^{40}Ti εp decay (52.4 ms) 1998Bh12,1998Li46,2007Do17

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 149, 1 (2018)	1-Jan-2018

Parent: ^{40}Ti: E=0; $J^{\pi}=0^{+}$; $T_{1/2}$=52.4 ms *3*; Q(εp)=11.14×10^{3} *16*; %εp decay=100.0

^{40}Ti-$T_{1/2}$: From Adopted Levels of ^{40}Ti, taken from 2007Do17. Others: 53.5 ms *25* (2001Gi01,2001Gi02), 52.7 ms *15* (reported in 1998Bh12 as the average of 53.6 ms *6* from an independent analysis of the same data in 1997Tr11, and 51.7 ms *6* in 1997Tr11), 54 ms *2* (1998Li46, 55 ms *2* in 1997Li25), and 56 ms *+18−12* (1990De43).

^{40}Ti-Q(εp): From 2017Wa10.

^{40}Ti-%εp decay: From Adopted Levels of ^{40}Ti. 95.8% *13* from 2007Do17, which gives Iγ=4.2 *13* for γ transitions in ^{40}Sc presumably ending up feeding the ^{40}Sc ground state.

^{40}Ti decays to ^{39}Ca by εp (≈100%).

1998Bh12 (also 1998Le45,1997Tr11): ^{40}Ti ions were produced at GANIL by fragmentation of a 82.6 MeV/nucleon ^{50}Cr beam on a 272.4 mg/cm^{2} nickel target. Fragments were separated and selected by the LISE3 spectrometer and then implanted into a stack of five Si surface-barrier detectors. γ rays were detected with five HPGe detectors. Measured E(p), I(p), Eγ, Iγ, pγ-coin, pβ-coin, decay time distribution. Deduced levels, β-delayed proton emission probabilities, ^{40}Ti half-life. Comparisons with data from other measurements.

1998Li46 (also 2001Li56,1997Li25): ^{40}Ti ions were produced at GSI by fragmentation of a 500 MeV/nucleon ^{58}Ni beam from the heavy-ion synchrotron SIS on a 4 g/cm^{2} ^{9}Be target. Fragments were separated by the separator FRS by energy loss determined by a multiple sampling ionization chamber (MUSIC) and mass-to-charge ratio determined with FRS. Selected ^{40}Ti ions were implanted into a stack of eight Si detectors. γ rays were detected with an array of 14 large-volume Crystal Ball NaI detectors. Measured E(p), I(p), Eγ, Iγ, pγ-coin, decay time distribution. Deduced levels, β-delayed proton emission probabilities, ^{40}Ti half-life. Comparisons with data from other measurements.

2007Do17: ^{40}Ti source was produced via fragmentation of ^{58}Ni beam at 74.5 MeV/nucleon on a natural Ni target at SISSE/LISE3 facility in GANIL. Fragments were separated by the fragment separator α-LISE3, identified by energy loss, residual energy and time-of-flight measured using two micro-channel plate (MCP) detectors and Si detectors. detectors and implanted into double-sided silicon-strip detectors (DSSSD) and a thick Si(Li) detector to detect implanted events, charged particles and β particles. γ rays were detected by four Ge detectors. Measured E(p), I(p), Eγ, Iγ, pγ-coin, decay time distribution. Deduced levels, β-delayed proton emission probabilities, ^{40}Ti half-life.

Others:

1990De43: ^{40}Ti isotope identified and four proton groups.

2001Gi01 (also 2001Gi02): four most intense proton groups reported. Also measured $T_{1/2}$.

Comparison of proton energies (E_p(lab))

1998Bh12		1998Li46		2001Gi01		2007Do17		adopted		E_x	
p1		242	80					242	80	3221	60*
p1		400	60					400	60	3409	62*
p1	747 36	759	60					750	36	3780	9*
p2		951	86					951	86	4518	12*
p1	1111 20	1157	60					1116	20	4129	21*
p1	1325 7	1322	25	1332	25	1330	19	1326	7	4359	8*
p1	1608 17	1580	40					1604	17	4649	11*
p0	1701 6	1705	10	1703	10	1697	19	1702	6	2276	7
p1	1849 14							1849	14	4895	15
p1	1957 21	1992	40					1965	21	5014	22*
p1	2027 28							2027	28	5080	29*
p0	2160 6	2167	10	2154	9	2161	18	2160	6	2746	7
p0	2341 10	2366	40					2342	10	2933	11
p0	2542 16	2518	46					2539	16	3135	17
p0		2609	60					2609	60	3221	60*
p0	2728 16	2733	40					2729	16	3330	17
p0	2957 47	2907	40					2928	40	3534	41
p0	3039 8	3045	40					3039	8	3648	9
p0	3170 8	3158	27					3169	8	3780	9*
p0	3242 41							3242	41	3856	42
p0	3443 21	3407	88					3441	21	4060	22

