## $^{164}$Dy(d,p) 1994Sc41,1970Gr46,1964Sh13

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Balraj Singh and Jun Chen | NDS 194,460 (2024) | 31-Oct-2022 |

1994Sc41: E=14 and 22 MeV deuteron beams were produced from the Tandem Accelerator of the University of Munich and the Technical University of Munich. Target was 33 $\mu$g/cm$^2$ $Dy_2O_3$ on a 4.1 $\mu$g/cm$^2$ carbon backing. Reaction products were momentum-analyzed with the Q3D spectrograph (FWHM=5-7 keV). Measured E(p), I(p). Deduced levels.

1970Gr46: E=12.1 MeV deuteron beam was produced from the Niels Bohr Institute tandem accelerator. Target was ≈40 $\mu$g/cm$^2$ $^{164}$Dy deposited on a ≈40 $\mu$g/cm$^2$ carbon backing. Reaction products were momentum analyzed with a broad-range magnetic spectrograph (FWHM≈12 keV). Measured $\sigma(\theta)$ at 60°, 90°, 125°. Deduced levels. Comparisons with DWBA calculations. Excitation energies reported up to 2.5 MeV.

1964Sh13: E=12 MeV deuteron beam was produced from the Florida State University tandem Van de Graaff. Targets were 100-200 $\mu$g/cm$^2$ $Dy_2O_3$ on 15-30 $\mu$g/cm$^2$ carbon backings. Reaction products were momentum-analyzed with a modifed Browne-Buechner broad-range magnetic spectrograph (FHWM≈12 keV). Measured $\sigma(\theta)$ at 45° and 65°. Deduced levels.Comparisons with DWBA calculation.

### $^{165}$Dy Levels

Relative proton intensities at E(d)=14 and 22 MeV under comments are from 1994Sc41.
Band assignments are from 1970Gr46.

| E(level)[†] | J$^\pi$[@] | d$\sigma$/d$\Omega$ ($\mu$b/sr)[&] | Comments |
|---|---|---|---|
| 0[a] | 7/2$^+$ | 2 | I(p)(14 MeV)<0.5, I(p)(22 MeV)<0.5. |
| 83.44[a] *16* | 9/2$^+$ | 22 | I(p)(14 MeV)=6.0 *6*, I(p)(22 MeV)=15.4 *11*. |
| 108.13[b] *10* | 1/2$^-$ | 295 | I(p)(14 MeV)=100 *4*, I(p)(22 MeV)=100.0 *24*. |
| 158.73[b] *16* | 3/2$^-$ | 7 | I(p)(14 MeV)=6.9 *7*, I(p)(22 MeV)=7.5 *8*. |
| 180.8[b] *3* | 5/2$^-$ | 76 | I(p)(14 MeV)=15.4 *13*, I(p)(22 MeV)=46 *3*. |
| 184.9[#c] *5* | 5/2$^-$ | | I(p)(14 MeV)=6.3 *10*, I(p)(22 MeV)=5.0 *22*. |
| 261.84[c] *8* | 7/2$^-$ | 250 | I(p)(14 MeV)=98 *3*, I(p)(22 MeV)=178 *4*. |
| 297.75[b] *15* | 7/2$^-$ | 117 | I(p)(14 MeV)=40.7 *22*, I(p)(22 MeV)=73 *3*. |
| 307.74[a] *12* | 13/2$^+$ | 27 | J$^\pi$: (13/2$^+$) in the Adopted Levels.<br>I(p)(14 MeV)=6.3 *8*, I(p)(22 MeV)=49.4 *18*. |
| 336.94[b] *16* | 9/2$^-$ | 8 | I(p)(14 MeV)=3.2 *4*, I(p)(22 MeV)=12.2 *8*. |
| 360.73[c] *16* | 9/2$^-$ | 11 | I(p)(14 MeV)=3.1 *5*, I(p)(22 MeV)=15.6 *8*. |
| 404.6[#] *9* | | | I(p)(14 MeV)=1.2 *3*. |
| 479.98[c] *24* | (11/2$^-$) | 8 | I(p)(14 MeV)=1.48 *25*, I(p)(22 MeV)=5.4 *5*. |
| 518.65[b] *23* | (11/2$^-$) | 8 | I(p)(14 MeV)=1.9 *6*, I(p)(22 MeV)=6.1 *6*. |
| 534.4 *3* | | 5 | I(p)(14 MeV)=2.1 *3*, I(p)(22 MeV)=3.3 *4*. |
| 572.6 *3* | | 36 | I(p)(14 MeV)=9.5 *6*, I(p)(22 MeV)=8.2 *6*. |
| 584.2[#] *3* | | | I(p)(14 MeV)=3.1 *6*, I(p)(22 MeV)=4.0 *5*. |
| 605.37[d] *13* | 3/2$^-$ | 246 | I(p)(14 MeV)=117 *6*, I(p)(22 MeV)=97 *7*. |
| 628.84 *11* | | 39 | I(p)(14 MeV)=11.4 *11*, I(p)(22 MeV)=19.9 *22*. |
| 657.99[d] *9* | 5/2$^-$ | 48 | I(p)(14 MeV)=17.1 *12*, I(p)(22 MeV)=30 *3*. |
| 706.16 *13* | | 98 | I(p)(14 MeV)=39.7 *16*, I(p)(22 MeV)=61.9 *23*. |
| 730.4[#] *8* | | | I(p)(14 MeV)=0.9 *4*, I(p)(22 MeV)=3.2 *4*. |
| 738.4[d] *4* | 7/2$^-$ | 7 | L: (1) suggested by intensity ratio, 3 expected from band assignment.<br>I(p)(14 MeV)=2.1 *4*, I(p)(22 MeV)=1.8 *4*. |
| 771.4 *4* | | | I(p)(14 MeV)=3.0 *6*, I(p)(22 MeV)=1.2 *3*. |
| 785.2[#] *8* | | | I(p)(14 MeV)=1.0 *3*, I(p)(22 MeV)=0.55 *24*. |
| 803.2 *5* | | 4 | I(p)(14 MeV)=1.1 *4*, I(p)(22 MeV)=3.6 *5*. |
| 818.8[#] *5* | | | I(p)(22 MeV)=1.8 *3*. |

