# $^{178}$Ir ε decay 1994Ki01

History

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

Parent: $^{178}$Ir: E=0.0; $T_{1/2}$=12 s *2*; Q(ε)=7294 *26*; %ε+%$β^+$ decay=100.0
$^{178}$Ir-$T_{1/2}$ from 1973HaVR; Q($β^+$) from 2003Au03; branching from 2003Au02.

$^{178}$Ir activity produced by $^{164}$Er($^{19}$F,5n), E=110 MeV. Measured Eγ, Iγ, γγ coin, γγ(θ), γ-ce coin, Ice. Detectors: CAESAR array of six Compton-suppressed HPGe detectors. Superconducting solenoid electron spectrometer. Determined angular correlation and conversion coefficients. Deduced γ-ray multipolarities and level spins and parities.

## $^{178}$Os Levels

| E(level) | $J^π$ | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0.0† | $0^+$ | 5.0 min *4* | |
| 132.26† *17* | $2^+$ | | $J^π$: E2 132.2 keV γ ray to the $0^+$ g.s., and E0 component in the 732.2 keV transition from the $2^+$ 864 keV level. |
| 398.89† *21* | $4^+$ | | $J^π$: E2 266.6-keV γ ray to the $2^+$ 132 keV level, and E2 372.1 keV γ ray from the $2^+$ 772 keV level, which allows the range ($0^+$ to $4^+$). Rotational g.s. band level sequence indicates $J^π=4^+$. |
| 650.5‡ *4* | $0^+$ | | $J^π$: E2 518.0 keV γ ray to the $2^+$ 132 keV level, which allows the range ($0^+$ to $4^+$). Band-head of the β band suggests $J^π=0^+$. If that is correct, the 650 keV γ ray deexciting to the $0^+$ g.s. would have to have pure E0 character. The available spectra in 1994Ki01 do not allow to decide this issue unambiguously (see also Comment for the 650.4 keV transition). |
| 761.63† *24* | $6^+$ | | $J^π$: E2 362.8 keV γ to the $4^+$ 399 keV level; rotational band level sequence supports $J^π=6^+$. |
| 771.04‡ *23* | $2^+$ | | $J^π$: E0 component in the 638.8 keV transition to the $2^+$ 132-keV level. |
| 864.40# *21* | $2^+$ | | $J^π$: E2 864.4 keV γ ray to the $0^+$ g.s., and E0 component in the 732.2 keV transition to the $2^+$ 132 keV level. |
| 1023.22‡ *25* | $4^+$ | | $J^π$: E0 component in the 624.4 keV transition to the $4^+$ 399 keV level. Agreement with level sequence in β band. |
| 1032.0# *3* | $3^+$ | | $J^π$: M1+E2 multipolarities of the 633.0 keV transition to the $4^+$ 399 keV level, and of the 899.7 keV transition to the $2^+$ 132 keV level, establish the $J^π=3^+$ value uniquely. |
| 1194.1† *4* | $8^+$ | | $J^π$: from g.s. rotational band level membership. |
| 1213.0# *3* | $4^+$ | | $J^π$: M1+E2 814.2-keV transition to the $4^+$ 399 keV level, E2 1080.7 keV transition to the $2^+$ 132 keV level. |
| 1302.0 *4* | $3^-$ | | $J^π$: Suggested as band head of a negative parity band (1994Ki01). |
| 1395.8‡ *4* | $6^+$ | | $J^π$: E0 component in 634.4 keV transition to the $6^+$ 762 keV level, E2 372.6 keV transition to the $4^+$ 1023 keV level. |
| 1416.5# *4* | $5^+$ | | $J^π$: M1+E2 654.8-keV transition to the $6^+$ 762 keV level, and E2 1017.7 keV transition to the $4^+$ 399 keV level.<br>Additional information 1. |
| 1469.8 *4* | $4^-$ | | |
| 1539.0 *4* | $5^-$ | | |
| 1706.8 *4* | $6^-$ | | |
| 1781.6 *5* | $7^-$ | | |

† Band(A): $K^π=0^+$ g.s. (yrast) rotational band.
‡ Band(B): $K^π=0^+$ Quasi-β band.
# Band(C): $K^π=2^+$ Quasi-γ band.