p0	3487	25							3487	25	4129	21*
p0	3639	8	3632	46					3639	8	4264	9
p0	3734	7	3731	10	3736	14	3748	20	3734	7	4359	8*
p0	3887	11	3972	100					3887	11	4518	12*
p0	4017	10							4017	10	4649	11*
p0	4184	18	4137	60					4180	18	4819	19
p0	4371	23	4347	74					4369	23	5014	22*
p0	4433	31	4481	88					4438	31	5080	29*
p0	4572	28							4572	28	5221	29
p0			4702	60					4702	60	5354	62
p0			4909	40					4909	40	5567	41
p0	5034	20	5107	60					5041	20	5702	21
p0			5213	80					5213	80	5879	82
p0	5336	19							5336	19	6005	20
p0			5448	60					5448	60	6120	62
p0			5740	60					5740	60	6419	62

Notes:
1. Adopted proton energy is from weighted average if applicable.
2. $E_x=E_p*1.026092+529.6$ *29*+$E_x(^{39}Ca)$.
$E_x(^{39}Ca)=0$ for decay to ^{39}Ca ground state (p0 mode),
$E_x(^{39}Ca)=2468.5$ *9* for p1 mode, 3026 *3* for p2 mode.
Values marked with (*) are the averages from two proton groups.

Comparison of proton intensities(I_p)

E_p	E_x	1998Bh12		1998Li46		2001Gi01		2007Do17		adopted*	
p1	242	3221		1.32	40					1.32	40
p1	400	3409		0.70	30					0.70	30
p1	750	3780	0.49 17	0.77	43					0.53	17
p2	951	4518		0.80	32					0.80	32
p1	1116	4129	0.53 13	0.77	42					0.55	13
p1	1326	4359	3.58 60	4.35	82	5.8	20	2.9	14	3.85	60
p1	1604	4649	0.38 18	0.40	20					0.39	18
p0	1702	2276	23.76 59	22.5	21	21.7	30	18.1	19	23.16	59
p1	1849	4895	1.41 32							1.41	32
p1	1965	5014	0.85 26	0.95	43					0.88	26
p1	2027	5080	0.44 11							0.44	11
p0	2160	2746	29.80 66	28.5	19	27.4	36	24.2	19	29.08	66
p0	2342	2933	1.94 41	0.60	18					1.94	41
p0	2539	3135	0.91 21	1.01	56					0.92	21
p0	2609	3221		1.05	42					1.05	42
p0	2729	3330	0.58 17	1.6	11					0.58	7
p0	2928	3534	0.11 11	0.69	28					0.69	28
p0	3039	3648	1.73 20	1.43	78					1.71	20
p0	3169	3780	2.09 23	3.4	16					2.12	23
p0	3242	3856	0.11 11							0.11	11
p0	3441	4060	0.43 14	0.57	30					0.46	14
p0	3487	4129	0.33 14							0.33	14
p0	3639	4264	2.05 22	1.09	27					2.05	22
p0	3734	4359	21.71 54	22.8	19	23.8	36	20.0	20	21.72	54
p0	3887	4518	1.83 28							1.83	28
p0	4017	4649	1.59 23	1.40	42					1.55	23
p0	4180	4819	0.72 17	1.27	53					0.77	17
p0	4369	5014	0.53 23	0.97	40					0.64	23
p0	4438	5080	0.42 24	0.73	22					0.59	22
p0	4572	5221	0.11 11							0.11	11
p0	4702	5354		0.55	21					0.55	21
p0	4909	5567		0.16	10					0.16	10
p0	5041	5702	0.24 9	0.41	30					0.25	9
p0	5213	5879		0.30	12					0.30	12
p0	5336	6005	0.21 7							0.21	7
p0	5448	6120		0.18	10					0.18	10
p0	5740	6419		0.11	6					0.11	6

sum of I_p: 99.9 16 101.4 44 79 6# 95.8 13@ 103.9 18

Notes:
*: Adopted proton intensity is from weighted average if applicable. If data from 1998Bh12 and 1998Li46 are not consistent within error, value from 1998Bh12 is taken, unless otherwise noted.
#: sum of the four most intense proton groups
@: total proton branching ratio reported in 2007Do17

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^{39}Ca Levels

E(level)†	J^π†
0	$3/2^+$
2468.5	$1/2^+$
3026	$3/2^-$

† From Adopted Levels.

