## $^{9}$Be($^{18}$O,pn$\gamma$) 2015Vo12

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | M. Shamsuzzoha Basunia, Anagha Chakraborty | NDS 205,1 (2025) | 31-May-2025 |

Adapted/Edited the XUNDL dataset compiled by B. Singh (McMaster), Sept 5, 2015.

2015Vo12: E($^{18}$O)=35 MeV beam from FSU tandem accelerator facility. Measured E$\gamma$, I$\gamma$, E(p), $\gamma\gamma$-coin, p$\gamma$-coin, $\gamma(\theta)$, level half-lives by DSAM using E-$\Delta$E Si detectors for protons, and seven Compton- suppressed single crystal Ge detectors, and three four-crystal Compton- suppressed Clover Ge detectors for $\gamma$ rays. The $\gamma$ detectors were placed at 35°, 90° and 145°. Target was thick enough to stop the incident beam. Deduced levels, J, $\pi$, multipolarity. Comparison with shell-model calculations.

Other: $^{9}$Be($^{18}$O,d), E = 10 − 40 MeV (1985Di17).

### $^{25}$Na Levels

| E(level)† | J$^{\pi}$‡ | T$_{1/2}$# | Comments |
|---|---|---|---|
| 0.0 | 5/2$^+$ | | |
| 89.80 *21* | 3/2$^+$ | | |
| 1069.52 *20* | 1/2$^+$ | 1.21 ps *14* | T$_{1/2}$: from $\tau$=1750 fs *200* (2015Vo12). |
| 2202.16 *22* | 3/2$^+$ | 17 fs *10* | T$_{1/2}$: from measured mean lifetime of $\tau$=25 fs *15* from 2202$\gamma$ as well as from 1132$\gamma$. |
| 2418.5 *8* | (9/2)$^+$ | 166 fs *28* | J$^{\pi}$: 2015Vo12 list (9/2)$^+$ in some places in the paper and (7/2,9/2)$^+$ in others. Comparison with shell-model calculations suggests 9/2$^+$; and also from decay pattern of this level as discussed in 2015Vo12.<br>T$_{1/2}$: from $\tau$=240 fs *40* (2015Vo12). |
| 2789.9 *7* | (7/2)$^+$ | 132 fs *24* | T$_{1/2}$: from $\tau$=190 fs *35* (2015Vo12). |
| 2916.0 *11* | 5/2$^+$ | 42 fs *28* | T$_{1/2}$: from $\tau$=60 fs *40* (2015Vo12). |
| 3356.5 *10* | (7/2)$^+$ | | J$^{\pi}$: 3356 $\gamma(\theta)$ measurement implies $\Delta$J=1 (i.e. 3/2$^+$ or 7/2$^+$), 7/2 for feeding from higher spin states ($^{18}$O,pn$\gamma$). |
| 3458.6 *8* | (9/2$^+$) | 90 fs *28* | J$^{\pi}$: population of high spin state in ($^{18}$O,pn$\gamma$), absence of $\gamma$ feeding the low spin state, and 668.6 $\gamma(\theta)$ measurement implies $\Delta$J=1.<br>T$_{1/2}$: from $\tau$=130 fs *40* (2015Vo12). |
| 3955.2 *10* | | | J$^{\pi}$: (3/2$^+$) from comparison with shell-model calculations. |
| 3999.0 *9* | (9/2)$^+$ | 69 fs *14* | T$_{1/2}$: from $\tau$=100 fs *20* (2015Vo12). |
| 4015.7 *21* | | | J$^{\pi}$: (5/2$^+$) from comparison with shell-model calculations. |
| 4290.7 *11* | 1/2$^+$ | | J$^{\pi}$: from Adopted Levels. |
| 4965.4 *9* | (11/2)$^+$ | 64 fs *14* | T$_{1/2}$: from $\tau$=92 fs *20*: weighted average of mean lifetime $\tau$=120 fs *30* from 2547$\gamma$, and 80 fs *20* from 1507$\gamma$. |
| 5232.6 *14* | | | J$^{\pi}$: (9/2$^+$) from comparison with shell-model calculations. |
| 5390.0 *12* | (9/2,11/2)$^+$ | | J$^{\pi}$: (11/2$^+$) from comparison with shell-model calculations. |
| 6384 *3* | (9/2$^+$,11/2$^+$,13/2$^+$) | | J$^{\pi}$: (11/2$^+$) from comparison with shell-model calculations. |
| 6735.5 *14* | (11/2 to 15/2)$^{(+)}$ | | J$^{\pi}$: (13/2$^+$) from comparison with shell-model calculations. |
| 6858.4 *14* | (11/2,13/2)$^+$ | | J$^{\pi}$: (13/2$^+$) from comparison with shell-model calculations. |

† From a least-squares fit to E$\gamma$.

