

$^{28}\text{Si}(\text{p},\gamma),(\text{p},\text{p}'\gamma),(\text{p},\text{p}') : \text{res}$  1974By01,1990Ti07,1962Br29

| Type            | Author                 | History             | Citation | Literature Cutoff Date |
|-----------------|------------------------|---------------------|----------|------------------------|
| Full Evaluation | M. Shamsuzzoha Basunia | NDS 113, 909 (2012) |          | 1-Jan-2012             |

Others:

- 1959Vo29:  $^{28}\text{Si}(\text{p},\text{p}')$ ; E=1.4 to 3.8 MeV.  
 1961Be11:  $^{28}\text{Si}(\text{p},\text{p})$ ; E=2 and 5 MeV;  $^{28}\text{Si}(\text{p},\text{p}')$ ; E=3 and 5.2 MeV.  
 1964Ej02:  $^{28}\text{Si}(\text{p},\gamma)$ ; E=1.3 to 3.2 MeV.  
 1969Te02:  $^{28}\text{Si}(\text{p},\text{p}')$ ; E=5.6 to 7.4 MeV.  
 1970Wi10:  $^{28}\text{Si}(\text{p},\gamma)$ ; E=1.38 MeV.  
 1970Mo29:  $^{28}\text{Si}(\text{p},\gamma)$ ; E=1-5 MeV.  
 1971Zu02:  $^{28}\text{Si}(\text{p},\gamma)$ , E=350-1450 keV.  
 1972Ba26:  $^{28}\text{Si}(\text{p},\gamma)$ ; E=5.83 MeV.  
 1973Ba35:  $^{28}\text{Si}(\text{p},\gamma)$ ; E=0.72, 1.381, 1.652, 2.086 MeV; measured DSA,  $\gamma(\theta)$ ,  $^{29}\text{P}$  levels, resonances, deduced J,  $\pi$ , level-width,  $\gamma$ -branching,  $\gamma$ -mixing,  $T_{1/2}$ .  
 1974Ge12:  $^{28}\text{Si}(\text{p},\text{p}'\gamma)$ , E=3.1 to 5.7 MeV.  
 1974Mc20:  $^{28}\text{Si}(\text{p},\text{p})$ , E=2-3.8 MeV.  
 1975Al24:  $^{28}\text{Si}(\text{p},\gamma)$ , E<2 MeV; measured  $\sigma(\text{E},\text{E}\gamma,\theta)$ ,  $\gamma\gamma(\theta)$ ,  $\gamma(\text{t})$ , deduced  $^{29}\text{P}$  resonances, J,  $\pi$ ,  $\Gamma$ ,  $\delta$ ,  $T_{1/2}$ .  
 1975Ka36:  $^{28}\text{Si}(\text{p},\text{p}'),(\text{p},\text{p}'\gamma),(\text{p},\gamma)$ , E=4.97, 5.30 MeV; measured  $\sigma(\text{E})$ ; deduced  $^{29}\text{P}$  resonances,  $\Gamma$ .  
 1976Ts02:  $^{28}\text{Si}(\text{p},\text{p}'\gamma)$ , E=3.0 to 5.2 MeV.  
 1979Te05:  $^{28}\text{Si}(\text{p},\gamma)$ , E=1.3 to 2.3 MeV.  
 1980AdZM:  $^{28}\text{Si}(\text{p},\text{p}')$ , E<8 MeV.  
 1980AdZN:  $^{28}\text{Si}(\text{p},\text{p})$ , E=2.6, 7.9 MeV.  
 1990Gr04:  $^{28}\text{Si}(\text{p},\gamma)$ , 0.37 to 2.95 MeV.  
 1974By01:  $^{28}\text{Si}(\text{p},\gamma)$  E=0.35-2.65 MeV,  $^{28}\text{Si}(\text{d},\text{n}\gamma)$  E=2.8,5.1 MeV; Ge(Li), multiscaler goniometer; measured  $\gamma$ -ray angular distribution,  $\gamma$ - $\gamma$  angular correlation, resonance strength,  $\gamma$ -ray branching ratios, mixing ratio, mean lifetime by Doppler-shift attenuation method.  
 1990Ti07:  $^{28}\text{Si}(\text{p},\gamma)$  E=1.38,1.65,2.08,2.29 MeV; Ge(Li) detectors at  $0^\circ$  and  $90^\circ$  with respect to beam direction; Deduced lifetime by Doppler Shift Attenuation method.  
 1962Br29:  $^{28}\text{Si}(\text{p},\text{p}')$ ; E=4.8 to 7.0 MeV; magnetic spectrometer, scintillation counter of CsI crystal, photomultiplier tube; measured  $\sigma(\text{p},\text{p})$ , proton spectrum; deduced excited energies of  $^{29}\text{P}$  levels, resonance width.