$\gamma(^{39}Ca)$

E_γ	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Comments
2467.3 *5*	9 *5*	2468.5	$1/2^+$	0	$3/2^+$	E_γ,I_γ: from 2007Do17.

† Absolute intensity per 100 decays.

Delayed Protons (^{39}Ca)

E(p)†	E(^{39}Ca)	I(p)†‡*b*	E(^{40}Sc)#	Comments
242@ *80*	2468.5	1.3@ *4*	3221	
400@ *60*	2468.5	0.7@ *3*	3409	
750 *36*	2468.5	0.53 *17*	3780	
951@ *86*	3026	0.8@ *3*	4518	
1116 *20*	2468.5	0.55 *13*	4129	
1326 *7*	2468.5	3.9 *6*	4359	
1604 *17*	2468.5	0.39 *18*	4649	
1702 *6*	0	23.2 *6*	2276	Additional information 4.
1849*ac* *14*	2468.5	1.4 *3*	4904	
1965 *21*	2468.5	0.86 *26*	5014	
2027 *28*	2468.5	0.44 *11*	5080	E(p)=1992 *40*, Ip=1.0 *4* (1998Li46) probably corresponds to 1957+2027 in 1998Bh12.
2160 *6*	0	29.1 *7*	2746	Additional information 3.
2342 *10*	0	1.9 *4*	2933	
2539 *16*	0	0.92 *21*	3135	Additional information 2.
2609@ *60*	0	1.1@ *4*	3221	
2729 *16*	0	0.58 *17*	3330	
2928*c* *40*	0	0.7 *3*	3534	
3039 *8*	0	1.71 *20*	3648	
3169 *8*	0	2.12 *23*	3780	
3242&*c* *41*	0	0.11& *11*	3856	
3441 *21*	0	0.46 *14*	4060	
3487 *25*	0	0.33 *14*	4129	E(p)=3407 *88*, Ip=0.6 *3* (1998Li46) probably corresponds to 3443+3487 in 1998Bh12.

Continued on next page (footnotes at end of table)

^{40}Ti εp decay (52.4 ms) 1998Bh12,1998Li46,2007Do17 (continued)

Delayed Protons (continued)

E(p)[†]	E(^{39}Ca)	I(p)[†‡b]	E(^{40}Sc)[#]	Comments
3639 *8*	0	2.05 *22*	4264	
3734 *7*	0	21.7 *5*	4359	Additional information 1.
3887 *11*	0	1.8 *3*	4518	
4017 *10*	0	1.55 *23*	4649	E(p)=3972 *100*, Ip=1.4 *4* (1998Li46) probably corresponds to 3887 or 4017 in 1998Bh12.
4180 *18*	0	0.77 *17*	4819	
4369 *23*	0	0.64 *23*	5022	
4438 *31*	0	0.59 *20*	5080	
4572[&c] *28*	0	0.11[&] *11*	5221	
4702[@] *60*	0	0.55[@] *21*	5354	
4909[@] *40*	0	0.16[@] *10*	5567	
5041 *20*	0	0.25 *9*	5702	
5213[@] *80*	0	0.30[@] *12*	5879	
5336[&] *19*	0	0.21[&] *7*	6005	
5448[@] *60*	0	0.18[@] *10*	6120	
5740[@] *60*	0	0.11[@] *6*	6419	

[†] Weighted average of values from 1998Bh12, 1998Li46, 2001Gi01 and 2007Do17 if available. See all values in tables for proton energies, intensities.

[‡] Additional information 5.

[#] From ^{40}Ti ε decay (52.4 ms).

[@] From 1998Li46 only.

[&] From 1998Bh12 only.

[a] This proton group is considered as suspect by the evaluators. With I(p)=1.4 in 1998Bh12, this group should have been seen by 1998Li46. In addition 1998Bh12 do not list, in their table III, a level at 4904 in ^{40}Sc corresponding to this proton group.

