1). |
| 948.09 15 | (3/2⁻,5/2,7/2⁻) | | E | Jπ: 142.4γ to 3/2⁻, 439.9γ to 5/2⁻; direct feeding in $^{177}$Ta ε decay ($J^{\pi}$=7/2⁺). |
| 979‡ | (7/2)⁻ | | J | Jπ: L(d,p)=3. |
| 1002.83 5 | (7/2⁻) | | E | Jπ: 197.1γ to 3/2⁻, 681.5γ to 9/2⁺. |
| 1016‡ | 5/2⁻,7/2⁻ | | J | Jπ: L(d,p)=3. |
| 1017.7911@ 20 | 19/2⁻ | | A D FG M | Jπ: 223.3γ to 17/2⁻ and 426.4726γ E2 to 15/2⁻; band assignment. |
| 1057.74f 5 | 7/2⁻ | | E J | XREF: J(1058).<br>Jπ: L(d,p)=3; 944.8γ M1(+E2) to 9/2⁻, 736.4γ E1 to 9/2⁺.<br>configuration: ν7/2[503] Nilsson configuration. The assignment is supported by the deduced $C_{j,l}$ coefficients ($^{176}$Hf(d,p), $^{178}$Hf(d,t)). |
| 1086.9662& 6 | 19/2⁺ | | A D F M | Jπ: 204.1050γ M1+E2 to 17/2⁺ and 378.5036γ E2 to 15/2⁺; band assignment. |
| 1101‡d | (13/2⁺) | | JK | XREF: K(1099).<br>Jπ: From $^{178}$Hf($^{3}$He,α),(d,t); band assignment. |
| 1113.5c 5 | (13/2⁻) | | M | Jπ: 272.0γ to (9/2⁻); band assignment. |
| 1143.3b 5 | (13/2⁻) | | M | Jπ: 297.7γ to (9/2⁻); band assignment. |
| 1156.9b 9 | (11/2⁻) | | M | Jπ: 317.8γ to (7/2⁻); band assignment. |
| 1260.2817@ 14 | 21/2⁻ | | A D FG M | Jπ: 242.07γ to 19/2⁻ and 465.8416γ E2 to 17/2⁻; band assignment. |
| 1294‡ | 1/2⁻,3/2⁻ | | J | Jπ: L(d,p)=1. |
| 1301.4004& 6 | 21/2⁺ | | A D F M | Jπ: 214.4341γ to 19/2⁺, 418.5388γ E2 to 17/2⁺; band assignment. |
| 1315.4502i 8 | 23/2⁺ | 1.09 s 5 | AB D F M | %IT=100<br>Jπ: From 228.4838γ E2 to 19/2⁺. Direct feeding in β⁻ decay of the $K^{\pi}$=23/2⁻ isomer in $^{177}$Lu ($T_{1/2}$=160.4 d).<br>$T_{1/2}$: Weighted average of 1.08 s 6 (1971Gl09) and 1.12 s 10 |

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**Adopted Levels, Gammas (continued)**

$^{177}$Hf Levels (continued)

| E(level)† | Jπ | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| | | | | (1966Bo01) measured from βγ(t) in $^{177}$Lu β⁻ decay (160.4 d). Others: 1.1 s (1967Ra36). configuration: $K^\pi$=23/2⁺: ν7/2[514]⊗π²(7/2[404],9/2[514]). The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values, and systematics of similar structures in neighboring nuclei. |
| 1342.4[h] *10* | (19/2⁻) | 55.9 μs *12* | F M | Jπ: 548.0γ M1+E2 to 17/2⁻; assigned configuration. $T_{1/2}$: From 1976ReZH in $^{176}$Yb(α,3nγ). configuration: $K^\pi$=19/2⁻: ν7/2[514]⊗π²(5/2[402],7/2[404]). |
| 1350‡ | | | J | |
| 1434‡[g] | (3/2)⁻ | | J | Jπ: L(d,p)=1; assigned configuration. configuration: ν3/2[501] Nilsson configuration. The assignment is supported by the deduced $C_{j,l}$ coefficients ($^{176}$Hf(d,p), $^{178}$Hf(d,t)). |
| 1475‡[g] | (5/2⁻) | | J | Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07). |
| 1477.2[c] *6* | (17/2⁻) | | M | Jπ: 363.7γ to (13/2⁻); band assignment. |
| ≈1485# | (9/2⁺) | | K | Jπ: From $^{178}$Hf($^3$He,α),(d,t). The assignment is tentative. |
| 1502‡[r] | (3/2⁻) | | J | Jπ: L(d,p)=(1). |
| 1520.6[@] *3* | 23/2⁻ | | FG M | Jπ: 502.9γ E2 to 19/2⁻; band assignment. |
| 1534.9[b] *6* | (17/2⁻) | | M | Jπ: 391.6γ to (13/2⁻); band assignment. |
| 1535‡[g] | (7/2)⁻ | | J | Jπ: L(d,p)=3. |
| 1561.36[&] *19* | 23/2⁺ | | F M | Jπ: 260.0γ M1+E2 to 21/2⁺; 474.4γ E2 to 19/2⁺; band assignment. |
| 1564.6[b] *9* | (15/2⁻) | | M | Jπ: 407.7γ to (11/2⁻); band assignment. |
| 1565‡[r] | (5/2⁻) | | J | Jπ: L(d,p)=(3). |
| 1583.0[h] *11* | (21/2⁻) | | M | Jπ: 240.6γ to (19/2⁻); band assignment. |
| 1592.75[i] *21* | 25/2⁺ | | B F M | Jπ: 277.3γ M1+E2 to 23/2⁺; band assignment. |
| ≈1609# | (13/2⁺) | | K | Jπ: From $^{178}$Hf($^3$He,α),(d,t). The assignment is tentative. |
| 1634‡[s] | (1/2)⁻ | | J | Jπ: L(d,p)=1. |
| 1666‡ | (3/2⁻) | | J | Jπ: L(d,p)=(1). |
| 1701‡[s] | (3/2)⁻ | | J | Jπ: L(d,p)=1. |
| 1713.15[k] *24* | 25/2⁻ | <1 ns | F M | Jπ: 120.4γ E1 to 25/2⁺, 397.7γ E1 to 23/2⁺; band assignment. $T_{1/2}$: From γγ(Δt) in 1998Mu14. configuration: $K^\pi$=25/2⁻:ν9/2[624]⊗π²(7/2[404],9/2[514]). The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values ($^{176}$Yb($^9$Be,xnγ)) and systematics of similar structures in neighboring nuclei. |
| 1743‡ | (5/2⁻) | | J | Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07). |
| 1779‡[s] | (5/2)⁻ | | J | Jπ: L(d,p)=3. |
| 1798.2[@] *3* | 25/2⁻ | | FG M | Jπ: 537.9γ E2 to 21/2⁻; band assignment. |
| 1803.06[&] *22* | 25/2⁺ | | M | Jπ: 241.8γ to 23/2⁺, 501.6γ E2 to 21/2⁺; band assignment. |
| 1845.9[h] *11* | (23/2⁻) | | M | Jπ: 263.0γ to the (21/2⁻), 503.4γ to (19/2⁻); band assignment. |
| 1847‡ | (7/2⁻) | | J | Jπ: 7/2⁻ in $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07). |
| 1882‡[t] | (1/2)⁻ | | J | Jπ: L(d,p)=1. |
| 1887.75[i] *23* | 27/2⁺ | | B F M | Jπ: 295.1γ M1+E2 to the 25/2⁺ level, 572.3γ E2 to the 23/2⁺ level; band assignment. |
| 1925.3[c] *6* | (21/2⁻) | | M | Jπ: 448.1γ to (17/2⁻); band assignment. |
| 1932‡[t] | (3/2)⁻ | | J | Jπ: L(d,p)=1. |
| 1932?‡[s] | (7/2⁻) | | J | Jπ: From $^{176}$Hf(d,p), $^{178}$Hf(d,t) (1968Ri07). |
| 1968.0[k] *3* | 27/2⁻ | | F M | Jπ: 254.8γ M1+E2 to 25/2⁻; band assignment. |
| 1969‡[t] | (5/2)⁻ | | J | Jπ: L(d,p)=3. |
| 2005.1[b] *6* | (21/2⁻) | | M | Jπ: 470.2γ to (17/2⁻); band assignment. |

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## Adopted Levels, Gammas (continued)

### $^{177}$Hf Levels (continued)

| E(level)[†] | Jπ | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 2007[‡] | 5/2⁻,7/2⁻ | | J | Jπ: L(d,p)=3. |
| 2048.2[b] *10* | (19/2⁻) | | M | Jπ: 483.6γ to (15/2⁻); band assignment. |
| 2070.2[l] *4* | (23/2⁻) | | M | Jπ: 357.1γ to 25/2⁻.<br>configuration: $K^{\pi}$=(23/2⁻). A mixture of several 3-quasiparticle configurations. See 1998Mu14 for details. |
| 2071[‡t] | (7/2)⁻ | | J | Jπ: L(d,p)=3. |
| 2091.0[@] *4* | 27/2⁻ | | FG M | Jπ: 570.4γ E2 to 23/2⁻; band assignment. |
| 2114[‡] | 5/2⁻,7/2⁻ | | J | Jπ: L(d,p)=3. |
| 2124.0[h] *11* | (25/2⁻) | | M | Jπ: 278.2γ to (23/2⁻), 541.0γ to (21/2⁻); band assignment. |
| 2128.5[&] *3* | 27/2⁺ | | M | Jπ: 325.4γ to 25/2⁺, 567.1γ to 23/2⁺; band assignment. |
| 2199.2[i] *3* | 29/2⁺ | | B F M | Jπ: 311.5γ M1+E2 to 27/2⁺, 606.3γ E2 to 25/2⁺; band assignment. |
| 2249.3[k] *3* | 29/2⁻ | | F M | Jπ: 281.4γ M1+E2 to 27/2⁻, 536.3γ to 25/2⁻; band assignment. |
| 2335.9[l] *3* | (25/2⁻) | | M | Jπ: 266.0γ to (23/2⁻), 368.0γ M1(+E2) to 27/2⁻; band assignment. |
| 2378.0[&] *3* | 29/2⁺ | | M | Jπ: 249.4γ to 27/2⁺, 575.0γ E2 to 25/2⁺; band assignment. |
| 2399.1[@] *5* | 29/2⁻ | | G M | Jπ: 600.9γ E2 to the 25/2⁻ level; band assignment. |
| 2409.6[m] *3* | (27/2⁻) | | M | Jπ: 339.4γ to (23/2⁻), 441.6γ to 27/2⁻; band assignment.<br>configuration: $K^{\pi}$=(23/2⁻). A mixture of several 3-quasiparticle configurations. See 1998Mu14 for details. |
| 2416.5[h] *11* | (27/2⁻) | | M | Jπ: 292.6γ to (25/2⁻), 570.5γ to (23/2⁻); band assignment. |
| 2418.0 *4* | (27/2⁻) | | M | Jπ: 82.2γ to (27/2⁻). The assignment is from 1998Mu14. |
| 2451.4[c] *7* | (25/2⁻) | | M | Jπ: 526.1γ to (21/2⁻); band assignment. |
| 2525.5[i] *3* | 31/2⁺ | | B F M | Jπ: 326.5γ M1+E2 to 29/2⁺, 637.8γ E2 to 27/2⁺; band assignment. |
| 2539.1[b] *7* | (25/2⁻) | | M | Jπ: 534.0γ to (21/2⁻); band assignment. |
| 2554.7[k] *4* | 31/2⁻ | | M | Jπ: 305.4γ M1+E2 to 29/2, 586.7γ E2 to 27/2⁻; band assignment. |
| 2589.8[b] *10* | (23/2⁻) | | M | Jπ: 541.6γ to (21/2⁻); band assignment. |
| 2615.3[l] *4* | (27/2⁻) | | M | Jπ: 280.0γ to (25/2⁻), 366.2γ to 29/2⁻; band assignment. |
| 2700.2[n] *4* | (29/2⁻) | | M | Jπ: 364.0γ to (25/2⁻); 450.8γ to 29/2⁻; band assignment.<br>configuration: $K^{\pi}$=(23/2⁻). A mixture of several 3-quasiparticle configurations. See 1998Mu14 for details. |
| 2719.9[@] *5* | 31/2⁻ | | G M | Jπ: 628.9γ E2 to 27/2⁻; band assignment. |
| 2724.4[h] *11* | (29/2⁻) | | M | Jπ: 308.1γ to (27/2⁻), 600.5γ to (25/2⁻); band assignment. |
| 2740.02[o] *15* | 37/2⁻ | 51.4 min *5* | B F M | %IT=100<br>μ=7.33 *9*<br>Jπ: 214.0γ E3 to 31/2⁺.<br>$T_{1/2}$: From 1972Ch48. Others: 51.6 m *16* (1971Wa16, superseded by 1972Ch48) and 76 m *+16−9* in 2004Al04.<br>μ: From 2014Mu03 using the NMR on oriented nuclei method.<br>configuration: $K^{\pi}$=37/2⁻: $\nu^3$(5/2[512],7/2[514],9/2[624])⊗ $\pi^2$(7/2[404],9/2[514]) The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values, comparison between the measured μ with Nilsson model predictions systematics of similar structures in neighboring nuclei, and results from multi-quasiparticle blocking calculations (1998Mu14). |
| 2783.1[&] *4* | 31/2⁺ | | M | Jπ: 654.6γ E2 to 27/2⁺; band assignment. |
| 2865.5[i] *4* | 33/2⁺ | | M | Jπ: 340.1γ M1+E2 to 31/2⁺, 666.2γ E2 to 29/2⁺; band assignment. |
| 2873.4[j] *3* | (29/2⁺) | | M | Jπ: 674.2γ to 29/2⁺, 985.6γ to 27/2⁺; proposed configuration.<br>configuration: $K^{\pi}$=(29/2⁺): ν(7/2[514])⊗ $\pi^4$(1/2[411],5/2[402],7/2[404],9/2[514]) The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values and systematics of similar structures in neighboring nuclei, and results from multi-quasiparticle blocking calculations (1998Mu14). |

Continued on next page (footnotes at end of table)

**Adopted Levels, Gammas (continued)**

$^{177}$Hf Levels (continued)

| E(level)[†] | Jπ | $T_{1/2}$ | XREF | | Comments |
|---|---|---|---|---|---|
| 2882.0[k] 4 | 33/2⁻ | | | M | Jπ: 327.3γ M1+E2 to 31/2⁻, 632.6γ E2 to 29/2⁻; band assignment. |
| 2896.8[n] 5 | (31/2⁻) | | | M | Jπ: 196.6γ M1(+E2) to (29/2⁻); band assignment. |
| 2908.9[l] 5 | (29/2⁻) | | | M | Jπ: 293.0γ to (27/2⁻), 659.6γ to 29/2⁻; band assignment. |
| 2936.0[q] 5 | (33/2⁻) | | | M | Jπ: 196.5γ to 37/2⁻; proposed configuration.<br>configuration: $K^{\pi}=(33/2^-)$: $\nu^3$(1/2[521],7/2[514],9/2[624])⊗ $\pi^2$(7/2[404],9/2[514]). The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values and systematics of similar structures in neighboring nuclei, and results from multi-quasiparticle blocking calculations (1998Mu14). |
| 3015.8[&] 5 | 33/2⁺ | | | M | Jπ: 637.8γ E2 to 29/2⁺; band assignment. |
| 3047.3[h] 11 | (31/2⁻) | | | M | Jπ: 323.2γ to (29/2⁻), 630.5γ to (27/2⁻); band assignment. |
| 3053.7[@] 6 | 33/2⁻ | | G | M | Jπ: 654.6γ E2 to 29/2⁻; band assignment. |
| 3105.2[p] 5 | 39/2⁺ | <1 ns | | M | Jπ: 365.7γ (E1) to 37/2⁻; proposed configuration.<br>$T_{1/2}$: From 1998Mu14 in $^{176}$Yb($^9$Be,xnγ).<br>configuration: $K^{\pi}=39/2^+$: $\nu^3$(7/2[514],7/2[633],9/2[624])⊗ $\pi^2$(7/2[404],9/2[514]). The assignment is supported by the observed in-band properties, such as alignment, $g_K$-$g_R$ values and systematics of similar structures in neighboring nuclei, and results from multi-quasiparticle blocking calculations (1998Mu14). |
| 3133.5[b] 8 | (29/2⁻) | | | M | Jπ: 594.4γ to (25/2⁻); band assignment. |
| 3141.2[o] 4 | 39/2⁻ | | | M | Jπ: 401.3γ M1+E2 to 37/2⁻; band assignment. |
| 3217.4[i] 4 | 35/2⁺ | | | M | Jπ: 351.9γ M1+E2 to 33/2⁺, 691.8γ E2 to 31/2⁺; band assignment. |
| 3217.6[l] 5 | (31/2⁻) | | | M | Jπ: 308.6γ to (29/2⁻), 662.9γ to 31/2⁻; band assignment. |
| 3222.0[j] 5 | (31/2⁺) | | | M | Jπ: 348.6γ to (29/2⁺); band assignment. |
| 3228.8[k] 4 | 35/2⁻ | | | M | Jπ: 346.9γ M1+E2 to 33/2⁻, 674.3γ E2 to 31/2⁻; band assignment. |
| 3237.4[n] 6 | (33/2⁻) | | | M | Jπ: 340.6γ to (31/2⁻); band assignment. |
| 3302.5[q] 6 | (35/2⁻) | | | M | Jπ: 366.5γ to (33/2⁻); band assignment. |
| 3398.7[@] 6 | 35/2⁻ | | G | M | Jπ: 678.8γ E2 to 31/2⁻; band assignment. |
| 3465.0[p] 5 | 41/2⁺ | | | M | Jπ: 359.8γ M1+E2 to 39/2⁺; band assignment. |
| 3517.8[&] 5 | 35/2⁺ | | | M | Jπ: 734.7γ E2 to 31/2⁺; band assignment. |
| 3562.2[o] 4 | 41/2⁻ | | | M | Jπ: 420.9γ M1+E2 to 39/2⁻, 823.0γ to 37/2⁻; band assignment. |
| 3579.1[i] 4 | 37/2⁺ | | | M | Jπ: 361.7γ M1+E2 to 35/2⁺, 713.6γ to 33/2⁺; band assignment. |
| 3582.1[j] 6 | (33/2⁺) | | | M | Jπ: 360.1γ to (31/2⁺), 709.6γ to (29/2⁺); band assignment. |
| 3593.3[k] 5 | 37/2⁻ | | | M | Jπ: 364.6γ to 35/2⁻ level, 711.2γ E2 to 33/2⁻; band assignment. |
| 3685.8[q] 6 | (37/2⁻) | | | M | Jπ: 383.3γ to (35/2⁻), 753.4γ to (33/2⁻); band assignment. |
| 3703.4[&] 6 | 37/2⁺ | | | M | Jπ: 687.6γ E2 to 33/2⁺; band assignment. |
| 3753.7[@] 6 | 37/2⁻ | | G | M | Jπ: 700.0γ E2 to 33/2⁻; band assignment. |
| 3840.2[p] 5 | 43/2⁺ | | | M | Jπ: 375.1γ M1+E2 to 41/2⁺, 734.9γ to 39/2⁺; band assignment. |
| 3948.5[i] 5 | 39/2⁺ | | | M | Jπ: 369.4γ to 37/2⁺ level, 730.7γ to 35/2⁺; band assignment. |
| 4001.8[o] 5 | 43/2⁻ | | | M | Jπ: 440.0γ M1+E2 to 41/2⁻, 860.5γ to 39/2⁻; band assignment. |
| 4120.9[@] 7 | 39/2⁻ | | G | M | Jπ: 722.2γ to 35/2⁻; band assignment. |
| 4231.5[p] 6 | 45/2⁺ | | | M | Jπ: 391.3γ M1+E2 to 43/2⁺, 766.5γ to 41/2⁺; band assignment. |
| 4459.6[o] 5 | 45/2⁻ | | | M | Jπ: 458.0γ to 43/2⁻, 897.1γ to 41/2⁻; band assignment. |
| 4497.8[@] 7 | 41/2⁻ | | | M | Jπ: 744.1γ to 37/2⁻; band assignment. |
| 4639.8[p] 6 | 47/2⁺ | | | M | Jπ: 408.1γ to 45/2⁺, 799.6γ to 43/2⁺; band assignment. |
| 5064.2[p] 6 | 49/2⁺ | | | M | Jπ: 424.0γ to 47/2⁺, 833.1γ to 45/2⁺; band assignment. |

[†] From a least-squares fit to Eγ, unless otherwise stated.