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## $^{164}$Dy(d,p) 1994Sc41,1970Gr46,1964Sh13 (continued)

### $^{165}$Dy Levels (continued)

| E(level)[†] | Jπ[@] | dσ/dΩ (μb/sr)[&] | Comments |
|---|---|---|---|
| 834.5[#] *8* | | | I(p)(22 MeV)=1.0 *3*. |
| 877.2 *5* | | | I(p)(14 MeV)=3.4 *8*, I(p)(22 MeV)=1.9 *4*. |
| 911.9[#] *4* | | | I(p)(14 MeV)=1.6 *4*, I(p)(22 MeV)=1.0 *3*. |
| 921.35 *22* | | 4 | I(p)(14 MeV)=4.1 *7*, I(p)(22 MeV)=3.5 *5*. |
| 957.1[#] *5* | | | I(p)(22 MeV)=1.8 *3*. |
| 976.4[#] *10* | | | I(p)(22 MeV)=0.7 *3*. |
| 988.1[#] *11* | | | I(p)(14 MeV)=1.8 *7*, I(p)(22 MeV)=1.8 *5*. |
| 1031.6[#] *9* | | | I(p)(22 MeV)=1.8 *5*. |
| 1051.9 *6* | | 8 | I(p)(22 MeV)=7.4 *7*. |
| 1064.9[#] *6* | | | I(p)(22 MeV)=1.3 *3*. |
| 1087.8[#] *6* | | | I(p)(22 MeV)=1.4 *3*. |
| 1102.91 *17* | | 8 | I(p)(14 MeV)=8.0 *10*, I(p)(22 MeV)=5.6 *12*. |
| 1135.71 *18* | | 22 | I(p)(14 MeV)=3.7 *6*, I(p)(22 MeV)=14.3 *13*. |
| 1159.65[#] *10* | | | I(p)(14 MeV)=56 *3*, I(p)(22 MeV)=66 *4*. |
| 1169.4 *5* | | 108 | I(p)(14 MeV)=5.5 *9*. |
| 1174.3[#] *9* | | | I(p)(22 MeV)=1.9 *6*. |
| 1197.1[#] *5* | | | I(p)(14 MeV)=0.6 *3*, I(p)(22 MeV)=1.9 *4*. |
| 1218.8[#] *6* | | | I(p)(14 MeV)=1.7 *4*, I(p)(22 MeV)=2.5 *6*. |
| 1256.60[e] *16* | (3/2$^-$) | 130 | Jπ: (3/2) in the Adopted Levels.<br>I(p)(14 MeV)=5.6 *4*, I(p)(22 MeV)=48 *5*. |
| 1283.0 *3* | | 15 | I(p)(14 MeV)=5.5 *18*, I(p)(22 MeV)=11.5 *18*. |
| 1309.35[#] *12* | | | I(p)(14 MeV)=77 *6*, I(p)(22 MeV)=88 *10*. |
| 1316.7[e] *4* | (5/2$^-$) | 156 | Jπ: none in the Adopted Levels.<br>I(p)(14 MeV)=3.9 *12*, I(p)(22 MeV)=9.0 *18*. |
| 1327.7[#] *7* | | | I(p)(14 MeV)=1.4 *4*, I(p)(22 MeV)=2.4 *10*. |
| 1337.23 *17* | | 172 | I(p)(14 MeV)=75 *12*, I(p)(22 MeV)=30 *4*. |
| 1356.1[#] *7* | | | I(p)(22 MeV)=2.9 *9*. |
| 1380.75[#] *14* | | | I(p)(14 MeV)=87 *9*, I(p)(22 MeV)=78 *13*. |
| 1384.29 *24* | | 272 | I(p)(14 MeV)=40 *6*, I(p)(22 MeV)=43 *11*. |
| 1400.36[e] *12* | (7/2$^-$) | 108 | Jπ: (3/2$^+$) in the Adopted Levels.<br>I(p)(14 MeV)=46 *4*, I(p)(22 MeV)=39 *5*.<br>L: (1) suggested by intensity ratio, 3 expected from band assignment. |
| 1439.4[#] *8* | | | I(p)(14 MeV)=2.8 *4*. |
| 1444.31 *18* | | 54 | I(p)(14 MeV)=11.0 *10*, I(p)(22 MeV)=10.9 *18*. |
| 1460.6[#] *10* | | | I(p)(22 MeV)=2.1 *10*. |
| 1477.29 *24* | | 14 | I(p)(14 MeV)=4.6 *5*, I(p)(22 MeV)=8.5 *12*. |
| 1500.39 *25* | | 239 | I(p)(14 MeV)=112 *9*, I(p)(22 MeV)=62 *7*. |
| 1509.9[#] *4* | | | I(p)(14 MeV)=4.3 *9*, I(p)(22 MeV)=4.7 *10*. |
| 1523.1[#] *3* | | | I(p)(14 MeV)=3.6 *4*, I(p)(22 MeV)=5.2 *9*. |
| 1535.18[#] *21* | | | I(p)(14 MeV)=3.9 *6*, I(p)(22 MeV)=5.6 *10*. |
| 1555.29[#] *18* | | | I(p)(14 MeV)=147 *13*, I(p)(22 MeV)=127 *17*. |
| 1561.37 *15* | | 368 | I(p)(14 MeV)=65 *6*, I(p)(22 MeV)=43 *10*. |
| 1591.83 *9* | | 268 | I(p)(14 MeV)=190 *17*, I(p)(22 MeV)=86 *10*. |
| 1607.5[#] *3* | | | I(p)(14 MeV)=5.6 *9*, I(p)(22 MeV)=7.2 *15*. |
| 1621.8 *3* | | 27 | I(p)(14 MeV)=7.0 *19*, I(p)(22 MeV)=6.9 *16*. |
| 1643.71[#] *18* | | | I(p)(14 MeV)=27 *3*, I(p)(22 MeV)=40 *5*. |
| 1652.4 *5* | | 113 | I(p)(22 MeV)=15 *3*. |
| 1699[‡] | | 91 | |
| 1723[‡] | | 41 | |