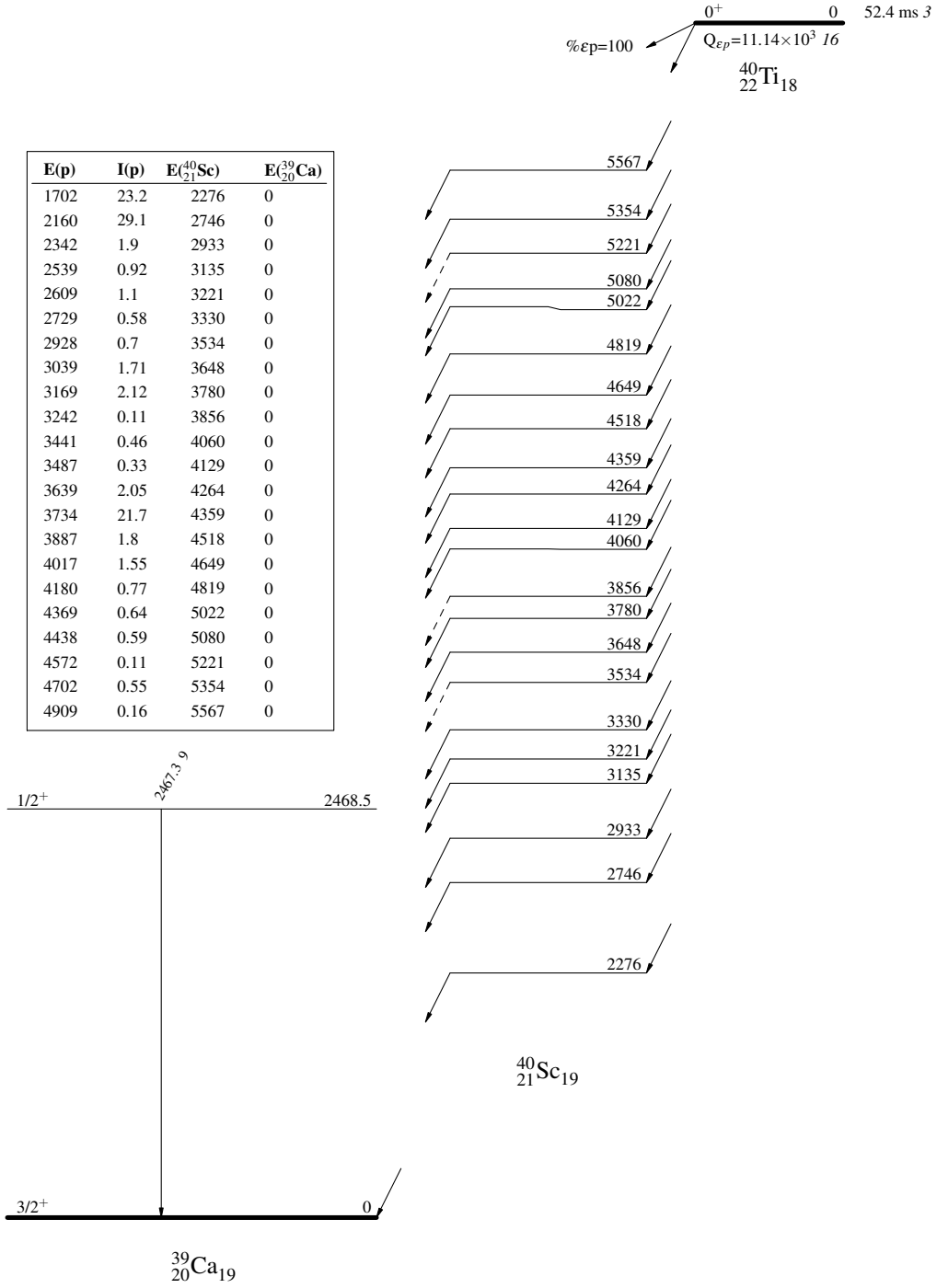
[b] Absolute intensity per 100 decays.

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

^{40}Ti εp decay (52.4 ms) 1998Bh12,1998Li46,2007Do17

Decay Scheme

γ Intensities: I_γ per 100 parent decays
I(p) Intensities: I(p) per 100 parent decays

