## $^{181}$Ta(p,4nγ) 1976Ca15

History

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

Target: $^{181}$Ta. Projectile: protons, E=33.3-42.6 MeV. Measured Eγ, Iγ, γγ coin, γγ(t), γe$^-$(t), pγ(θ) at θ=90° to 150° in steps of 10°, E(ce), Ice. Detectors: Ge(Li), magnetic spectrometer. Others: 1973Bi10, 1965Mi02.

### $^{178}$W Levels

Note that there is a significant disagreement between the $J^\pi$ assignments for the bands based on the 1666 and 1740 keV levels proposed in 1976Ca15, and those from other experiments. See Adopted Levels, and the individual source datasets. The changes have been noted for the respective levels in the table below.

| E(level)† | Jπ‡ | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0.0# | $0^+$ | | |
| 106.20# *10* | $2^+$ | | |
| 342.82# *14* | $4^+$ | | |
| 694.18# *17* | $6^+$ | | |
| 1001? | $(0^+)$ | | |
| 1045.15@ *21* | $2^-$ | | |
| 1083.3& *5* | $2^+$ | | |
| 1111.0 *10* | $(2^+)$ | | |
| 1120.48@ *21* | $3^-$ | | |
| 1131.9? *3* | $(1^-)$ | | |
| 1141.82# *20* | $8^+$ | | |
| 1225.83@ *22* | $4^-$ | | |
| 1275.7& *4* | $4^+$ | | |
| 1344.82@ *23* | $5^-$ | | |
| 1381.0 *8* | $(4^+)$ | | |
| 1509.2@ *3* | $6^-$ | | |
| 1556.2& *4* | $6^+$ | | |
| 1656.3@ *3* | $7^-$ | | |
| 1665.3# *3* | $10^+$ | | |
| 1665.55a *21* | $6^+$ | 3.0 ns *4* | Jπ: from Adopted Levels. 1976Ca15 assigned $J^\pi=5^-$. |
| 1709? | | | |
| 1739.65b *23* | $7^-$ | 8.3 ns *14* | Jπ: from Adopted Levels. 1976Ca15 assigned $J^\pi=(6)^+$. |
| 1836.3a *3* | $7^+$ | | Jπ: from Adopted Levels. 1976Ca15 assigned $J^\pi=6^-$. |
| 1876.7 *6* | | | |
| 1888.9@ *5* | $(8^-)$ | | |
| 1917.8& *6* | $8^+$ | | |
| 1965? | | | |
| 2024.1a *4* | $8^+$ | | Jπ: from Adopted Levels. 1976Ca15 assigned $J^\pi=7^-$. |
| 2041.3@ *4* | $(9^-)$ | | |
| 2044.7 *6* | | | |
| 2227.6a *4* | $(9^+)$ | | Jπ: from Adopted Levels. 1976Ca15 assigned $J^\pi=(8^-)$. |
| 2240.4 *7* | | | |
| 2244.3# *5* | $12^+$ | | |
| 2340?& | $(10^+)$ | | |
| 2353.9@ *11* | $(10^-)$ | | |

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## $^{181}$Ta(p,4n$\gamma$) 1976Ca15 (continued)

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

† From a least-squares fit to $\gamma$-ray energies.
‡ From 1976Ca15, except when indicated otherwise. Assignments in this reference are based on $\gamma$-ray angular distributions and decay patterns, and on rotational band structure.
# Band(A): $K^\pi=0^+$ g.s. rotational band.
@ Band(B): $K^\pi=2^-$ octupole-vibrational band.
& Band(C): $K^\pi=0^+$ $\beta$-vibrational band.
a Band(D): $K^\pi=(6^+)$ From Adopted Levels. $K^\pi=5^-$ proposed in 1976Ca15.
b Band(E): $K^\pi=(7^-)$ From Adopted Levels. $K^\pi=(6)^+$ proposed in 1976Ca15.