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## $^{164}$Dy(d,p) 1994Sc41,1970Gr46,1964Sh13 (continued)

### $^{165}$Dy Levels (continued)

| E(level)† | dσ/dΩ (μb/sr)& | E(level)† | dσ/dΩ (μb/sr)& | E(level)† |
|---|---|---|---|---|
| 1752‡ | 85 | 2152 | | 2596 |
| 1780‡ | 17 | 2178‡ | 78 | 2620 |
| 1805‡ | 9 | 2208‡ | 25 | 2657 |
| 1833‡ | 91 | 2230 | | 2704 |
| 1861‡ | 56 | 2247 | | 2741 |
| 1891‡ | 44 | 2268 | | 2792 |
| 1916‡ | 23 | 2294‡ | 35 | 2815 |
| 1947‡ | 45 | 2320‡ | 74 | 2834 |
| 1970‡ | 28 | 2371‡ | 46 | 2859 |
| 2000‡ | 9 | 2432‡ | 62 | 2899 |
| 2027‡ | 25 | 2445‡ | 46 | 2920 |
| 2069 | | 2459‡ | 118 | 2948 |
| 2076 | | 2495‡ | 98 | 3006 |
| 2097‡ | 35 | 2524? | | 3016 |
| 2121‡ | 16 | 2576 | | |