 $^{29}\text{P}$  Levels

| E(level) <sup>†</sup>   | $T_{1/2}$ <sup>@</sup> | $E_p$ <sup>a</sup>   | Comments                                                                                                                                                                                                                                                                   |
|-------------------------|------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                       |                        |                      |                                                                                                                                                                                                                                                                            |
| 1383.55 <sup>‡</sup> 7  | 151 fs 12              |                      | $T_{1/2}$ : From mean lifetime 218 fs 18, weighted average of mean lifetimes 244 fs 32 (1990Ti07), 240 fs 70, 205 fs 40 (1974By01), 190 fs 40 (1973Ba35), 240 fs 80 (1970Wi10), and 200 fs 60 (1970Mo29).                                                                  |
| 1953.91 <sup>‡</sup> 17 | 268 fs 21              |                      | $T_{1/2}$ : From mean lifetime 386 fs 31, weighted average of mean lifetimes 450 fs 90, 465 fs 60 (1974By01), 340 fs 90 (1973Ba35), 390 fs 140 (1970Wi10), 370 fs 80 (1970Mo29), 590 fs +132-90 (1990Ti07), and 280 fs 60 (1975Al24).                                      |
| 2422.7 <sup>‡</sup> 3   | 19 fs 3                |                      | $T_{1/2}$ : From mean lifetime 28 fs 4 (1990Ti07). Others: 25 fs 12 and 33 fs 11 (1974By01), 70 fs 35 (1973Ba35).                                                                                                                                                          |
| 3105.9 <sup>#</sup> 3   | 23 fs 10               | 370.7 <sup>b</sup> 8 | $T_{1/2}$ : From mean lifetime 33 fs 15 (1974By01).<br>(2J+1) $\Gamma_p\Gamma_\gamma/\Gamma$ =2.7 meV 6 (1974By01).                                                                                                                                                        |
| 3447.6 <sup>‡</sup> 4   | 9 fs 6                 |                      | $T_{1/2}$ : From mean lifetime 13 fs 8 (1975Al24).<br>(2J+1) $\Gamma_p\Gamma_\gamma/\Gamma$ =0.30 meV 8 (1974By01).                                                                                                                                                        |
| 4080.4 <sup>#</sup> 4   | 11 fs 1                |                      | $T_{1/2}$ : From mean lifetime 16 fs 2, weighted average of mean lifetimes 15 fs 4 (1974By01), 13 fs 5 (1973Ba35), 13 fs 5 (1970Wi10), 15 fs 4 (1970Mo29), and 24 fs 5 (1990Ti07).<br>(2J+1) $\Gamma_p\Gamma_\gamma/\Gamma$ =63 meV 13 (1974By01) and 28 meV 6 (1971Zu02). |

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$^{28}\text{Si}(\text{p},\gamma),(\text{p},\text{p}'\gamma),(\text{p},\text{p}') : \text{res}$  [1974By01](#),[1990Ti07](#),[1962Br29](#) (continued) $^{29}\text{P}$  Levels (continued)

