## (HI,xnγ) 1977Wa16,1985Pa02

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Balraj Singh | NDS 75,199 (1995) | 31-May-1995 |

Main reactions studied are: $^{160}$Gd($^{16}$O,4nγ) and $^{128}$Te($^{48}$Ca,4nγ).
1977Wa16, 1980Wa03: $^{160}$Gd($^{16}$O,4nγ) E=87 MeV. Measured γ, γγ, γ(θ), γγ(θ) (DCO: θ=0°,90°), γγ(t).
1985Pa02 (also 1991ChZW): $^{128}$Te($^{48}$Ca,4nγ) E=205 MeV. Measured γ, γγ, γ(θ) (at θ=30°, 90°).
1994CuZZ: $^{130}$Te($^{48}$Ca,6nγ) E=200 MeV. Five rotational bands are reported, but details of this study are not yet available. Additional information 1.
1975Sk01: $^{160}$Gd($^{16}$O,4nγ) E=81 MeV. Measured γ(θ,H), deduced g factor.
1974SaZP: $^{154}$Sm($^{20}$Ne,2nγ). Measured γ, Xγ coin, excitation function.
1967Ne02 (also 1967Di07): $^{165}$Ho($^{11}$B,4nγ) E=54 MeV. Measured γ, γ(θ). g.s. band observed up to $14^+$.
1965St03 (also 1964St12): $^{165}$Ho($^{11}$B,4nγ) E≈120 MeV. Measured ce. g.s. band reported up to $18^+$ with 9 γ rays in the cascade.
Reaction mechanism:
1988Ta18: $^{170}$Er($^{22}$Ne,X) E=10 MeV/nucleon. Measured fragment kinetic energy, fragment(γγ) coin.
1986So05: $^{174}$Yb($^{80}$Kr,X) E=684 MeV. Measured fragment-γ coin.
1982Pe10: $^{160}$Gd($^{16}$O,4nγ) E=80 MeV, 90 MeV. Measured γ, deduced average multiplicity. 7 γ rays reported for the g.s. band up to $20^+$. Average multiplicity=14.3 (at 80 MeV), 13.1 (at 90 MeV).
1974De24: $^{164}$Dy($^{12}$C,4nγ) E=70 MeV. Measured γ, γγ, γγ(θ). Deduced average multiplicity of photons in the continuum of γ rays by gating on the transitions in the g.s. band up to $16^+$. Average multiplicity is found to be≈6.
Theoretical: 1983Pe21.

### $^{172}$Hf Levels

Average g-factor=0.14 *4* (1975Sk01), of high-spin states above the g.s. rotational band. Technique: transient magnetic field (IMPAC).

| E(level)[†] | Jπ[‡] | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0.0[#] | $0^+$ | | |
| 95.22[#] *4* | $2^+$ | | |
| 309.20[#] *6* | $4^+$ | | |
| 628.28[#] *7* | $6^+$ | | |
| 1037.42[#] *8* | $8^+$ | | |
| 1304.6[@] *2* | $(4^+)$ | | |
| 1418.28[&] *15* | $(4^-)$ | | |
| 1462.8[@] *2* | $(5^+)$ | | |
| 1503.33[a] *11* | $(5^-)$ | | Jπ: ΔJ=1 γ to $4^+$. |
| 1521.19[#] *11* | $10^+$ | | |
| 1597.43[&] *11* | $(6^-)$ | | |
| 1621.4[@] *2* | $(6^+)$ | | |
| 1684.60[b] *10* | $(6^+)$ | ≤16 ns | $T_{1/2}$: γ(t) for a two-component decay curve (1977Wa16). |
| 1722.7 *3* | $(6,7,8^+)$ | | |
| 1727.41[a] *12* | $(7^-)$ | | Jπ: ΔJ=1 γ to $6^+$. |
| 1852.36[&] *12* | $(8^-)$ | | |
| 1856.53[d] *14* | $(6^-)$ | <16 ns | $T_{1/2}$: from a two-component decay curve (1977Wa16). |
| 1878.03[b] *12* | $(7^+,8^+,9^+)$ | | |
| 1964.80[d] *17* | | | |
| 1968.11[a] *14* | $(9^-)$ | | |
| 2005.73[c] *12* | $(8^-)$ | 163 ns *6* | $T_{1/2}$: from γγ(t). Weighted average of values for 95γ, 128γ, 193γ, 214γ, 319γ, |

Continued on next page (footnotes at end of table)

**(HI,xnγ) 1977Wa16,1985Pa02 (continued)**

$^{172}$Hf Levels (continued)

| E(level)† | Jπ‡ | Comments |
|---|---|---|
| | | 1056γ, 1375γ (1977Wa16). |
| 2064.68# *14* | $12^+$ | |
| 2093.55b *20* | $(8^+)$ | |
| 2094.83d *23* | | |
| 2186.17& *15* | $(10^-)$ | |
| 2235.82c *15* | | |
| 2245.7d *3* | | |
| 2329.71b *25* | $(9^+)$ | |
| 2336.92a *14* | $(11^-)$ | |
| 2415.6d *3* | | |
| 2426.4e *3* | | |
| 2488.09c *17* | | |
| 2584.5b *4* | $(10^+)$ | |
| 2598.15& *18* | $(12^-)$ | |
| 2611.1d *3* | | |
| 2654.13# *16* | $14^+$ | |
| 2760.14c *19* | | |
| 2777.51a *20* | $(13^-)$ | |
| 2822.3d *4* | | |
| 2855.1b *5* | $(11^+)$ | |
| 2900.4e *4* | | |
| 3050.11c *21* | | |
| 3059.2d *4* | | |
| 3085.39& *23* | $(14^-)$ | |
| 3277.29# *19* | $(16^+)$ | |
| 3286.0a *4* | $(15^-)$ | |
| 3304.3d *4* | | |
| 3355.63c *23* | | |
| 3448.5e *8* | | |
| 3643.1& *3* | $(16^-)$ | |
| 3672.9c *3* | | |
| 3858.5a *5* | $(17^-)$ | |
| 3919.7# *3* | $(18^+)$ | |
| 3997.3c *4* | | |
| 4061.3e *9* | | |
| 4264.2& *5* | $(18^-)$ | |
| 4492.8a *5* | $(19^-)$ | |
| 4576.6# *4* | $(20^+)$ | |
| 4730.3e *13* | | |
| 4942.2& *6* | $(20^-)$ | |
| 5184.4a *6* | $(21^-)$ | |
| 5275.1# *5* | $(22^+)$ | |
| 5670.3& *8* | $(22^-)$ | |
| 5931.5a *8* | $(23^-)$ | |
| 6033.1# *6* | $(24^+)$ | |
| 6445.3& *13* | $(24^-)$ | |
| 6725.4a *9* | $(25^-)$ | |

