^{3}H β^- decay

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. E. Purcell#, C. G. Sheu*	NDS 130 1 (2015)	30-Jun-2015

Parent: ^{3}H: E=0.0; J^π=1/2+; $T_{1/2}$=12.32 y *2*; Q(β^-)=18.5906 *32*; %β^- decay=100.0

Measurements of the β-decay spectrum of tritium in solid tritiated valine by (1981Lu06,1985Bo34) indicated a nonzero electron antineutrino mass within the limits from 20 eV to 45 eV.

^{3}He Levels

E(level)	J^π	$T_{1/2}$
0.0	1/2+	stable

β^- radiations

The Q value for this decay process is given in (2012Wa38) to be 18.591 keV *1*. The β decay of ^{3}H is 100% to the ground state of ^{3}He. As stated earlier, the half-life of ^{3}H is 12.32 y *2*. This gives log *ft*=3.0524 *7* and the average E_β=5.68 keV.

Measurements of ^{3}H β-decay end point energy (EPE) or ^{3}H-^{3}He mass difference (MD): [Note: Table VII in (1950Ho80) lists eight measurements of EPE prior to 1950 ranging from 12 keV *5* to 18.9 keV *5*.].

The β spectrum end point energy differs from the ^{3}H-^{3}He mass difference due to the recoil energy, the final state of the residual system and the mass of the emitted but not detected anti-electron neutrino. In the table above, most of the references that measured the end point energy (EPE) also put upper limits on the neutrino mass. An early history of the role that the β decay of ^{3}H has played in attempts to measure the neutrino mass can be found in (1988Ro21). Fig. 1 in this article is a graph of the ^{3}H β spectrum near the EPE for the electron neutrino masses of 0 and 30 eV. Fig. 1 in (2006We03) and Fig. 3 in (2013Dr11) show the β spectrum near the end point energy for electron neutrino masses of 0 and 1 eV. Modern refinements of these measurements have resulted in the upper limit of the electron neutrino mass being just over 2 eV; see (2005Kr03,2010Ot02,2011As10,2013Dr11).

Studies of atomic and molecular effects on the ^{3}H β spectrum near the end point energy are reported in (1971Sc23,2010Ot02,2015Bo02).

Reference	Energy (keV)	Comment
1950Je60	18.6 2	Calorimetry, measured average energy, deduced \ EPE
1959Po78	18.61 10	EPE, double lens spectrometer
1969Sa21	18.72 5	EPE; retarding electrostatic field
1970Le15	18.540 95	EPE, ^{3}H implantation
1972Be11	18.610 16	EPE, magnetic-electrostatic spectrometer
1972Be11	18.651 16	MD, magnetic-electrostatic spectrometer
1973Pi01	18.538 0	EPE, magnetic spectrometer
1974Ro08	18.648 26	EPE, magnetic spectrometer
1975Sm02	18.600 7	MD, mass spectrometer, ^{3}H, ^{3}He masses measured
1976Tr07	18.575 13	EPE, magnetic spectrometer
1981Lu07	18.577 13	EPE, magnetic spectrometer
1981Si18	18.567 5	EPE, ^{3}H implantation
1981Sm02	18.573 7	MD, mass spectrometer; reconsider (1975Sm02) \ results
1982Di01	18.594 25	EPE, ion implantation reconsider
1983De47	18.562 6	EPE, thermal diffusion
1984Ni16	18.584 4	MD, ion cyclotron resonance
1985Bo34	18.5842 16	EPE, magnetic-electrostatic spectrometer
1985Li02	18.599 2	MD, ion cyclotron resonance
1985Si07	18.577 7	EPE, ^{3}H implantation
1985TaZK	18.582 3	MD
1986Fr09	18.5823 1	EPE, magnetic spectrometer
1987Bo07	18.5793 8	EPE, β spectrometer
1987Ka51	18.593 5	EPE, β spectrometer; also see \ (1988Ka12,1988Ka32)
1989Re04	18.590 8	EPE, reconsideration of earlier results
1989St05	18.5890 26	MD, β spectrometer
1991Bu12	18.595 6	MD, bremsstrahlung
1992Ho09	18.57332 18	EPE, β spectrometer

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1993Va04  18.5901 17  MD, Penning trap mass spectrometer
1993We03  18.5748 6   EPE, β spectrometer, also see (1993Ba08)
1995Hi14  18.597  14  MD, magnetic spectrometer
2006Na49  18.5898 12  MD, Penning trap mass spectrometer
2015My03  18.59201 7  MD, cyclotron frequency ratio
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E(decay)†	E(level)	Iβ^-‡	Log *ft*	Comments
(18.591 *3*)	0.0	100.0	3.0524 *8*	av Eβ=5.6817 *12* av Eβ: weight-average heat output 0.3233 *10* W/γ from (0.321 *3* (1950Je60)), (0.321 *1* (1958Gr93)), (0.312 *1* (1958Po64)), (0.3240 *9* (1961Pi01)), (0.3244 *13* (1961Jo22)).

† A review of early work is found in (1973Pi01).

‡ Absolute intensity per 100 decays.