Continued on next page (footnotes at end of table)

## Adopted Levels, Gammas (continued)

### $^{177}$Hf Levels (continued)

‡ From $^{176}$Hf(d,p), $^{178}$Hf(d,t).
# From $^{176}$Hf($^{3}$He,$\alpha$), (d,t).
@ Band(A): $K^{\pi}=7/2^{-}$: $\nu 7/2[514]$ band.
& Band(B): $K^{\pi}=9/2^{+}$: $\nu 9/2[624]$ band.
a Band(C): $K^{\pi}=5/2^{-}$: $\nu 5/2[512]$ band.
b Band(D): $K^{\pi}=1/2^{-}$: $\nu 1/2[521]$ band.
c Band(E): $K^{\pi}=1/2^{-}$: $\nu 1/2[510]$ band.
d Band(F): $K^{\pi}=7/2^{+}$: $\nu 7/2[633]$ band.
e Band(G): $K^{\pi}=3/2^{-}$: $\nu 3/2[512]$ band.
f Band(H): $K^{\pi}=7/2^{-}$: $\nu 7/2[503]$ band.
g Band(I): $K^{\pi}=3/2^{-}$: $\nu 3/2[501]$ band.
h Band(J): $K^{\pi}=(19/2^{-})$: $\nu(7/2[514])\otimes\pi^{2}(5/2[402],7/2[404])$.
i Band(K): $K^{\pi}=23/2^{+}$: $\nu(7/2[514])\otimes\pi^{2}(7/2[404],9/2[514])$.
j Band(L): $K^{\pi}=(29/2^{+})$: $\nu(7/2[514])\otimes\pi^{4}(1/2[411],5/2[402],7/2[404],\ 9/2[514])$.
k Band(M): $K^{\pi}=25/2^{-}$: $\nu(9/2[624])\otimes\pi^{2}(7/2[404],9/2[514])$.
l Band(N): $K^{\pi}=(23/2^{-})$. See 1998Mu14 for details.
m Band(O): $K^{\pi}=(23/2^{-})$. See 1998Mu14 for details.
n Band(P): $K^{\pi}=(23/2^{-})$. See 1998Mu14 for details.
o Band(Q): $K^{\pi}=37/2^{-}$: $\nu^{3}(5/2[512],7/2[514],9/2[624])\otimes\ \pi^{2}(7/2[404],9/2[514])$.
p Band(R): $K^{\pi}=39/2^{+}$: $\nu^{3}(7/2[514],7/2[633],9/2[624])\otimes\ \pi^{2}(7/2[404],9/2[514])$.
q Band(S): $K^{\pi}=(33/2^{-})$: $\nu^{3}(1/2[521],7/2[514],9/2[624])\otimes\ \pi^{2}(7/2[404],9/2[514])$.
r Band(T): $K^{\pi}=(3/2)$ band.
s Band(U): $K^{\pi}=(1/2)$ band.
t Band(V): $K^{\pi}=(1/2)$ band.

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 112.9498 | 9/2⁻ | 112.9498[‡] *4* | 100[‡] | 0.0 | 7/2⁻ | M1+E2 | −4.77 *19* | 2.23 | α(K)=0.805 *13*; α(L)=1.085 *16*; α(M)=0.270 *4*<br>α(N)=0.0627 *9*; α(O)=0.00798 *12*; α(P)=5.14×10$^{-5}$ *9*<br>B(M1)(W.u.)=0.00037 *3*; B(E2)(W.u.)=286 *8*<br>Mult.,δ: From γγ(θ) and electron conversion data. The briccmixing program and the following data were used for δ: δ=−4.85 *5* (1992De53), −4.7 *3* (1979Er12), −4.8 *2* (1977Ke12), −4.7 *2* (1974Kr12), −4.75 *7* (1972Ho54), −4.5 *3* (1972Ho39), −5.0 *6* (1966Bl05, symmetrized from −4.7 *+8−4*), −4.4 *3* (1962Ma42), −4.3 *3* (1958Be23), −4.6 *4* (1957St07); (K/L)exp=0.82 *9* (2012De24), α(K)exp=0.78 *5*, (L1/L2)exp=0.165 *10*, (L2/L3)exp=1.15 *5* and (L1/L3)exp=0.190 *11* (1974Ag01); (K/L)exp= 0.723 *23*, (L/M)exp=3.97 *3*, (L1/L2)exp=0.170 *3*, (L1/L3)exp= 0.191 *2*, (L2/L3)exp=1.122 *8*, (M1/M2)exp=0.152 *6*, (M1/M3)exp= 0.162 *6*, (M2/M3)exp=1.066 *15* (1972Ho39); (K/L)exp=0.58 *7*, (K/MN)exp=1.97 *24*, (L/MN)exp=3.40 *16* and α(L)exp=1.35 *10* (1961We11). Others (not used in the analysis): δ=−5.5 *3* (1978Br37), −4.0 *3* (1974Ag01), −3.7 *3* (1970Hr01), −3.0 *8*, −3.1 *14*, −3.8 *16*, −3.1 *12* (1968To07), −5.4 *4* (1957Of04), −4.0 *2* (1955Ha84), −4.0 *2* (1961We11); (K/L)exp=0.59 *5*, (K/M)exp=1.97 *16* and (L/M)exp=3.32 *37* (2011De07), α(K)exp=0.78 *5* (1974Je02) and α(K)exp=0.98 *15* (1968To07). The sign is from 1974Kr12. |
| 249.6744 | 11/2⁻ | 136.7245 *5* | 23.27[#] *19* | 112.9498 | 9/2⁻ | M1+E2 | −3.31 *15* | 1.130 *17* | α(K)=0.540 *10*; α(L)=0.450 *7*; α(M)=0.1113 *17*<br>α(N)=0.0259 *4*; α(O)=0.00334 *5*; α(P)=3.57×10$^{-5}$ *9*<br>B(M1)(W.u.)=0.00096 *12*; B(E2)(W.u.)=244 *23*<br>$E_\gamma$: From $^{177}$Lu $\beta^-$ decay (160.4 d).<br>Mult.,δ: Mult. is from γγ(θ) and electron conversion data. The briccmixing program and the following data were used for δ: δ(γγθ)=−3.0 *7* (1974Kr12); (K/L)exp=1.2 *4* (2011De07), (L1/L2)exp=0.24 *6*, (L2/L3)exp=1.12 *20* and (L1/L3)exp=0.27 *7* (1974Ag01), (K/L)exp=1.24 *7* and (L12/L3)exp=1.56 *15* (1972Gr35). Others (not used in the analysis): (K/M)exp=8.1 *22* (2012De24); (K/M)exp=2.3 *10* and (K/L)exp=2.0 *8* (2011De07); (K/L1)exp=6.1 *16*, (K/L2)exp=1.45 *24* and (K/L3)exp=1.62 *32* (1974Ag01); α(K)exp=0.42 *4* and α(L)exp=0.39 *3* (1974Je02); (K/L)exp=1.06 *8* (1961We11). The sign is from 1974Kr12. |
| | | 249.6742 *6* | 100.0[#] *5* | 0.0 | 7/2⁻ | E2 | | 0.1395 | α(K)=0.0905 *13*; α(L)=0.0375 *6*; α(M)=0.00911 *13*<br>α(N)=0.00213 *3*; α(O)=0.000284 *4*; α(P)=6.23×10$^{-6}$ *9*<br>B(E2)(W.u.)=56 *6* |





$^{177}_{72}Hf_{105}$-8

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $E_\gamma$: From $^{177}$Lu $\beta^-$ decay (160.4 d).<br>Mult.: From α(K)exp=0.106 *11* (2012De24), 0.101 *9* (1974Ag01), 0.090 (1974Je02) and 0.148 *23* (1961We11); α(L)exp=0.035 *3* (1974Je02) and 0.057 *9* (1961We11); α(M)exp=0.018 *3* (1961We11). |
| 321.3162 | 9/2$^+$ | 71.6418[‡] *6* | 1.58[‡] *5* | 249.6744 | 11/2$^-$ | E1+M2 | −0.018 *9* | 0.89 *6* | α(K)=0.71 *4*; α(L)=0.136 *14*; α(M)=0.031 *4*<br>α(N)=0.0072 *9*; α(O)=0.00101 *12*; α(P)=4.5×10$^{-5}$ *7*<br>B(E1)(W.u.)=1.24×10$^{-5}$ *6*; B(M2)(W.u.)=4 *4*<br>Mult.: From γγ(θ) (1970Hr01,1974Kr12) and electron conversion data. α(K)exp=0.90 *11* (1974Ag01), α(L1)exp=0.072 *6* (1972Gr35) and 0.087 *10* (1974Ag01), α(L2)exp=0.028 *3* (1972Gr35) and 0.038 *8* (1974Ag01), α(L3)exp=0.030 *3* (1972Gr35) and 0.033 *7* (1974Ag01).<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.017 *7* (1970Hr01) and −0.051 *37* (1974Kr12), and δ(ce data)=0.014 *57* using the analysis of ce data in 1974Ag01. The sign is from 1970Hr01 and 1974Kr12.<br>B(M2)(W.u.): Note that B(M2)(W.u.) exceeds RUL, presumably due to anomalous α (penetration effect). |
| | | 208.3662[‡] *4* | 100.0[‡] *14* | 112.9498 | 9/2$^-$ | E1+M2 | +0.076 *19* | 0.068 *9* | α(K)=0.055 *7*; α(L)=0.0094 *15*; α(M)=0.0022 *4*<br>α(N)=0.00051 *9*; α(O)=7.5×10$^{-5}$ *13*; α(P)=4.3×10$^{-6}$ *8*<br>B(E1)(W.u.)=3.17×10$^{-5}$ *8*; B(M2)(W.u.)=19 *10*<br>Mult.: From γγ(θ) (1979Er12,1977Ke12,1974Kr12) and electron conversion data. α(K)exp=0.0433 *19* (1972Gr35), 0.046 *4* (1974Ag01), 0.043 *4* (1974Je02) and 0.043 *2* (1961We11); α(L1)exp=0.0052 *2* (1972Gr35) and 0.0063 *6* (1974Ag01),α(L2)exp=0.00091 *5* (1972Gr35) and 0.00110 *12* (1974Ag01),α(L3)exp=0.00089 *5* (1972Gr35) and 0.00100 *12* (1974Ag01), α(L)exp=0.0098 *5* (2012De24), 0.0070 *6* (1974Je02) and 0.0071 *3* (1961We11); α(M)exp=0.0020 *1* (1961We11). Others: 1971Ho37.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=0.08 *4* (1979Er12), −0.08 *2* (1977Ke12) and +0.07 *2* (1974Kr12). The sign is from 1974Kr12.<br>B(M2)(W.u.): Note that B(M2)(W.u.) exceeds RUL, presumably due to anomalous α (penetration effect). |
| | | 321.3159[‡] *6* | 2.10[‡] *4* | 0.0 | 7/2$^-$ | E1+M2 | +0.175 *10* | 0.0354 *21* | α(K)=0.0289 *16*; α(L)=0.0050 *4*; α(M)=0.00116 *8*<br>α(N)=0.000274 *18*; α(O)=4.1×10$^{-5}$ *3*; α(P)=2.52×10$^{-6}$ *17*<br>B(E1)(W.u.)=1.77×10$^{-7}$ *6*; B(M2)(W.u.)=0.24 *3*<br>Mult.: From γγ(θ) (1979Er12,1974Kr12) and electron conversion data. α(K)exp=0.094 *5* (1972Gr35), 0.102 *13* |





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## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | (1974Ag01), 0.078 *7* (1974Je02) and 0.080 *6* (1961We11); α(L1)exp=0.0136 *7* (1972Gr35) and 0.0170 *24* (1974Ag01); α(L2)exp=0.0023 *3* (1972Gr35) and 0.0034 *8* (1974Ag01); α(L3)exp=0.000350 *25* (1974Ag01); α(L)exp=0.017 *2* (1974Je02) and 0.0176 *16* (1961We11); α(M)exp=0.0042 *9* (1961We11).<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=+0.18 *1* (1979Er12) and +0.17 *1* (1974Kr12), and δ(ce data)=0.18 *5* using the analysis of ce data in 1974Ag01. The sign is from 1974Kr12. |
| 409.4085 | 13/2$^-$ | 159.7341[‡] *7* | 10.66[‡] *18* | 249.6744 | 11/2$^-$ | M1+E2 | −2.4 *10* | 0.69 *9* | α(K)=0.39 *11*; α(L)=0.223 *20*; α(M)=0.055 *6*<br>α(N)=0.0127 *13*; α(O)=0.00167 *13*; α(P)=2.8×10$^{-5}$ *11*<br>Mult.,δ: From γγ(θ) in 1974Kr12; $A_2$=−0.12 *4* and DCO(ΔJ=2)=0.71 *9* in (1998Mu14). |
| | | 296.4584[‡] *5* | 100.0[‡] *25* | 112.9498 | 9/2$^-$ | E2 | | 0.0821 | α(K)=0.0567 *8*; α(L)=0.0195 *3*; α(M)=0.00469 *7*<br>α(N)=0.001097 *16*; α(O)=0.0001490 *21*; α(P)=4.04×10$^{-6}$ *6*<br>Mult.: From α(K)exp=0.066 *8* and α(K)exp=0.023 *3* (2012De24); $A_2$=+0.25 *2*, DCO(ΔJ=2)=0.95 *4* and DCO(ΔJ=1)=1.01 *9* (1998Mu14). |
| 426.6752 | 11/2$^+$ | 105.3589[‡] *4* | 100.0[‡] | 321.3162 | 9/2$^+$ | M1+E2 | −0.330 *13* | 3.39 | α(K)=2.67 *4*; α(L)=0.555 *11*; α(M)=0.129 *3*<br>α(N)=0.0304 *7*; α(O)=0.00443 *9*; α(P)=0.000226 *4*<br>B(M1)(W.u.)=0.088 *7*; B(E2)(W.u.)=3.8×10$^2$ *4*<br>Mult.: From γγ(θ) (2014Mu03,1974Kr12,1969Hu06) and electron conversion data.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.23 *4* (2014Mu03), −0.36 *4* (1974Kr12) and −0.344 *20* (1969Hu06); (K/L)exp=3.8 *4* (2012De24) and (L2/L1)exp=0.265 *35* and (L3/L1)exp=0.1922 *54* (1969Hu06). |
| | | 177.0007[‡] *4* | 28.6[‡] *3* | 249.6744 | 11/2$^-$ | [E1] | | 0.0808 | α(K)=0.0672 *10*; α(L)=0.01057 *15*; α(M)=0.00238 *4*<br>α(N)=0.000558 *8*; α(O)=8.15×10$^{-5}$ *12*; α(P)=4.42×10$^{-6}$ *7*<br>B(E1)(W.u.)=5.8×10$^{-5}$ *5* |
| | | 313.7250[‡] *5* | 10.35[‡] *11* | 112.9498 | 9/2$^-$ | E1+M2 | +0.06 *5* | 0.021 *6* | α(K)=0.018 *5*; α(L)=0.0028 *9*; α(M)=0.00063 *20*<br>α(N)=0.00015 *5*; α(O)=2.2×10$^{-5}$ *8*; α(P)=1.3×10$^{-6}$ *5*<br>B(E1)(W.u.)=3.7×10$^{-6}$ *3*; B(M2)(W.u.)=0.6 *+11−6*<br>Mult.: From γγ(θ) in 1974Kr12 and α(K)exp=0.073 *12* in 2012De24.<br>δ: From γγ(θ) in 1974Kr12. |
| 508.13 | 5/2$^-$ | 395.2[@] *1* | 7.5[@] *7* | 112.9498 | 9/2$^-$ | E2 | | 0.0359 | α(K)=0.0267 *4*; α(L)=0.00706 *10*; α(M)=0.001676 *24*<br>α(N)=0.000393 *6*; α(O)=5.49×10$^{-5}$ *8*; α(P)=1.99×10$^{-6}$ *3*<br>Mult.: From α(K)exp=0.036 *5* (1974Je02). |





$^{177}_{72}Hf_{105}$-10

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 508.13 | 5/2⁻ | 508.1[@] *1* | 100[@] *8* | 0.0 | 7/2⁻ | M1+E2 | 0.7 *4* | 0.037 *7* | α(K)=0.031 *6*; α(L)=0.0050 *7*; α(M)=0.00112 *14*<br>α(N)=0.00027 *4*; α(O)=4.0×10$^{-5}$ *6*; α(P)=2.5×10$^{-6}$ *6*<br>Mult.,δ: From α(K)exp=0.031 *3* and α(L)exp=0.0050 *5* (1974Je02), and K/L=6.11 *46*, K/(M+N)=18.5 *29* and L/(M+N)=3.0 *5* (1961We11); L2:L3:M23:N=35:23:22:5 (1967Pr08). |
| 555.1779 | 13/2⁺ | 128.5027[‡] *4* | 100.0[‡] *9* | 426.6752 | 11/2⁺ | M1+E2 | −0.336 *10* | 1.90 | α(K)=1.519 *22*; α(L)=0.291 *5*; α(M)=0.0671 *11*<br>α(N)=0.0159 *3*; α(O)=0.00234 *4*; α(P)=0.0001277 *19*<br>Mult.: From (L2/L1)exp=0.2328 *56* and (L3/L1)exp=0.1345 *35* (1969Hu06); (K/L)exp=7.0 *9*, (K/M)exp=13.0 *3* and (L/M)exp=1.9 *5* (2012De24); γγ(θ) in 2014Mu03, 1974Kr12 and 1969Hu06; $A_2$=−0.53 *2*; DCO(ΔJ=2)=0.63 *7*; DCO(ΔJ=1)=0.50 *5* (1998Mu14).<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.34 *3* (2014Mu03), −0.37 *6* (1974Kr12) and −0.371 *20* (1969Hu06); (L2/L1)exp=0.2328 *56* and (L3/L1)exp=0.1345 *35* (1969Hu06). |
| | | 145.7693[‡] *7* | 6.02[‡] *9* | 409.4085 | 13/2⁻ | [E1] | | 0.1339 | α(K)=0.1109 *16*; α(L)=0.01781 *25*; α(M)=0.00402 *6*<br>α(N)=0.000940 *14*; α(O)=0.0001361 *19*; α(P)=7.10×10$^{-6}$ *10* |
| | | 233.8615[‡] *5* | 29.0[‡] *9* | 321.3162 | 9/2⁺ | E2 | | 0.1719 | α(K)=0.1084 *16*; α(L)=0.0486 *7*; α(M)=0.01183 *17*<br>α(N)=0.00276 *4*; α(O)=0.000367 *6*; α(P)=7.36×10$^{-6}$ *11*<br>Mult.: From (K/L)exp=2.5 *4*, α(K)exp=0.112 *11* and α(L)exp=0.046 *6* (2012De24); DCO(ΔJ=2)=1.2 *3* (1998Mu14). |
| | | 305.5033[‡] *5* | 11.22[‡] *14* | 249.6744 | 11/2⁻ | E1+M2 | +0.16 *7* | 0.038 *18* | α(K)=0.031 *14*; α(L)=0.005 *3*; α(M)=0.0012 *7*<br>α(N)=0.00029 *16*; α(O)=4.4×10$^{-5}$ *24*; α(P)=2.6×10$^{-6}$ *15*<br>Mult.: From γγ(θ) in 1974Kr12 and α(K)exp=0.074 *11* (2012De24).<br>δ: From γγ(θ) in 1974Kr12. |
| 591.3179 | 15/2⁻ | 181.9093[‡] *13* | 5.55[‡] *22* | 409.4085 | 13/2⁻ | [M1+E2] | | 0.734 | α(K)=0.612 *9*; α(L)=0.0947 *14*; α(M)=0.0214 *3*<br>α(N)=0.00508 *8*; α(O)=0.000779 *11*; α(P)=5.18×10$^{-5}$ *8*<br>$I_\gamma$: Weighted average of 5.6 *5* (2014La20), 6.0 *7* (2012De24), 5.43 *33* (1998Mu14), 5.4 *13* (1972Ch48) and 5.8 *10* (1967Ha09). Other: 7.4 *7* (1981Hn03).<br>Mult.: DCO(ΔJ=2)=0.51 *13* (1998Mu14). |
| | | 341.6432[‡] *10* | 100.0[‡] *16* | 249.6744 | 11/2⁻ | E2 | | 0.0540 | α(K)=0.0389 *6*; α(L)=0.01165 *17*; α(M)=0.00279 *4*<br>α(N)=0.000652 *10*; α(O)=8.98×10$^{-5}$ *13*; α(P)=2.84×10$^{-6}$ *4* |