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**(HI,xnγ) 1977Wa16,1985Pa02 (continued)**

$^{172}$Hf Levels (continued)

| E(level)† | Jπ‡ | E(level)† | Jπ‡ | E(level)† | Jπ‡ | E(level)† | Jπ‡ |
|---|---|---|---|---|---|---|---|
| 6849.8# *8* | (26+) | 8106.9a *10* | (29−) | 9070.3& *22* | (30−) | 10823.5a *14* | (35−) |
| 7275.3& *16* | (26−) | 8149.3& *19* | (28−) | 9601.5# *17* | (32+) | 11612.5# *22* | (36+) |
| 7312.6a *10* | (27−) | 8643.5# *14* | (30+) | 9860.5a *10* | (33−) | 11841.5a *18* | (37−) |
| 7725.5# *10* | (28+) | 8954.8a *10* | (31−) | 10595.5# *20* | (34+) | 12644.5# *25* | (38+) |

† From least-squares fit to Eγ's, assuming an uncertainty of 0.2 or 1.0 keV on energies where no uncertainty is given.
‡ From Adopted Levels.
# Band(A): (π=+,α=0) g.s. band.
@ Band(B): $K^{\pi}=2^{+}$ γ-band.
& Band(C): (π=−,α=0) band.
a Band(D): (π=−,α=1) band.
b Band(E): ΔJ=(1), $K^{\pi}=(6^{+})$ band.
c Band(F): ΔJ=(1), $K^{\pi}=(8^{-})$ band.
d Band(G): band 1, ΔJ=(1).
e Band(H): band 2, ΔJ=(2).

γ(172Hf)

Iγ's from 128Te(48Ca,4nγ) E=205 MeV (1985Pa02)

| Eγ | Iγ | Eγ | Iγ | Eγ | Iγ |
|---|---|---|---|---|---|
| 95.4 2 | 3.8 2 | 508.1 2 | 15.6 25 | 698.3 3 | 7.7 4 |
| 125.0 10 | <1.0 | 543.2 2 | 49.9 4 | 728.1 5 | 3.8 8 |
| 179.4 3 | 5.6 5 | 549.0 10 | 2.4 4 | 747.1 5 | 3.7 5 |
| 214.2 1 | 84.0 3 | 557.4 3 | 7.1 5 | 758.0 4 | 6.9 3 |
| 242.0 10 | <1.0 | 572.3 2 | 13.8 7 | 775.0 10 | 3.4 4 |
| 254.9 3 | 8.4 6 | 589.2 2 | 45.4 3 | 793.9 5 | 3.5 7 |
| 319.2 1 | 100 | 613.0 10 | 2.5 3 | 815.6 4 | 6.1 5 |
| 333.9 2 | 16.1 6 | 621.1 3 | 4.8 6 | 816.7 5 | 4.8 5 |
| 368.7 2 | 4.6 2 | 622.8 2 | 26.5 5 | 834.0 6 | 1.7 2 |
| 409.2 1 | 88.9 6 | 633.8 3 | 5.9 5 | 875.7 5 | 4.6 5 |
| 412.1 3 | 15.2 6 | 642.0 2 | 17.1 2 | 903.0 10 | 2.4 5 |
| 440.6 2 | 16.9 9 | 655.9 3 | 11.0 2 | 918.0 10 | 3.3 8 |
| 474.0 10 | <1.0 | 677.5 5 | 5.9 6 | 930.7 5 | 3.4 5 |
| 483.8 2 | 73.5 20 | 689.0 10 | 1.9 5 | 1108.0 10 | 1.2 8 |
| 487.3 3 | 17.3 16 | 691.7 4 | 4.4 5 | | |

| $E_\gamma$ [†] | $I_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | α[d] | Comments |
|---|---|---|---|---|---|---|---|---|
| 63.2[‡] | | 1684.60 | (6+) | 1621.4 | (6+) | | | |
| 87.5[‡] | | 1684.60 | (6+) | 1597.43 | (6−) | | | |
| 94.15 *10* | 0.6 *3* | 1597.43 | (6−) | 1503.33 | (5−) | | | |
| 95.22 *4* | 26 *4* | 95.22 | 2+ | 0.0 | 0+ | E2[a] | 4.35 | α(K)= 1.064; α(L)= 2.487; α(M)= 0.618; α(N+..)= 0.1768<br>$A_2$=0.18 *6*, $A_4$=−0.14 *9* (1975Sk01). |
| 108.27 *10* | 0.7 *3* | 1964.80 | | 1856.53 | (6−) | | | |
| 124.98 *10* | 1.5 *4* | 1852.36 | (8−) | 1727.41 | (7−) | [M1] | 2.17 | α(K)= 1.806; α(L)= 0.282; α(M)=0.0636; α(N+..)=0.01895 |
| 127.67 *10* | 3.4 *3* | 2005.73 | (8−) | 1878.03 | (7+,8+,9+) | (E1) | 0.19 | α(K)= 0.1573; α(L)= 0.0257; α(M)=0.00577; α(N+..)=0.00166<br>Mult.: from α(exp)<0.5, deduced from delayed γ-ray intensities. |
| 130.03 *15* | 0.9 *4* | 2094.83 | | 1964.80 | | | | |
| 149.4[‡] | | 2005.73 | (8−) | 1856.53 | (6−) | | | |
| 150.84 *14* | 1.3 *6* | 2245.7 | | 2094.83 | | | | |
| 169.90 *10* | 1.3 *6* | 2415.6 | | 2245.7 | | | | |
| 171.92 *20* | 1.0 *4* | 1856.53 | (6−) | 1684.60 | (6+) | | | |
| 179.13 *10* | 2.5 *15* | 1597.43 | (6−) | 1418.28 | (4−) | [E2][c] | 0.42 | α(K)= 0.2285; α(L)= 0.1472; α(M)=0.0360; α(N+..)=0.01026 |
| 180.9[‡] | | 1684.60 | (6+) | 1503.33 | (5−) | | | |
| 193.41 *10* | 4.0 *8* | 1878.03 | (7+,8+,9+) | 1684.60 | (6+) | | | |
| 195.49 *10* | 1.3 *6* | 2611.1 | | 2415.6 | | | | |
| 211.23 *15* | 1.0 *5* | 2822.3 | | 2611.1 | | | | |
| 213.98 *4* | 100 | 309.20 | 4+ | 95.22 | 2+ | E2[a] | 0.232 | α(K)= 0.1398; α(L)= 0.0702; α(M)=0.01709; α(N+..)=0.00485 |







