

⁴⁴Cr ε decay (42.8 ms) 2014Po05,2007Do17,2020Fu05

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh		NDS 190,1 (2023)	20-Jun-2023

Parent: ⁴⁴Cr: E=0; J^π=0⁺; T_{1/2}=42.8 ms 6; Q(ε)=10382 50; %ε+%β⁺ decay=100

⁴⁴Cr-T_{1/2}: Measured by 2007Do17 from time correlation of implantation events due to ⁴⁴Cr and subsequent emission of protons and γ rays. Same value is listed in the Adopted Levels.

⁴⁴Cr-Q(ε): Deduced by the evaluators based on newly measured mass of ⁴⁴V by 2022Wa39. Other: 10390 50 from 2021Wa16.

⁴⁴Cr-%ε+%β⁺ decay: %εp=12 2 from Adopted Levels of ⁴⁴Cr, from unweighted average of 10 1 (2014Po05) and 14.9 9 (2007Do17). Other: >7 3 (1996Fa09).

⁴⁴Cr identified in Ni(⁵⁸Ni,X) E=55 MeV/nucleon (1987Po04,1992Bo37) and ⁹Be(⁵⁸Ni,X) E=650 MeV/nucleon (1996Fa09).

2014Po05: ⁴⁴Cr ions were produced by fragmentation of a 160 MeV/nucleon ⁵⁸Ni beam on a 580 mg/cm² natural nickel target at NSCL. Fragments were separated and identified according to time-of-flight and energy-loss with the A1900 separator, a Si detector, and an optical time-projection chamber (OPTC). Measured β-delayed delayed proton emission. Deduced decay branching ratios, parent T_{1/2}.

2007Do17: ⁴⁴Cr isotope produced by fragmentation of 74.5 MeV/nucleon ⁵⁸Ni beam on natural Ni target at SISSE/LISE3 facility in GANIL. Fragments separated by the α-LISE3 separator and identified by energy loss, residual energy and time-of-flight. Double-sided silicon strip detectors (DSSSDs) and a thick Si(Li) detector for detecting protons and four Ge detectors for detecting γ-rays. Measured E_γ, pγ-coin. Deduced levels, T_{1/2}.

2020Fu05: re-analyzed β-delayed proton data in 2014Po05 and 2007Do17 and proposed decay scheme.

Others: 1992Bo37, 1996Fa09.

2014Po05 and 2007Do17 report delayed proton emissions from ⁴⁴Cr decay but do not assign them to levels in ⁴⁴V, except for a branch at E_p(c.m.)=910, which is assigned to be from the decay of the IAS of ⁴⁴Cr g.s. in ⁴⁴V to g.s. of ⁴³Ti. 2020Fu05 claim that this assignment, however, is not supported by dedicated theoretical calculations as cited in 2020Fu05.

The current decay scheme is partial and proposed by 2020Fu05 based on re-analysis of delayed-proton data in 2014Po05 and 2007Do17. Only 4.4% β⁺+ε feeding is known through proton decays. It is possible that 1⁺ state at 676.9 keV is populated through Gamow-Teller β transition, in which case major fraction of the 59% 5 of the γ intensity for the 676.9-keV transition could be assigned as β⁺+ε feeding for the 676.9-keV level.

1992Bo37 reported two additional β⁺-delayed proton peaks at 2180 keV 50 and 3140 keV 50, which have not been confirmed in later studies by 2007Do17 and 2014Po05.

1996Fa09 report E(p)=900-1100 keV with intensity of 7% 3.

⁴⁴V Levels

From E_p(c.m.)=759 26 (2014Po05) to 313 1 level in ⁴³Ti, 2020Fu05 tentatively proposed a level at 2853 28 as the T=2, 0⁺ IAS of ⁴⁴Cr g.s. in ⁴⁴V, which possibly decays by the 759-keV proton emission. But 2020Fu05 also proposed that the 759-keV proton more likely decays from a level at 3015 keV to the 475 10 level in ⁴³Ti. See comment for 3015 level. However, evaluators note that intensity of 0.6% 2 of the 759-keV proton peak in 2014Po05 is too low for T=2, 0⁺ IAS in ⁴⁴V, as it implies log ft value of 4.8 2, instead of the expected value of 3.2. For this reason, evaluators have not included this level in the decay scheme.

S(p)(⁴⁴V)=1781 9 (2021Wa16).