$^{177}_{72}Hf_{105}$-11

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Mult.: From α(K)exp=0.040 *4* (2012De24); $A_2$=+0.29 *2*, DCO(ΔJ=2)=0.96 *6* and DCO(ΔJ=1)=0.83 *8* (1998Mu14). |
| 604.49 | 7/2$^-$ | 96.3[@] *1* | 29[@] *5* | 508.13 | 5/2$^-$ | M1+E2 | 0.7 *3* | 4.34 *10* | α(K)=2.8 *6*; α(L)=1.2 *4*; α(M)=0.28 *9*<br>α(N)=0.065 *20*; α(O)=0.0088 *24*; α(P)=0.00023 *5*<br>Mult.,δ: From α(L)exp=1.2 *3* (1974Je02). |
| | | 283.2[@] *1* | 1.79[@] *18* | 321.3162 | 9/2$^+$ | [E1] | | | |
| | | 354.9[@] *1* | 6.1[@] *9* | 249.6744 | 11/2$^-$ | E2 | | 0.0485 | α(K)=0.0352 *5*; α(L)=0.01019 *15*; α(M)=0.00243 *4*<br>α(N)=0.000570 *8*; α(O)=7.88×10$^{-5}$ *11*; α(P)=2.59×10$^{-6}$ *4*<br>Mult.: α(K)exp=0.06 *2* and α(L)exp=0.03 *2* (1974Je02). |
| | | 491.5[@] *1* | 100[@] *9* | 112.9498 | 9/2$^-$ | M1(+E2) | <0.6 | 0.046 *4* | α(K)=0.039 *4*; α(L)=0.0060 *4*; α(M)=0.00135 *9*<br>α(N)=0.000320 *20*; α(O)=4.9×10$^{-5}$ *4*; α(P)=3.2×10$^{-6}$ *3*<br>Mult.,δ: From α(K)exp=0.042 *4* and α(L)exp=0.0064 *7* (1974Je02), and K/L=6.5 *7* (1961We11). |
| | | 604.4[@] *1* | 70[@] *9* | 0.0 | 7/2$^-$ | (E2) | | 0.01220 | α(K)=0.00970 *14*; α(L)=0.00193 *3*; α(M)=0.000448 *7*<br>α(N)=0.0001055 *15*; α(O)=1.533×10$^{-5}$ *22*; α(P)=7.51×10$^{-7}$ *11*<br>Mult.: From α(K)exp=0.0092 *10* and α(L)exp≤0.002 (1974Je02). |
| 623.0 | (3/2$^-$) | 623.0 *7* | 100 | 0.0 | 7/2$^-$ | | | | $E_\gamma$,$I_\gamma$: From $^{176}$Hf(n,γ) E=thermal. |
| 708.4622 | 15/2$^+$ | 117.1442[‡] *12* | 1.17[‡] *7* | 591.3179 | 15/2$^-$ | [E1] | | 0.237 | α(K)=0.196 *3*; α(L)=0.0323 *5*; α(M)=0.00730 *11*<br>α(N)=0.001704 *24*; α(O)=0.000244 *4*; α(P)=1.213×10$^{-5}$ *17* |
| | | 153.2842[‡] *4* | 100.0[‡] *10* | 555.1779 | 13/2$^+$ | M1+E2 | −0.352 *17* | 1.135 *17* | α(K)=0.918 *15*; α(L)=0.168 *3*; α(M)=0.0386 *7*<br>α(N)=0.00913 *15*; α(O)=0.001357 *21*; α(P)=7.70×10$^{-5}$ *13*<br>Mult.: From (L2/L1)exp=0.2215 *80* and (L3/L1)exp=0.116 *10* (1969Hu06), (K/M)exp=21.9 *27* (2012De24) and γγ(θ) in 2014Mu03, 1974Kr12 and 1969Hu06.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.317 *13* (2014Mu03), −0.33 *5* (1974Kr12) and −0.362 *16* (1969Hu06); (L2/L1)exp=0.2215 *80* and (L3/L1)exp=0.116 *10* (1969Hu06); (K/M)exp=21.9 *27* (2012De24). |
| | | 281.7868[‡] *5* | 84.4[‡] *8* | 426.6752 | 11/2$^+$ | E2 | | 0.0958 | α(K)=0.0650 *10*; α(L)=0.0236 *4*; α(M)=0.00569 *8*<br>α(N)=0.001329 *19*; α(O)=0.000180 *3*; α(P)=4.59×10$^{-6}$ *7*<br>Mult.: From α(K)exp=0.071 *8*, α(L)exp=0.027 *1* and α(M)exp=0.0096 *12* (2012De24); $A_2$=+0.30 *2* and DCO(ΔJ=1)=1.14 *22* (1998Mu14). |





$^{177}_{72}Hf_{105}$-12

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 708.4622 | 15/2$^+$ | 299.0534[‡] *7* | 9.87[‡] *34* | 409.4085 | 13/2$^-$ | E1+M2 | +0.11 *5* | 0.030 *10* | α(K)=0.025 *8*; α(L)=0.0041 *16*; α(M)=0.0009 *4*<br>α(N)=0.00022 *9*; α(O)=3.3×10$^{-5}$ *14*; α(P)=2.0×10$^{-6}$ *9*<br>Mult.,δ: From γγ(θ) in 1974Kr12. |
| 727.1 | 9/2$^-$ | 123.1 | 67 *24* | 604.49 | 7/2$^-$ | [M1+E2] | | 2.21 | α(K)=1.84 *3*; α(L)=0.287 *4*; α(M)=0.0647 *9*<br>α(N)=0.01538 *22*; α(O)=0.00236 *4*; α(P)=0.0001564 *22* |
| | | 218.5 | 100 *36* | 508.13 | 5/2$^-$ | [E2] | | 0.214 | α(K)=0.1309 *19*; α(L)=0.0638 *9*; α(M)=0.01560 *22*<br>α(N)=0.00363 *5*; α(O)=0.000480 *7*; α(P)=8.75×10$^{-6}$ *13* |
| 745.91 | (7/2)$^+$ | 319.3[@] *1* | 1.14[@] *14* | 426.6752 | 11/2$^+$ | [E2] | | 0.0658 | α(K)=0.0465 *7*; α(L)=0.01484 *21*; α(M)=0.00356 *5*<br>α(N)=0.000833 *12*; α(O)=0.0001140 *16*; α(P)=3.36×10$^{-6}$ *5* |
| | | 424.6[@] *1* | 50[@] *5* | 321.3162 | 9/2$^+$ | M1(+E2) | ≤0.7 | 0.066 *8* | α(K)=0.055 *7*; α(L)=0.0087 *7*; α(M)=0.00197 *14*<br>α(N)=0.00047 *4*; α(O)=7.1×10$^{-5}$ *6*; α(P)=4.6×10$^{-6}$ *6*<br>Mult.,δ: From α(K)exp=0.058 *6* and α(L)exp=0.010 *2* (1974Je02), and K/L=6.0 *9* (1961We11). |
| | | 632.9[@] *1* | 14.1[@] *14* | 112.9498 | 9/2$^-$ | E1 | | 0.00399 | α(K)=0.00337 *5*; α(L)=0.000482 *7*; α(M)=0.0001077 *15*<br>α(N)=2.55×10$^{-5}$ *4*; α(O)=3.86×10$^{-6}$ *6*; α(P)=2.47×10$^{-7}$ *4*<br>Mult.: From α(K)exp=0.0033 *4* (1974Je02). |
| | | 745.9[@] *1* | 100[@] *8* | 0.0 | 7/2$^-$ | E1 | | 0.00286 | α(K)=0.00242 *4*; α(L)=0.000343 *5*; α(M)=7.66×10$^{-5}$ *11*<br>α(N)=1.81×10$^{-5}$ *3*; α(O)=2.76×10$^{-6}$ *4*; α(P)=1.79×10$^{-7}$ *3*<br>Mult.: From α(K)exp=0.0023 *3* (1974Je02). |
| 794.4394 | 17/2$^-$ | 203.0 *1* | 3.90 *21* | 591.3179 | 15/2$^-$ | [M1+E2] | | 0.541 | α(K)=0.451 *7*; α(L)=0.0697 *10*; α(M)=0.01572 *23*<br>α(N)=0.00374 *6*; α(O)=0.000573 *8*; α(P)=3.81×10$^{-5}$ *6*<br>$E_\gamma$: From 2012De24. Other: 203.0 keV (1998Mu14).<br>$I_\gamma$: Weighted average of 3.9 *4* (2014La20), 3.9 *4* (2012De24), and 3.9 *3* (1998Mu14). |
| | | 385.0304[‡] *9* | 100.0[‡] *12* | 409.4085 | 13/2$^-$ | E2 | | 0.0386 | α(K)=0.0285 *4*; α(L)=0.00771 *11*; α(M)=0.00183 *3*<br>α(N)=0.000429 *6*; α(O)=5.98×10$^{-5}$ *9*; α(P)=2.12×10$^{-6}$ *3*<br>Mult.: From α(K)exp=0.026 *3* and α(L)exp=0.011 *1* (2012De24); $A_2$=+0.25 *2*, DCO(ΔJ=2)=0.95 *7*, and DCO(ΔJ=1)=0.97 *9* (1998Mu14). |
| 805.75 | 3/2$^-$ | 297.7[@] *1* | 48[@] *4* | 508.13 | 5/2$^-$ | M1+E2 | 1.2 *4* | 0.126 *22* | α(K)=0.098 *21*; α(L)=0.0213 *11*; α(M)=0.00497 *19*<br>α(N)=0.00117 *5*; α(O)=0.000168 *11*; α(P)=7.8×10$^{-6}$ *19*<br>Mult.,δ: From α(K)exp=0.10 *2* (1974Je02). |
| | | 805.7[@] *1* | 100[@] *10* | 0.0 | 7/2$^-$ | [E2] | | 0.00641 | α(K)=0.00523 *8*; α(L)=0.000913 *13*; α(M)=0.000209 *3*<br>α(N)=4.94×10$^{-5}$ *7*; α(O)=7.32×10$^{-6}$ *11*; α(P)=4.08×10$^{-7}$ *6* |
| 839.1 | (7/2$^-$) | 216.1 *3* | 100 | 623.0 | (3/2$^-$) | | | | |
| 841.5 | (9/2$^-$) | 176.5 *3* | 100 | 665 | (5/2)$^-$ | | | | |
| 845.6 | (9/2$^-$) | 193.6 *3* | 100 | 652 | (5/2$^-$) | | | | |
| 847.41 | 9/2$^+$ | 420.8[@] *1* | 79[@] *7* | 426.6752 | 11/2$^+$ | M1+E2 | 0.6 *4* | 0.063 *11* | α(K)=0.052 *10*; α(L)=0.0086 *9*; α(M)=0.00194 *19*<br>α(N)=0.00046 *5*; α(O)=7.0×10$^{-5}$ *8*; α(P)=4.3×10$^{-6}$ *9*<br>Mult.,δ: From α(K)exp=0.051 *9* and α(L)exp=0.011 *3* (1974Je02). |





$^{177}_{72}Hf_{105}$-13

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 847.41 | 9/2$^+$ | 526.1[@] *1* | 43[@] *5* | 321.3162 | 9/2$^+$ | M1+E2 | 0.77 *15* | 0.0328 *25* | α(K)=0.0271 *22*; α(L)=0.00440 *24*; α(M)=0.00100 *6*<br>α(N)=0.000237 *13*; α(O)=3.59×10$^{-5}$ *21*; α(P)=2.22×10$^{-6}$ *19*<br>Mult.,δ: From α(K)exp=0.027 *2* and α(L)exp=0.0046 *8* (1974Je02). |
| | | 597.7[@] *1* | 24[@] *19* | 249.6744 | 11/2$^-$ | E1 | | 0.00449 | α(K)=0.00379 *6*; α(L)=0.000544 *8*; α(M)=0.0001216 *17*<br>α(N)=2.88×10$^{-5}$ *4*; α(O)=4.36×10$^{-6}$ *7*; α(P)=2.77×10$^{-7}$ *4*<br>Mult.: From α(K)exp=0.005 *3* (1974Je02). |
| | | 734.4[@] *1* | 100[@] *10* | 112.9498 | 9/2$^-$ | E1 | | 0.00295 | α(K)=0.00250 *4*; α(L)=0.000354 *5*; α(M)=7.91×10$^{-5}$ *11*<br>α(N)=1.87×10$^{-5}$ *3*; α(O)=2.85×10$^{-6}$ *4*; α(P)=1.84×10$^{-7}$ *3*<br>Mult.: From α(K)exp<0.0037 (1974Je02). ce intensity is from 734γ doublet. |
| | | 847.4[@] *1* | 69[@] *7* | 0.0 | 7/2$^-$ | E1 | | 0.00223 | α(K)=0.00189 *3*; α(L)=0.000266 *4*; α(M)=5.93×10$^{-5}$ *9*<br>α(N)=1.405×10$^{-5}$ *20*; α(O)=2.14×10$^{-6}$ *3*; α(P)=1.402×10$^{-7}$ *20*<br>Mult.: From α(K)exp=0.0015 *2* (1974Je02). |
| 872.96 | (5/2)$^-$ | 268.5[@c] *2* | 15[@] *4* | 604.49 | 7/2$^-$ | | | | |
| | | 365.1[@c] *2* | 18[@] *4* | 508.13 | 5/2$^-$ | | | | |
| | | 760.0[@] *1* | 77[@] *8* | 112.9498 | 9/2$^-$ | | | | |
| | | 873.0[@] *1* | 100[@] *10* | 0.0 | 7/2$^-$ | | | | |
| 882.8611 | 17/2$^+$ | 88.4[‡] *1* | 0.23[‡] *3* | 794.4394 | 17/2$^-$ | [E1] | | 0.494 | α(K)=0.403 *6*; α(L)=0.0701 *10*; α(M)=0.01587 *23*<br>α(N)=0.00369 *6*; α(O)=0.000519 *8*; α(P)=2.41×10$^{-5}$ *4*<br>$E_\gamma$: From 2012De24. |
| | | 174.3988[‡] *4* | 67.7[‡] *6* | 708.4622 | 15/2$^+$ | M1+E2 | −0.313 *16* | 0.793 *12* | α(K)=0.649 *10*; α(L)=0.1116 *17*; α(M)=0.0255 *4*<br>α(N)=0.00604 *9*; α(O)=0.000908 *13*; α(P)=5.45×10$^{-5}$ *9*<br>Mult.: From (K/M)exp=14.6 *38* (2012De24) and γγ(θ) in 2014Mu03, 1974Kr12 and 1969Hu06.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.296 *13* (2014Mu03), −0.32 *4* (1974Kr12) and −0.376 *26* (1969Hu06). |
| | | 291.5429[‡] *12* | 5.60[‡] *16* | 591.3179 | 15/2$^-$ | E1+M2 | +0.08 *8* | 0.028 *15* | α(K)=0.023 *12*; α(L)=0.0037 *25*; α(M)=0.0008 *6*<br>α(N)=0.00020 *14*; α(O)=3.0×10$^{-5}$ *21*; α(P)=1.8×10$^{-6}$ *13*<br>Mult.,δ: From γγ(θ) in 1974Kr12. |
| | | 327.6829[‡] *5* | 100.0[‡] *11* | 555.1779 | 13/2$^+$ | E2 | | 0.0610 | α(K)=0.0434 *6*; α(L)=0.01352 *19*; α(M)=0.00324 *5*<br>α(N)=0.000758 *11*; α(O)=0.0001040 *15*; α(P)=3.15×10$^{-6}$ *5*<br>Mult.: From α(K)exp=0.045 *3*, α(L)exp=0.013 *1* and |





$^{177}_{72}Hf_{105}$-14

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | α(M)exp=0.0035 *6* (2012De24); $A_2$=+0.18 *2*, DCO(ΔJ=2)=0.84 *22* and DCO(ΔJ=1)=1.26 *14* (1998Mu14). |
| 948.09 | (3/2$^-$,5/2,7/2$^-$) | 142.4[@] *2* | 100[@] *16* | 805.75 | 3/2$^-$ | | | | |
| | | 439.9[@] *2* | 64[@] *14* | 508.13 | 5/2$^-$ | | | | |
| 1002.83 | (7/2$^-$) | 129.9[@] *1* | 24[@] *4* | 872.96 | (5/2)$^-$ | | | | |
| | | 197.1[@] *1* | 69[@] *7* | 805.75 | 3/2$^-$ | | | | |
| | | 256.9[@] *1* | 20.7[@] *20* | 745.91 | (7/2)$^+$ | | | | |
| | | 398.3[@] *2* | 13.3[@] *20* | 604.49 | 7/2$^-$ | | | | |
| | | 494.7[@] *1* | 100[@] *9* | 508.13 | 5/2$^-$ | | | | |
| | | 681.5[@] *1* | 17.8[@] *22* | 321.3162 | 9/2$^+$ | | | | |
| | | 1002.8[@] *1* | 24.4[@] *22* | 0.0 | 7/2$^-$ | | | | |
| 1017.7911 | 19/2$^-$ | 223.3 *3* | 2.70 *17* | 794.4394 | 17/2$^-$ | [M1+E2] | | 0.415 | α(K)=0.347 *5*; α(L)=0.0534 *8*; α(M)=0.01206 *18*<br>α(N)=0.00287 *5*; α(O)=0.000440 *7*; α(P)=2.93×10$^{-5}$ *5*<br>$I_\gamma$: Weighted average of 2.5 *3* (2014La20), 3.0 *3* (2012De24), and 2.6 *3* (1998Mu14). |
| | | 426.4726[‡] *24* | 100[‡] *8* | 591.3179 | 15/2$^-$ | E2 | | 0.0292 | α(K)=0.0221 *3*; α(L)=0.00550 *8*; α(M)=0.001299 *19*<br>α(N)=0.000305 *5*; α(O)=4.29×10$^{-5}$ *6*; α(P)=1.662×10$^{-6}$ *24*<br>Mult.: DCO(ΔJ=2)=0.89 *5* and DCO(ΔJ=1)=1.07 *15* (1998Mu14). |
| 1057.74 | 7/2$^-$ | 210.2[@] *5* | 1.6[@] *10* | 847.41 | 9/2$^+$ | | | | |
| | | 311.9[@] *2* | 0.17[@] *3* | 745.91 | (7/2)$^+$ | | | | |
| | | 453.2[@] *1* | 0.77[@] *10* | 604.49 | 7/2$^-$ | M1(+E2) | 0.4 *4* | 0.057 *10* | α(K)=0.047 *9*; α(L)=0.0074 *9*; α(M)=0.00167 *18*<br>α(N)=0.00040 *5*; α(O)=6.1×10$^{-5}$ *8*; α(P)=3.9×10$^{-6}$ *8* |
| | | 549.6[@] *1* | 2.06[@] *16* | 508.13 | 5/2$^-$ | M1(+E2) | 0.3 *3* | 0.036 *5* | α(K)=0.030 *4*; α(L)=0.0046 *4*; α(M)=0.00103 *9*<br>α(N)=0.000244 *22*; α(O)=3.7×10$^{-5}$ *4*; α(P)=2.5×10$^{-6}$ *4* |
| | | 736.4[@] *1* | 5.5[@] *7* | 321.3162 | 9/2$^+$ | E1 | | 0.00294 | α(K)=0.00248 *4*; α(L)=0.000352 *5*; α(M)=7.86×10$^{-5}$ *11*<br>α(N)=1.86×10$^{-5}$ *3*; α(O)=2.83×10$^{-6}$ *4*; α(P)=1.83×10$^{-7}$ *3* |
| | | 944.8[@] *1* | 19.0[@] *16* | 112.9498 | 9/2$^-$ | M1(+E2) | <0.3 | 0.00937 *25* | α(K)=0.00787 *21*; α(L)=0.00116 *3*; |





