## Adopted Levels

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Jun Chen | NDS 140, 1 (2017) | 30-Sep-2015 |

Q($\beta^-$)=−11.67×10$^3$ *16*; S(n)=14422 *24*; S(p)=529.6 *29*; Q($\alpha$)=−5531.2 *28* 2012Wa38
S(2n)=32120 *200* (syst), S(2p)=6300.5 *28*, Q($\varepsilon$p)=5994.9 *28* (2012Wa38).

Other reactions:

$^{40}$Ca($\gamma,\pi^-$): 1985To14, 1982To10: E=400 MeV. Measured $\sigma$, deduced pion production. 1973Gr21: E=340 MeV. Measured $\sigma$. Additional information 1.

$^{40}$Ca($\pi^+,\pi$): 1987Bo43, 1986Ir02, 1986Er09, 1984Er03, 1984Bo51, 1983Ba13, 1982Ba50: E=120, 165, 230 MeV. Measured $\sigma(\theta)$.

$^{40}$Ca($\pi+,\pi+\pi^-$): 2001Ca53, 2000Bo38, 2000Gr28, 1999Bo25, 1997Bo15, 1996Bo09: E=283 MeV, measured pion invariant mass spectra.

$^{40}$Ca($^6$Li,$^6$He): 1974Ga11: E=38 MeV. Upper limits on cross sections estimated for excitation energy up to 1700 as: <2.5 $\mu$b for 10° <0.4 $\mu$b for 30°. No peaks were observed in $^6$He spectra.

$^{40}$Ca($^6$Li,$^6$He): 1980GuZW: E=92 MeV. Measured $\sigma$, deduced T=1 magnetic giant resonance. Details of this study are not available.

Delayed 2-proton radioactivity of $^{42}$Cr to levels in $^{40}$Sc is possible but none has been detected by 2001Gi01. An unexplained proton group at 2490 *30* from $^{42}$Cr decay could be an L=0 *2*-proton transition from IAS to first excited 0$^+$ state in $^{40}$Sc, but no $\gamma$ rays were observed.

In ($^{12}$C,$^{12}$B), 1988Vo06 identify population of 1$^+$ states in 4.9-5.0 MeV region at low angles; a 6$^-$ state near 6 MeV at larger angles; and strong low-lying states of unnatural parity characterized by L=1, L=3 and L=5 transitions giving rise to 2$^-$, 4$^-$ and 6$^-$ states, respectively. Population of a spin-flip dipole resonance ($J^\pi$=0$^-$,1$^-$,2$^-$) is suggested by strong enhancement of cross section in the 7-15 MeV range.

All levels populated in $^{40}$Ti $\varepsilon$ decay are proton unbound.

### $^{40}$Sc Levels

Cross Reference (XREF) Flags

- A $^{40}$Ti $\varepsilon$ decay (52.4 ms)
- B $^{40}$Ca($^3$He,t)
- C $^{40}$Ca($^{12}$C,$^{12}$B)
- D $^{40}$Ca(p,n),(pol p,n)

| E(level)† | J$^\pi$‡ | T$_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 0 | 4$^-$ | 182.3 ms *7* | BCD | %$\varepsilon$+%$\beta^+$=100; %$\varepsilon\alpha$=0.017 *5*; %$\varepsilon$p=0.44 *7*<br>T=1<br>J$^\pi$: log *ft*=4.7 to 5$^-$, log *ft*=4.8 to 3$^-$ (see $^{40}$Sc $\varepsilon$ decay),<br>T$_{1/2}$: weighted average of 179 ms *2* (1962Sc08), 186 ms *4* (1966An01), 182.7 ms *8* (1968Ar03), and 183 ms *3* (1972Mo08).<br>%$\varepsilon\alpha$, %$\varepsilon$p: from 1982Ho09.<br>dominant configuration=($\pi f_{7/2}$,$\nu d_{3/2}^{-1}$) (1986Ch19) in (p,n). |
| 34.3 *15* | (3$^-$) | | BCD | T=1<br>dominant configuration=($\pi f_{7/2}$,$\nu d_{3/2}^{-1}$) (1986Ch19) in (p,n). |
| 772.1 *16* | (2$^-$) | | BCD | XREF: C(740).<br>J$^\pi$: from DWBA analysis of $\sigma(\theta)$ in ($^3$He,t) and L($^{12}$C,$^{12}$B)=(1) from 0$^+$. |
| 893.5 *20* | (5$^-$) | | BCD | |
| 1670.7 *19* | (1$^-$&2$^-$) | | B | J$^\pi$: from DWBA analysis of $\sigma(\theta)$ for a possible triplet in ($^3$He,t). |
| 1703.2 *22* | | | B | |
| 1797.0 *24* | (3$^-$) | | B | J$^\pi$: from $\sigma(\theta)$. |
| 1871 *3* | | | B | |
| 1933 *3* | | | B | |
| 2276 *7* | 1$^+$ | | A | |
| 2370 *4* | (4$^-$) | | B D | XREF: D(2300). |