$^{172}_{72}Hf_{100}$-4

## (HI,xnγ) 1977Wa16,1985Pa02 (continued)

### γ($^{172}$Hf) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | α [d] | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $A_2$=0.261 *10*, $A_4$=−0.098 *11*. Additional information 2. |
| 215.52 *15* | 1.6 *7* | 2093.55 | (8$^+$) | 1878.03 | (7$^+$,8$^+$,9$^+$) | | | |
| 218.25 *20* | 0.56 *20* | 2186.17 | (10$^-$) | 1968.11 | (9$^-$) | | | |
| 221.6[‡] | | 1684.60 | (6$^+$) | 1462.8 | (5$^+$) | | | |
| 230.08 *10* | 2.7 *5* | 2235.82 | | 2005.73 | (8$^-$) | | | $A_2$=0.21 *9*, $A_4$=0.04 *10*. |
| 236.16 *15* | 1.0 *5* | 2329.71 | (9$^+$) | 2093.55 | (8$^+$) | | | |
| 237.02 *20* | 0.6 *3* | 3059.2 | | 2822.3 | | | | |
| 242.0[@] *10* | <1.1 | 1968.11 | (9$^-$) | 1727.41 | (7$^-$) | [E2] | 0.156 | α(K)= 0.0994; α(L)= 0.0429; α(M)=0.01038; α(N+..)=0.00294 |
| 245.2 *3* | 0.4 *2* | 3304.3 | | 3059.2 | | | | |
| 252.26 *10* | 2.0 *5* | 2488.09 | | 2235.82 | | | | |
| 254.8 *3* | 0.7 *3* | 2584.5 | (10$^+$) | 2329.71 | (9$^+$) | | | |
| 254.86 *10* | 6 *3* | 1852.36 | (8$^-$) | 1597.43 | (6$^-$) | [E2][c] | 0.132 | α(K)= 0.0862; α(L)= 0.0350; α(M)=0.00846; α(N+..)=0.00240 |
| 270.6 *3* | 0.6 *3* | 2855.1 | (11$^+$) | 2584.5 | (10$^+$) | | | |
| 272.04 *10* | 1.6 *4* | 2760.14 | | 2488.09 | | | | |
| 278.2[‡] | | 2005.73 | (8$^-$) | 1727.41 | (7$^-$) | | | |
| 289.87 *15* | 1.1 *3* | 3050.11 | | 2760.14 | | | | |
| 305.47 *20* | 0.9 *3* | 3355.63 | | 3050.11 | | | | |
| 317.62 *25* | 0.5 *2* | 3672.9 | | 3355.63 | | | | |
| 319.09 *4* | 90 *4* | 628.28 | 6$^+$ | 309.20 | 4$^+$ | E2[a] | 0.066 | α(K)= 0.0468; α(L)=0.01501; α(M)=0.00360; α(N+..)=0.00102 $A_2$=0.284 *10*, $A_4$=−0.087 *11*. Additional information 3. |
| 321.7 *10* | 0.25 *10* | 2005.73 | (8$^-$) | 1684.60 | (6$^+$) | | | |
| 324.9 *4* | 0.5 *3* | 3997.3 | | 3672.9 | | | | |
| 333.76 *10* | 6.5 *20* | 2186.17 | (10$^-$) | 1852.36 | (8$^-$) | [E2][c] | 0.058 | α(K)= 0.0416; α(L)= 0.01277; α(M)=0.00306; α(N+..)=0.00087 |
| 353.32 *15* | 3.0 *12* | 1856.53 | (6$^-$) | 1503.33 | (5$^-$) | | | |
| 365.8 *3* | 0.9 *2* | 2611.1 | | 2245.7 | | | | $A_2$=0.31 *20*, $A_4$=−0.10 *20*. |
| 368.7 *3* | 2.8 *5* | 2336.92 | (11$^-$) | 1968.11 | (9$^-$) | (E2)[b] | 0.044 | α(K)= 0.0320; α(L)=0.00900; α(M)=0.00215; α(N+..)=0.00061 $A_2$=0.38 *8*, $A_4$=−0.13 *10*. |
| 380.0[‡] | | 1684.60 | (6$^+$) | 1304.6 | (4$^+$) | | | |
| 406.5 *3* | 0.7 *3* | 2822.3 | | 2415.6 | | | | |
| 408.4[‡] | | 2005.73 | (8$^-$) | 1597.43 | (6$^-$) | | | |
| 409.16 *4* | 70 *4* | 1037.42 | 8$^+$ | 628.28 | 6$^+$ | E2[b] | 0.033 | α(K)=0.02458; α(L)=0.00635; α(M)=0.00150; α(N+..)=0.00043 $A_2$=0.309 *10*, $A_4$=−0.098 *11*. Additional information 4. DCO=0.99 *3* (1980Wa03). |
| 411.98 *10* | 6.7 *15* | 2598.15 | (12$^-$) | 2186.17 | (10$^-$) | | | |
| 440.69 *20* | 7 *3* | 2777.51 | (13$^-$) | 2336.92 | (11$^-$) | [c] | | |
| 447.5[e] *4* | 2.0 *7* | 1968.11 | (9$^-$) | 1521.19 | 10$^+$ | | | |
| 448.0 *3* | 0.7 *3* | 3059.2 | | 2611.1 | | | | |
| 474.1 *4* | 1.4 *3* | 2900.4 | | 2426.4 | | (E2)[b] | | $A_2$=0.38 *9*, $A_4$=−0.20 *10*. |
| 482.0 *3* | 0.9 *4* | 3304.3 | | 2822.3 | | | | |