$^{177}_{72}Hf_{105}$-15

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | α(M)=0.000261 *7*<br>α(N)=6.21×10$^{-5}$ *15*; α(O)=9.56×10$^{-6}$ *24*;<br>α(P)=6.47×10$^{-7}$ *18* |
| 1057.74 | 7/2$^-$ | 1057.8[@] *1* | 100[@] *10* | 0.0 | 7/2$^-$ | M1(+E2) | <0.5 | 0.0069 *4* | α(K)=0.0058 *4*; α(L)=0.00085 *5*; α(M)=0.000192 *10*<br>α(N)=4.56×10$^{-5}$ *23*; α(O)=7.0×10$^{-6}$ *4*;<br>α(P)=4.7×10$^{-7}$ *3* |
| 1086.9662 | 19/2$^+$ | 69.2[‡] *1* | 0.034[‡] *4* | 1017.7911 | 19/2$^-$ | [E1] | | 0.919 | α(K)=0.742 *11*; α(L)=0.1381 *21*; α(M)=0.0313 *5*<br>α(N)=0.00725 *11*; α(O)=0.001000 *15*;<br>α(P)=4.33×10$^{-5}$ *7*<br>$E_\gamma$: From 2012De24. |
| | | 204.1050[‡] *4* | 46.0[‡] *8* | 882.8611 | 17/2$^+$ | M1+E2 | −0.335 *23* | 0.506 *8* | α(K)=0.415 *7*; α(L)=0.0702 *10*; α(M)=0.01601 *24*<br>α(N)=0.00379 *6*; α(O)=0.000572 *8*;<br>α(P)=3.48×10$^{-5}$ *6*<br>Mult.: From (L2/L1)exp=0.167 *13* and (L3/L1)exp=0.0685 *34* (1969Hu06); (K/L)exp=5.6 *4*,(K/M)exp=24.3 *51* and (L/M)exp=4.4 *9* (2012De24); γγ(θ) in 2014Mu03, 1974Kr12 and 1969Hu06.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.289 *13* (2014Mu03), −0.33 *5* (1974Kr12) and −0.358 *34* (1969Hu06); (L2/L1)exp=0.167 *13* and (L3/L1)exp=0.0685 *34* (1969Hu06); (K/L)exp=5.6 *4*, (K/M)exp=24.3 *51* and (L/M)exp=4.4 *9* (2012De24). |
| | | 292.5266[‡] *14* | 2.76[‡] *17* | 794.4394 | 17/2$^-$ | E1+M2 | +0.08 *8* | 0.028 *15* | α(K)=0.023 *12*; α(L)=0.0037 *24*; α(M)=0.0008 *6*<br>α(N)=0.00020 *14*; α(O)=3.0×10$^{-5}$ *21*;<br>α(P)=1.8×10$^{-6}$ *13*<br>Mult.,δ: From γγ(θ) in 1974Kr12. |
| | | 378.5036[‡] *5* | 100.0[‡] *10* | 708.4622 | 15/2$^+$ | E2 | | 0.0404 | α(K)=0.0298 *5*; α(L)=0.00817 *12*; α(M)=0.00194 *3*<br>α(N)=0.000455 *7*; α(O)=6.34×10$^{-5}$ *9*;<br>α(P)=2.21×10$^{-6}$ *3*<br>Mult.: From α(K)exp=0.026 *1*, α(L)exp=0.014 *1* and α(M)exp=0.0018 *2* (2012De24). |
| 1113.5 | (13/2$^-$) | 272.0 *3* | 100 | 841.5 | (9/2$^-$) | | | | |
| 1143.3 | (13/2$^-$) | 297.7 *3* | 100 | 845.6 | (9/2$^-$) | | | | |
| 1156.9 | (11/2$^-$) | 317.8 *3* | 100 | 839.1 | (7/2$^-$) | | | | |
| 1260.2817 | 21/2$^-$ | 242.1 *3* | 2.34 *12* | 1017.7911 | 19/2$^-$ | [M1+E2] | | 0.333 | α(K)=0.278 *4*; α(L)=0.0427 *7*; α(M)=0.00964 *14*<br>α(N)=0.00229 *4*; α(O)=0.000352 *5*;<br>α(P)=2.34×10$^{-5}$ *4* |





$^{177}_{72}Hf_{105}$-16

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $E_\gamma$: From 2012De24. Other: 242.07 *10* (1981Hn03).<br>$I_\gamma$: Unweighted average of 2.31 *12* (2014La20) and 2.24 *47* (2012De24). Other: 1.56 *52* (1981Hn03). |
| 1260.2817 | 21/2$^-$ | 465.8416[‡] *10* | 100.0[‡] *11* | 794.4394 | 17/2$^-$ | E2 | | 0.0232 | α(K)=0.01778 *25*; α(L)=0.00415 *6*; α(M)=0.000977 *14*<br>α(N)=0.000230 *4*; α(O)=3.26×10$^{-5}$ *5*; α(P)=1.351×10$^{-6}$ *19*<br>Mult.: From α(K)exp=0.020 *1* (2012De24); $A_2$=+0.15 *3*, DCO(ΔJ=2)=0.81 *5* and DCO(ΔJ=1)=1.01 *13* (1998Mu14). |
| 1301.4004 | 21/2$^+$ | 214.4341[‡] *5* | 29.6[‡] *3* | 1086.9662 | 19/2$^+$ | M1+E2 | −0.30 *3* | 0.445 *8* | α(K)=0.367 *7*; α(L)=0.0605 *9*; α(M)=0.01377 *20*<br>α(N)=0.00327 *5*; α(O)=0.000494 *7*; α(P)=3.08×10$^{-5}$ *6*<br>Mult.: From From (K/L)exp=7.2 *11* (2012De24) and γγ(θ) in 1974Kr12 and 1969Hu06.<br>δ: Using the briccmixing program and the following experimental data: δ(γγ(θ))=−0.29 *2* (1974Kr12) and −0.334 *40* (1969Hu06), and (K/L)exp=7.2 *11* (2012De24). |
| | | 283.609[‡] *3* | 1.90[‡] *11* | 1017.7911 | 19/2$^-$ | [E1] | | 0.0245 | α(K)=0.0205 *3*; α(L)=0.00310 *5*; α(M)=0.000697 *10*<br>α(N)=0.0001642 *23*; α(O)=2.44×10$^{-5}$ *4*;<br>α(P)=1.425×10$^{-6}$ *20* |
| | | 418.5388[‡] *5* | 100.0[‡] *8* | 882.8611 | 17/2$^+$ | E2 | | 0.0307 | α(K)=0.0231 *4*; α(L)=0.00584 *9*; α(M)=0.001382 *20*<br>α(N)=0.000324 *5*; α(O)=4.56×10$^{-5}$ *7*; α(P)=1.738×10$^{-6}$ *25*<br>Mult.: From α(K)exp=0.023 *1*, α(L)exp=0.0066 *6* and α(M)exp=0.0024 *2* (2012De24); $A_2$=+0.19 *3*, DCO(ΔJ=2)=0.93 *13* and DCO(ΔJ=1)=1.15 *13* (1998Mu14). |
| 1315.4502 | 23/2$^+$ | (14.050 *10*) | 0.41 *1* | 1301.4004 | 21/2$^+$ | [M1+E2] | | 217 | α(L)=167.8 *24*; α(M)=38.2 *6*<br>α(N)=9.08 *13*; α(O)=1.389 *20*; α(P)=0.0917 *13*<br>$E_\gamma$: From level energy differences. |
| | | 55.15[‡] *2* | 5.45[‡] *6* | 1260.2817 | 21/2$^-$ | [E1] | | 0.333 | α(L)=0.259 *4*; α(M)=0.0589 *9*<br>α(N)=0.01357 *19*; α(O)=0.00183 *3*; α(P)=7.37×10$^{-5}$ *11*<br>B(E1)(W.u.)=2.97×10$^{-14}$ *15*<br>$E_\gamma$: From 1964Al04. Other: 55.2 *1* (2012De24).<br>Mult.: α(T)exp=0.54 *4* (2013La08,2014La20) from intensity balances, interpreted as anomalous E1. It should be noted that 55.15γ overlaps with the Hf X rays and determination of its γ-ray intensity is not unambiguous. |
| | | 228.4838[‡] *6* | 100.0[‡] *21* | 1086.9662 | 19/2$^+$ | E2 | | 0.185 | α(K)=0.1156 *17*; α(L)=0.0533 *8*; α(M)=0.01300 *19*<br>α(N)=0.00303 *5*; α(O)=0.000402 *6*; α(P)=7.81×10$^{-6}$ *11*<br>B(E2)(W.u.)=6.6×10$^{-9}$ *4* |





$^{177}_{72}Hf_{105}$-17

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$ † | $I_\gamma$ † | $E_f$ | $J_f^\pi$ | Mult. † | δ | α [b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Mult.: α(L1)exp=0.0144 *6*, α(L2)exp=0.0243 *9*, α(L3)exp=0.0152 *6*, ce(L1)/ce(L3) exp=0.94 *4*, and ce(L2)/ce(L3) exp=1.60 *3* (1990Bu31). α(K)exp=0.1156 *59*, α(L)exp=0.053 *5* and α(M)exp=0.0125 *8* (2012De24); |
| 1342.4 | (19/2$^-$) | 548.0& | 100& | 794.4394 | 17/2$^-$ | M1+E2 | | 0.0379 | α(K)=0.0318 *5*; α(L)=0.00478 *7*; α(M)=0.001075 *15*<br>α(N)=0.000255 *4*; α(O)=3.93×10$^{-5}$ *6*; α(P)=2.64×10$^{-6}$ *4*<br>Mult.: From measured conversion electron spectra in 1976ReZH ($^{176}$Yb(α,3nγ)), but values are not provided by the authors. |
| 1477.2 | (17/2$^-$) | 363.7 *3* | 100 | 1113.5 | (13/2$^-$) | [E2] | | 0.0452 | α(K)=0.0330 *5*; α(L)=0.00936 *14*; α(M)=0.00223 *4*<br>α(N)=0.000523 *8*; α(O)=7.25×10$^{-5}$ *11*; α(P)=2.44×10$^{-6}$ *4* |
| 1520.6 | 23/2$^-$ | 260[a] *1* | | 1260.2817 | 21/2$^-$ | | | | |
| | | 502.9 *3* | 100 | 1017.7911 | 19/2$^-$ | E2 | | 0.0191 | α(K)=0.01481 *21*; α(L)=0.00329 *5*; α(M)=0.000769 *11*<br>α(N)=0.000181 *3*; α(O)=2.59×10$^{-5}$ *4*; α(P)=1.133×10$^{-6}$ *16*<br>Mult.: DCO(ΔJ=2)=0.87 *5* (1998Mu14). |
| 1534.9 | (17/2$^-$) | 391.6 *3* | 100 | 1143.3 | (13/2$^-$) | [E2] | | 0.0368 | α(K)=0.0273 *4*; α(L)=0.00728 *11*; α(M)=0.001729 *25*<br>α(N)=0.000405 *6*; α(O)=5.66×10$^{-5}$ *8*; α(P)=2.04×10$^{-6}$ *3* |
| 1561.36 | 23/2$^+$ | 260.0 *3* | 19.4 *11* | 1301.4004 | 21/2$^+$ | M1+E2 | | 0.274 | α(K)=0.229 *4*; α(L)=0.0351 *5*; α(M)=0.00792 *12*<br>α(N)=0.00188 *3*; α(O)=0.000289 *5*; α(P)=1.93×10$^{-5}$ *3*<br>Mult.: DCO(ΔJ=2)=0.46 *11* (1998Mu14). |
| | | 474.4 *3* | 100 *3* | 1086.9662 | 19/2$^+$ | E2 | | 0.0221 | α(K)=0.01701 *24*; α(L)=0.00393 *6*; α(M)=0.000922 *13*<br>α(N)=0.000217 *3*; α(O)=3.08×10$^{-5}$ *5*; α(P)=1.296×10$^{-6}$ *19*<br>Mult.: $A_2$=+0.15 *3*, DCO(ΔJ=2)=1.03 *14*, DCO(ΔJ=1)=1.26 *16* (1998Mu14). |
| 1564.6 | (15/2$^-$) | 407.7 *3* | 100 | 1156.9 | (11/2$^-$) | [E2] | | 0.0330 | α(K)=0.0247 *4*; α(L)=0.00637 *9*; α(M)=0.001509 *22*<br>α(N)=0.000354 *5*; α(O)=4.96×10$^{-5}$ *7*; α(P)=1.85×10$^{-6}$ *3* |
| 1583.0 | (21/2$^-$) | 240.6 *3* | 100 | 1342.4 | (19/2$^-$) | [M1+E2] | | 0.338 | α(K)=0.282 *4*; α(L)=0.0435 *7*; α(M)=0.00981 *15*<br>α(N)=0.00233 *4*; α(O)=0.000358 *6*; α(P)=2.38×10$^{-5}$ *4* |
| 1592.75 | 25/2$^+$ | 277.3 *3* | 100 | 1315.4502 | 23/2$^+$ | M1+E2 | +0.302 *4* | 0.219 *4* | α(K)=0.182 *3*; α(L)=0.0291 *5*; α(M)=0.00659 *10*<br>α(N)=0.001564 *23*; α(O)=0.000238 *4*; α(P)=1.520×10$^{-5}$ *22*<br>Mult.: From (K/L)exp=6.29 *39* (1972Ch48) and γ(θ) (2014Mu03) $^{177}$Hf IT decay (51.4 m).<br>δ: Using the briccmixing program and (K/L)exp=6.29 *39* (1972Ch48) and δ=+0.302 *4* (2014Mu03) in $^{177}$Hf IT decay (51.4 m). |
| 1713.15 | 25/2$^-$ | 120.4 *3* | 100 *3* | 1592.75 | 25/2$^+$ | E1 | | 0.221 *4* | α(K)=0.182 *3*; α(L)=0.0300 *5*; α(M)=0.00677 *11*<br>α(N)=0.001581 *25*; α(O)=0.000227 *4*; α(P)=1.134×10$^{-5}$ *18*<br>B(E1)(W.u.)>9.2×10$^{-5}$<br>Mult.: $A_2$=+0.31 *1* and DCO(ΔJ=1)=0.97 *3* (1998Mu14).<br>Proposed configuration and deduced transition strength. |
| | | 397.7 *3* | 9.7 *6* | 1315.4502 | 23/2$^+$ | E1 | | 0.01096 | α(K)=0.00922 *13*; α(L)=0.001360 *20*; α(M)=0.000305 *5*<br>α(N)=7.20×10$^{-5}$ *11*; α(O)=1.080×10$^{-5}$ *16*; α(P)=6.59×10$^{-7}$ *10*<br>B(E1)(W.u.)>2.5×10$^{-7}$ |





$^{177}_{72}Hf_{105}$-18

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$ † | $I_\gamma$ † | $E_f$ | $J_f^\pi$ | Mult.† | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Mult.: $A_2$=−0.06 *5* and DCO(ΔJ=1)=0.60 *10* (1998Mu14) Proposed configuration and deduced transition strength. |
| 1798.2 | 25/2− | 278[a] *1* | | 1520.6 | 23/2− | | | |
| | | 537.9 *3* | 100 | 1260.2817 | 21/2− | E2 | 0.01614 | α(K)=0.01265 *18*; α(L)=0.00269 *4*; α(M)=0.000628 *9*<br>α(N)=0.0001478 *21*; α(O)=2.13×10$^{-5}$ *3*; α(P)=9.73×10$^{-7}$ *14*<br>Mult.: $A_2$=+0.27 *3*, DCO(ΔJ=2)=0.95 *7* and DCO(ΔJ=1)=0.86 *22* (1998Mu14). |
| 1803.06 | 25/2+ | 241.8 *3* | 12.4 *21* | 1561.36 | 23/2+ | [M1+E2] | 0.334 | α(K)=0.279 *4*; α(L)=0.0429 *7*; α(M)=0.00967 *14*<br>α(N)=0.00230 *4*; α(O)=0.000353 *5*; α(P)=2.35×10$^{-5}$ *4* |
| | | 501.6 *3* | 100 *4* | 1301.4004 | 21/2+ | E2 | 0.0192 | α(K)=0.01490 *21*; α(L)=0.00331 *5*; α(M)=0.000775 *11*<br>α(N)=0.000182 *3*; α(O)=2.61×10$^{-5}$ *4*; α(P)=1.140×10$^{-6}$ *16*<br>Mult.: DCO(ΔJ=2)=0.83 *12*; DCO(ΔJ=1)=0.95 *14* (1998Mu14). |
| 1845.9 | (23/2−) | 263.0 *3* | 100 *4* | 1583.0 | (21/2−) | [M1+E2] | 0.265 | α(K)=0.222 *4*; α(L)=0.0340 *5*; α(M)=0.00767 *11*<br>α(N)=0.00182 *3*; α(O)=0.000280 *4*; α(P)=1.87×10$^{-5}$ *3* |
| | | 503.4 *3* | 12.8 *15* | 1342.4 | (19/2−) | [E2] | 0.0190 | α(K)=0.01477 *21*; α(L)=0.00328 *5*; α(M)=0.000767 *11*<br>α(N)=0.000180 *3*; α(O)=2.58×10$^{-5}$ *4*; α(P)=1.130×10$^{-6}$ *16* |
| 1887.75 | 27/2+ | 295.1 *3* | 100 *4* | 1592.75 | 25/2+ | M1+E2 | 0.194 | α(K)=0.1622 *24*; α(L)=0.0248 *4*; α(M)=0.00560 *8*<br>α(N)=0.001331 *19*; α(O)=0.000204 *3*; α(P)=1.364×10$^{-5}$ *20*<br>Mult.: From (K/L)exp=6.55 *47* (1972Ch48) in $^{177}$Hf IT decay (51.4 m) $A_2$=+0.18 *3* and DCO(ΔJ=1)=0.77 *4* (1998Mu14). |
| | | 572.3 *3* | 12.8 *15* | 1315.4502 | 23/2+ | E2 | 0.01389 | α(K)=0.01097 *16*; α(L)=0.00225 *4*; α(M)=0.000523 *8*<br>α(N)=0.0001233 *18*; α(O)=1.78×10$^{-5}$ *3*; α(P)=8.47×10$^{-7}$ *12*<br>Mult.: From (K/L)exp=4.89 *64* (1972Ch48) in $^{177}$Hf IT decay (51.4 m). |
| 1925.3 | (21/2−) | 448.1 *3* | 100 | 1477.2 | (17/2−) | [E2] | 0.0256 | α(K)=0.0195 *3*; α(L)=0.00469 *7*; α(M)=0.001106 *16*<br>α(N)=0.000260 *4*; α(O)=3.67×10$^{-5}$ *6*; α(P)=1.479×10$^{-6}$ *21* |
| 1968.0 | 27/2− | 254.8 *3* | 100 | 1713.15 | 25/2− | M1+E2 | 0.289 *5* | α(K)=0.242 *4*; α(L)=0.0371 *6*; α(M)=0.00837 *12*<br>α(N)=0.00199 *3*; α(O)=0.000305 *5*; α(P)=2.04×10$^{-5}$ *3*<br>Mult.: $A_2$=+0.25 *1*; DCO(ΔJ=1)=0.95 *8* (1998Mu14). |
| 2005.1 | (21/2−) | 470.2 *3* | 100 | 1534.9 | (17/2−) | [E2] | 0.0226 | α(K)=0.01738 *25*; α(L)=0.00404 *6*; α(M)=0.000948 *14*<br>α(N)=0.000223 *4*; α(O)=3.17×10$^{-5}$ *5*; α(P)=1.322×10$^{-6}$ *19* |
| 2048.2 | (19/2−) | 483.6 *3* | 100 | 1564.6 | (15/2−) | [E2] | 0.0211 | α(K)=0.01625 *23*; α(L)=0.00370 *6*; α(M)=0.000868 *13*<br>α(N)=0.000204 *3*; α(O)=2.91×10$^{-5}$ *5*; α(P)=1.239×10$^{-6}$ *18* |
| 2070.2 | (23/2−) | 357.1 *3* | 100 | 1713.15 | 25/2− | | | |
| 2091.0 | 27/2− | 570.4 *3* | 100 | 1520.6 | 23/2− | E2 | 0.01400 | α(K)=0.01105 *16*; α(L)=0.00227 *4*; α(M)=0.000528 *8*<br>α(N)=0.0001245 *18*; α(O)=1.80×10$^{-5}$ *3*; α(P)=8.53×10$^{-7}$ *12*<br>Mult.: DCO(ΔJ=2)=1.02 *7* (1998Mu14). |
| 2124.0 | (25/2−) | 278.2 *3* | 100 *9* | 1845.9 | (23/2−) | [M1+E2] | 0.228 | α(K)=0.190 *3*; α(L)=0.0292 *5*; α(M)=0.00658 *10*<br>α(N)=0.001564 *23*; α(O)=0.000240 *4*; α(P)=1.601×10$^{-5}$ *23* |
| | | 541.0 *3* | 41 *7* | 1583.0 | (21/2−) | [E2] | 0.01591 | α(K)=0.01248 *18*; α(L)=0.00265 *4*; α(M)=0.000617 *9*<br>α(N)=0.0001453 *21*; α(O)=2.09×10$^{-5}$ *3*; α(P)=9.60×10$^{-7}$ *14* |
| 2128.5 | 27/2+ | 325.4 *3* | 12.2 *24* | 1803.06 | 25/2+ | [M1+E2] | 0.1493 *22* | α(K)=0.1247 *18*; α(L)=0.0190 *3*; α(M)=0.00429 *7*<br>α(N)=0.001021 *15*; α(O)=0.0001568 *23*; α(P)=1.047×10$^{-5}$ *15* |