‡ From Table I and Figure 1 in 2015Vo12, based on $\gamma$ transition placement and known spin-parity for low lying states, $\gamma(\theta)$ measurements, etc. Specific and additional arguments, if available, are listed in the comments section.

# From DSAM (2015Vo12) unless otherwise stated.

### $\gamma$($^{25}$Na)

| E$_{\gamma}$ | I$_{\gamma}$ | E$_i$(level) | J$_i^{\pi}$ | E$_f$ | J$_f^{\pi}$ | Mult.† | Comments |
|---|---|---|---|---|---|---|---|
| 89.7 *3* | 50 *10* | 89.80 | 3/2$^+$ | 0.0 | 5/2$^+$ | M1 | A$_2$=−0.56 *9*<br>B(M1)(W.u.)=0.020 *2* (2015Vo12). |
| 668.6 *5* | 3.6 *2* | 3458.6 | (9/2$^+$) | 2789.9 | (7/2)$^+$ | M1 | A$_2$=−0.67 *8*<br>B(M1)(W.u.)=0.18 *+7−4* (2015Vo12). |
| 966 *1* | 3.3 *3* | 4965.4 | (11/2)$^+$ | 3999.0 | (9/2)$^+$ | [M1] | B(M1)(W.u.)=0.08 *+9−3* (2015Vo12). |

Continued on next page (footnotes at end of table)