$^{172}_{72}Hf_{100}$-5

## (HI,xnγ) 1977Wa16,1985Pa02 (continued)

### γ($^{172}$Hf) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | α [d] | Comments |
|---|---|---|---|---|---|---|---|---|
| 482.42 *20* | 0.4 *2* | 2488.09 | | 2005.73 | (8⁻) | | | |
| 483.80 *8* | 54 *3* | 1521.19 | 10⁺ | 1037.42 | 8⁺ | E2 [b] | 0.021 | α(K)=0.01629; α(L)=0.00373; α(M)=0.00087; α(N+..)=0.00025<br>$A_2$=0.325 *10*, $A_4$=−0.108 *11*.<br>Additional information 5.<br>DCO=0.96 *3* (1980Wa03). |
| 487.24 *15* | 5.0 *20* | 3085.39 | (14⁻) | 2598.15 | (12⁻) | | | |
| 508.5 *3* | 5.0 *20* | 3286.0 | (15⁻) | 2777.51 | (13⁻) | [c] | | |
| 524.26 *25* | 0.3 *2* | 2760.14 | | 2235.82 | | | | |
| 543.47 *8* | 34.3 *20* | 2064.68 | 12⁺ | 1521.19 | 10⁺ | E2 [b] | | $A_2$=0.327 *10*, $A_4$=−0.120 *11*.<br>Additional information 6.<br>DCO=0.99 *4* (1980Wa03). |
| 548.5 *10* | 2.0 *10* | 3448.5 | | 2900.4 | | | | |
| 557.75 *20* | 4.5 *5* | 3643.1 | (16⁻) | 3085.39 | (14⁻) | (E2) [b] | | $A_2$=0.12 *3*, $A_4$=−0.07 *4*. |
| 562.13 *25* | 0.3 *2* | 3050.11 | | 2488.09 | | | | |
| 572.5 *3* | 2.8 *6* | 3858.5 | (17⁻) | 3286.0 | (15⁻) | (E2) [b] | | $A_2$=0.36 *4*, $A_4$=−0.16 *4*. |
| 587.2 [#] | | 7312.6 | (27⁻) | 6725.4 | (25⁻) | | | |
| 589.45 *8* | 17.3 *15* | 2654.13 | 14⁺ | 2064.68 | 12⁺ | E2 [b] | | $A_2$=0.299 *15*, $A_4$=−0.116 *17*.<br>Additional information 7.<br>DCO=1.00 *6* (1980Wa03). |
| 595.62 *20* | 0.6 *2* | 3355.63 | | 2760.14 | | | | |
| 612.8 *4* | 3.1 *10* | 4061.3 | | 3448.5 | | | | |
| 621.1 *4* | 3.0 *10* | 4264.2 | (18⁻) | 3643.1 | (16⁻) | | | |
| 622.6 *3* | 0.5 *2* | 3672.9 | | 3050.11 | | | | |
| 623.16 *10* | 10.8 *20* | 3277.29 | (16⁺) | 2654.13 | 14⁺ | (E2) [b] | | For 621.1γ+622.6γ+623.2: $A_2$=0.260 *23*, $A_4$=−0.09 *3*.<br>Additional information 8.<br>DCO=0.99 *7* (1980Wa03). |
| 634.33 *20* | 3.1 *6* | 4492.8 | (19⁻) | 3858.5 | (17⁻) | (E2) [b] | | $A_2$=0.13 *5*, $A_4$=−0.14 *6*. |
| 641.2 *4* | 0.4 *2* | 3997.3 | | 3355.63 | | | | |
| 642.36 *20* | 5.7 *20* | 3919.7 | (18⁺) | 3277.29 | (16⁺) | E2 [b] | | $A_2$=0.27 *3*, $A_4$=−0.23 *3*.<br>Additional information 9.<br>DCO=0.92 *13* (1980Wa03). |
| 647.4 [‡] | | 1684.60 | (6⁺) | 1037.42 | 8⁺ | | | |
| 656.99 *25* | 2.1 *5* | 4576.6 | (20⁺) | 3919.7 | (18⁺) | (E2) [b] | | $A_2$=0.30 *6*, $A_4$=−0.05 *7*.<br>DCO=0.92 *14* (1980Wa03). |
| 669 [#] | | 4730.3 | | 4061.3 | | | | |
| 678.0 *2* | & | 4942.2 | (20⁻) | 4264.2 | (18⁻) | [c] | | $E_\gamma$: from 1980Wa03, 677.5 *5* (1985Pa02). |
| 690.4 *3* | 0.9 *2* | 1727.41 | (7⁻) | 1037.42 | 8⁺ | | | |
| 691.6 *2* | & | 5184.4 | (21⁻) | 4492.8 | (19⁻) | [c] | | $E_\gamma$: from 1980Wa03, 691.7 *4* (1985Pa02). |
| 698.5 *2* | & | 5275.1 | (22⁺) | 4576.6 | (20⁺) | (E2) [b] | | $E_\gamma$: from 1980Wa03, 698.3 *3* (1985Pa02).<br>DCO=1.07 *20* (1980Wa03). |