$^{177}_{72}Hf_{105}$-19

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | δ | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 2128.5 | 27/2$^+$ | 567.1 *3* | 100 *4* | 1561.36 | 23/2$^+$ | [E2] | | 0.01419 | α(K)=0.01120 *16*; α(L)=0.00231 *4*; α(M)=0.000537 *8*<br>α(N)=0.0001266 *18*; α(O)=1.83×10$^{-5}$ *3*; α(P)=8.64×10$^{-7}$ *13* |
| 2199.2 | 29/2$^+$ | 311.5 *3* | 100 *4* | 1887.75 | 27/2$^+$ | M1+E2 | 0.285 *5* | 0.1606 | α(K)=0.1334 *20*; α(L)=0.0210 *3*; α(M)=0.00476 *7*<br>α(N)=0.001131 *17*; α(O)=0.0001725 *25*; α(P)=1.117×10$^{-5}$ *16*<br>Mult.: From (K/L)exp=6.24 *51* (1972Ch48) and γ(θ) (2014Mu03) in $^{177}$Hf IT decay (51.4 m); DCO(ΔJ=1)=0.74 *5* (1998Mu14).<br>δ: Using the briccmixing program and (K/L)exp=6.24 *51* (1972Ch48) and δ=0.285 *5* (2014Mu03) in $^{177}$Hf IT decay (51.4 m). |
| | | 606.3 *3* | 34.4 *23* | 1592.75 | 25/2$^+$ | E2 | | 0.01211 | α(K)=0.00963 *14*; α(L)=0.00191 *3*; α(M)=0.000444 *7*<br>α(N)=0.0001046 *15*; α(O)=1.520×10$^{-5}$ *22*; α(P)=7.46×10$^{-7}$ *11*<br>$I_\gamma$: Other: 19.6 *16* in $^{177}$Hf IT decay (51.4 m).<br>Mult.: (K/L)exp=4.9 6 (1972Ch48) in $^{177}$Hf IT decay (51.4 m). |
| 2249.3 | 29/2$^-$ | 281.4 *3* | 100 *3* | 1968.0 | 27/2$^-$ | M1+E2 | | 0.221 *4* | α(K)=0.184 *3*; α(L)=0.0283 *4*; α(M)=0.00638 *10*<br>α(N)=0.001516 *22*; α(O)=0.000233 *4*; α(P)=1.552×10$^{-5}$ *23*<br>Mult.: $A_2$=+0.20 *4*; DCO(ΔJ=1)=0.90 *5* (1998Mu14). |
| | | 536.3 *3* | 13.9 *11* | 1713.15 | 25/2$^-$ | [E2] | | 0.01626 | α(K)=0.01274 *18*; α(L)=0.00271 *4*; α(M)=0.000633 *9*<br>α(N)=0.0001491 *21*; α(O)=2.14×10$^{-5}$ *3*; α(P)=9.79×10$^{-7}$ *14* |
| 2335.9 | (25/2$^-$) | 266.0[c] *3* | | 2070.2 | (23/2$^-$) | | | | |
| | | 368.0 *3* | 100 *5* | 1968.0 | 27/2$^-$ | M1(+E2) | | 0.1075 *16* | α(K)=0.0899 *13*; α(L)=0.01368 *20*; α(M)=0.00308 *5*<br>α(N)=0.000733 *11*; α(O)=0.0001125 *16*; α(P)=7.53×10$^{-6}$ *11*<br>Mult.: $A_2$=+0.32 *6* and DCO(ΔJ=1)=0.89 *9* (1998Mu14). |
| | | 623.1 *3* | 29.4 *24* | 1713.15 | 25/2$^-$ | | | | |
| 2378.0 | 29/2$^+$ | 249.4 *3* | 10.3 *19* | 2128.5 | 27/2$^+$ | [M1+E2] | | 0.307 | α(K)=0.256 *4*; α(L)=0.0394 *6*; α(M)=0.00888 *13*<br>α(N)=0.00211 *3*; α(O)=0.000324 *5*; α(P)=2.16×10$^{-5}$ *4* |
| | | 575.0 *3* | 100 *5* | 1803.06 | 25/2$^+$ | E2 | | 0.01373 | α(K)=0.01085 *16*; α(L)=0.00222 *4*; α(M)=0.000516 *8*<br>α(N)=0.0001216 *18*; α(O)=1.759×10$^{-5}$ *25*; α(P)=8.38×10$^{-7}$ *12*<br>Mult.: DCO(ΔJ=2)=0.9 *3* and DCO(ΔJ=1)=0.73 *16* (1998Mu14). |
| 2399.1 | 29/2$^-$ | 600.9 *3* | 100 | 1798.2 | 25/2$^-$ | E2 | | 0.01237 | α(K)=0.00983 *14*; α(L)=0.00196 *3*; α(M)=0.000455 *7*<br>α(N)=0.0001073 *15*; α(O)=1.557×10$^{-5}$ *22*; α(P)=7.61×10$^{-7}$ *11*<br>Mult.: DCO(ΔJ=2)=1.17 *10* (1998Mu14). |
| 2409.6 | (27/2$^-$) | 74.3 *3* | 22.0 *24* | 2335.9 | (25/2$^-$) | | | | |
| | | 339.4 *3* | 49 *5* | 2070.2 | (23/2$^-$) | | | | |
| | | 441.6 *3* | 100 *8* | 1968.0 | 27/2$^-$ | | | | |
| | | 696.0 *3* | 64 *8* | 1713.15 | 25/2$^-$ | | | | |
| 2416.5 | (27/2$^-$) | 292.6 *3* | 100 *11* | 2124.0 | (25/2$^-$) | | | | |
| | | 570.5 *3* | 85 *13* | 1845.9 | (23/2$^-$) | | | | |
| 2418.0 | (27/2$^-$) | 82.2 *3* | 100 | 2335.9 | (25/2$^-$) | | | | |
| 2451.4 | (25/2$^-$) | 526.1 *3* | 100 | 1925.3 | (21/2$^-$) | [E2] | | 0.01704 | α(K)=0.01332 *19*; α(L)=0.00287 *4*; α(M)=0.000671 *10*<br>α(N)=0.0001579 *23*; α(O)=2.27×10$^{-5}$ *4*; α(P)=1.023×10$^{-6}$ *15* |
| 2525.5 | 31/2$^+$ | 326.5 *3* | 100 *4* | 2199.2 | 29/2$^+$ | M1+E2 | 0.278 *5* | 0.1417 *21* | α(K)=0.1179 *17*; α(L)=0.0185 *3*; α(M)=0.00419 *6* |





$^{177}_{72}Hf_{105}$-20

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | α(N)=0.000994 *15*; α(O)=0.0001518 *22*; α(P)=9.86×10$^{-6}$ *15*<br>Mult.: From (K/L)exp=6.26 *60* (1972Ch48) and γ(θ) (2014Mu03) in $^{177}$Hf IT decay (51.4 m); DCO(ΔJ=1)=0.78 *6* (1998Mu14).<br>δ: Using the briccmixing program and (K/L)exp=6.26 *60* (1972Ch48) and δ=0.278 *5* (2014Mu03) in $^{177}$Hf IT decay (51.4 m). |
| 2525.5 | 31/2$^+$ | 637.8 *3* | 38 *3* | 1887.75 | 27/2$^+$ | E2 | 0.01076 | α(K)=0.00861 *12*; α(L)=0.001666 *24*; α(M)=0.000385 *6*<br>α(N)=9.09×10$^{-5}$ *13*; α(O)=1.325×10$^{-5}$ *19*; α(P)=6.68×10$^{-7}$ *10*<br>Mult.: From (K/L)exp=4.9 *6* (1972Ch48). |
| 2539.1 | (25/2$^-$) | 534.0 *3* | 100 | 2005.1 | (21/2$^-$) | | | |
| 2554.7 | 31/2$^-$ | 305.4 *3* | 100 *4* | 2249.3 | 29/2$^-$ | M1+E2 | 0.177 *3* | α(K)=0.1479 *21*; α(L)=0.0226 *4*; α(M)=0.00510 *8*<br>α(N)=0.001212 *18*; α(O)=0.000186 *3*; α(P)=1.243×10$^{-5}$ *18*<br>Mult.: DCO(ΔJ=1)=0.90 *6* (1998Mu14). |
| | | 586.7 *3* | 39.0 *24* | 1968.0 | 27/2$^-$ | E2 | 0.01309 | α(K)=0.01037 *15*; α(L)=0.00210 *3*; α(M)=0.000487 *7*<br>α(N)=0.0001148 *17*; α(O)=1.663×10$^{-5}$ *24*; α(P)=8.02×10$^{-7}$ *12*<br>Mult.: DCO(ΔJ=1)=0.72 17 (1998Mu14). |
| 2589.8 | (23/2$^-$) | 541.6 *3* | 100 | 2048.2 | (19/2$^-$) | [E2] | 0.01587 | α(K)=0.01245 *18*; α(L)=0.00264 *4*; α(M)=0.000615 *9*<br>α(N)=0.0001448 *21*; α(O)=2.08×10$^{-5}$ *3*; α(P)=9.58×10$^{-7}$ *14* |
| 2615.3 | (27/2$^-$) | 280.0[c] *3* | | 2335.9 | (25/2$^-$) | | | |
| | | 366.2 *3* | 100 *6* | 2249.3 | 29/2$^-$ | | | |
| | | 647.1 *3* | 61 *5* | 1968.0 | 27/2$^-$ | | | |
| 2700.2 | (29/2$^-$) | 282.3 *3* | 9.1 *21* | 2418.0 | (27/2$^-$) | | | |
| | | 290.8 *3* | 100 *4* | 2409.6 | (27/2$^-$) | M1(+E2) | 0.202 | α(K)=0.1688 *24*; α(L)=0.0258 *4*; α(M)=0.00583 *9*<br>α(N)=0.001386 *20*; α(O)=0.000213 *3*; α(P)=1.420×10$^{-5}$ *21*<br>Mult.: DCO(ΔJ=1)=0.75 13 (1998Mu14). |
| | | 364.0 *3* | 40 *3* | 2335.9 | (25/2$^-$) | | | |
| | | 450.8 *3* | 13 *3* | 2249.3 | 29/2$^-$ | | | |
| | | 732 *1* | | 1968.0 | 27/2$^-$ | | | |
| 2719.9 | 31/2$^-$ | 628.9 *3* | 100 | 2091.0 | 27/2$^-$ | E2 | 0.01112 | α(K)=0.00888 *13*; α(L)=0.001731 *25*; α(M)=0.000401 *6*<br>α(N)=9.45×10$^{-5}$ *14*; α(O)=1.376×10$^{-5}$ *20*; α(P)=6.89×10$^{-7}$ *10*<br>Mult.: DCO(ΔJ=2)=1.41 *16* (1998Mu14). |
| 2724.4 | (29/2$^-$) | 308.1 *3* | 87 *10* | 2416.5 | (27/2$^-$) | | | |
| | | 600.5 *3* | 100 *12* | 2124.0 | (25/2$^-$) | | | |
| 2740.02 | 37/2$^-$ | 214.0 *1* | 100 | 2525.5 | 31/2$^+$ | E3 | 1.512 | α(K)=0.425 *6*; α(L)=0.821 *12*; α(M)=0.211 *3*<br>α(N)=0.0492 *7*; α(O)=0.00630 *9*; α(P)=4.04×10$^{-5}$ *6*<br>B(E3)(W.u.)=4.10×10$^{-6}$ *6*<br>$E_\gamma$,$I_\gamma$: From $^{177}$Hf IT decay (51.4 min).<br>Mult.: (K/L)exp=0.526 *17* and [ce(L1):ce(L2):ce(L3)]exp=0.139 *14*:1.00 *5*:0.520 *26* (1972Ch48) in $^{177}$Hf IT decay (51.4 min). |
| 2783.1 | 31/2$^+$ | 654.6 *3* | 100 | 2128.5 | 27/2$^+$ | E2 | 0.01014 | α(K)=0.00813 *12*; α(L)=0.001554 *22*; α(M)=0.000359 *5*<br>α(N)=8.47×10$^{-5}$ *12*; α(O)=1.237×10$^{-5}$ *18*; α(P)=6.32×10$^{-7}$ *9*<br>Mult.: DCO(ΔJ=2)=0.95 *17* (1998Mu14). |
| 2865.5 | 33/2$^+$ | 340.1 *3* | 100 *5* | 2525.5 | 31/2$^+$ | M1+E2 | 0.1326 | α(K)=0.1109 *16*; α(L)=0.01691 *24*; α(M)=0.00381 *6* |





$^{177}_{72}Hf_{105}$-21

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | α(N)=0.000906 *13*; α(O)=0.0001391 *20*; α(P)=9.30×10$^{-6}$ *14*<br>Mult.: DCO(ΔJ=1)=0.96 *10* (1998Mu14). |
| 2865.5 | 33/2$^+$ | 666.2 *3* | 42 *4* | 2199.2 | 29/2$^+$ | E2 | 0.00974 | α(K)=0.00783 *11*; α(L)=0.001483 *21*; α(M)=0.000342 *5*<br>α(N)=8.07×10$^{-5}$ *12*; α(O)=1.181×10$^{-5}$ *17*; α(P)=6.08×10$^{-7}$ *9*<br>Mult.: DCO(ΔJ=1)=1.36 *42* (1998Mu14). |
| 2873.4 | (29/2$^+$) | 674.2 *3* | 39 *9* | 2199.2 | 29/2$^+$ | | | |
| | | 985.6 *3* | 100 *14* | 1887.75 | 27/2$^+$ | | | |
| 2882.0 | 33/2$^-$ | 327.3 *3* | 100 *5* | 2554.7 | 31/2$^-$ | M1+E2 | 0.1470 | α(K)=0.1228 *18*; α(L)=0.0188 *3*; α(M)=0.00423 *6*<br>α(N)=0.001005 *15*; α(O)=0.0001543 *22*; α(P)=1.031×10$^{-5}$ *15*<br>Mult.: DCO(ΔJ=1)=0.85 *14* (1998Mu14). |
| | | 632.6 *3* | 81 *5* | 2249.3 | 29/2$^-$ | E2 | 0.01097 | α(K)=0.00877 *13*; α(L)=0.001704 *24*; α(M)=0.000394 *6*<br>α(N)=9.30×10$^{-5}$ *13*; α(O)=1.355×10$^{-5}$ *19*; α(P)=6.80×10$^{-7}$ *10*<br>Mult.: DCO(ΔJ=1)=0.77 *17* (1998Mu14). |
| 2896.8 | (31/2$^-$) | 196.6 *3* | 100 | 2700.2 | (29/2$^-$) | M1(+E2) | 0.591 | α(K)=0.493 *8*; α(L)=0.0762 *12*; α(M)=0.0172 *3*<br>α(N)=0.00409 *6*; α(O)=0.000627 *10*; α(P)=4.17×10$^{-5}$ *7*<br>Mult.: $A_2$=−0.28 *2* and DCO(ΔJ=1)=0.64 *6* (1998Mu14). |
| 2908.9 | (29/2$^-$) | 293.0[c] *3* | | 2615.3 | (27/2$^-$) | | | |
| | | 659.6 *3* | 100 | 2249.3 | 29/2$^-$ | | | |
| 2936.0 | (33/2$^-$) | 196.5 *3* | 100 | 2740.02 | 37/2$^-$ | | | |
| 3015.8 | 33/2$^+$ | 637.8 *3* | 100 | 2378.0 | 29/2$^+$ | E2 | 0.01076 | α(K)=0.00861 *12*; α(L)=0.001666 *24*; α(M)=0.000385 *6*<br>α(N)=9.09×10$^{-5}$ *13*; α(O)=1.325×10$^{-5}$ *19*; α(P)=6.68×10$^{-7}$ *10*<br>Mult.: DCO(ΔJ=2)=1.3 *3* and DCO(ΔJ=1)=1.1 *4* (1998Mu14). |
| 3047.3 | (31/2$^-$) | 323.2 *3* | 100 *18* | 2724.4 | (29/2$^-$) | | | |
| | | 630.5 *3* | 100 *23* | 2416.5 | (27/2$^-$) | | | |
| 3053.7 | 33/2$^-$ | 654.6 *3* | 100 | 2399.1 | 29/2$^-$ | E2 | 0.01014 | α(K)=0.00813 *12*; α(L)=0.001554 *22*; α(M)=0.000359 *5*<br>α(N)=8.47×10$^{-5}$ *12*; α(O)=1.237×10$^{-5}$ *18*; α(P)=6.32×10$^{-7}$ *9*<br>Mult.: DCO(ΔJ=2)=0.71 *20* and DCO(ΔJ=1)=0.9 *4* (1998Mu14). |
| 3105.2 | 39/2$^+$ | 365.7 *3* | 100 | 2740.02 | 37/2$^-$ | (E1) | 0.01332 | α(K)=0.01118 *16*; α(L)=0.001661 *24*; α(M)=0.000373 *6*<br>α(N)=8.79×10$^{-5}$ *13*; α(O)=1.316×10$^{-5}$ *19*; α(P)=7.94×10$^{-7}$ *12*<br>Mult.: $A_2$=−0.06 *3* and DCO(ΔJ=1)=0.55 *6* (1998Mu14). |
| 3133.5 | (29/2$^-$) | 594.4 *3* | 100 | 2539.1 | (25/2$^-$) | | | |
| 3141.2 | 39/2$^-$ | 401.3 *3* | 100 | 2740.02 | 37/2$^-$ | M1+E2 | 0.0855 | α(K)=0.0715 *11*; α(L)=0.01085 *16*; α(M)=0.00244 *4*<br>α(N)=0.000581 *9*; α(O)=8.93×10$^{-5}$ *13*; α(P)=5.98×10$^{-6}$ *9*<br>Mult.: DCO(ΔJ=1)=1.10 *22* (1998Mu14). |
| 3217.4 | 35/2$^+$ | 351.9 *3* | 100 *6* | 2865.5 | 33/2$^+$ | M1+E2 | 0.1211 *18* | α(K)=0.1012 *15*; α(L)=0.01542 *22*; α(M)=0.00348 *5*<br>α(N)=0.000826 *12*; α(O)=0.0001269 *18*; α(P)=8.49×10$^{-6}$ *12*<br>Mult.: DCO(ΔJ=1)=0.82 *15* (1998Mu14). |
| | | 691.8 *3* | 37 *5* | 2525.5 | 31/2$^+$ | E2 | 0.00895 | α(K)=0.00721 *11*; α(L)=0.001342 *19*; α(M)=0.000309 *5*<br>α(N)=7.30×10$^{-5}$ *11*; α(O)=1.071×10$^{-5}$ *15*; α(P)=5.61×10$^{-7}$ *8*<br>Mult.: DCO(ΔJ=1)=0.77 *21* (1998Mu14). |
| 3217.6 | (31/2$^-$) | 308.6[c] *3* | 14 *7* | 2908.9 | (29/2$^-$) | | | |
| | | 662.9 *3* | 100 *10* | 2554.7 | 31/2$^-$ | | | |
| 3222.0 | (31/2$^+$) | 348.6 *3* | 100 | 2873.4 | (29/2$^+$) | | | |