Continued on next page (footnotes at end of table)

**Adopted Levels (continued)**

$^{40}$Sc Levels (continued)

| E(level)† | Jπ‡ | XREF | Comments |
|---|---|---|---|
| | | | E(level): from ($^3$He,t).<br>Jπ: from DWIA analysis of σ(θ) in (p,n) for a complex structure and DWBA analysis of σ(θ) in ($^3$He,t). In higher-energy ($^3$He,t) experiments of 1984Ta11, a 1$^+$ level at 2370 is proposed from σ(θ) data with the speculation that this state may be the analog of T=1 *10310*, 1$^+$ state or T=1 *9400*, 0$^+$ state in $^{40}$Ca.<br>dominant configuration=($\pi f_{7/2}, \nu s^{-1}_{1/2}$) (1986Ch19) in (p,n). |
| 2746 *7* | 1$^+$ | A D | T=1<br>XREF: D(2700). |
| 2933 *11* | 1$^+$ | A | |
| 3030 | (3$^-$) | B | Jπ: from DWBA analysis of σ(θ) in ($^3$He,t). |
| 3135 *17* | 1$^+$ | AB | XREF: B(3140). |
| 3221 *60* | 1$^+$ | A | |
| 3330 *17* | 1$^+$ | AB | XREF: B(3360). |
| 3409 *62* | 1$^+$ | AB | XREF: B(3450). |
| 3494 *8* | | AB | XREF: A(3534).<br>E(level): uncertain in $^{40}$Ti ε decay. |
| 3648 *9* | 1$^+$ | A | |
| 3780 *9* | 1$^+$ | A | |
| 3.9×10$^3$ *1* | (1$^-$,2$^-$) | A D | XREF: A(?).<br>E(level),Jπ: from DWIA analysis of σ(θ) for a complex structure in (p,n). E=3856 *42* from $^{40}$Ti ε decay. |
| 4060 *22* | 1$^+$ | A | |
| 4129 *21* | 1$^+$ | A | |
| 4264 *9* | 1$^+$ | A D | XREF: D(4300).<br>E(level): from $^{40}$Ti ε decay, complex structure in (p,n). |
| 4359 *8* | 0$^+$ | A | T=2<br>Jπ: log *ft*=3.26 from 0$^+$; IAS of $^{40}$Ti g.s. |
| 4518 *12* | 1$^+$ | A | |
| 4649 *11* | 1$^+$ | A | |
| 4819 *19* | 1$^+$ | A | |
| 4895? *15* | | A | |
| 5014 *22* | 1$^+$ | A | |
| 5080 *29* | 1$^+$ | A | |
| 5221? *29* | | A | |
| 5354 *62* | 1$^+$ | A | |
| 5567 *41* | 1$^+$ | A | |
| 5702 *21* | 1$^+$ | A | |
| 5879 *82* | 1$^+$ | A | |
| 6005 *20* | 1$^+$ | A | |
| 6120 *62* | 1$^+$ | A | |
| 6419 *62* | 1$^+$ | A | |
| 7.5×10$^3$ *25* | (6$^-$) | D | T=1<br>Jπ: from DWIA analysis of σ(θ) for a complex structure in (p,n).<br>dominant configuration=($\pi f_{7/2}, \nu d^{-1}_{5/2}$) (1983An06, 1986Ch19) in (p,n). |
| 12.9×10$^3$ *37* | (0$^-$,1$^-$,2$^-$) | AB D | XREF: D(12000).<br>E(level): from ($^3$He,t).<br>Jπ: from DWIA analysis of σ(θ) for a giant resonance in (p,n). |

† From ($^3$He,t) for levels up to E=1933 keV and from $^{40}$Ti ε decay, unless otherwise noted.

‡ 1$^+$ assignments for levels above E=1933 keV are from $^{40}$Ti ε decay based on log *ft*<5.2 from 0$^+$; assignments for levels up to E=1933 keV are from DWBA analysis of σ(θ) in ($^3$He,t) if applicable, unless otherwise noted.