$^{172}_{72}Hf_{100}$-6

**(HI,xnγ) 1977Wa16,1985Pa02 (continued)**

γ($^{172}$Hf) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | Comments |
|---|---|---|---|---|---|---|---|---|
| 712.68 *25* | 1.6 *4* | 2777.51 | (13$^-$) | 2064.68 | 12$^+$ | D(+Q) | <0.14 | $A_2$=−0.24 *11*, $A_4$=−0.10 *11*. |
| 728.1[@] *5* | | 5670.3 | (22$^-$) | 4942.2 | (20$^-$) | | | |
| 747.1[@] *5* | | 5931.5 | (23$^-$) | 5184.4 | (21$^-$) | *c* | | |
| 758.0[@] *4* | | 6033.1 | (24$^+$) | 5275.1 | (22$^+$) | *c* | | |
| 775.0[@] *10* | | 6445.3 | (24$^-$) | 5670.3 | (22$^-$) | *c* | | |
| 793.9[@] *5* | | 6725.4 | (25$^-$) | 5931.5 | (23$^-$) | | | |
| 794[#] | | 3448.5 | | 2654.13 | 14$^+$ | | | |
| 794.3[#] | | 8106.9 | (29$^-$) | 7312.6 | (27$^-$) | | | |
| 815.76 *9* | 4.1 *3* | 2336.92 | (11$^-$) | 1521.19 | 10$^+$ | D(+Q) | ≈−0.07 | $A_2$=−0.31 *4*, $A_4$=−0.05 *4*. |
| 816.7[@] *5* | | 6849.8 | (26$^+$) | 6033.1 | (24$^+$) | *c* | | |
| 830[#] | | 7275.3 | (26$^-$) | 6445.3 | (24$^-$) | | | |
| 834.3[‡] | | 1462.8 | (5$^+$) | 628.28 | 6$^+$ | | | |
| 835.8 *5* | 1.0 *5* | 2900.4 | | 2064.68 | 12$^+$ | | | |
| 847.9[#] | | 8954.8 | (31$^-$) | 8106.9 | (29$^-$) | | | |
| 874[#] | | 8149.3 | (28$^-$) | 7275.3 | (26$^-$) | | | |
| 875.4 *3* | 2.3 *6* | 1503.33 | (5$^-$) | 628.28 | 6$^+$ | | | |
| 875.7[@] *5* | | 7725.5 | (28$^+$) | 6849.8 | (26$^+$) | *c* | | |
| 905.20 *25* | 1.9 *3* | 2426.4 | | 1521.19 | 10$^+$ | | | $A_2$=−0.09 *9*, $A_4$=0.07 *11*. |
| 905.7[#] | | 9860.5 | (33$^-$) | 8954.8 | (31$^-$) | | | |
| 918.0[@] *10* | | 8643.5 | (30$^+$) | 7725.5 | (28$^+$) | | | |
| 921[#e] | | 9070.3 | (30$^-$) | 8149.3 | (28$^-$) | | | |
| 930.65 *15* | 3.9 *3* | 1968.11 | (9$^-$) | 1037.42 | 8$^+$ | D(+Q)[b] | <0.14 | $A_2$=−0.29 *6*, $A_4$=−0.03 *6*. |
| 958[#] | | 9601.5 | (32$^+$) | 8643.5 | (30$^+$) | | | |
| 963[#e] | | 10823.5 | (35$^-$) | 9860.5 | (33$^-$) | | | |
| 968.2[‡] | | 2005.73 | (8$^-$) | 1037.42 | 8$^+$ | | | |
| 993.1[‡] | | 1621.4 | (6$^+$) | 628.28 | 6$^+$ | | | |
| 994[#] | | 10595.5 | (34$^+$) | 9601.5 | (32$^+$) | | | |
| 995.4[‡] | | 1304.6 | (4$^+$) | 309.20 | 4$^+$ | | | |
| 1017[#e] | | 11612.5 | (36$^+$) | 10595.5 | (34$^+$) | | | |
| 1018[#e] | | 11841.5 | (37$^-$) | 10823.5 | (35$^-$) | | | |
| 1032[#e] | | 12644.5 | (38$^+$) | 11612.5 | (36$^+$) | | | |
| 1056.26 *16* | 4.6 *3* | 1684.60 | (6$^+$) | 628.28 | 6$^+$ | D+Q[b] | | $A_2$=−0.06 *3*, $A_4$=−0.01 *4*. |
| 1094.46[e] *25* | 1.4 *2* | 1722.7 | (6,7,8$^+$) | 628.28 | 6$^+$ | | | $A_2$=0.27 *12*, $A_4$=−0.04 *13*. |
| 1099.05 *15* | 2.6 *3* | 1727.41 | (7$^-$) | 628.28 | 6$^+$ | D[b] | | $A_2$=−0.24 *6*, $A_4$=0.11 *7*. |
| 1108.95 *25* | 1.4 *2* | 1418.28 | (4$^-$) | 309.20 | 4$^+$ | | | $A_2$=0.08 *11*, $A_4$=0.07 *13*. |
| 1153.5[‡] | | 1462.8 | (5$^+$) | 309.20 | 4$^+$ | | | |





$^{172}_{72}Hf_{100}$-7

**(HI,xnγ) 1977Wa16,1985Pa02 (continued)**

γ($^{172}$Hf) (continued)

| $E_\gamma$ † | $I_\gamma$ † | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | Comments |
|---|---|---|---|---|---|---|---|
| 1194.08 *16* | 3.2 *3* | 1503.33 | ($5^-$) | 309.20 | $4^+$ | D[b] | $A_2$=−0.22 *5*, $A_4$=0.08 *6*. |
| 1375.5 *3* | 2.7 *4* | 1684.60 | ($6^+$) | 309.20 | $4^+$ | | |

† From 1977Wa16.
‡ From delayed γ-ray study (1994Wa07). See also (HI,xnγ):isomer decay.
# From 1991ChZW.
@ From 1985Pa02.
& From 1985Pa02.
[a] ce data (1965St03) and γ(θ) give ΔJ=2, E2.
[b] From γ(θ) and/or γγ(θ). ΔJ=2 transitions are further restricted to E2 from RUL (for E2 and M2), assuming timing resolution of a few ns in γγ coin.
[c] Iγ(θ=30°)/Iγ(θ=90°) (relative to ΔJ=2,E2 214γ) suggests ΔJ=2, E2 transition (1985Pa02).
[d] 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.
[e] Placement of transition in the level scheme is uncertain.





