

$^{42}\text{Ca}(\text{pol d},\alpha),(\text{d},\alpha)$  1981Sh12

| Type            | Author   | History Citation  | Literature Cutoff Date |
|-----------------|----------|-------------------|------------------------|
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**1981Sh12:** (pol d, $\alpha$ ), (d, $\alpha$ ) E=7-10 MeV deuteron beams were produced from the McMaster University Lamb-shift ion source and FN tandem accelerator. Target were enriched  $^{42}\text{Ca}$  (about 94%) evaporated to  $40\text{ }\mu\text{g}/\text{cm}^2$  thickness on  $10\text{ }\mu\text{g}/\text{cm}^2$  carbon backings. Reaction products were momentum analyzed with an Engel split-pole magnetic spectrograph (FWHM=15-20 keV) and detected with a proportional counter. Measured  $\sigma(\theta)$ , tensor analyzing power at  $4^\circ$ . Deduced levels, J,  $\pi$ .

**1971Pa16:** (d, $\alpha$ ) E=11.0 MeV deuteron beam was produced from a tandem Van de Graaff accelerator. Target is  $50\text{ }\mu\text{g}/\text{cm}^2$   $^{42}\text{Ca}$  (97% enriched) evaporated onto a carbon backing. Reaction products were detected with a  $\Delta\text{E-E}$  telescope of silicon surface-barrier detectors (FWHM=35-40 keV). Measured  $\sigma(\theta)$ . Deduced levels, J,  $\pi$ . About ten groups reported up to about 4 MeV excitation energy.

**1970Ko13:** (d, $\alpha$ ) E=19.7 MeV. Measured  $\sigma(\theta)$ . Deduced non-population of the 1644 level.

All data are from **1981Sh12**, unless otherwise noted.

 $^{40}\text{K}$  Levels

1644,  $0^+$  level was not populated in this reaction which is consistent with its interpretation by **1981Sh12** and 1970Ko13 as an anti-analog state of the 4380,  $0^+$  level in  $^{40}\text{Ar}$ .

| E(level)             | $J^\pi$   | Comments                                                               |
|----------------------|-----------|------------------------------------------------------------------------|
| 0                    | UNNATURAL | $\langle T_{20} \rangle = -0.57$ 25.                                   |
| 29 5                 | NATURAL   | $\langle T_{20} \rangle = +0.67$ 28.                                   |
| 800 5                | UNNATURAL | $\langle T_{20} \rangle = -0.47$ 22.                                   |
| 888 5                |           |                                                                        |
| 1959 5               | NATURAL   | $\langle T_{20} \rangle = +0.71$ 18.                                   |
| 2049 5               | UNNATURAL | $\langle T_{20} \rangle = -0.29$ 21.                                   |
| 2262 5               | UNNATURAL | $\langle T_{20} \rangle = -1.01$ 17.                                   |
| 2289 <sup>†</sup> 5  |           | E(level): possibly 2290+2291.                                          |
| 2400 5               | UNNATURAL | $\langle T_{20} \rangle = -0.87$ 12.                                   |
| 2413 5               | UNNATURAL | $\langle T_{20} \rangle = -1.14$ 18.                                   |
| 2545 5               | UNNATURAL | $\langle T_{20} \rangle = -0.45$ 14.                                   |
| 2574 5               |           |                                                                        |
| 2634 5               | $0^-$     | $J^\pi$ : from Adopted Levels.<br>$\langle T_{20} \rangle = -1.50$ 24. |
| 2747 <sup>†</sup> 5  |           | E(level): possibly 2748+2756.                                          |
| 2798 <sup>†</sup> 5  |           | E(level): possibly 2786+2787.                                          |
| 2811 5               |           |                                                                        |
| 2990 5               | UNNATURAL | $\langle T_{20} \rangle = -0.01$ 23.                                   |
| 3033 5               | UNNATURAL | $\langle T_{20} \rangle = -0.04$ 18.                                   |
| 3096 <sup>†</sup> 10 |           | E(level): possibly 3100+3110.                                          |
| 3125 10              |           |                                                                        |
| 3156 <sup>†</sup> 10 |           | E(level): possibly 3146+3154.                                          |
| 3236 10              | UNNATURAL | $\langle T_{20} \rangle = +0.29$ 30.                                   |
| 3293 10              | UNNATURAL | $\langle T_{20} \rangle = -0.19$ 27.                                   |
| 3369 10              |           |                                                                        |
| 3389 10              | UNNATURAL | $\langle T_{20} \rangle = +0.17$ 22.                                   |
| 3415 10              |           |                                                                        |
| 3448 10              | UNNATURAL | $\langle T_{20} \rangle = -0.45$ 18.                                   |
| 3491 10              | UNNATURAL | $\langle T_{20} \rangle = +0.25$ 13.                                   |
| 3568 10              | (NATURAL) | $\langle T_{20} \rangle = +0.64$ 27.                                   |
| 3618 <sup>†</sup> 10 | UNNATURAL | $\langle T_{20} \rangle = -0.47$ 23.                                   |
|                      |           | E(level): possibly 3599+3630.                                          |
| 3682 10              |           |                                                                        |