### $\gamma(^{178}W)$

| $E_\gamma$ | $I_\gamma$† | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.‡ | $\alpha$# | Comments |
|---|---|---|---|---|---|---|---|---|
| 74.1 *1* | 10.4 *7* | 1739.65 | $7^-$ | 1665.55 | $6^+$ | E1 | 0.803 | B(E1)(W.u.)=3.5×10$^{-5}$ *6*<br>Mult.: from $\alpha$ exp ≤1.2, determined from transition intensity balance. |
| 105.3 *2* | 1.9 *3* | 1225.83 | $4^-$ | 1120.48 | $3^-$ | | | |
| 106.2 *1* | 35.2 *18* | 106.20 | $2^+$ | 0.0 | $0^+$ | | | |
| 137.0 *5* | 3.4 *10* | 1876.7 | | 1739.65 | $7^-$ | | | |
| 170.7 *2* | 4.8 *8* | 1836.3 | $7^+$ | 1665.55 | $6^+$ | | | |
| 180.8 *3* | 2.0 *8* | 1225.83 | $4^-$ | 1045.15 | $2^-$ | | | |
| 187.7 *5* | 0.8 *5* | 2024.1 | $8^+$ | 1836.3 | $7^+$ | | | |
| 224.2 *5* | 3.4 *15* | 1344.82 | $5^-$ | 1120.48 | $3^-$ | | | |
| 225.4@ *5* | 1.8 *10* | 1965? | | 1739.65 | $7^-$ | | | |
| 236.6 *1* | 100 | 342.82 | $4^+$ | 106.20 | $2^+$ | | | |
| 283.4 *2* | 10.8 *2* | 1509.2 | $6^-$ | 1225.83 | $4^-$ | | | |
| 305.0 *5* | 1.3 *6* | 2044.7 | | 1739.65 | $7^-$ | | | |
| 311.8 *5* | 5.0 *25* | 1656.3 | $7^-$ | 1344.82 | $5^-$ | | | |
| 351.3 *1* | 63.0 *25* | 694.18 | $6^+$ | 342.82 | $4^+$ | E2 | 0.0537 | Mult.: from $\alpha$(K)exp=0.036 *5*. |
| 358.6 *3* | 2.5 *5* | 2024.1 | $8^+$ | 1665.55 | $6^+$ | | | |
| 363.7 *3* | 2.8 *3* | 2240.4 | | 1876.7 | | | | |
| 379.7 *3* | 3.0 *6* | 1888.9 | $(8^-)$ | 1509.2 | $6^-$ | | | |
| 385.4 *3* | 2.6 *5* | 2041.3 | $(9^-)$ | 1656.3 | $7^-$ | | | |
| 391.3 *3* | 2.2 *4* | 2227.6 | $(9^+)$ | 1836.3 | $7^+$ | | | |
| 447.6 *1* | 26.7 *20* | 1141.82 | $8^+$ | 694.18 | $6^+$ | (E2) | 0.0278 | Mult.: from adopted gammas. |