$^{172}_{72}Hf_{100}$-8

**(HI,xnγ) 1977Wa16,1985Pa02**

Level Scheme

Intensities: Relative $I_\gamma$

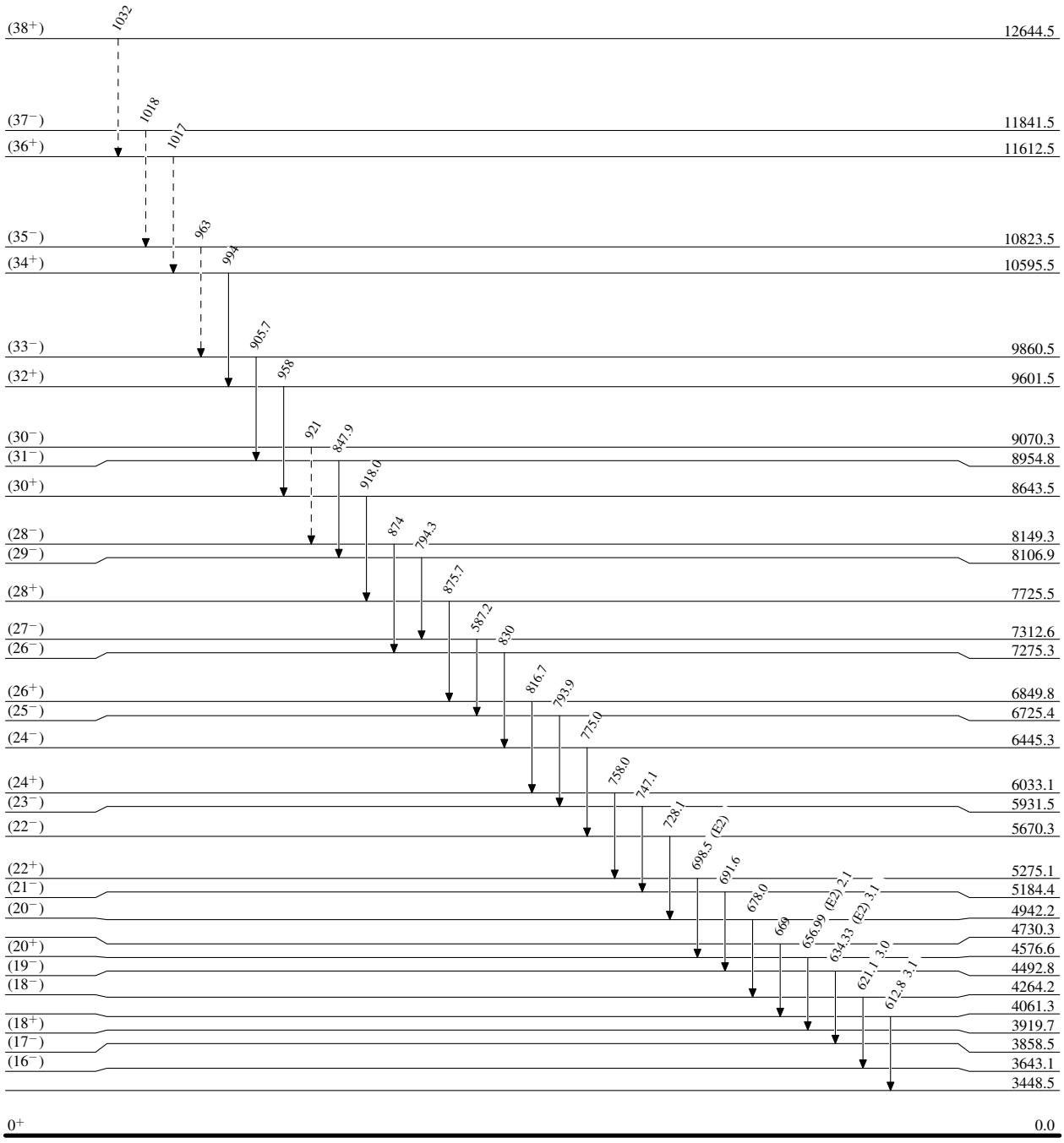
Legend

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

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

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

γ Decay (Uncertain)




$^{172}_{72}Hf_{100}$

**(HI,xnγ) 1977Wa16,1985Pa02**

Level Scheme (continued)