$^{177}_{72}Hf_{105}$-22

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| 3228.8 | 35/2$^-$ | 346.9 *3* | 86 *6* | 2882.0 | 33/2$^-$ | M1+E2 | 0.1258 | α(K)=0.1052 *15*; α(L)=0.01603 *23*; α(M)=0.00361 *6*<br>α(N)=0.000859 *13*; α(O)=0.0001319 *19*; α(P)=8.82×10$^{-6}$ *13*<br>Mult.: $A_2$=+0.46 *11* and DCO(ΔJ=1)=0.89 *22* (1998Mu14). |
| | | 674.2 *3* | 100 *7* | 2554.7 | 31/2$^-$ | E2 | 0.00948 | α(K)=0.00762 *11*; α(L)=0.001436 *21*; α(M)=0.000331 *5*<br>α(N)=7.82×10$^{-5}$ *11*; α(O)=1.145×10$^{-5}$ *16*; α(P)=5.93×10$^{-7}$ *9*<br>Mult.: DCO(ΔJ=1)=0.70 *14* (1998Mu14). |
| 3237.4 | (33/2$^-$) | 340.6 *3* | 100 | 2896.8 | (31/2$^-$) | | | |
| 3302.5 | (35/2$^-$) | 366.5 *3* | 100 | 2936.0 | (33/2$^-$) | | | |
| 3398.7 | 35/2$^-$ | 678.8 *3* | 100 | 2719.9 | 31/2$^-$ | E2 | 0.00934 | α(K)=0.00751 *11*; α(L)=0.001411 *20*; α(M)=0.000325 *5*<br>α(N)=7.68×10$^{-5}$ *11*; α(O)=1.125×10$^{-5}$ *16*; α(P)=5.84×10$^{-7}$ *9*<br>Mult.: DCO(ΔJ=2)=1.04 *19* (1998Mu14). |
| 3465.0 | 41/2$^+$ | 359.8 *3* | 100 | 3105.2 | 39/2$^+$ | M1+E2 | 0.1141 *17* | α(K)=0.0954 *14*; α(L)=0.01453 *21*; α(M)=0.00327 *5*<br>α(N)=0.000778 *11*; α(O)=0.0001196 *17*; α(P)=8.00×10$^{-6}$ *12*<br>Mult.: $A_2$=+0.17 *8* and DCO(ΔJ=1)=1.14 *20* (1998Mu14). |
| 3517.8 | 35/2$^+$ | 734.7 *3* | 100 | 2783.1 | 31/2$^+$ | E2 | 0.00783 | α(K)=0.00634 *9*; α(L)=0.001149 *17*; α(M)=0.000264 *4*<br>α(N)=6.24×10$^{-5}$ *9*; α(O)=9.19×10$^{-6}$ *13*; α(P)=4.94×10$^{-7}$ *7*<br>Mult.: DCO(ΔJ=2)=1.1 *5* (1998Mu14). |
| 3562.2 | 41/2$^-$ | 420.9 *3* | 100 *8* | 3141.2 | 39/2$^-$ | M1+E2 | 0.0754 | α(K)=0.0631 *9*; α(L)=0.00956 *14*; α(M)=0.00215 *3*<br>α(N)=0.000512 *8*; α(O)=7.86×10$^{-5}$ *12*; α(P)=5.27×10$^{-6}$ *8* |
| | | 823.0 *3* | 29 *16* | 2740.02 | 37/2$^-$ | [E2] | 0.00612 | α(K)=0.00500 *7*; α(L)=0.000867 *13*; α(M)=0.000198 *3*<br>α(N)=4.69×10$^{-5}$ *7*; α(O)=6.96×10$^{-6}$ *10*; α(P)=3.91×10$^{-7}$ *6* |
| 3579.1 | 37/2$^+$ | 361.7 *3* | 100 *7* | 3217.4 | 35/2$^+$ | M1+E2 | 0.1126 | α(K)=0.0941 *14*; α(L)=0.01433 *21*; α(M)=0.00323 *5*<br>α(N)=0.000767 *11*; α(O)=0.0001179 *17*; α(P)=7.89×10$^{-6}$ *12* |
| | | 713.6 *3* | 35 *7* | 2865.5 | 33/2$^+$ | [E2] | 0.00835 | α(K)=0.00675 *10*; α(L)=0.001239 *18*; α(M)=0.000285 *4*<br>α(N)=6.73×10$^{-5}$ *10*; α(O)=9.89×10$^{-6}$ *14*; α(P)=5.26×10$^{-7}$ *8* |
| 3582.1 | (33/2$^+$) | 360.1 *3* | 100 *16* | 3222.0 | (31/2$^+$) | | | |
| | | 709.6[c] *3* | <35 | 2873.4 | (29/2$^+$) | | | |
| 3593.3 | 37/2$^-$ | 364.6 *3* | 87 *11* | 3228.8 | 35/2$^-$ | [M1+E2] | 0.1102 | α(K)=0.0921 *13*; α(L)=0.01402 *20*; α(M)=0.00316 *5*<br>α(N)=0.000751 *11*; α(O)=0.0001154 *17*; α(P)=7.72×10$^{-6}$ *11* |
| | | 711.2 *3* | 100 *11* | 2882.0 | 33/2$^-$ | E2 | 0.00841 | α(K)=0.00680 *10*; α(L)=0.001249 *18*; α(M)=0.000288 *4*<br>α(N)=6.79×10$^{-5}$ *10*; α(O)=9.98×10$^{-6}$ *14*; α(P)=5.29×10$^{-7}$ *8*<br>Mult.: DCO(ΔJ=1)=1.2 *3* (1998Mu14). |
| 3685.8 | (37/2$^-$) | 383.3 *3* | 100 *15* | 3302.5 | (35/2$^-$) | [M1+E2] | 0.0965 | α(K)=0.0807 *12*; α(L)=0.01226 *18*; α(M)=0.00276 *4*<br>α(N)=0.000657 *10*; α(O)=0.0001009 *15*; α(P)=6.76×10$^{-6}$ *10* |
| | | 750[c] *1* | <15 | 2936.0 | (33/2$^-$) | [E2] | 0.00748 | α(K)=0.00607 *9*; α(L)=0.001091 *16*; α(M)=0.000251 *4*<br>α(N)=5.92×10$^{-5}$ *9*; α(O)=8.73×10$^{-6}$ *13*; α(P)=4.74×10$^{-7}$ *7*<br>$E_\gamma$: From level-energy difference. Eγ=753.4 keV is reported in 1998Mu14. |
| 3703.4 | 37/2$^+$ | 687.6 *3* | 100 | 3015.8 | 33/2$^+$ | E2 | 0.00907 | α(K)=0.00731 *11*; α(L)=0.001364 *20*; α(M)=0.000314 *5*<br>α(N)=7.42×10$^{-5}$ *11*; α(O)=1.088×10$^{-5}$ *16*; α(P)=5.69×10$^{-7}$ *8*<br>Mult.: DCO(ΔJ=2)=1.2 *4* (1998Mu14). |
| 3753.7 | 37/2$^-$ | 700.0 *3* | 100 | 3053.7 | 33/2$^-$ | E2 | 0.00871 | α(K)=0.00703 *10*; α(L)=0.001302 *19*; α(M)=0.000300 *5*<br>α(N)=7.08×10$^{-5}$ *10*; α(O)=1.039×10$^{-5}$ *15*; α(P)=5.47×10$^{-7}$ *8*<br>Mult.: DCO(ΔJ=2)=0.77 *23* (1998Mu14). |





$^{177}_{72}Hf_{105}$-23

## Adopted Levels, Gammas (continued)

### γ($^{177}$Hf) (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[†] | $E_f$ | $J_f^\pi$ | Mult.[†] | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| 3840.2 | 43/2$^+$ | 375.1 *3* | 100 *5* | 3465.0 | 41/2$^+$ | M1+E2 | 0.1022 | α(K)=0.0855 *13*; α(L)=0.01300 *19*; α(M)=0.00293 *5*<br>α(N)=0.000696 *10*; α(O)=0.0001069 *16*; α(P)=7.16×10$^{-6}$ *11*<br>Mult.: $A_2$=+0.25 *3* and DCO(ΔJ=1)=0.95 *14* (1998Mu14). |
| | | 734.9 *3* | 23 *4* | 3105.2 | 39/2$^+$ | [E2] | 0.00782 | α(K)=0.00634 *9*; α(L)=0.001149 *17*; α(M)=0.000264 *4*<br>α(N)=6.23×10$^{-5}$ *9*; α(O)=9.19×10$^{-6}$ *13*; α(P)=4.94×10$^{-7}$ *7* |
| 3948.5 | 39/2$^+$ | 369.4 *3* | 100 *11* | 3579.1 | 37/2$^+$ | [M1+E2] | 0.1064 | α(K)=0.0890 *13*; α(L)=0.01354 *20*; α(M)=0.00305 *5*<br>α(N)=0.000725 *11*; α(O)=0.0001114 *16*; α(P)=7.45×10$^{-6}$ *11* |
| | | 730.7[c] *3* | 49 *11* | 3217.4 | 35/2$^+$ | [E2] | 0.00792 | α(K)=0.00642 *9*; α(L)=0.001166 *17*; α(M)=0.000268 *4*<br>α(N)=6.33×10$^{-5}$ *9*; α(O)=9.32×10$^{-6}$ *13*; α(P)=5.00×10$^{-7}$ *7* |
| 4001.8 | 43/2$^-$ | 440.0 *3* | 100 *14* | 3562.2 | 41/2$^-$ | M1+E2 | 0.0671 | α(K)=0.0562 *8*; α(L)=0.00850 *12*; α(M)=0.00191 *3*<br>α(N)=0.000455 *7*; α(O)=6.99×10$^{-5}$ *10*; α(P)=4.69×10$^{-6}$ *7*<br>Mult.: DCO(ΔJ=1)=1.1 *3* (1998Mu14). |
| | | 860.5 *3* | 62 *15* | 3141.2 | 39/2$^-$ | [E2] | 0.00557 | α(K)=0.00457 *7*; α(L)=0.000779 *11*; α(M)=0.0001778 *25*<br>α(N)=4.20×10$^{-5}$ *6*; α(O)=6.26×10$^{-6}$ *9*; α(P)=3.57×10$^{-7}$ *5* |
| 4120.9 | 39/2$^-$ | 722.2 *3* | 100 | 3398.7 | 35/2$^-$ | [E2] | 0.00813 | α(K)=0.00658 *10*; α(L)=0.001201 *17*; α(M)=0.000276 *4*<br>α(N)=6.52×10$^{-5}$ *10*; α(O)=9.60×10$^{-6}$ *14*; α(P)=5.13×10$^{-7}$ *8* |
| 4231.5 | 45/2$^+$ | 391.3 *3* | 100 *7* | 3840.2 | 43/2$^+$ | M1+E2 | 0.0914 | α(K)=0.0764 *11*; α(L)=0.01161 *17*; α(M)=0.00261 *4*<br>α(N)=0.000622 *9*; α(O)=9.55×10$^{-5}$ *14*; α(P)=6.39×10$^{-6}$ *9*<br>Mult.: DCO(ΔJ=1)=1.23 *25* (1998Mu14). |
| | | 766.5 *3* | 52 *8* | 3465.0 | 41/2$^+$ | [E2] | 0.00713 | α(K)=0.00580 *9*; α(L)=0.001033 *15*; α(M)=0.000237 *4*<br>α(N)=5.60×10$^{-5}$ *8*; α(O)=8.27×10$^{-6}$ *12*; α(P)=4.53×10$^{-7}$ *7* |
| 4459.6 | 45/2$^-$ | 458.0 *3* | 100 *34* | 4001.8 | 43/2$^-$ | [M1+E2] | 0.0604 | α(K)=0.0506 *8*; α(L)=0.00764 *11*; α(M)=0.001721 *25*<br>α(N)=0.000409 *6*; α(O)=6.29×10$^{-5}$ *9*; α(P)=4.22×10$^{-6}$ *6* |
| | | 897.1 *3* | 13 *13* | 3562.2 | 41/2$^-$ | [E2] | 0.00511 | α(K)=0.00420 *6*; α(L)=0.000706 *10*; α(M)=0.0001609 *23*<br>α(N)=3.80×10$^{-5}$ *6*; α(O)=5.68×10$^{-6}$ *8*; α(P)=3.28×10$^{-7}$ *5* |
| 4497.8 | 41/2$^-$ | 744.1 *3* | 100 | 3753.7 | 37/2$^-$ | [E2] | 0.00761 | α(K)=0.00617 *9*; α(L)=0.001113 *16*; α(M)=0.000256 *4*<br>α(N)=6.04×10$^{-5}$ *9*; α(O)=8.90×10$^{-6}$ *13*; α(P)=4.81×10$^{-7}$ *7* |
| 4639.8 | 47/2$^+$ | 408.1 *3* | 100 *11* | 4231.5 | 45/2$^+$ | [M1+E2] | 0.0818 | α(K)=0.0684 *10*; α(L)=0.01038 *15*; α(M)=0.00234 *4*<br>α(N)=0.000556 *8*; α(O)=8.54×10$^{-5}$ *12*; α(P)=5.72×10$^{-6}$ *8* |
| | | 799.6 *3* | 65 *12* | 3840.2 | 43/2$^+$ | [E2] | 0.00651 | α(K)=0.00531 *8*; α(L)=0.000930 *13*; α(M)=0.000213 *3*<br>α(N)=5.03×10$^{-5}$ *7*; α(O)=7.46×10$^{-6}$ *11*; α(P)=4.15×10$^{-7}$ *6* |
| 5064.2 | 49/2$^+$ | 424.0 *3* | 27 *21* | 4639.8 | 47/2$^+$ | [M1+E2] | 0.0740 | α(K)=0.0619 *9*; α(L)=0.00937 *14*; α(M)=0.00211 *3*<br>α(N)=0.000502 *7*; α(O)=7.71×10$^{-5}$ *11*; α(P)=5.17×10$^{-6}$ *8* |
| | | 833.1 *3* | 100 *30* | 4231.5 | 45/2$^+$ | [E2] | 0.00597 | α(K)=0.00488 *7*; α(L)=0.000842 *12*; α(M)=0.000192 *3*<br>α(N)=4.55×10$^{-5}$ *7*; α(O)=6.76×10$^{-6}$ *10*; α(P)=3.81×10$^{-7}$ *6* |

[†] From $^{176}$Yb($^9$Be,xnγ), unless otherwise stated.
[‡] From $^{177}$Lu $\beta^-$ decay (160.4 d).
[#] From $^{177}$Lu $\beta^-$ decay (6.646 d).





$^{177}_{72}Hf_{105}$-24

## Adopted Levels, Gammas (continued)

### $\gamma(^{177}Hf)$ (continued)

@ From $^{177}Ta$ $\varepsilon$ decay.
& From $^{176}Yb(\alpha,3n\gamma)$.
a From Coulomb excitations (2007Ha05).
b Additional information 3.
c Placement of transition in the level scheme is uncertain.