| 465.0 *10* | 2.4 *12* | 2353.9 | $(10^-)$ | 1888.9 | $(8^-)$ | | | |
| 523.5 *2* | 10.6 *10* | 1665.3 | $10^+$ | 1141.82 | $8^+$ | | | |
| 579.0 *4* | 3.1 *8* | 2244.3 | $12^+$ | 1665.3 | $10^+$ | | | |
| 650.6 *2* | 4.5 *9* | 1344.82 | $5^-$ | 694.18 | $6^+$ | E1 | 0.00409 | Mult.: $\alpha$(K)exp=0.006 *2*. |
| 776.0 *5* | 0.8 *4* | 1917.8 | $8^+$ | 1141.82 | $8^+$ | E0+M1+E2 | 0.013 *6* | Mult.: from $\alpha$(K)exp=0.061 *20*. |
| 777.6 *2* | 7.8 *12* | 1120.48 | $3^-$ | 342.82 | $4^+$ | | | |
| 862.0 *3* | 1.4 *3* | 1556.2 | $6^+$ | 694.18 | $6^+$ | E0+M1+E2 | 0.010 *4* | Mult.: from $\alpha$(K)exp=0.028 *7*. |
| 883.0 *3* | 6.1 *15* | 1225.83 | $4^-$ | 342.82 | $4^+$ | E1 | 0.00225 | Mult.: from $\alpha$(K)exp=0.0026 *5*. |
| 898.6 *5* | 1.7 *10* | 2041.3 | $(9^-)$ | 1141.82 | $8^+$ | | | |
| 932.9 *3* | 1.8 *3* | 1275.7 | $4^+$ | 342.82 | $4^+$ | | | |
| 939.0 *2* | 10.6 *10* | 1045.15 | $2^-$ | 106.20 | $2^+$ | E1 | 0.00201 | Mult.: from $\alpha$(K)exp=0.0014 *5*. |
| 962.3 *3* | 2.3 *3* | 1656.3 | $7^-$ | 694.18 | $6^+$ | E1 | 0.00192 | Mult.: from $\alpha$(K)exp=0.0026 *10*. |
| 971.2 *2* | 10.0 *9* | 1665.55 | $6^+$ | 694.18 | $6^+$ | (M1+E2) | 0.008 *3* | Mult.: from adopted gammas. a(K)exp=0.0061 *10*, consistent with either (M1+E2) or (E1+M2). |
| 977.1 *5* | 1.2 *2* | 1083.3 | $2^+$ | 106.20 | $2^+$ | E0+M1+E2 | 0.007 *3* | Mult.: from $\alpha$(K)exp=0.019 *6*. |
| 1002.7 *5* | 3.0 *15* | 1344.82 | $5^-$ | 342.82 | $4^+$ | | | |
| 1014.6@ *3* | 3.0 *15* | 1709? | | 694.18 | $6^+$ | | | |
| 1038.0 *10* | 3.6 *9* | 1381.0 | $(4^+)$ | 342.82 | $4^+$ | | | |
| 1111.0 *10* | 1.5 *8* | 1111.0 | $(2^+)$ | 0.0 | $0^+$ | | | |