| E(level) <sup>†</sup> | T <sub>1/2</sub> <sup>@</sup> | E <sub>p</sub> <sup>a</sup> | Comments                                                                                           |
|-----------------------|-------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------|
| 4343 <sup>#</sup> 3   | 52 keV 8                      |                             | (2J+1)Γ <sub>p</sub> Γ <sub>γ</sub> /Γ=5200 meV 800 ( <a href="#">1974By01</a> ).                  |
| 4642.0 <sup>‡</sup> 6 | 35 fs 15                      |                             | T <sub>1/2</sub> : From mean lifetime 52 fs 20 ( <a href="#">1975Al24</a> ).                       |
|                       |                               |                             | (2J+1)Γ <sub>p</sub> Γ <sub>γ</sub> /Γ=0.27 meV 8 ( <a href="#">1974By01</a> ).                    |
| 4759 <sup>#</sup> 3   | 15.6 keV 6                    |                             | (2J+1)Γ <sub>p</sub> Γ <sub>γ</sub> /Γ=850 meV 120 ( <a href="#">1974By01</a> ).                   |
| 4954.1 <sup>#</sup> 5 | <2 keV                        |                             | (2J+1)Γ <sub>p</sub> Γ <sub>γ</sub> /Γ=225 meV 50 ( <a href="#">1974By01</a> ).                    |
| 5293.0 <sup>#</sup> 5 | <2 keV                        |                             | (2J+1)Γ <sub>p</sub> Γ <sub>γ</sub> /Γ=50 meV 12 ( <a href="#">1974By01</a> ).                     |
| 5527 20               | 400 keV 20                    |                             |                                                                                                    |
| 5739 3                | 12.5 keV 7                    |                             |                                                                                                    |
| 5968 3                | 9.5 keV 15                    |                             |                                                                                                    |
| 6191 5                | 95 keV 6                      |                             |                                                                                                    |
| 6328 5                | 73 keV 5                      |                             |                                                                                                    |
| 6505                  |                               |                             | E(level): From <a href="#">1980AdZM</a> and <a href="#">1980AdZN</a> .                             |
| 6577 5                | 200 keV 20                    |                             |                                                                                                    |
| 6828 5                | 4.9 keV 4                     |                             |                                                                                                    |
| 6956 10               | 120 keV 10                    |                             |                                                                                                    |
| 7021 5                | 100 keV 8                     |                             |                                                                                                    |
| 7272 5                | <3 keV                        |                             |                                                                                                    |
| 7361 10               |                               |                             |                                                                                                    |
| 7456 5                | 8.4 keV 7                     |                             |                                                                                                    |
| 7523 5                | 7 keV 3                       |                             |                                                                                                    |
| 7641 40               | 165 keV 25                    | 5070 40                     |                                                                                                    |
| 7755 5                | ≈2 keV                        |                             |                                                                                                    |
| 7950 15               | 14 keV 4                      | 5390 15                     |                                                                                                    |
| 7998 30               | 125 keV 25                    | 5440 30                     |                                                                                                    |
| 8104 15               | 36 keV 10                     | 5550 15                     |                                                                                                    |
| 8220 15               | 20 keV 4                      | 5670 15                     |                                                                                                    |
| 8297 15               | ≈40 keV                       | 5750 15                     |                                                                                                    |
| 8379 3                | 0.17 keV 5                    |                             | T <sub>1/2</sub> : From <a href="#">1969Te02</a> . Other: 0.36 keV 5 ( <a href="#">1976Ik03</a> ). |
| 8432                  |                               |                             |                                                                                                    |
| 8510 15               | 36 keV 10                     | 5970 15                     |                                                                                                    |
| 8529 15               | 25 keV 7                      | 5990 15                     |                                                                                                    |
| 8645 15               | ≈10 keV                       | 6110 15                     |                                                                                                    |
| 8693 30               | 120 keV 30                    | 6160 30                     |                                                                                                    |
| 8780 15               | 14 keV 3                      | 6250 15                     |                                                                                                    |
| 8867 15               | 9 keV 3                       | 6340 15                     |                                                                                                    |
| 8915 15               | 33 keV 6                      | 6390 15                     |                                                                                                    |
| 9002 15               | ≈50 keV                       | 6480 15                     |                                                                                                    |
| 9079 15               | 23 keV 5                      | 6560 15                     |                                                                                                    |
| 9118 40               | ≈150 keV                      | 6600 40                     |                                                                                                    |
| 9301 15               | 7 keV 3                       | 6790 15                     |                                                                                                    |
| 9369 15               |                               | 6860 15                     |                                                                                                    |
| 9388 15               | 13 keV 5                      | 6880 15                     |                                                                                                    |
| 9455 15               | 20 keV 5                      | 6950 15                     |                                                                                                    |
| 9548                  | 50 <sup>&amp;</sup> keV 10    | 7046 <sup>&amp;</sup>       |                                                                                                    |
| 9625                  | 40 <sup>&amp;</sup> keV 10    | 7126 <sup>&amp;</sup>       |                                                                                                    |
| 9660                  | 8.6 <sup>&amp;</sup> keV 3    | 7162 <sup>&amp;</sup>       |                                                                                                    |
| 9743                  | 6.5 <sup>&amp;</sup> keV 3    | 7248 <sup>&amp;</sup>       |                                                                                                    |
| 9760                  | 7.6 <sup>&amp;</sup> keV 3    | 7266 <sup>&amp;</sup>       |                                                                                                    |
| 9773                  | 7.6 <sup>&amp;</sup> keV 3    | 7279 <sup>&amp;</sup>       |                                                                                                    |
| 9815                  | 19.8 <sup>&amp;</sup> keV 10  | 7322 <sup>&amp;</sup>       |                                                                                                    |
| 9871                  | 11.7 <sup>&amp;</sup> keV 5   | 7381 <sup>&amp;</sup>       |                                                                                                    |

