## $^{178}$Hf($\gamma,\gamma'$) 1997Pi08

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | E. Achterberg, O. A. Capurro, G. V. Marti | NDS 110, 1473 (2009) | 31-May-2008 |

1997Pi08: Inelastic gamma ray scattering (nuclear resonance fluorescence) technique. Studied dipole excitation of J=1 and 2 states in a 92.4% enriched $^{178}$Hf target, using an E < 4.3 MeV bremsstrahlung source, and observing their subsequent decay with Ge(Li) detectors. Cross-section measurements and angular distributions. Calculated branching ratio R(exp)=$(1+\delta^2) \times$ B(Q1;$1^\pi$->$2^+_1$) / B(Q1;$1^\pi$->$0^+_1$), with Q either E or M, where $\delta$ is the quadrupole-dipole mixing ratio for the $1^\pi$->$2^+_1$ transition, deduced probable K values.

NOTE: Except for the two lowest states, these authors see none of the levels reported in other datasets for this nuclide, and, conversely, none of the levels reported here, except for those two, have been reported in any of the other publications for the various datasets with spectroscopic information on $^{178}$Hf.

### $^{178}$Hf Levels

In the following tabulation $\Gamma_0$ is the partial decay width to the $0^+$ g.s., K is the most probable value for the level, as deduced from the branching ratio R(exp) defined in the description of the experiment given above. See 1997Pi08 for details of calculation. Since in most cases the parity of the excited states is unknown, the dipole excitation strengths are listed as B(M1)↑ values in units of $\mu^2_N$, unless stated otherwise. Conversion to B(E1)↑ in units of $e^2fm^2$, if appropriate, is obtained by multiplying the quoted value by the factor 0.01106 $e^2fm^2$ / $\mu^2_N$.

| E(level) | $J^\pi$ † | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0.0 | $0^+$ | | |
| 1174.63 | $2^+$ | 0.62 ps *2* | E(level),$J^\pi$,$T_{1/2}$: from Adopted Levels. |
| 1310.07 | $1^-$ | | E(level),$J^\pi$: from Adopted Levels.<br>R(exp)=0.216 *20*. K=1. $\Gamma_0$=0.6 *3* meV. B(E1)↑=0.8 *4* $10^{-3}e^2fm^2$. |
| 2247.8 *10* | 1 | | $J^\pi$: from angular correlations (1997Pi08).<br>R(exp)=1.5 *6*. K=0. $\Gamma_0$=3.7 *15* meV. B(M1)↑=0.08 *3*. |
| 2334.4 *10* | 1 | | R(exp)=1.30 *17*. K=(0). $\Gamma_0$=13.7 *17* meV. B(M1)↑=0.28 *3*. |
| 2432.5 *10* | 1,2‡# | | $\Gamma_0$=1.8 *6* meV. B(M1)↑=0.032 *10*. |
| 2438.8 *10* | 1 | | R(exp)=1.3 *4*. K=(0). $\Gamma_0$=6.3 *17* meV. B(M1)↑=0.11 *3*. |
| 2612.7 *10* | 1 | | R(exp)=0.53 *5*. K=1. $\Gamma_0$=31.6 *19* meV. B(M1)↑=0.46 *3*. |
| 2827.5 *10* | 1 | | R(exp)=1.9 *7*. K=0. $\Gamma_0$=8 *3* meV. B(M1)↑=0.09 *3*. |
| 2839.6 *10* | 1 | | R(exp)=0.53 *6*. K=1. $\Gamma_0$=26.2 *20* meV. B(M1)↑=0.297 *22*. |
| 2894.1 *10* | 1 | | R(exp)=0.71 *16*. K=1. $\Gamma_0$=11.5 *18* meV. B(M1)↑=0.123 *19*. |
| 2915.7 *10* | 1 | | R(exp)=0.76 *15*. K=1. $\Gamma_0$=13.8 *19* meV. B(M1)↑=0.144 *20*. |
| 3018.8 *10* | 1 | | R(exp)=0.93 *14*. K=(1). $\Gamma_0$=18.1 *22* meV. B(M1)↑=0.170 *21*. |
| 3144.4 *10* | 1 | | R(exp)=2.1 *3*. K=0. $\Gamma_0$=33 *4* meV. B(M1)↑=0.28 *4*. |
| 3293.4 *10* | 1 | | R(exp)=0.5 *3*. K=1. $\Gamma_0$=6.6 *23* meV. B(M1)↑=0.048 *17*. |
| 3410.0 *10* | 1 | | R(exp)=0.7 *3*. K=1. $\Gamma_0$=10 *3* meV. B(M1)↑=0.068 *20*. |
| 3452.7 *10* | 1‡ | | R(exp)=1.5 *7*. K=0. $\Gamma_0$=15 *7* meV. B(M1)↑=0.10 *4*. |
| 3546.0 *10* | 1 | | R(exp)=0.50. K=1. $\Gamma_0$=29 *3* meV. B(M1)↑=0.171 *18*. |
| 3572.5 *10* | 1 | | R(exp)=1.7 *5*. K=0. $\Gamma_0$=17 *5* meV. B(M1)↑=0.09 *3*. |
| 3577.7 *10* | 1 | | R(exp)=0.64 *17*. K=1. $\Gamma_0$=21 *4* meV. B(M1)↑=0.119 *20*. |
| 3589.3 *10* | 1 | | R(exp)=0.52 *9*. K=1. $\Gamma_0$=37 *4* meV. B(M1)↑=0.209 *24*. |
| 3609.9 *10* | 1 | | R(exp)=0.58 *13*. K=1. $\Gamma_0$=30 *4* meV. B(M1)↑=0.165 *22*. |
| 3625.6 *10* | 1,2‡ | | R(exp)=0.8 *4*. K=(1). $\Gamma_0$=13 *4* meV. B(M1)↑=0.071 *21*. |
| 3710.8 *10* | 1# | | $\Gamma_0$=14.9 *22* meV. B(M1)↑=0.076 *11*. |
| 3773.2 *10* | 1 | | R(exp)=0.75 *25*. K=1. $\Gamma_0$=20 *5* meV. B(M1)↑=0.095 *23*. |
| 3823.9 *10* | 1 | | R(exp)=0.57 *25*. K=1. $\Gamma_0$=21 *5* meV. B(M1)↑=0.096 *25*. |
| 3890.0 *10* | 1,2‡ | | R(exp)=2.4 *10*. K=(0). $\Gamma_0$=27 *13* meV. B(M1)↑=0.12 *6*. |

Continued on next page (footnotes at end of table)

## $^{178}$Hf($\gamma,\gamma'$) 1997Pi08 (continued)

### $^{178}$Hf Levels (continued)

| E(level) | $J^{\pi}$[†] | Comments |
|---|---|---|
| 3925.2 *10* | 1[#] | $\Gamma_0$=27 *5* meV. B(M1)↑=0.116 *21*. |
| 3932.2 *10* | 1 | R(exp)=0.51 *22*. K=1. $\Gamma_0$=34 *8* meV. B(M1)↑=0.14 *3*. |

[†] J=1 assumes a transfer of one unit of angular momentum.
[‡] Assuming J=1 for the calculation of K, $\Gamma_0$ and B(M1)↑ values.
[#] Inelastic decay to $2^+_1$ state not observed. $\Gamma_0$ and B(M1)↑ values deduced from decay to ground state.