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(\text{pol d},\alpha),(\text{d},\alpha)$  [1981Sh12](#) (continued) $^{40}\text{K}$  Levels (continued)

| E(level)             | $J^\pi$     | Comments                                                              |
|----------------------|-------------|-----------------------------------------------------------------------|
| 3710 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.10$ 28.                                  |
| 3737 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.2$ 6.                                    |
| 3770 10              | (UNNATURAL) | $\langle T_{20} \rangle = +0.1$ 7.                                    |
| 3797 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.54$ 25.                                  |
| 3821 10              | UNNATURAL   | $\langle T_{20} \rangle = 0.00$ 20.                                   |
| 3869 10              | (NATURAL)   | $\langle T_{20} \rangle = +0.9$ 3.                                    |
| 3892 <sup>†</sup> 10 |             | E(level): possibly 3888+3902.<br>$\langle T_{20} \rangle = +0.6$ 5.   |
| 3921 10              | (UNNATURAL) | $\langle T_{20} \rangle = +0.47$ 28.                                  |
| 3996 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.1$ 3.                                    |
| 4033 10              | (UNNATURAL) | $\langle T_{20} \rangle = -1.2$ 3.                                    |
| 4071 10              |             | $\langle T_{20} \rangle = -0.79$ 19.                                  |
| 4118 10              | UNNATURAL   | $\langle T_{20} \rangle = +0.07$ 15.                                  |
| 4154 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.05$ 10.                                  |
| 4181 10              |             |                                                                       |
| 4217 10              | UNNATURAL   | $\langle T_{20} \rangle = +0.4$ 4.                                    |
| 4255 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.30$ 25.                                  |
| 4310 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.60$ 19.                                  |
| 4362 <sup>†</sup> 10 | UNNATURAL   | $\langle T_{20} \rangle = -0.21$ 26.<br>E(level): possibly 4350+4366. |
| 4398 <sup>†</sup> 10 | (UNNATURAL) | $\langle T_{20} \rangle = -0.22$ 19.<br>E(level): possibly 4384+4396. |
| 4470 10              | NOT $0^-$   | $\langle T_{20} \rangle = +0.42$ 16.                                  |
| 4535 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.04$ 75.                                  |
| 4590 10              | UNNATURAL   | $\langle T_{20} \rangle = +0.11$ 14.                                  |
| 4663 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.22$ 11.                                  |
| 4697 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.5$ 3.                                    |
| 4749 10              |             |                                                                       |
| 4762 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.03$ 21.                                  |
| 4786 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.38$ 26.                                  |
| 4827 10              | UNNATURAL   | $\langle T_{20} \rangle = +0.30$ 10.                                  |
| 4848 10              |             |                                                                       |
| 4873 <sup>†</sup> 10 |             | E(level): possibly 4874+4876.                                         |
| 4930 10              | UNNATURAL   | $\langle T_{20} \rangle = +0.38$ 9.                                   |
| 4942 10              | (UNNATURAL) | $\langle T_{20} \rangle = -0.15$ 28.                                  |
| 4995 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.7$ 4.                                    |
| 5030 10              |             |                                                                       |
| 5068 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.66$ 16.                                  |
| 5111 <sup>†</sup> 10 | UNNATURAL   | $\langle T_{20} \rangle = -0.21$ 9.<br>E(level): possibly 5112+5132.  |
| 5169 10              |             |                                                                       |
| 5212 10              | UNNATURAL   | $\langle T_{20} \rangle = -0.36$ 13.                                  |

<sup>†</sup> Unresolved multiplet.<sup>‡</sup> From average tensor analyzing powers ( $\langle T_{20} \rangle$ ) at  $4^\circ$  over 4 or 5 (in some cases 3) energies. Except for 2633 and 4033 levels,  $J^\pi=0^-$  is not allowed by the measured  $\langle T_{20} \rangle$ . In most cases of unnatural parity  $J^\pi=2^-$  when combined with restrictions from other experiments.