## $^{178}$Ir ε decay 1994Ki01 (continued)

### γ($^{178}$Os)

No absolute intensity normalization is provided because the ε decay to the g.s. is unknown, and because the 1994Ki01 authors restricted their study to γ-ray data relevant to the g.s., quasi-β, quasi-γ, and odd-parity octupole states. Their experimental ≈ 2 MeV γ-ray energy cutoff could miss a significant fraction of the ε decay intensity.

| $E_\gamma$[‡] | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α[#] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 120.3 *4* | 1.0 *4* | 771.04 | $2^+$ | 650.5 | $0^+$ | | | | Additional information 2. |
| 132.2 *2* | 78 *5* | 132.26 | $2^+$ | 0.0 | $0^+$ | E2 | | 1.460 | Mult.: $\alpha_L$(exp)=0.72 *5*, $\alpha_M$(exp)=0.18 *1*, theory: $\alpha_L$=0.746 *11*, $\alpha_M$=0.190 *3*. |
| 236.8 *4* | 0.8 *4* | 1706.8 | $6^-$ | 1469.8 | $4^-$ | | | | |
| 237.0 *4* | 1.2 *2* | 1539.0 | $5^-$ | 1302.0 | $3^-$ | | | | |
| 242.7 *4* | 0.8 *2* | 1781.6 | $7^-$ | 1539.0 | $5^-$ | | | | |
| 252.2 *4* | 1.5 *3* | 1023.22 | $4^+$ | 771.04 | $2^+$ | [E2][†] | | 0.1556 | Mult.: transition to the 771 keV $2^+$ level. |
| 261.4 *4* | 0.9 *3* | 1023.22 | $4^+$ | 761.63 | $6^+$ | [E2][†] | | 0.1390 | Mult.: transition to the 762 keV $6^+$ level. |
| 266.6 *2* | 100.0 *22* | 398.89 | $4^+$ | 132.26 | $2^+$ | E2 | | 0.1308 | Mult.: $\alpha_K$(exp)=0.079 *3*, $\alpha_L$(exp)=0.037 *3*, $\alpha_M$(exp)=0.0094 *9*, theory: $\alpha_K$=0.0801 *12*, $\alpha_L$=0.0385 *6*, $\alpha_M$=0.00958 *14*. |
| 270.1 *4* | 0.6 *2* | 1302.0 | $3^-$ | 1032.0 | $3^+$ | | | | |
| 326.0 *4* | 0.54 *25* | 1539.0 | $5^-$ | 1213.0 | $4^+$ | | | | |
| 348.6 *5* | 0.8 *2* | 1213.0 | $4^+$ | 864.40 | $2^+$ | [E2][†] | | 0.0591 | Additional information 3. |
| 362.8 *2* | 39.9 *8* | 761.63 | $6^+$ | 398.89 | $4^+$ | E2 | | 0.0528 | Mult.: $\alpha_K$(exp)=0.036 *2*, $\alpha_L$(exp)=0.014 *2*, theory: $\alpha_K$=0.0366 *6*, $\alpha_L$=0.01234 *18*. |