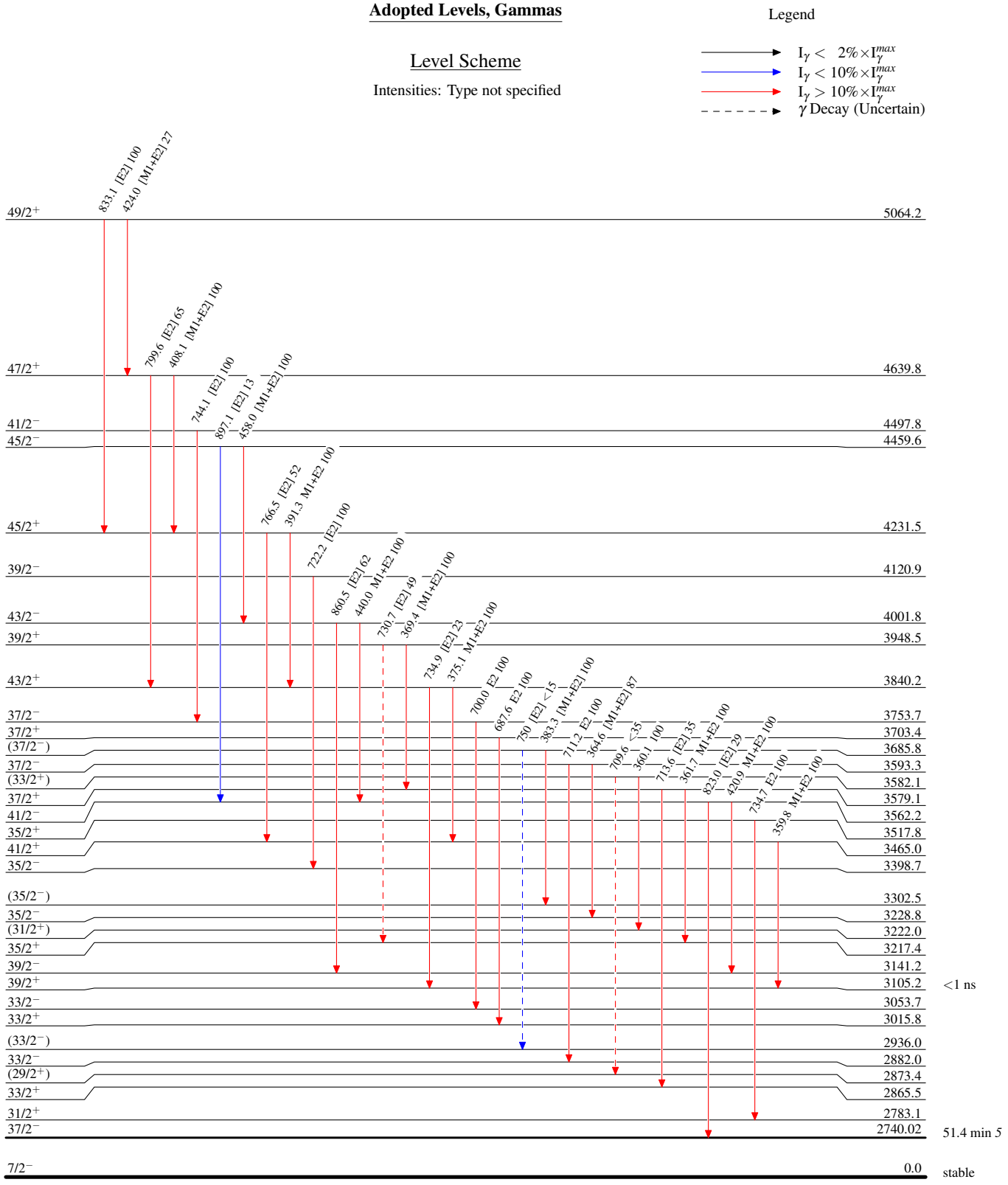


$^{177}_{72}Hf_{105}$-25

## Adopted Levels, Gammas

### Level Scheme

Intensities: Type not specified

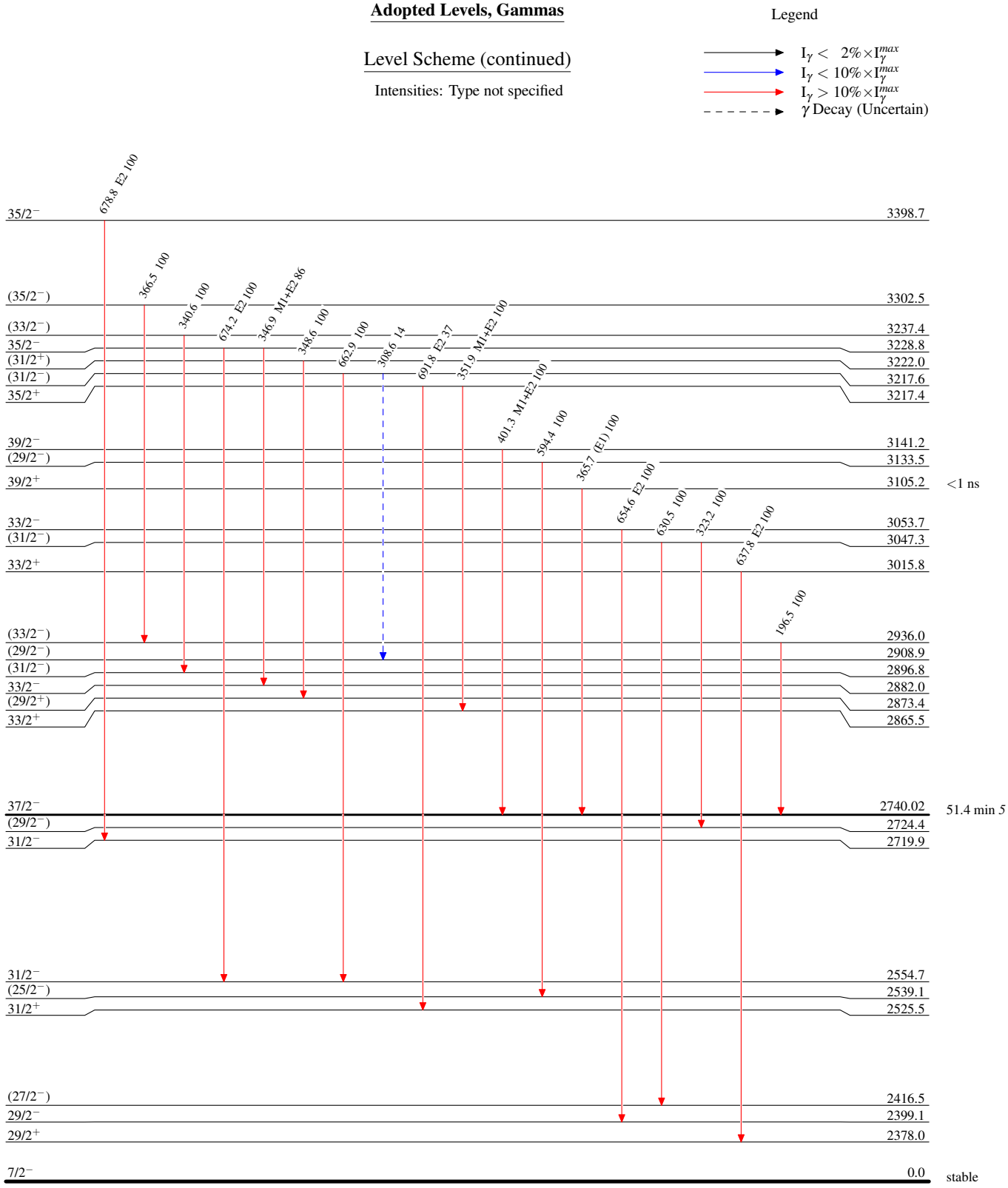



$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas

### Level Scheme (continued)

Intensities: Type not specified

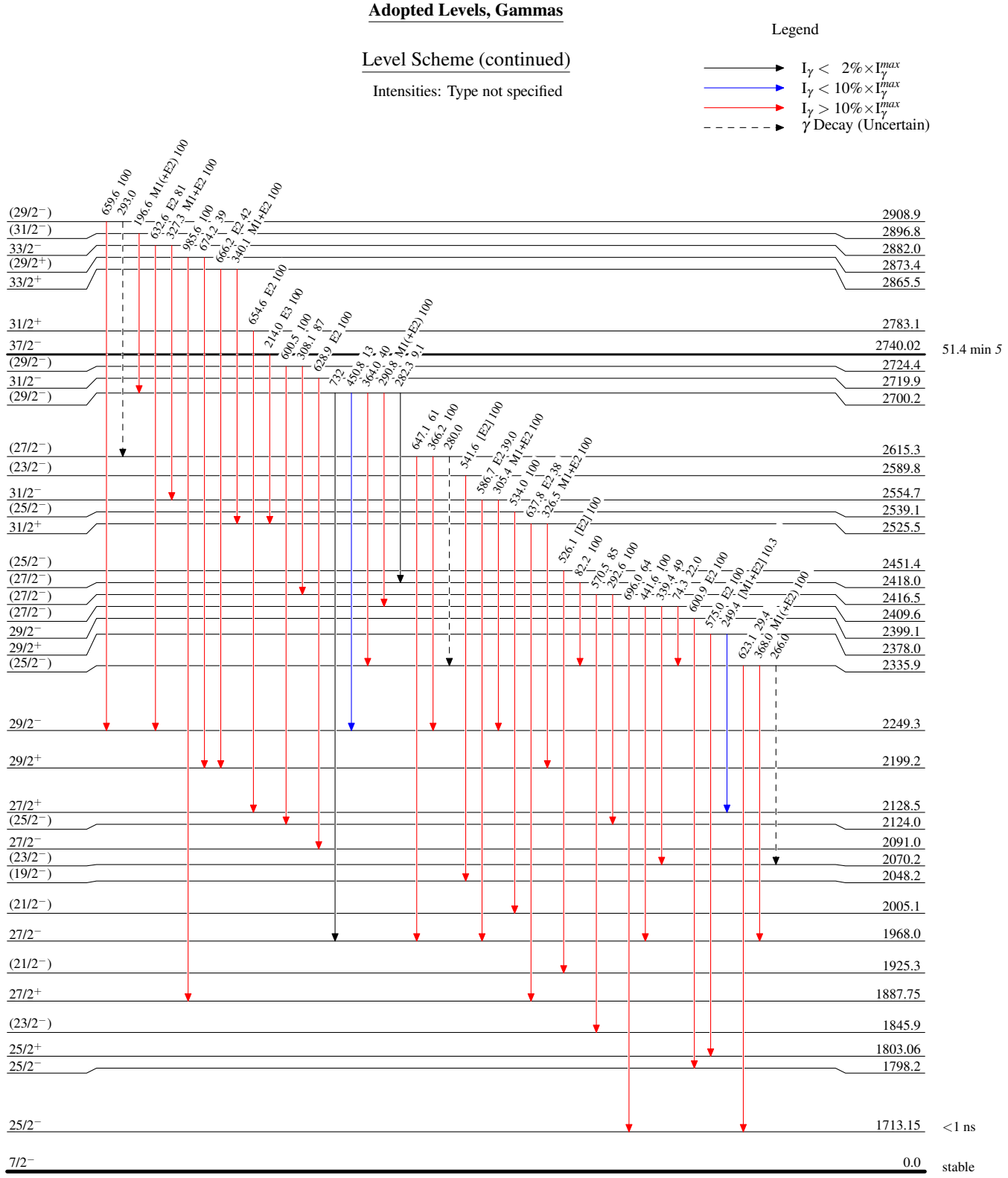



$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas

### Level Scheme (continued)

Intensities: Type not specified

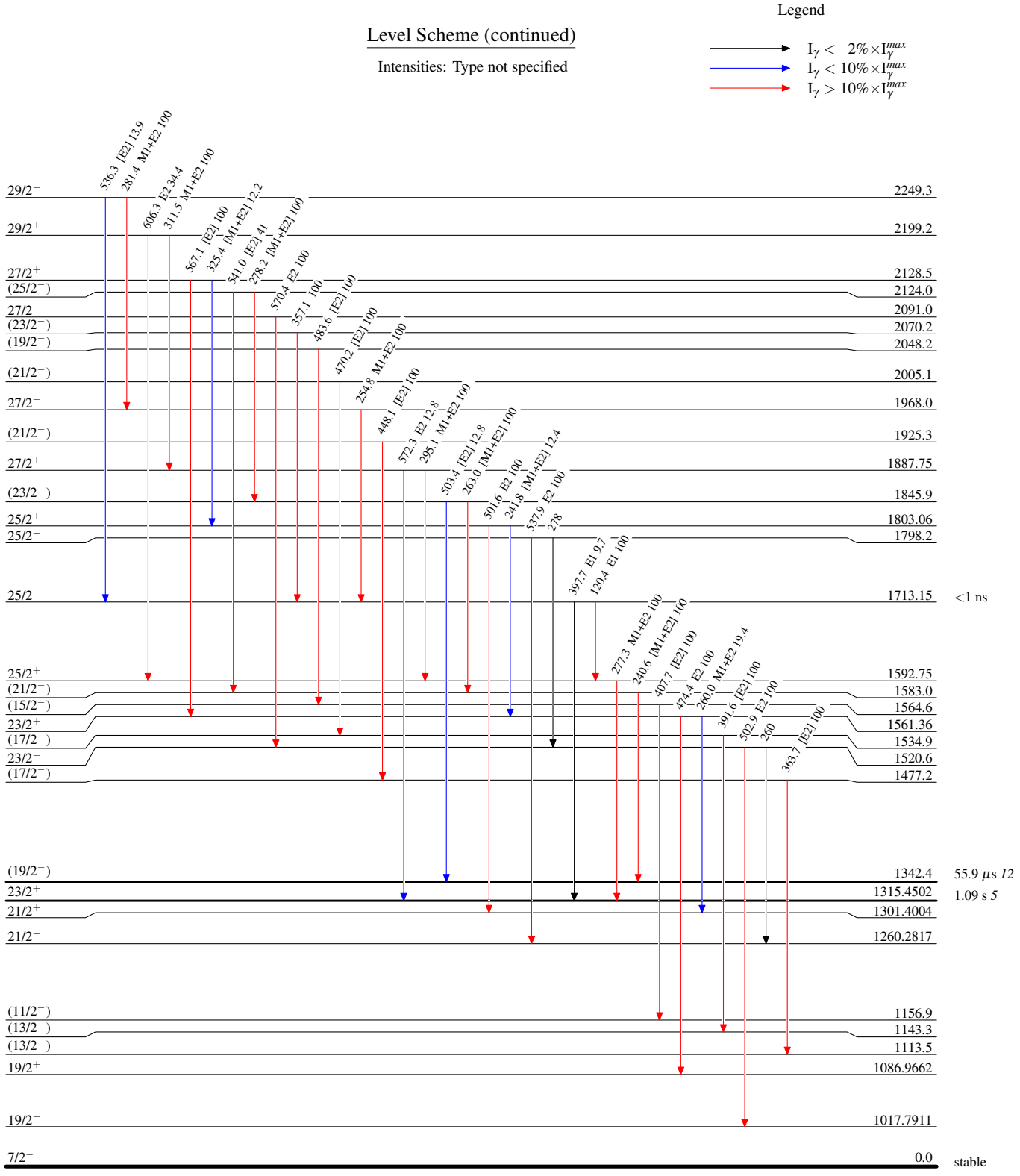



$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas

### Level Scheme (continued)

Intensities: Type not specified

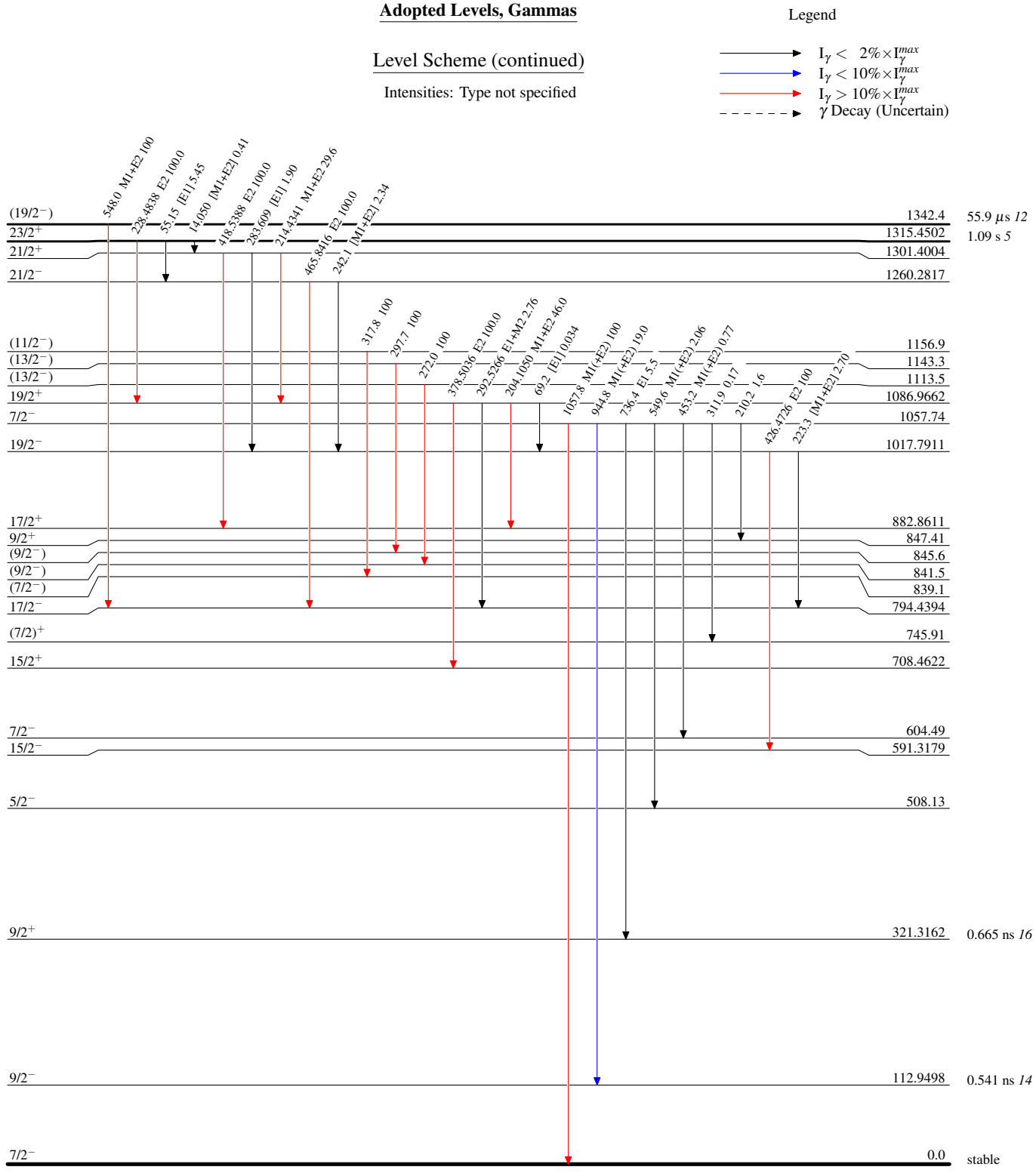



$^{177}_{72}Hf_{105}$

**Adopted Levels, Gammas**

Level Scheme (continued)

Intensities: Type not specified

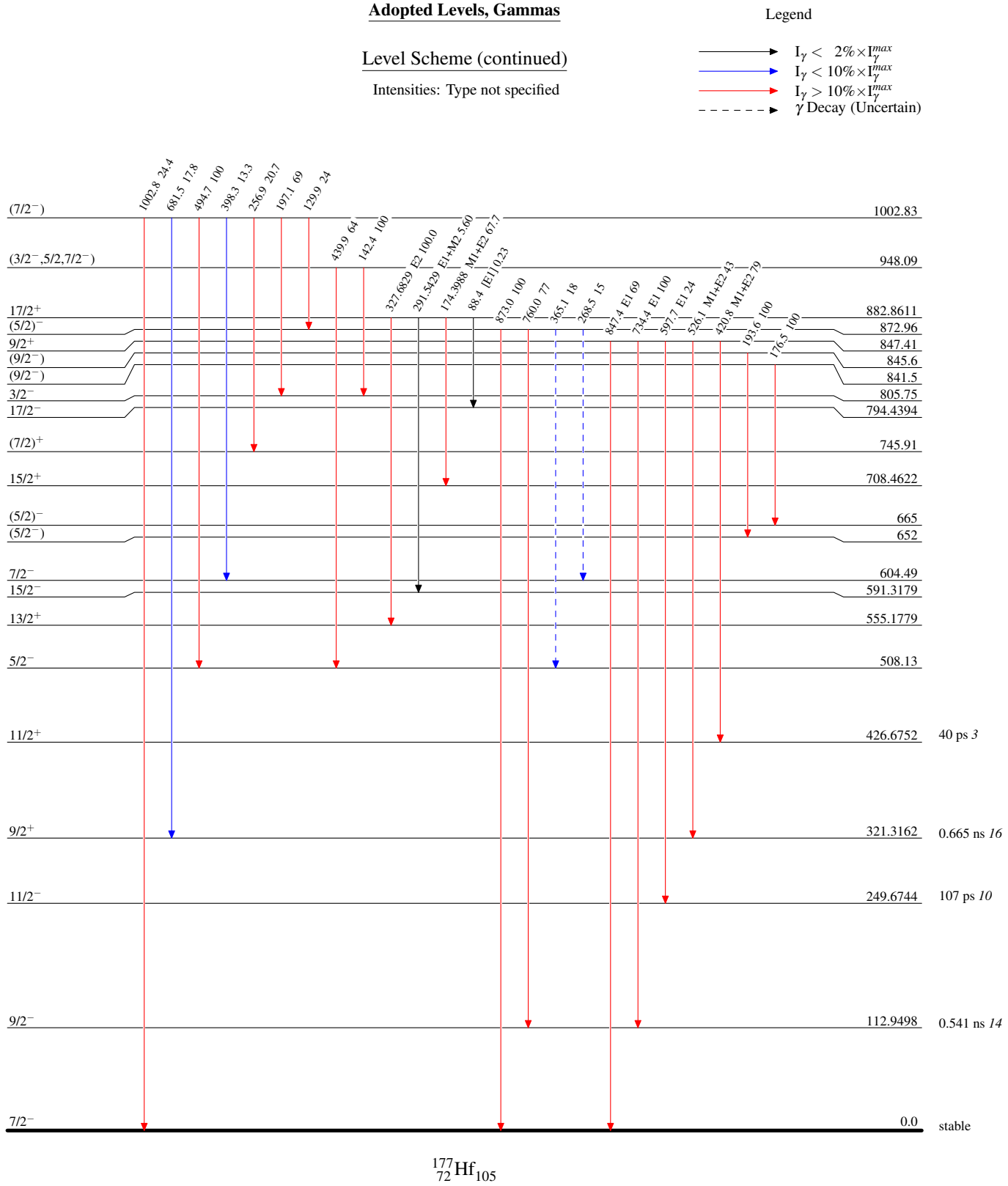



$^{177}_{72}Hf_{105}$

**Adopted Levels, Gammas**

Level Scheme (continued)