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$^{28}\text{Si}(\text{p},\gamma),(\text{p},\text{p}'\gamma),(\text{p},\text{p}') : \text{res}$  1974By01,1990Ti07,1962Br29 (continued) $^{29}\text{P}$  Levels (continued)

<sup>†</sup> Level energies are from 1990Ti07, 1975Ka36, 1975Al24, 1974By01, 1973Ba35, 1972Ba26, 1969Te02, 1964Ej02, 1962Br29, 1960Od01, 1959Vo29, except otherwise noted.

<sup>‡</sup> From Adopted Levels.

<sup>#</sup> From 1974By01.

<sup>@</sup> Half-lives from 1990Ti07, except otherwise noted.  $\Gamma$  from 1975Ka36, 1975Al24, 1974By01, 1973Ba35, 1972Ba26, 1969Te02, 1964Ej02, 1962Br29, 1960Od01, 1959Vo29.

<sup>&</sup> From 1969Te02.

<sup>a</sup> In units of keV. From 1962Br29, except otherwise noted.

<sup>b</sup> From 1974By01.

 $\gamma(^{29}\text{P})$ 

| $E_i(\text{level})$ | $E_\gamma$ <sup>†</sup> | $I_\gamma$ <sup>‡</sup> | $E_f$   | Mult. <sup>a</sup> | $\delta$ <sup>‡</sup> | Comments                                                                                                           |
|---------------------|-------------------------|-------------------------|---------|--------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------|
| 1383.55             | 1383.48                 | 100                     | 0       | D+Q                | -0.15 2               | $\delta$ : Others: -0.22 8 (1973Ba35), -0.17 2 (1960Ok02).                                                         |
| 1953.91             | 570.35                  | 7 2                     | 1383.55 | D+Q                | -0.06 9               |                                                                                                                    |
|                     | 1953.77                 | 93 2                    | 0       |                    |                       |                                                                                                                    |
| 2422.7              | 468.8                   | 4 2                     | 1953.91 |                    |                       |                                                                                                                    |
|                     | 1039.1                  | 12 2                    | 1383.55 |                    |                       |                                                                                                                    |
|                     | 2422.5                  | 83 3                    | 0       | D+Q                | +0.29 7               | $\delta$ : Other: +0.23 3 (1973Ba35).                                                                              |
| 3105.9              | 1151.9                  | 24 2                    | 1953.91 |                    |                       |                                                                                                                    |
|                     | 1722.2                  | 76 2                    | 1383.55 | D+Q                | -0.25 2               | $\delta$ : From 1960Ok02.                                                                                          |
|                     | 3105.5                  | <3                      | 0       |                    |                       |                                                                                                                    |
| 3447.6              | 341.7                   | 7 & 5                   | 3105.9  |                    |                       |                                                                                                                    |
|                     | 1493.6                  | 93 & 5                  | 1953.91 |                    |                       |                                                                                                                    |
| 4080.4              | 1657.6                  | 4 2                     | 2422.7  |                    |                       | $I_\gamma$ : From 1970Mo29, however, gives a 3% 1 branch to the 3106 keV level.                                    |
|                     | 2126.3                  | 52 3                    | 1953.91 | D+Q                | -0.12 2               | $\delta$ : Weighted average of -0.14 3 (1974By01), -0.11 2 (1973Ba35), -0.17 5 (1970Mo29), and -0.09 9 (1970Wi10). |
|                     | 2696.6                  | 44 3                    | 1383.55 |                    |                       | $\delta$ : From 1960Ok02.                                                                                          |
| 4343                | 2959                    | 9 2                     | 1383.55 | D+Q                | -0.00 2               | $\delta$ : Other: +0.00 4 (1973Ba35).                                                                              |
|                     | 4342                    | 91 2                    | 0       | D+Q                | +0.02 3               |                                                                                                                    |