† From 1994Sc41 up to 1652.4; above this energy values are from 1964Sh13, unless otherwise noted. Uncertainties from 1964Sh13 are expected to be about 10 keV.
‡ From 1970Gr46.
# Reported only by 1994Sc41.
@ From "fingerprint" method using relative intensity pattern for rotational states (1970Gr46). When considered in Adopted Levels, assignments will be put in parentheses by evaluators if there are no other strong supporting arguments for firm assignments. The assignments from Adopted Levels are given under comments if different.
& At 60° (1970Gr46). See 1970Gr46 for data at 90° and 125°; see data also also in 1964Sh13.
[a] Band(A): $\nu$7/2[633] band.
[b] Band(B): $\nu$1/2[521] band.
[c] Band(C): $\nu$5/2[512] band.
[d] Band(D): $K^{\pi}=1/2^{-}$ band. From 1/2[510]+(K−2 $\gamma$ vibration built on 5/2[512]; K=5/2). Tentative 3/2[521] assignment by 1964Sh13 is not confirmed by 1970Gr46 from the intensity pattern of the band members.
[e] Band(E): $\nu$3/2[512] band (?).

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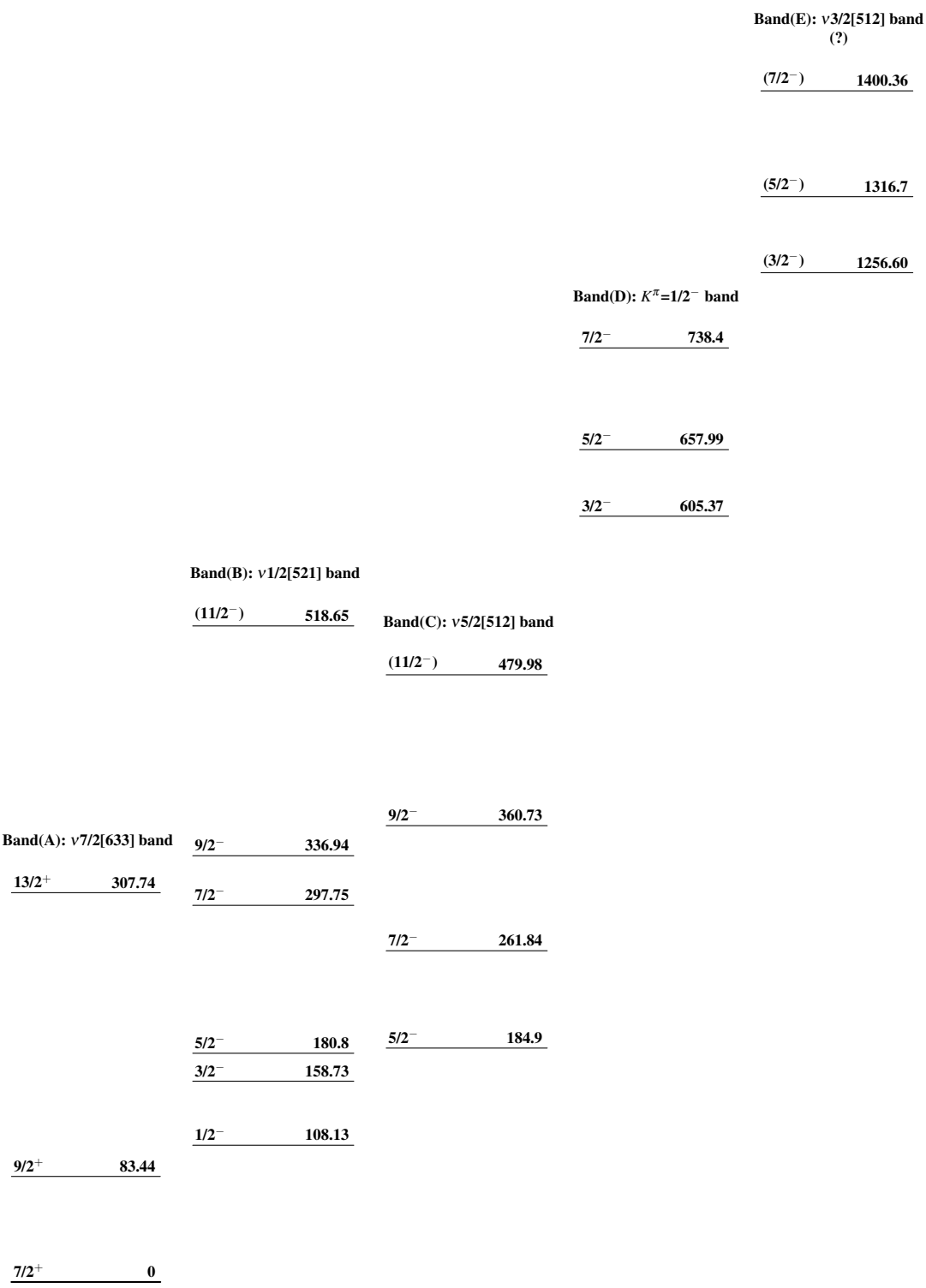


$^{165}_{66}Dy_{99}$