| 372.1 *4* | 2.4 *4* | 771.04 | $2^+$ | 398.89 | $4^+$ | E2 | | 0.0493 | Mult.: from γγ(θ) and α. Values from combined 372.1 and 372.6 γ rays: $A_2$=+0.23 *11*, $A_4$=+0.13 *11*; $\alpha_K$(exp)(372.1γ + 372.6γ)=0.036 *5*, theory (average): $\alpha_K$=0.0344 *5*. |
| 372.6 *4* | 2.9 *4* | 1395.8 | $6^+$ | 1023.22 | $4^+$ | E2 | | 0.0491 | Mult.: See comments and values for the 372.1 keV γ ray from the 771 keV level. |
| 384.5 *5* | 0.62 *12* | 1416.5 | $5^+$ | 1032.0 | $3^+$ | | | | |
| 432.4 *4* | 6.0 *3* | 1194.1 | $8^+$ | 761.63 | $6^+$ | E2 | | 0.0329 | Mult.: 1994Ki01 do not report any data for their multipolarity assignment. Agrees with $J^\pi=6^+$ for the 762 keV final level. |
| 437.6 *4* | 0.8 *2* | 1469.8 | $4^-$ | 1032.0 | $3^+$ | | | | |
| 451.5 *5* | 0.58 *16* | 1213.0 | $4^+$ | 761.63 | $6^+$ | [E2][†] | | 0.0294 | Additional information 4. |
| 465.4 *4* | 0.39 *12* | 864.40 | $2^+$ | 398.89 | $4^+$ | [E2][†] | | 0.0273 | Mult.: transition to the 399 keV $4^+$ level. |
| 518.0 *5* | 0.35 *8* | 650.5 | $0^+$ | 132.26 | $2^+$ | E2 | | 0.0209 | Mult.: from γγ(θ): $A_2$=+0.2 *1*, $A_4$=+0.85 *18*. |
| 587.4 *4* | 0.8 *2* | 1781.6 | $7^-$ | 1194.1 | $8^+$ | | | | |
| 624.4 *3* | 16.3 *6* | 1023.22 | $4^+$ | 398.89 | $4^+$ | E0+M1+E2 | −3.1 *+3−3* | 0.0157 *5* | Mult.,δ: from γγ(θ) and α: $A_2$=+0.00 *4*, $A_4$=+0.14 *7*; $\alpha_K$(exp)=0.097 *4*, $\alpha_L$(exp)=0.020 *2*, $\alpha_M$(exp)=0.0053 *9*, theory: $\alpha_K$=0.0124 *5*, $\alpha_L$=0.00252 *6*, $\alpha_M$=0.000592 *14*. 1994Ki01 estimate a 9.4 % M1 admixture for this transition. |
| 633.0 *4* | 3.1 *6* | 1032.0 | $3^+$ | 398.89 | $4^+$ | M1+E2 | −3.5 *+6−7* | 0.0148 *8* | Mult.,δ: from γγ(θ): $A_2$=+0.23 *12*, $A_4$=−0.19 *14*. 1994Ki01 estimate an 8 % M1 admixture for this transition. |
| 634.4 *4* | 9.5 *8* | 1395.8 | $6^+$ | 761.63 | $6^+$ | E0+M1+E2 | −2.2 *+3−4* | 0.0169 *11* | Mult.,δ: from γγ(θ) and α: $A_2$=+0.00 *5*, $A_4$=+0.12 *6*; |