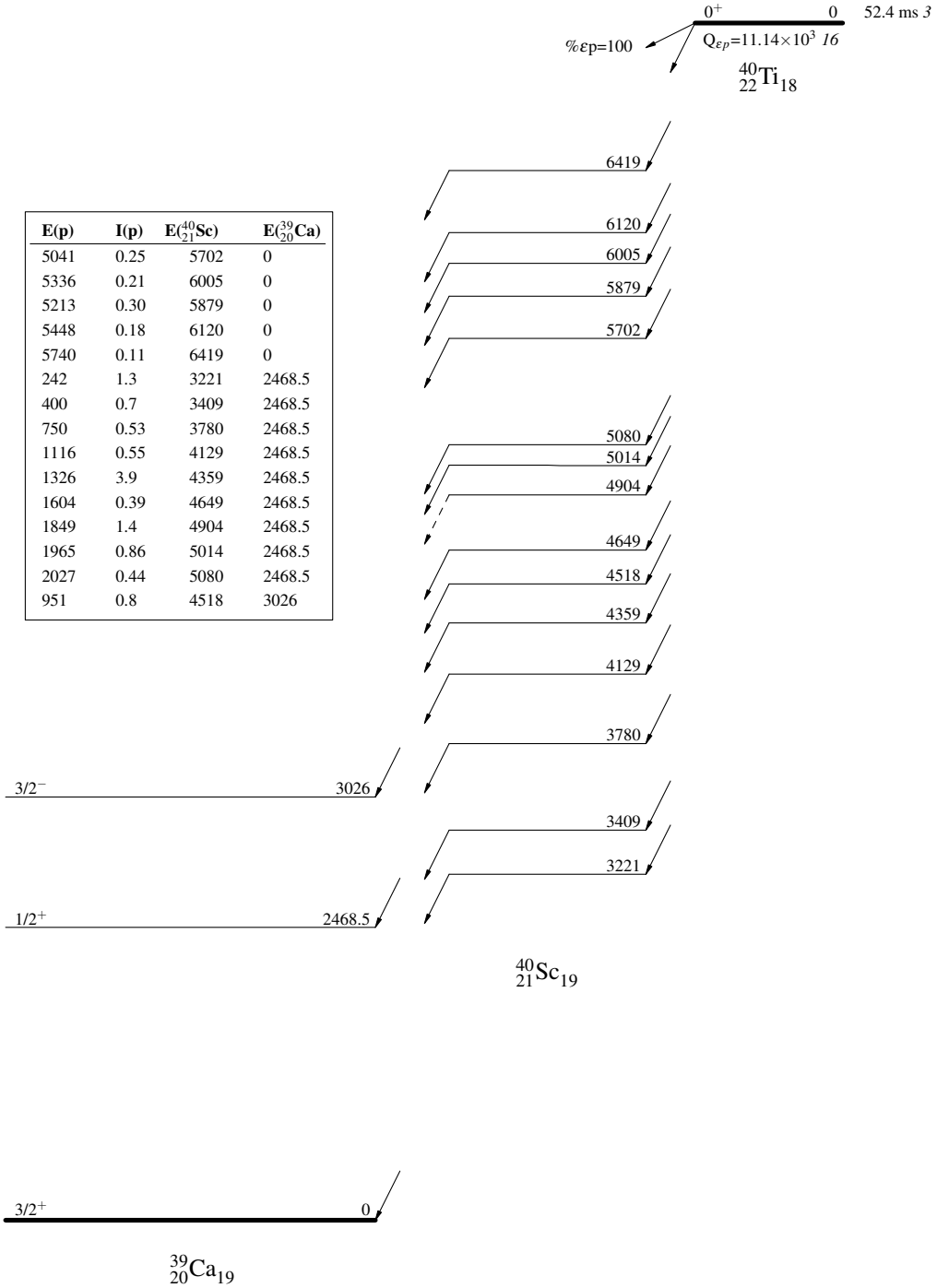


E(p)	I(p)	E($^{40}_{21}$Sc)	E($^{39}_{20}$Ca)
1702	23.2	2276	0
2160	29.1	2746	0
2342	1.9	2933	0
2539	0.92	3135	0
2609	1.1	3221	0
2729	0.58	3330	0
2928	0.7	3534	0
3039	1.71	3648	0
3169	2.12	3780	0
3242	0.11	3856	0
3441	0.46	4060	0
3487	0.33	4129	0
3639	2.05	4264	0
3734	21.7	4359	0
3887	1.8	4518	0
4017	1.55	4649	0
4180	0.77	4819	0
4369	0.64	5022	0
4438	0.59	5080	0
4572	0.11	5221	0
4702	0.55	5354	0
4909	0.16	5567	0

^{40}Ti εp decay (52.4 ms) 1998Bh12,1998Li46,2007Do17

Decay Scheme (continued)

γ Intensities: I_γ per 100 parent decays
I(p) Intensities: I(p) per 100 parent decays



E(p)	I(p)	E($^{40}_{21}$Sc)	E($^{39}_{20}$Ca)
5041	0.25	5702	0
5336	0.21	6005	0
5213	0.30	5879	0
5448	0.18	6120	0
5740	0.11	6419	0
242	1.3	3221	2468.5
400	0.7	3409	2468.5
750	0.53	3780	2468.5
1116	0.55	4129	2468.5
1326	3.9	4359	2468.5
1604	0.39	4649	2468.5
1849	1.4	4904	2468.5
1965	0.86	5014	2468.5
2027	0.44	5080	2468.5
951	0.8	4518	3026