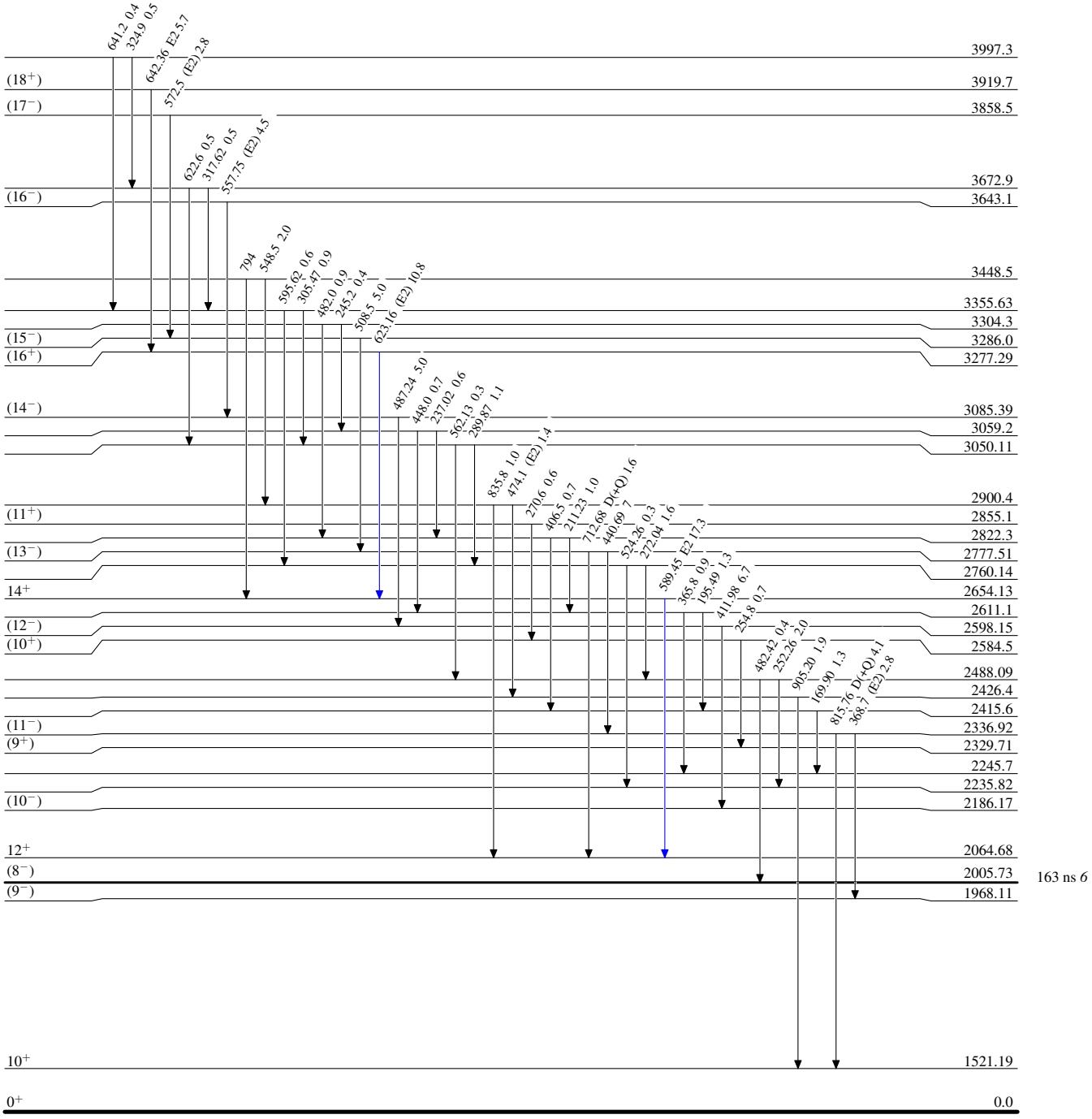
Intensities: Relative $I_\gamma$

Legend

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

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

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



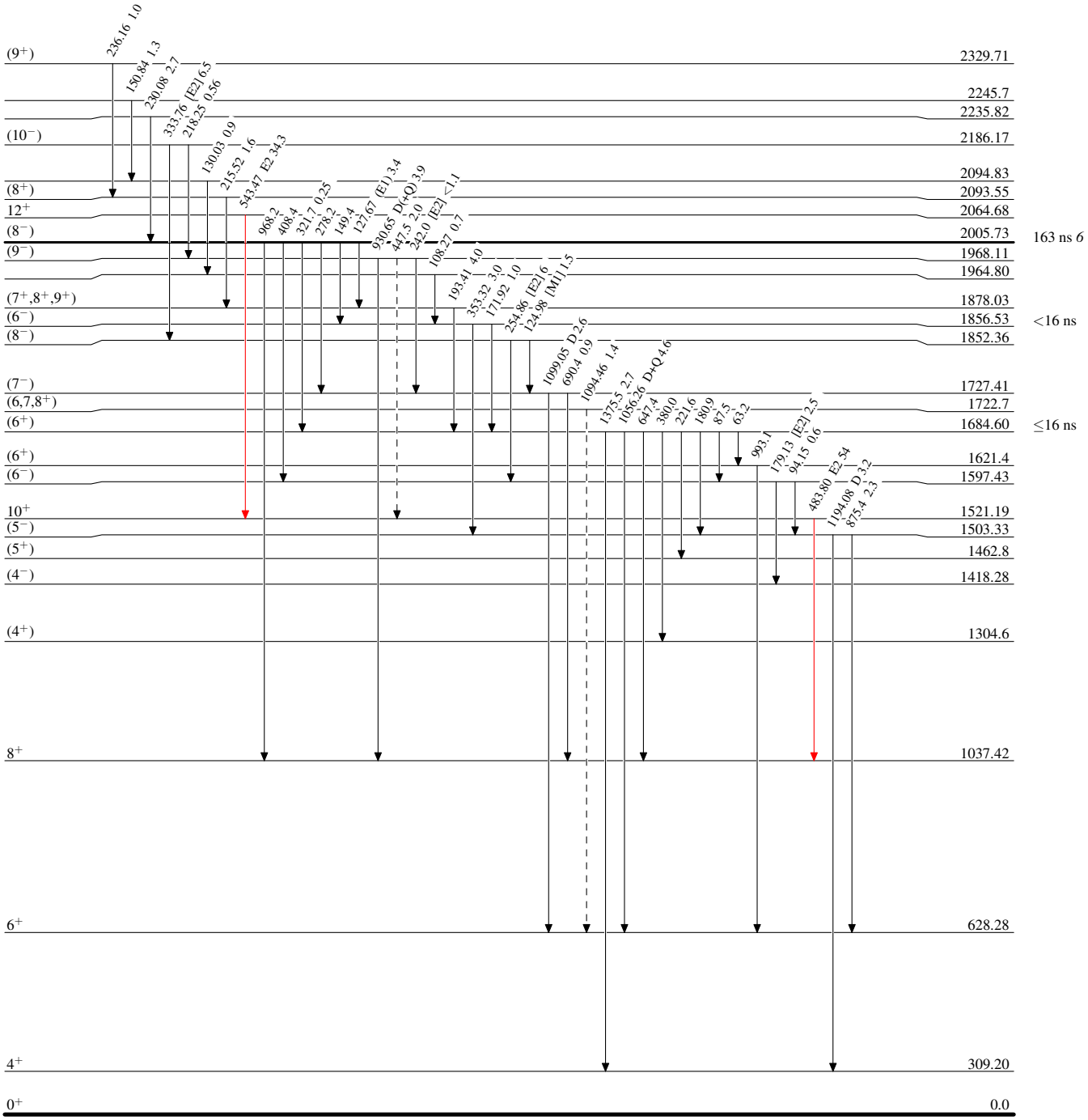

$^{172}_{72}Hf_{100}$

**(HI,xnγ) 1977Wa16,1985Pa02**

Level Scheme (continued)

Intensities: Relative $I_\gamma$

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)