Intensities: Type not specified

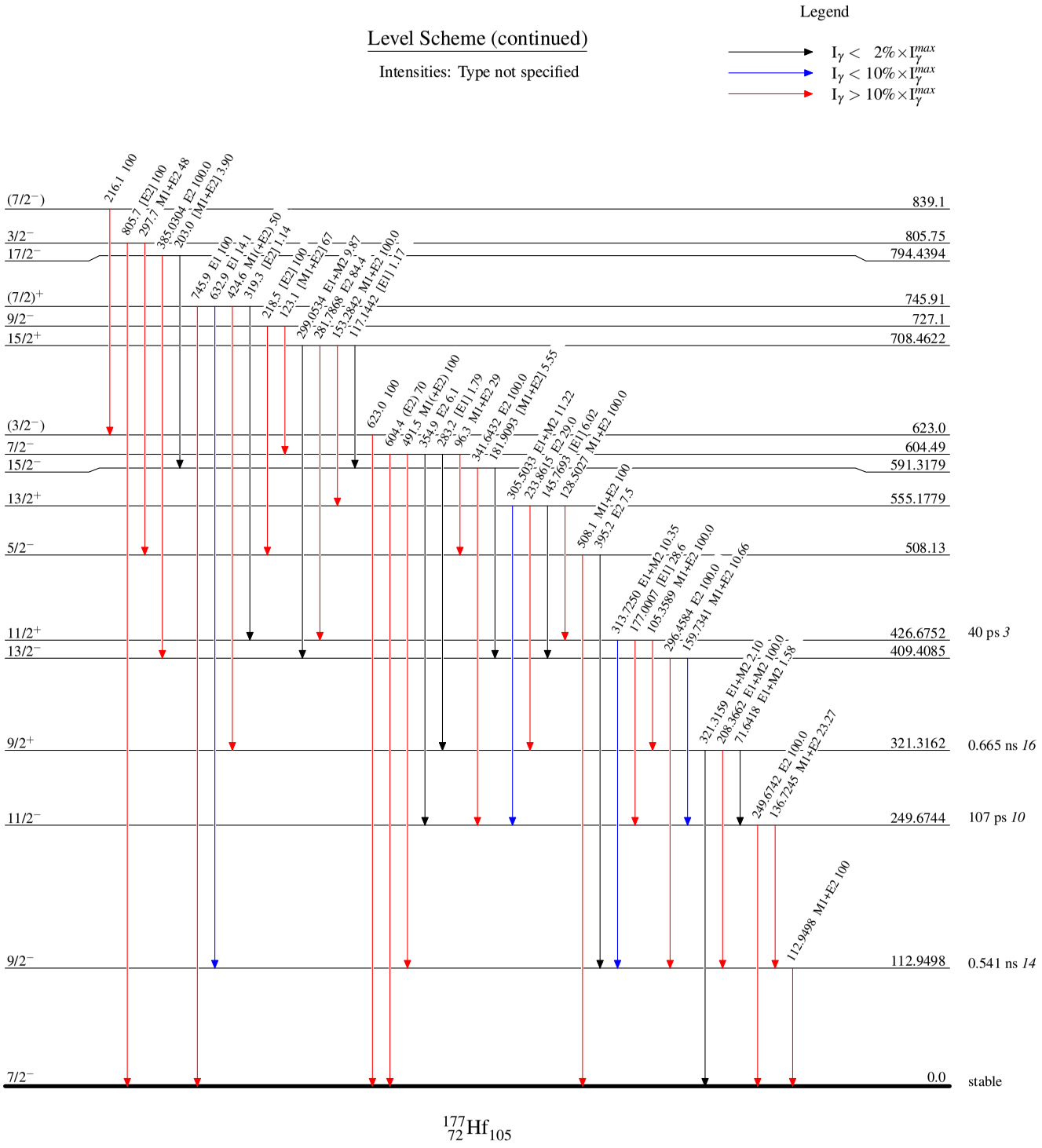



$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas

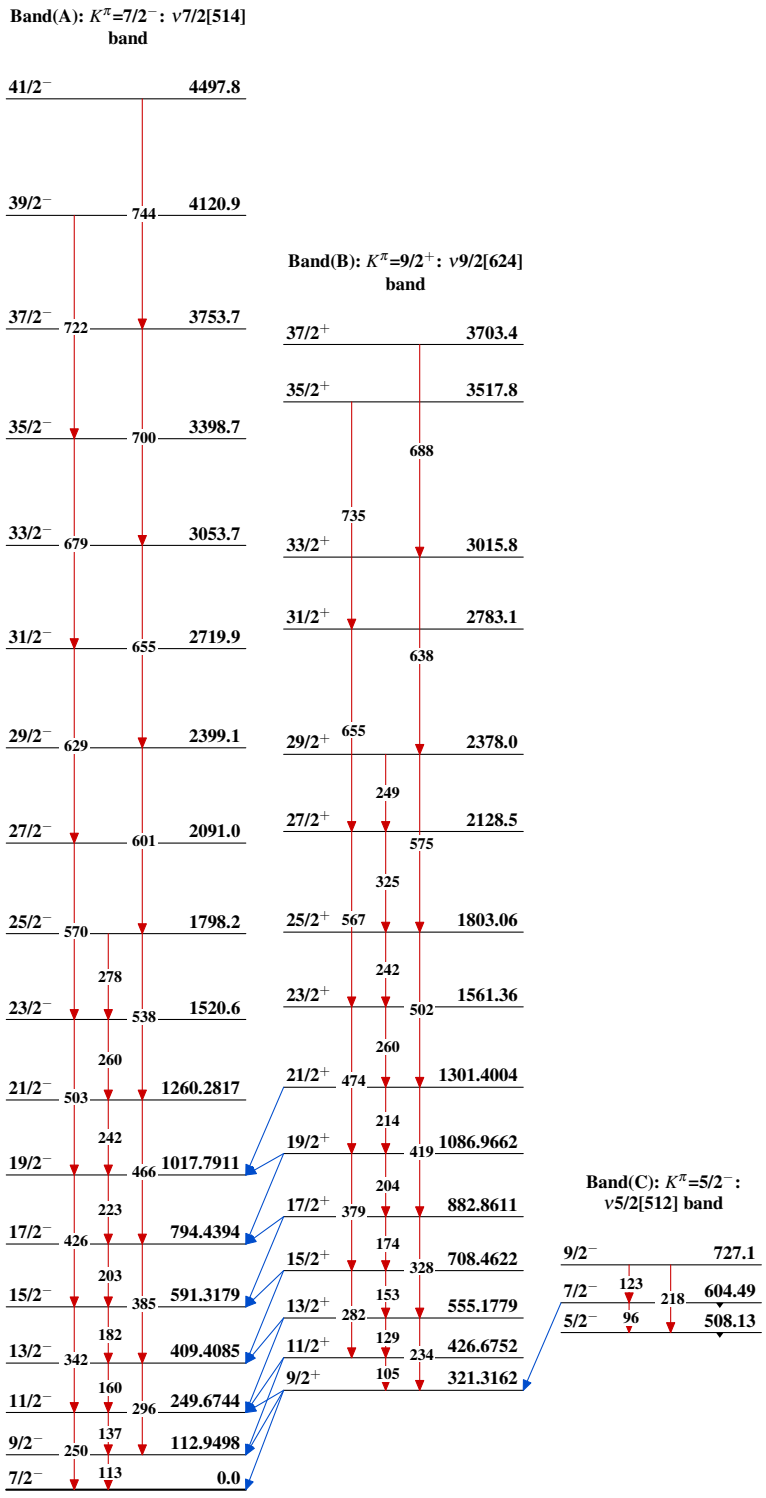
### Level Scheme (continued)

Intensities: Type not specified



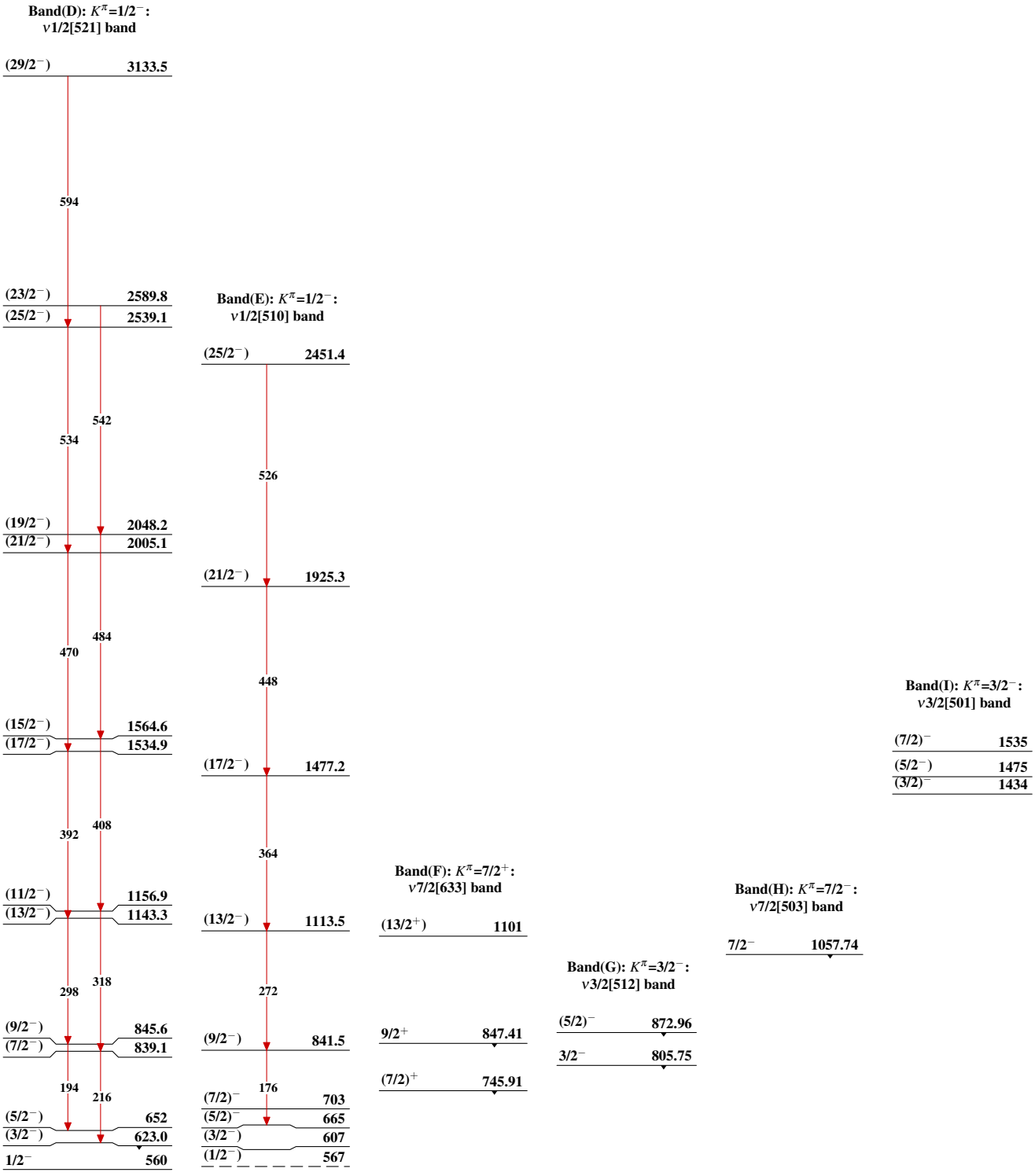

$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas



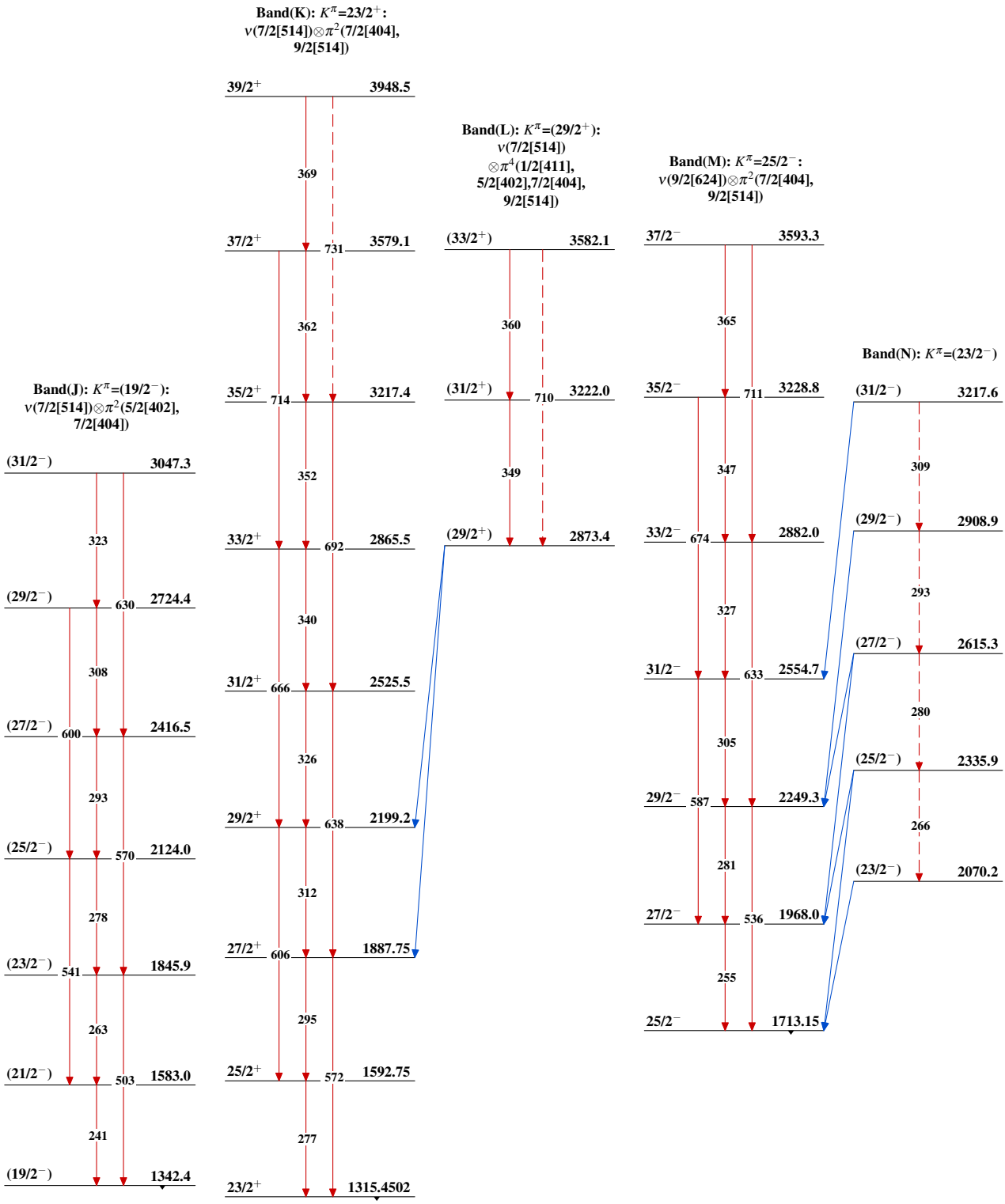

$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas (continued)

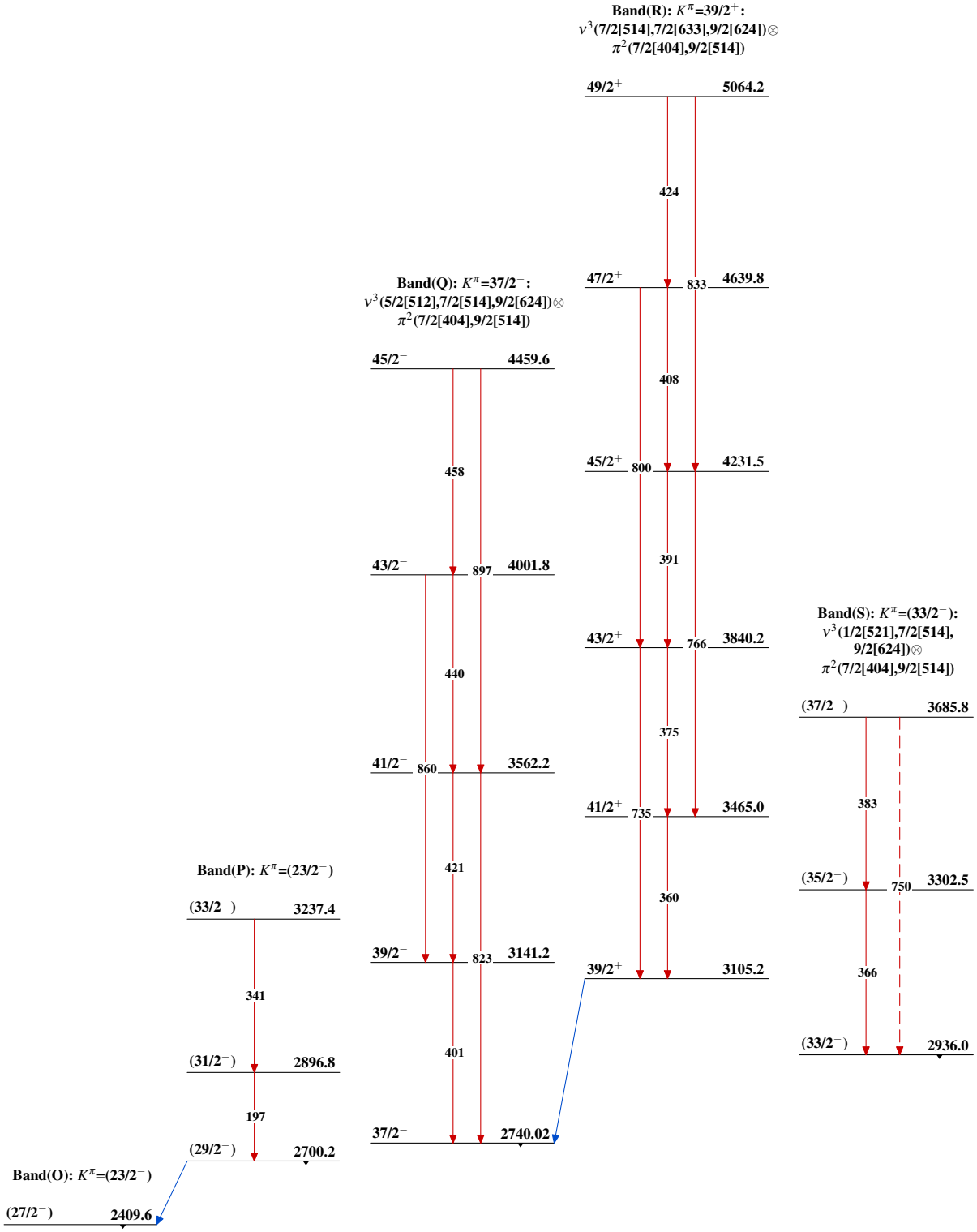



$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas (continued)



## Adopted Levels, Gammas (continued)




$^{177}_{72}Hf_{105}$

## Adopted Levels, Gammas (continued)

**Band(V): $K^{\pi}$=(1/2) band**

**(7/2)$^-$ 2071**

**(5/2)$^-$ 1969**

**Band(U): $K^{\pi}$=(1/2) band**

**(7/2$^-$) 1932** **(3/2)$^-$ 1932**

**(1/2)$^-$ 1882**

**(5/2)$^-$ 1779**

**(3/2)$^-$ 1701**

**(1/2)$^-$ 1634**

**Band(T): $K^{\pi}$=(3/2) band**

**(5/2$^-$) 1565**

**(3/2$^-$) 1502**

$^{177}_{72}Hf_{105}$