$^{178}_{76}Os_{102}$-2

## $^{178}$Ir ε decay 1994Ki01 (continued)

### γ($^{178}$Os) (continued)

| $E_\gamma$[‡] | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α[#] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $\alpha_K$(exp)=0.045 *6*, theory: $\alpha_K$=0.0135 *10*. 1994Ki01 estimate a 17 % M1 admixture for this transition. |
| 638.8 *3* | 16.7 *6* | 771.04 | $2^+$ | 132.26 | $2^+$ | E0+M1+E2 | −6.8 *+11−16* | 0.0133 *3* | Mult.,δ: from γγ(θ) and α: $A_2$=+0.04 *6*, $A_4$=+0.29 *9*; $\alpha_K$(exp)=0.082 *3*, $\alpha_L$(exp)=0.0128 *11*, $\alpha_M$(exp)=0.036 *6*, theory: $\alpha_K$=0.01041 *23*, $\alpha_L$=0.00219 *4*, $\alpha_M$=0.000517 *9*. 1994Ki01 estimate a 2.1 % M1 admixture for this transition. |
| (650.4 *10*) | | 650.5 | $0^+$ | 0.0 | $0^+$ | (E0) | | | No γ ray reported. It is not possible to decide whether the 650-kev peak in the γ spectrum shown in 1994Ki01 belongs to the $^{178}$Ir ε decay or if it is due to some contaminant. In view of this, the E0 assignment in 1994Ki01 is also questionable. |
| 654.8 *4* | 3.5 *3* | 1416.5 | $5^+$ | 761.63 | $6^+$ | M1+E2 | −2.3 *+3−3* | 0.0154 *9* | Mult.,δ: from γγ(θ): $A_2$=+0.23 *9*, $A_4$=−0.06 *11*. 1994Ki01 estimate a 16 % M1 admixture for this transition. |
| 732.2 *3* | 6.8 *6* | 864.40 | $2^+$ | 132.26 | $2^+$ | E0+E2(+M1) | +10 *+6−3* | 0.00961 *21* | Mult.,δ: from γγ(θ) and α: $A_2$=−0.16 *8*, $A_4$=+0.37 *9*; $\alpha_K$(exp)=0.0130 *19*, theory: $\alpha_K$=0.00765 *17*. 1994Ki01 estimate a 1 % M1 admixture for this transition. |
| 771.3 *4* | 1.7 *6* | 771.04 | $2^+$ | 0.0 | $0^+$ | [E2][†] | | 0.00847 | Mult.: transition to the $0^+$ g.s. |
| 777.4 *4* | 0.58 *18* | 1539.0 | $5^-$ | 761.63 | $6^+$ | | | | |
| 814.2 *4* | 5.8 *4* | 1213.0 | $4^+$ | 398.89 | $4^+$ | M1+E2 | +2.4 *+0−12* | 0.009 *3* | Mult.,δ: from γγ(θ) and α: $A_2$=−0.34 *19*, $A_4$=+0.18 *20*; $\alpha_K$(exp)=0.0052 *18*, theory: $\alpha_K$=0.007 *3*. 1994Ki01 estimate a 15 % M1 admixture for this transition. |
| 864.4 *3* | 8.7 *4* | 864.40 | $2^+$ | 0.0 | $0^+$ | E2 | | 0.00667 | Mult.: $\alpha_K$(exp)=0.0061 *8*, theory: $\alpha_K$=0.00538 *8*. |
| 891.0 *4* | 1.5 *2* | 1023.22 | $4^+$ | 132.26 | $2^+$ | E2 | | 0.00627 | Mult.: from γγ(θ): $A_2$=+0.10 *12*. Agrees with transition to the $2^+$ 132 keV level. |
| 899.7 *3* | 16.9 *4* | 1032.0 | $3^+$ | 132.26 | $2^+$ | M1+E2 | +9.0 *+16−11* | 0.00625 *10* | Mult.,δ: from γγ(θ) and α: $A_2$=−0.11 *6*, $A_4$=−0.09 *7*; $\alpha_K$(exp)=0.0049 *9*, theory: $a_K$=0.00506 *8*. 1994Ki01 estimate a 1.2 % M1 admixture for this transition. |
| 903.1 *5* | 0.56 *19* | 1302.0 | $3^-$ | 398.89 | $4^+$ | | | | |
| 945.5 *5* | 1.0 *2* | 1706.8 | $6^-$ | 761.63 | $6^+$ | | | | |
| 996.5 *5* | 0.39 *12* | 1395.8 | $6^+$ | 398.89 | $4^+$ | [E2][†] | | 0.00500 | Additional information 5. |
| 1017.7 *4* | 8.1 *4* | 1416.5 | $5^+$ | 398.89 | $4^+$ | E2 | | 0.00480 | Mult.: $\alpha_K$(exp)=0.004 *1*, theory: $\alpha_K$=0.00392 *6*. |
| 1070.9 *4* | 1.7 *3* | 1469.8 | $4^-$ | 398.89 | $4^+$ | | | | |
| 1080.7 *4* | 5.0 *5* | 1213.0 | $4^+$ | 132.26 | $2^+$ | E2 | | 0.00426 | Mult.: from γγ(θ): $A_2$=+0.11 *16*. |

[†] Multipolarity assumed by the evaluators based on the $J^\pi$ values of the initial and final levels.
[‡] Uncertainties estimated by evaluators, based on the average fit of γ ray cascades to the respective cross-over transitions.
[#] 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.



