## $^{209}$Bi($^{18}$O,2$\alpha$n$\gamma$) 2000De36

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Balraj Singh, M. S. Basunia, Murray Martin et al. , | NDS 160, 405 (2019) | 30-Oct-2019 |

2000De36: E=94 MeV. Measured E$\gamma$, I$\gamma$, $\gamma\gamma$, $\alpha\gamma\gamma$ coin using the 8$\pi$ GASP-ISIS spectrometer. Deduced high-spin levels, $J^\pi$, configuration assignments.
Additional information 1.

### $^{218}$Fr Levels

| E(level)† | J$^\pi$‡ | Comments |
|---|---|---|
| 0+x@ | (9$^-$) | Additional information 2.<br>E(level): it is possible that this level corresponds to 86 keV *8* level with $J^\pi$=(8$^-$,9$^-$) in the Adopted Levels. |
| 272.9+x@ *5* | (11$^-$) | |
| 450.0+x# *7* | (10$^-$) | |
| 586.8+x& *7* | (12$^+$) | |
| 596.0+x@ *7* | (13$^-$) | |
| 776.6+x# *9* | (12$^-$) | |
| 862.7+x& *7* | (14$^+$) | |
| 940.0+x *10* | (13$^+$) | |
| 973.1+x@ *8* | (15$^-$) | |
| 1143.8+x# *10* | (14$^-$) | |
| 1192.1+x& *8* | (16$^+$) | |
| 1421.7+x@ *8* | (17$^-$) | |
| 1572.5+x& *9* | (18$^+$) | |
| 1582.9+x# *11* | (16$^-$) | |
| 1921.7+x@ *10* | (19$^-$) | |
| 2035.2+x& *10* | (20$^+$) | |
| 2065.1+x# *12* | (18$^-$) | |
| 2477.9+x@ *12* | (21$^-$) | |
| 2527.6+x& *11* | (22$^+$) | |
| 3045.1+x& *12* | (24$^+$) | |

† From least-squares fit to E$\gamma$ data, assuming $\Delta$(E$\gamma$)=0.3 keV for each E$\gamma$.
‡ From probable (reflection asymmetric) band assignments for states other than the ground state. The assignments are the same in the Adopted Levels.
# Band(A): s=−1 band, $\pi$=−. Probable configuration=$\pi h_{9/2}\otimes\nu g_{9/2}$.
@ Band(B): s=+1 band, $\pi$=−. Probable configuration=$\pi h_{9/2}\otimes\nu g_{9/2}$. Average ($D_0/Q_0$)=0.00036 fm$^{-1}$ 7, from the $\gamma$-ray branching ratios and rotational model, where $D_0$ and $Q_0$ are intrinsic electric dipole moment and quadrupole moment, respectively.
& Band(b): s=+1 band, $\pi$=+. See comment for the $\pi$=− partner of s=+1 band.

### $\gamma$($^{218}$Fr)

| E$\gamma$ | I$\gamma$‡ | E$_i$(level) | J$_i^\pi$ | E$_f$ | J$_f^\pi$ | Mult.# | $\alpha$& | I$_{(\gamma+ce)}$† |
|---|---|---|---|---|---|---|---|---|
| 110.3 | 11 | 973.1+x | (15$^-$) | 862.7+x | (14$^+$) | (E1)@ | 0.372 | 15 |
| 150.6 | 13 | 1572.5+x | (18$^+$) | 1421.7+x | (17$^-$) | (E1)@ | 0.1750 | 15 |
| 163.5 | 2.6 | 940.0+x | (13$^+$) | 776.6+x | (12$^-$) | [E1] | 0.1433 | 3 |

Continued on next page (footnotes at end of table)