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## $^{181}$Ta(p,4n$\gamma$) 1976Ca15 (continued)

### $\gamma(^{178}W)$ (continued)

| $E_\gamma$ | $I_\gamma$[†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[‡] | $\alpha$[#] | Comments |
|---|---|---|---|---|---|---|---|---|
| 1131.9[@] *3* | 2.7 *7* | 1131.9? | $(1^-)$ | 0.0 | $0^+$ | | | |
| 1275.0 *10* | 3.3 *10* | 1381.0 | $(4^+)$ | 106.20 | $2^+$ | | | |
| 1322.9 *2* | 14.9 *12* | 1665.55 | $6^+$ | 342.82 | $4^+$ | (E2) | 0.00263 | B(E2)(W.u.)=0.00047 *8*<br>Mult.: from adopted gammas. a(K)exp=0.0013 *3*. |

[†] Measured at $\theta$=130°. Projectile energy E(p)=38 MeV.
[‡] From conversion electron data normalized to $\alpha$(K)(448$\gamma$, E2)=0.0209 and $\gamma(\theta)$.
[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on $\gamma$-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[@] Placement of transition in the level scheme is uncertain.

$^{181}$**Ta(p,4nγ) 1976Ca15**

Level Scheme

Intensities: Relative $I_\gamma$

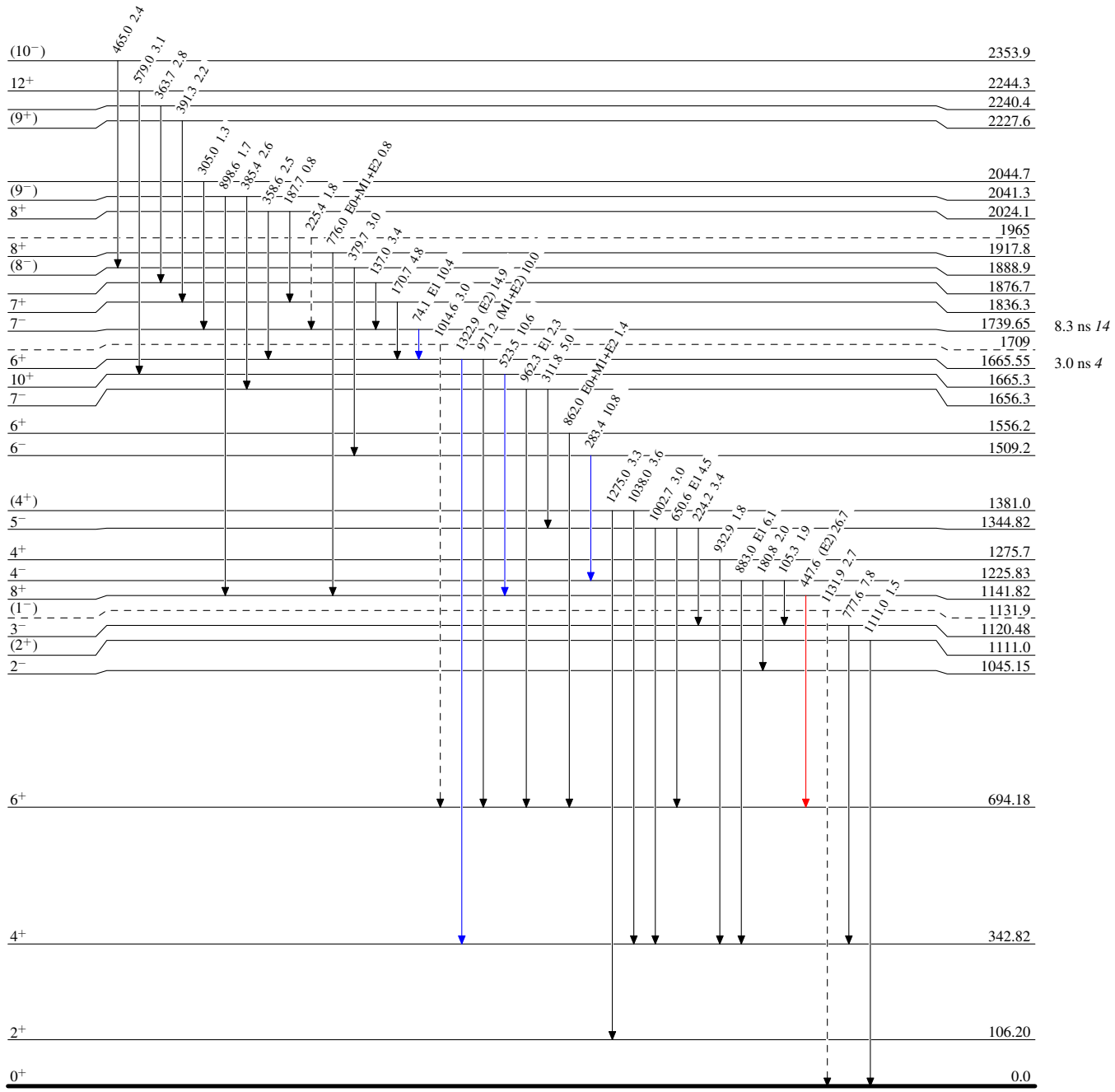
Legend

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

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

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

γ Decay (Uncertain)