| 4642.0              | 561.6                   | 13 & 7                  | 4080.4  |                    |                       |                                                                                                                    |
|                     | 1536.0                  | <4 &                    | 3105.9  |                    |                       |                                                                                                                    |
|                     | 2687.8                  | 87 & 7                  | 1953.91 |                    |                       |                                                                                                                    |
| 4759                | 2336                    | 5 @ 2                   | 2422.7  |                    |                       |                                                                                                                    |
|                     | 2805                    | <1 @                    | 1953.91 |                    |                       |                                                                                                                    |
|                     | 3375                    | 5 @ 2                   | 1383.55 |                    |                       |                                                                                                                    |
|                     | 4758                    | 90 @ 2                  | 0       |                    |                       |                                                                                                                    |
| 4954.1              | 1848.1                  | 3 1                     | 3105.9  |                    |                       |                                                                                                                    |
|                     | 2531.2                  | 11 3                    | 2422.7  | D+Q                | -0.02 4               |                                                                                                                    |
|                     | 2999.9                  | 16 3                    | 1953.91 | D+Q                | +0.02 9               |                                                                                                                    |
|                     | 3570.1                  | 59 3                    | 1383.55 | D+Q                | +0.05 2               |                                                                                                                    |
|                     | 4953.2                  | 11 3                    | 0       |                    |                       |                                                                                                                    |
| 5293.0              | 2186.9                  | 22 5                    | 3105.9  |                    |                       |                                                                                                                    |
|                     | 3338.7                  | 78 5                    | 1953.91 | D+Q                | +0.04 4               |                                                                                                                    |
|                     | 3908.9                  | <6                      | 1383.55 |                    |                       |                                                                                                                    |
| 8379                | 5956                    | 31 # 2                  | 2422.7  | D+Q                | +0.02 # 3             | $A_2 = -0.60$ 13, $A_4 = +0.13$ 13 (1972Ba26).                                                                     |
|                     | 6425                    | 54 # 2                  | 1953.91 | D+Q                | -0.18 # 6             | $A_2 = +0.28$ 6, $A_4 = -0.09$ 6 (1972Ba26).                                                                       |
|                     | 6995                    | 15 # 2                  | 1383.55 | D+Q                | +0.09 # 5             | $A_2 = -0.38$ 10, $A_4 = +0.06$ 10 (1972Ba26).                                                                     |

<sup>†</sup> Calculated from level energy differences,  $E_i - E_f$  and recoil energy subtracted, by the evaluator.

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$^{28}\text{Si}(\text{p},\gamma),(\text{p},\text{p}'\gamma),(\text{p},\text{p}') : \text{res}$     [1974By01](#),[1990Ti07](#),[1962Br29](#) (continued)

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$\gamma(^{29}\text{P})$  (continued)

<sup>‡</sup> From [1974By01](#), except otherwise noted.

<sup>#</sup> From [1972Ba26](#).

<sup>@</sup> From [1974By01](#) and [1973Ba35](#).

<sup>&</sup> From [1975Al24](#).

<sup>a</sup> Assigned by the evaluator based on the mixing ratio data.