E(level) [†]	J ^π [‡]	T _{1/2} [‡]	Comments
0.0	(2) ⁺	111 ms 7	
676.9 3	(1) ⁺		J ^π : probable Gamow-Teller β transition from 0 ⁺ parent.
3015 29	(1) ⁺		E(level): E _p (c.m.)=759 26 to 475 10 level in ⁴³ Ti (2020Fu05). See also comment in header section for a possible 2853 level as the T=2 IAS 0 ⁺ in ⁴⁴ V, tentatively proposed by 2020Fu05 from the same proton peak at E _p (c.m.)=759 26 keV.
3166 17	(1) ⁺		E(level): E _p (c.m.)=910 11 to 475 10 level in ⁴³ Ti (2020Fu05), with E _p (c.m.) from weighted average of 917 53 (2014Po05), 908 11 (2007Do17), and 950 50 (1992Bo37).
3640 18	(1) ⁺		E(level): E _p (c.m.)=1384 12 to 475 10 level in ⁴³ Ti (2020Fu05), with E _p (c.m.) from weighted average of 1371 62 (2014Po05) and 1384 12 (2007Do17).
3833? 18	(1) ⁺		E(level): E _p (c.m.)=1739 15 to 313 1 level in ⁴³ Ti (2020Fu05), with E _p (c.m.) from weighted

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^{44}Cr ϵ decay (42.8 ms) 2014Po05,2007Do17,2020Fu05 (continued)

^{44}V Levels (continued)

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>T_{1/2}[‡]</u>	Comments
			average of 1719 44 (2014Po05) and 1741 15 (2007Do17). This assignment is considered as uncertain by 2020Fu05.

[†] From E_p(c.m.)+S(p)+E(⁴³Ti) for proton-unbound levels, where E_p(c.m.) is the proton energy in the center-of-mass frame and E(⁴³Ti) is the energy of the final level in ⁴³Ti the delayed proton goes to.

[‡] From the Adopted Levels. J^π assignments for proton-unbound levels are from possible Gamow-Teller β transitions from 0⁺ parent, and as proposed by 2020Fu05, also based on comparisons with mirror levels in ⁴⁴Sc.

ϵ, β^+ radiations

<u>E(decay)</u>	<u>E(level)</u>	<u>Iβ^+[†]</u>	<u>Iϵ[†]</u>	<u>Log ft</u>	<u>I($\epsilon + \beta^+$)[†]</u>	Comments
(6.55×10 ³ [‡] 5)	3833?	0.5 2	<0.012	4.62 17	0.5 2	av E β =2559 24; ϵ K=0.00140 6; ϵ L=1.49×10 ⁻⁴ 6; ϵ M+=2.43×10 ⁻⁵ 10 I($\epsilon + \beta^+$): from I(p)(1739)=0.5 2, weighted average of 0.6 3 (2007Do17) and 0.5 2 (2014Po05).
(6.74×10 ³ 5)	3640	1.3 3	<0.018	4.27 10	1.3 3	av E β =2651 24; ϵ K=0.00126 5; ϵ L=1.35×10 ⁻⁴ 6; ϵ M+=2.20×10 ⁻⁵ 9 I($\epsilon + \beta^+$): from I(p)(1384)=1.3 3, weighted average of 1.1 3 (2007Do17) and 1.4 3 (2014Po05).
(7.22×10 ³ 5)	3166	2.0 5	<0.026	4.24 11	2.0 5	av E β =2880 24; ϵ K=0.001003 39; ϵ L=1.073×10 ⁻⁴ 42; ϵ M+=1.75×10 ⁻⁵ 7 I($\epsilon + \beta^+$): from I(p)(910)=2.0 5, weighted average of 1.7 3 (2007Do17) and 2.7 5 (2014Po05). 2.0 3 quoted as the average in 2020Fu05.
(7.37×10 ³ 6)	3015	0.6 2	<0.010	4.82 15	0.6 2	av E β =2958 29; ϵ K=9.36×10 ⁻⁴ 38; ϵ L=1.001×10 ⁻⁴ 41; ϵ M+=1.62×10 ⁻⁵ 7 I($\epsilon + \beta^+$): from I(p)(759)=0.6 2 in 2014Po05.
(9.71×10 ³ [‡] 5)	676.9	<59	<0.025	>3.47	<59	av E β =4099 25; ϵ K=3.81×10 ⁻⁴ 12; ϵ L=4.07×10 ⁻⁵ 12; ϵ M+=6.61×10 ⁻⁶ 20 I($\epsilon + \beta^+$) is unknown as no feeding γ rays are known for decay to the 676.9-keV level. It is possible that dominant decay of the ⁴⁴ Cr populates the 676.9-keV level through a Gamow-Teller transition, in which case %I γ =59 5 for the 676.9-keV transition can be associated with I($\epsilon + \beta^+$) feeding to the 676.9 level, with log ft=3.46 4.

[†] Absolute intensity per 100 decays.

[‡] Existence of this branch is questionable.

$\gamma(^{44}\text{V})$

I γ normalization: 2007Do17 give I γ per 100 parent decays.

<u>Eγ[†]</u>	<u>Iγ^{†‡}</u>	<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	Comments
676.9 3	59 5	676.9	(1 ⁺)	0.0	(2) ⁺	%I γ =59 5

[†] From 2007Do17.

[‡] Absolute intensity per 100 decays.

${}^{44}\text{Cr}$ ϵ decay (42.8 ms) 2014Po05,2007Do17,2020Fu05Decay SchemeIntensities: I_γ per 100 parent decays