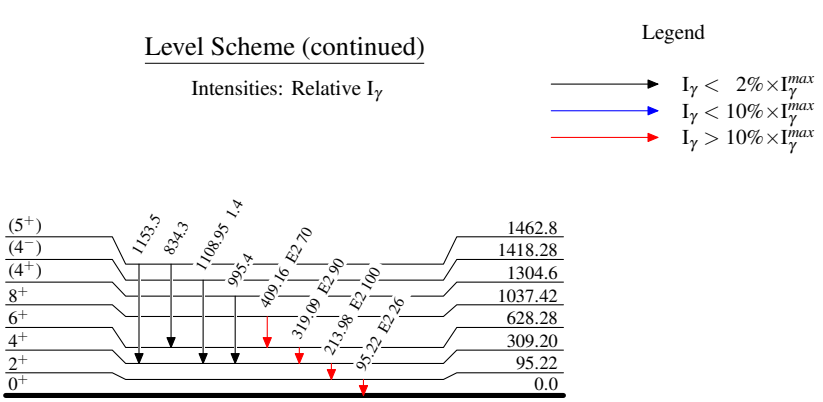



$^{172}_{72}Hf_{100}$

**(HI,xnγ) 1977Wa16,1985Pa02**

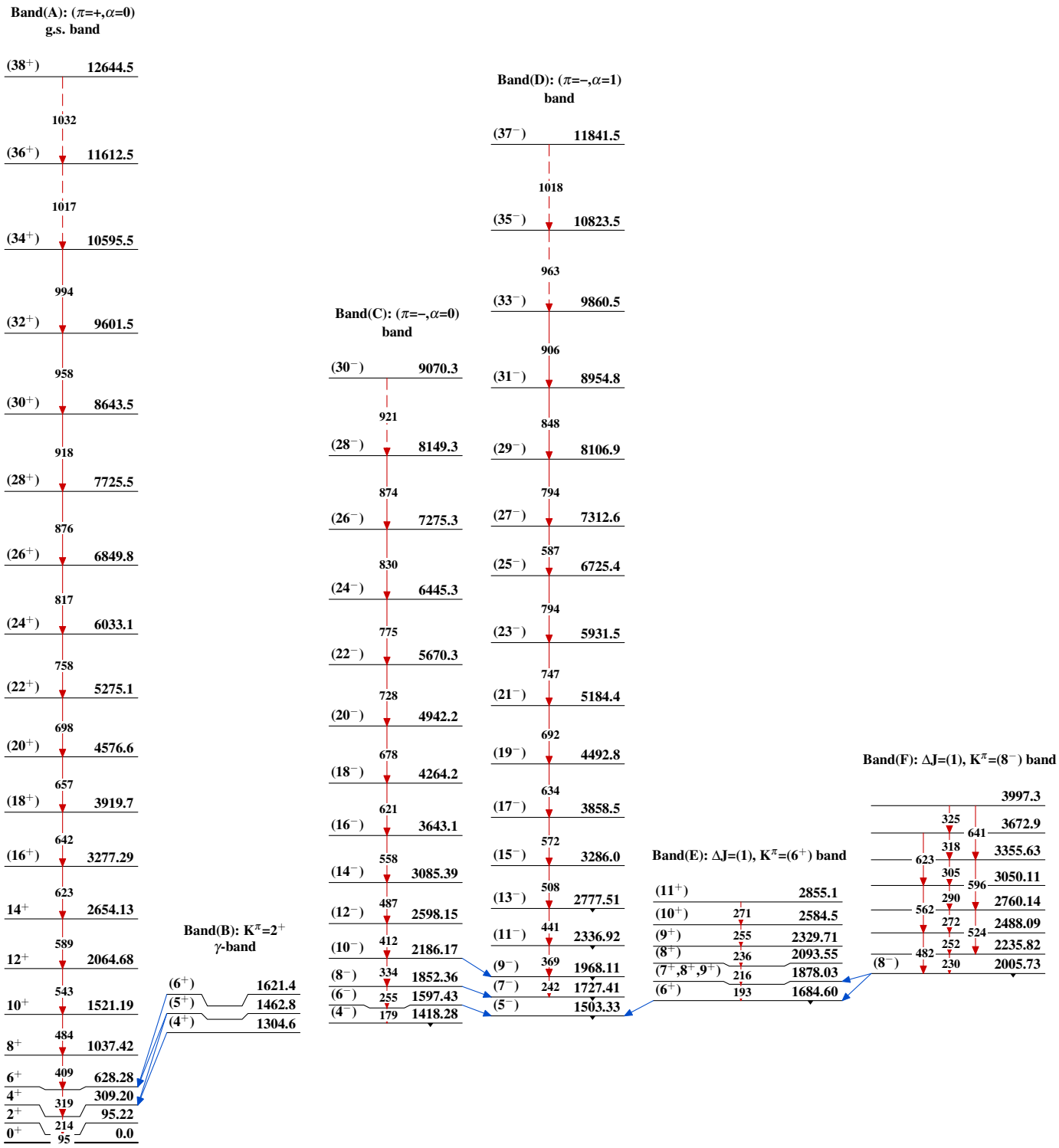
Level Scheme (continued)

Intensities: Relative $I_\gamma$



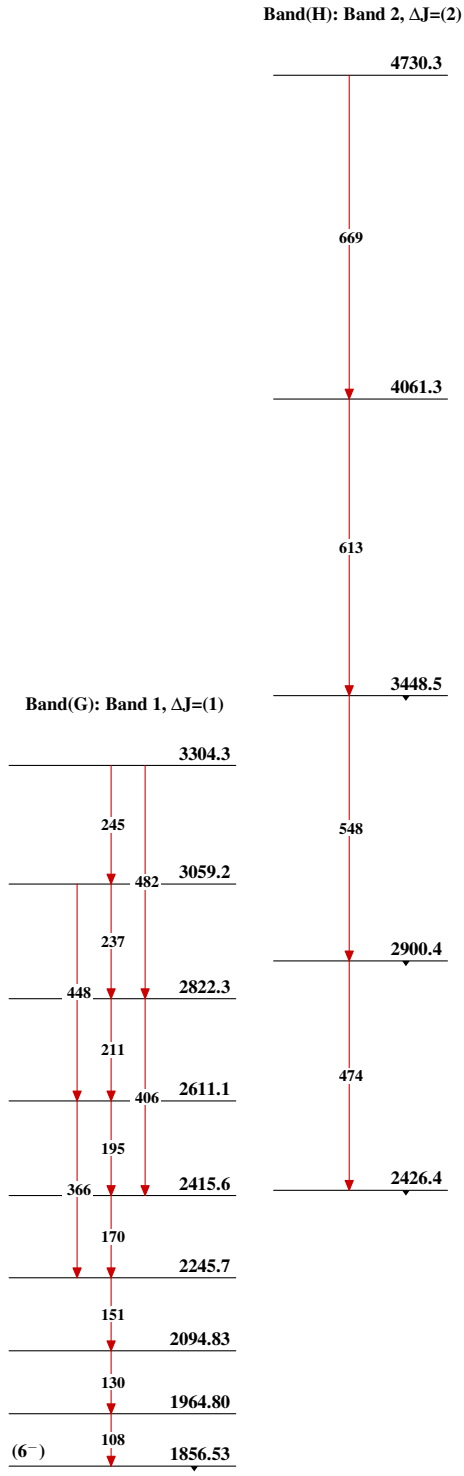

$^{172}_{72}Hf_{100}$

## (HI,xnγ) 1977Wa16,1985Pa02




$^{172}_{72}Hf_{100}$

**(HI,xnγ) 1977Wa16,1985Pa02 (continued)**




$^{172}_{72}Hf_{100}$