## $^{209}$Bi($^{18}$O,2αnγ) 2000De36 (continued)

### γ($^{218}$Fr) (continued)

| $E_\gamma$ | $I_\gamma$[‡] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[#] | α[&] | $I_{(\gamma+ce)}$[†] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 177.1 | 3.9 | 450.0+x | $(10^-)$ | 272.9+x | $(11^-)$ | (M1)[@] | 2.82 | 15 | Mult.: small E2 admixture is also possible. |
| 203.8 | 2.8 | 1143.8+x | $(14^-)$ | 940.0+x | $(13^+)$ | [E1] | 0.0843 | 3 | |
| 219.0 | 42 | 1192.1+x | $(16^+)$ | 973.1+x | $(15^-)$ | [E1] | 0.0710 | 45 | |
| 229.5 | 14 | 1421.7+x | $(17^-)$ | 1192.1+x | $(16^+)$ | [E1] | 0.0636 | 15 | |
| 266.5 | 29 | 862.7+x | $(14^+)$ | 596.0+x | $(13^-)$ | [E1] | 0.0448 | 30 | |
| 272.9 | 84 | 272.9+x | $(11^-)$ | 0+x | $(9^-)$ | [E2] | 0.194 | 100 | |
| 275.9 | 2.5 | 862.7+x | $(14^+)$ | 586.8+x | $(12^+)$ | [E2] | 0.187 | 3 | |
| 314.0 | 4.9 | 586.8+x | $(12^+)$ | 272.9+x | $(11^-)$ | [E1] | 0.0309 | 5 | |
| 323.0 | 81 | 596.0+x | $(13^-)$ | 272.9+x | $(11^-)$ | [E2] | 0.1163 | 90 | |
| 326.6 | 13 | 776.6+x | $(12^-)$ | 450.0+x | $(10^-)$ | [E2] | 0.1126 | 15 | |
| 329.4 | 9 | 1192.1+x | $(16^+)$ | 862.7+x | $(14^+)$ | [E2] | 0.1099 | 10 | |
| 367.1 | 9.3 | 1143.8+x | $(14^-)$ | 776.6+x | $(12^-)$ | [E2] | 0.0810 | 10 | |
| 377.2 | 56 | 973.1+x | $(15^-)$ | 596.0+x | $(13^-)$ | [E2] | 0.0753 | 60 | |
| 380.5 | 28 | 1572.5+x | $(18^+)$ | 1192.1+x | $(16^+)$ | [E2] | 0.0735 | 30 | |
| 439.1 | 9.5 | 1582.9+x | $(16^-)$ | 1143.8+x | $(14^-)$ | [E2] | 0.0506 | 10 | |
| 448.7 | 14 | 1421.7+x | $(17^-)$ | 973.1+x | $(15^-)$ | [E2] | 0.0480 | 15 | |
| 462.7 | 29 | 2035.2+x | $(20^+)$ | 1572.5+x | $(18^+)$ | [E2] | 0.0445 | 30 | |
| 482.2 | 2.9 | 2065.1+x | $(18^-)$ | 1582.9+x | $(16^-)$ | [E2] | 0.0402 | 3 | |
| 492.4 | 19 | 2527.6+x | $(22^+)$ | 2035.2+x | $(20^+)$ | [E2] | 0.0382 | 20 | |
| 500.0 | 9.6 | 1921.7+x | $(19^-)$ | 1421.7+x | $(17^-)$ | [E2] | 0.0369 | 10 | |
| 517.5 | 4.8 | 3045.1+x | $(24^+)$ | 2527.6+x | $(22^+)$ | [E2] | 0.0340 | 5 | |
| 556.2[a] | 2.9 | 2477.9+x | $(21^-)$ | 1921.7+x | $(19^-)$ | [E2] | 0.0288 | 3 | |

† Numerical values not given by 2000De36. Values listed here are estimates (by the evaluators) from thickness of arrows in the level-scheme figure 2 of 2000De36, and are assumed as the transition intensities i.e. I(γ+ce).

‡ Deduced by evaluators from I(γ+ce) and α(theory).