## $^{9}$Be($^{18}$O,pn$\gamma$) 2015Vo12 (continued)

### $\gamma(^{25}Na)$ (continued)

| $E_\gamma$ | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[†] | Comments |
|---|---|---|---|---|---|---|---|
| 979.7 *2* | 34 *2* | 1069.52 | $1/2^+$ | 89.80 | $3/2^+$ | [M1] | B(M1)(W.u.)=0.06 *1* (2015Vo12). |
| 1041 *1* | 50 *3* | 3458.6 | $(9/2^+)$ | 2418.5 | $(9/2)^+$ | M1 | $A_2$=+0.28 *9*<br>B(M1)(W.u.)=0.65 *+25−14* (2015Vo12). |
| 1069.3 *3* | 3.4 *3* | 1069.52 | $1/2^+$ | 0.0 | $5/2^+$ | [E2] | B(E2)(W.u.)=6.8 *7* (2015Vo12). |
| 1132.4 *3* | 13 *1* | 2202.16 | $3/2^+$ | 1069.52 | $1/2^+$ | M1 | $A_2$=−0.30 *9*<br>B(M1)(W.u.)=0.99 *+372−49* (2015Vo12). |
| 1209 *1* | 27 *1* | 3999.0 | $(9/2)^+$ | 2789.9 | $(7/2)^+$ | M1 | $A_2$=−0.38 *9*<br>B(M1)(W.u.)=0.51 *+29−13* (2015Vo12). |
| 1468 *1* | 3.8 *3* | 6858.4 | $(11/2,13/2)^+$ | 5390.0 | $(9/2,11/2)^+$ | D+Q[‡] | $A_2$=−0.87 *14* |
| 1507 *1* | 28 *2* | 4965.4 | $(11/2)^+$ | 3458.6 | $(9/2^+)$ | M1 | $A_2$=−0.60 *8*<br>B(M1)(W.u.)=0.18 *+19−6* (2015Vo12). |
| 1580 *1* | 3.7 *3* | 3999.0 | $(9/2)^+$ | 2418.5 | $(9/2)^+$ | [M1] | B(M1)(W.u.)=0.03 *+2−1* (2015Vo12). |
| 1770 *1* | 11 *1* | 6735.5 | $(11/2 \text{ to } 15/2)^{(+)}$ | 4965.4 | $(11/2)^+$ | | $A_2$=+0.21 *9* |
| 1773[@] *3* | 2.4 *7* | 5232.6 | | 3458.6 | $(9/2^+)$ | | |
| 1876 *1* | 8.4 *5* | 5232.6 | | 3356.5 | $(7/2)^+$ | | |
| 2112.2 *4* | 4.7 *5* | 2202.16 | $3/2^+$ | 89.80 | $3/2^+$ | [M1] | B(M1)(W.u.)=0.050 *+20−3* (2015Vo12). |
| 2202.3 *3* | 20 *2* | 2202.16 | $3/2^+$ | 0.0 | $5/2^+$ | M1[#] | $A_2$=−0.08 *9*<br>B(M1)(W.u.)=0.20 *+77−10* (2015Vo12). |
| 2419 *1* | 100 | 2418.5 | $(9/2)^+$ | 0.0 | $5/2^+$ | E2 | $A_2$=+0.27 *9*<br>B(E2)(W.u.)=9.4 *+18−14* |
| 2547 *1* | 10.9 *6* | 4965.4 | $(11/2)^+$ | 2418.5 | $(9/2)^+$ | M1[#] | $A_2$=+0.14 *9*<br>B(M1)(W.u.)=0.01 *1* (2015Vo12). |
| 2699 *1* | 3.0 *3* | 2789.9 | $(7/2)^+$ | 89.80 | $3/2^+$ | [E2] | B(E2)(W.u.)=0.5 *2* (2015Vo12). |
| 2790 *1* | 34 *2* | 2789.9 | $(7/2)^+$ | 0.0 | $5/2^+$ | M1[#] | $A_2$=+0.02 *9*<br>B(M1)(W.u.)=0.02 *1* (2015Vo12). |
| 2826 *1* | 25 *2* | 2916.0 | $5/2^+$ | 89.80 | $3/2^+$ | M1[#] | $A_2$=+0.39 *9*<br>B(M1)(W.u.)=0.08 *+18−3* (2015Vo12). |
| 2886 *2* | 2.3 *2* | 3955.2 | | 1069.52 | $1/2^+$ | | |
| 2946 *2* | 1.4 *1* | 4015.7 | | 1069.52 | $1/2^+$ | | |
| 2971 *1* | 17 *1* | 5390.0 | $(9/2,11/2)^+$ | 2418.5 | $(9/2)^+$ | D+Q[‡] | $A_2$=−0.15 *9* |
| 3221 *1* | 1.9 *2* | 4290.7 | $1/2^+$ | 1069.52 | $1/2^+$ | | |
| 3269 *3* | 1.6 *2* | 3356.5 | $(7/2)^+$ | 89.80 | $3/2^+$ | | |
| 3356 *1* | 12 *1* | 3356.5 | $(7/2)^+$ | 0.0 | $5/2^+$ | | $A_2$=+0.01 *9* |
| 3865 *1* | 3.9 *3* | 3955.2 | | 89.80 | $3/2^+$ | | |
| 3965 *3* | 4.5 *5* | 6384 | $(9/2^+,11/2^+,13/2^+)$ | 2418.5 | $(9/2)^+$ | | |
| 4441 *2* | 3.9 *4* | 6858.4 | $(11/2,13/2)^+$ | 2418.5 | $(9/2)^+$ | | |

[†] As listed in Table IV of 2015Vo12, except where otherwise noted. Listed multipolarities with transition strength, but without $\gamma(\theta)$ data are presented by the evaluators in square brackets (i.e. assumed assignment).

[‡] Assigned by the evaluator based on the $\gamma(\theta)$ data, deduced from two independent angles of 45°/135° and 90°. Assuming $A_4$ term in Legendre expansion is small, expected $A_2$=−0.32 for ΔJ=1, dipole and +0.45 for ΔJ=2, quadrupole transition. For ΔJ=1, mixed D+Q transition, $A_2$ can have a value between +0.5 and −1.0 for $\delta$ values between −0.5 and +0.5, as noted in 2015Vo12.

[#] $\gamma(\theta)$ datum is not consistent for a dipole, ΔJ=1, transition.

[@] Placement of transition in the level scheme is uncertain.