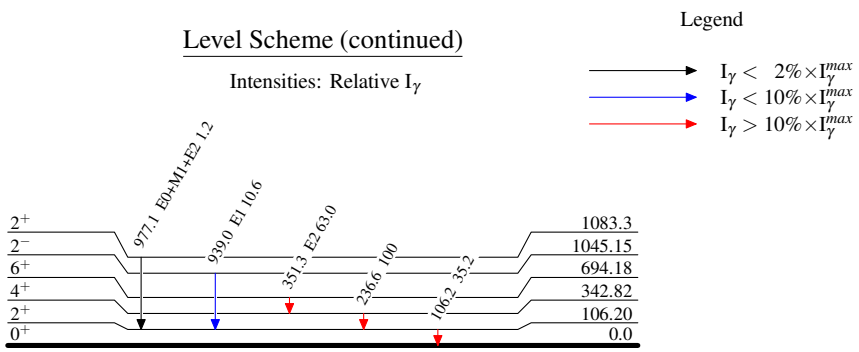



$^{178}_{74}W_{104}$

## $^{181}$Ta(p,4nγ) 1976Ca15

### Level Scheme (continued)

Intensities: Relative $I_\gamma$




$^{178}_{74}W_{104}$

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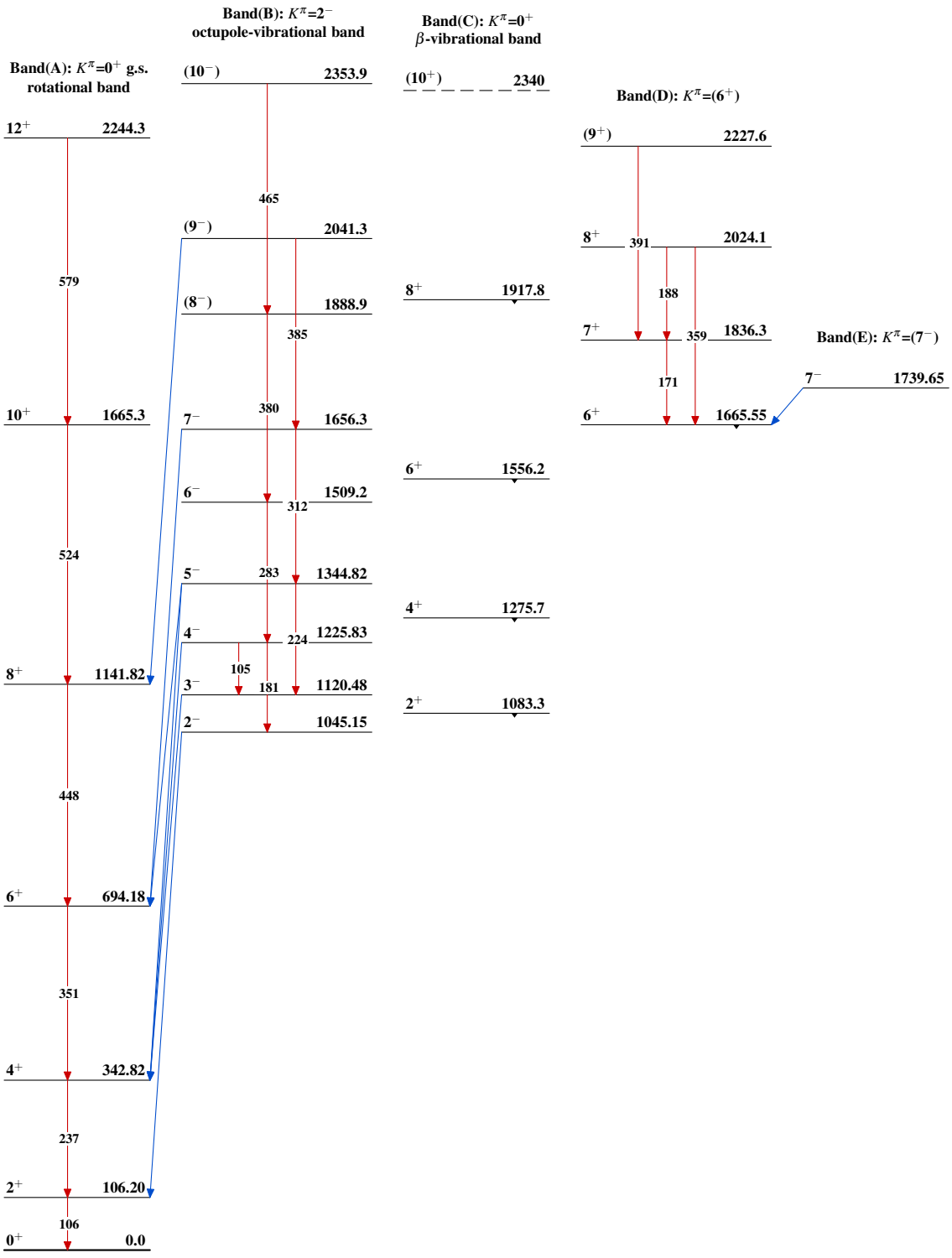


$^{178}_{74}W_{104}$