# 2000De36 assumed intraband transitions as stretched E2 transitions based on systematics of neighboring nuclides such as $^{217}$Fr, $^{219}$Ra, $^{220}$Ac, etc. The interband transitions of 219.0, 229.5 and 266.5 keV were assumed as E1. No angular correlation or conversion data are yet available to confirm these assignments.

@ From estimated intensity balance.

& 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.

a Placement of transition in the level scheme is uncertain.

**$^{209}$Bi($^{18}$O,2αnγ) 2000De36**

Level Scheme

Intensities: Relative $I_\gamma$

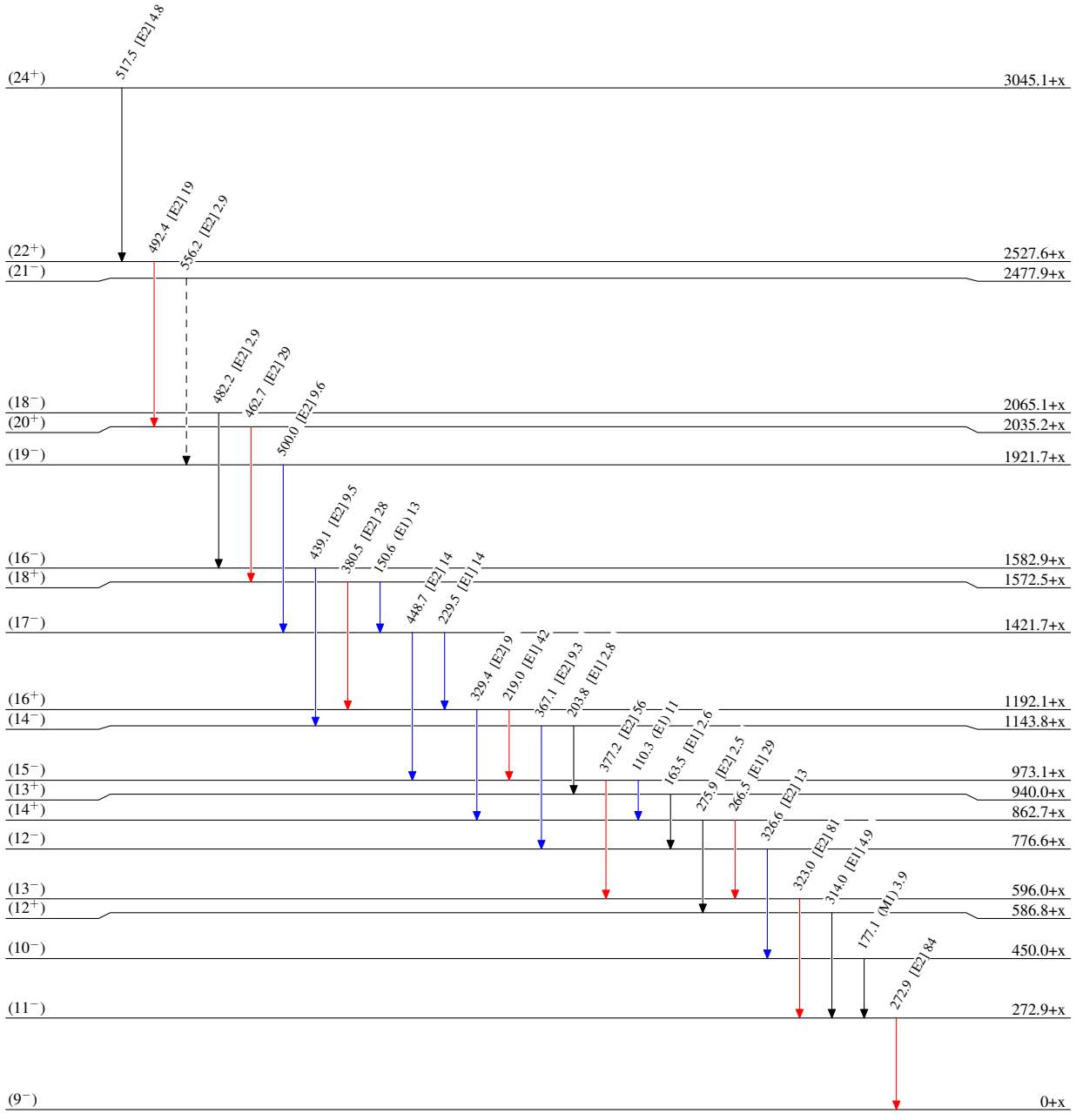
Legend

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

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

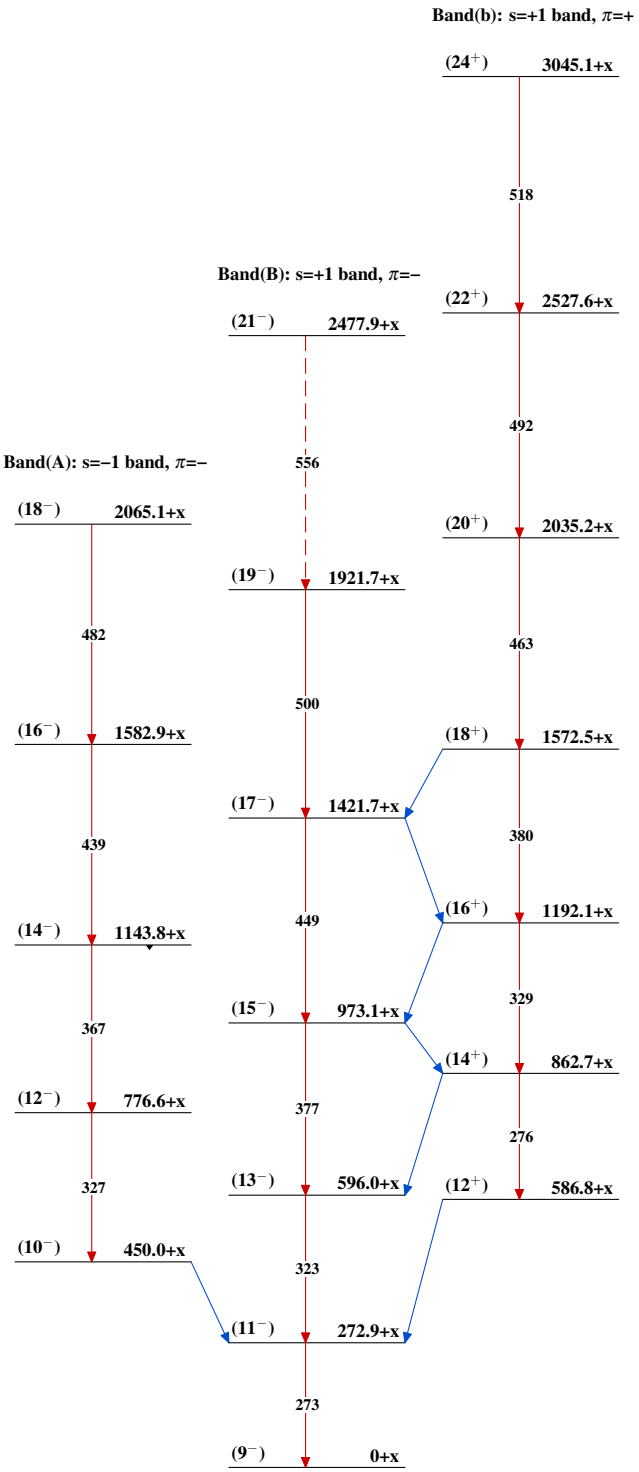
$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)




$^{218}_{87}Fr_{131}$

**$^{209}$Bi($^{18}$O,2αnγ) 2000De36**




$^{218}_{87}Fr_{131}$