**$^{9}$Be($^{18}$O,pn$\gamma$) 2015Vo12**

Level Scheme

Intensities: Relative $I_\gamma$

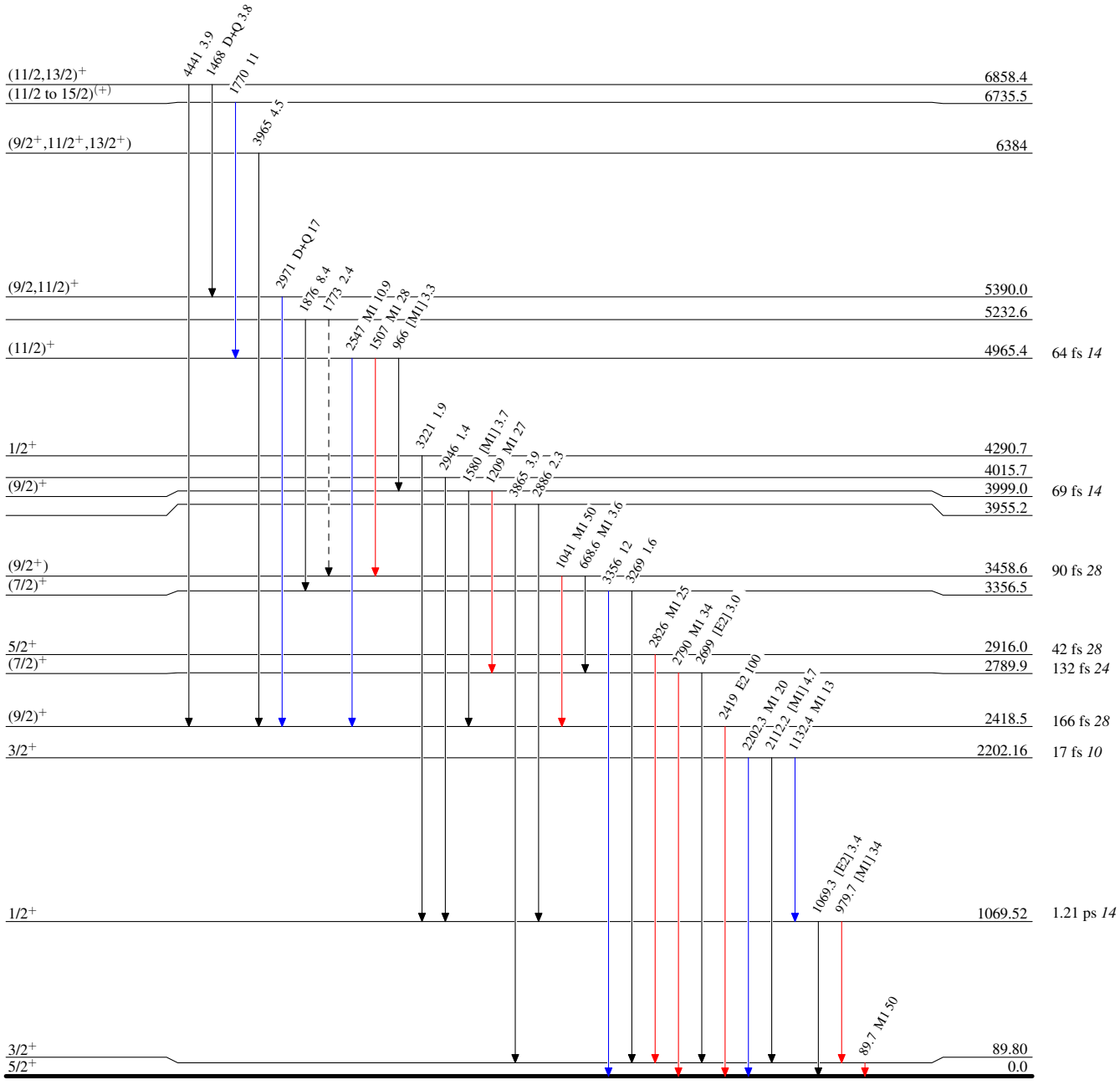
Legend

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

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

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

$\gamma$ Decay (Uncertain)




$^{25}_{11}Na_{14}$