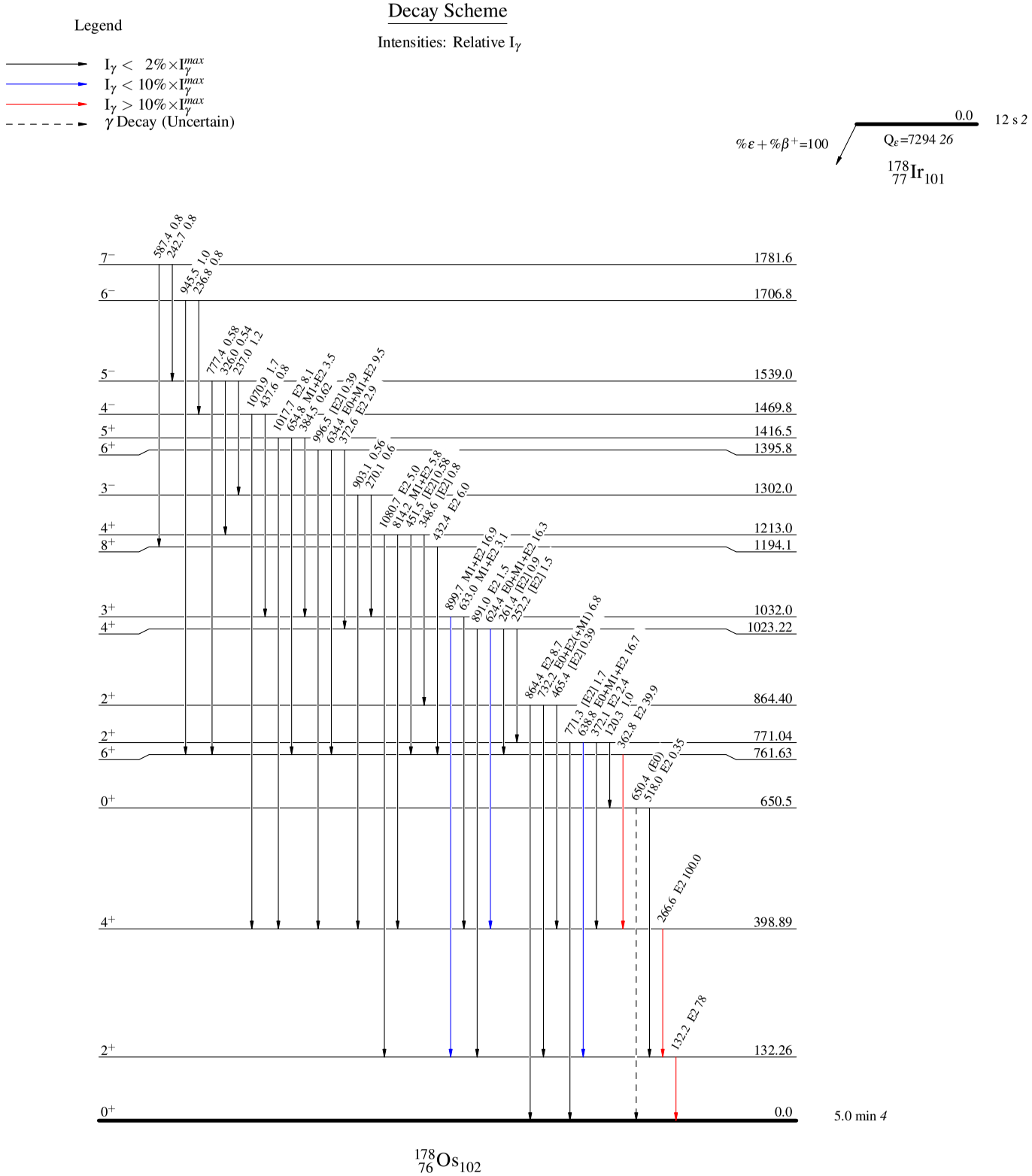


$^{178}_{76}Os_{102}$-3

## $^{178}$Ir ε decay 1994Ki01

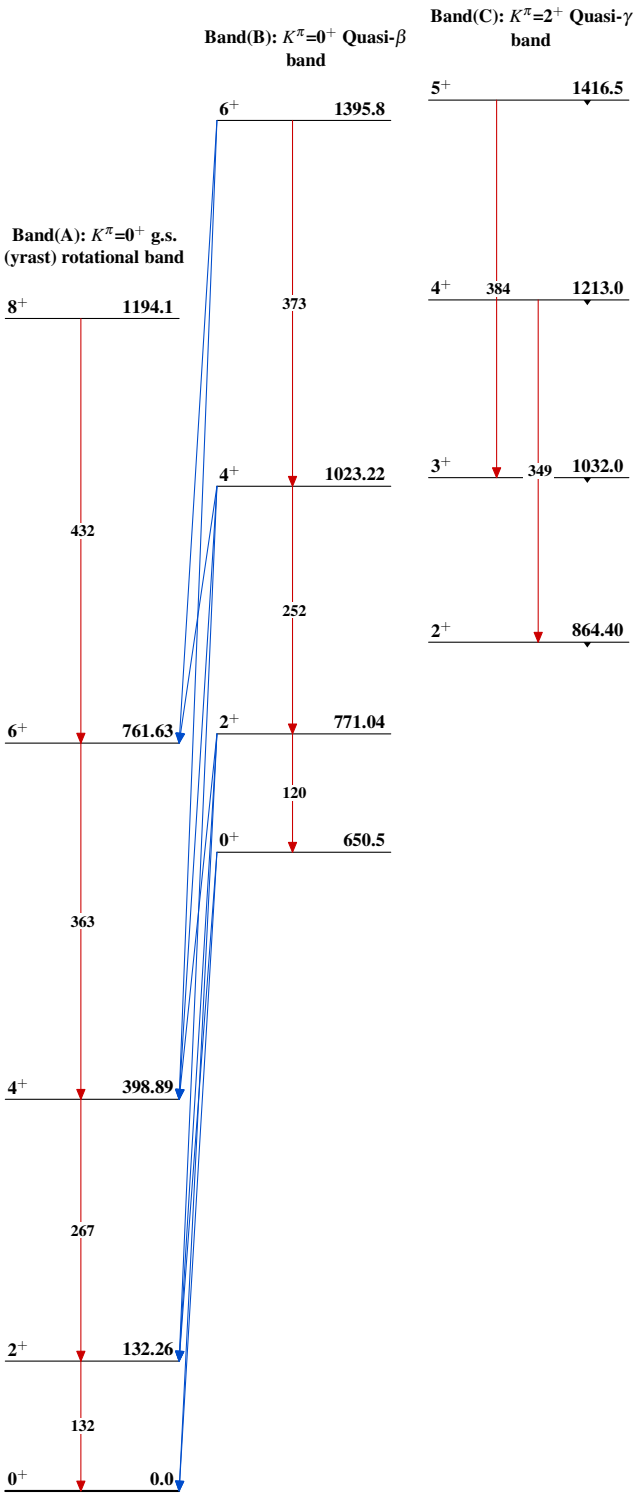
### Decay Scheme

Intensities: Relative $I_\gamma$




$^{178}_{76}Os_{102}$

## $^{178}$Ir ε decay 1994Ki01

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