Adopted Levels

Q(β^-)=23.1×10^3 *SY*; S(n)=0.8×10^3 *SY* 2017Wa10

As discussed in 2003Ko11, it is unlikely that ^{7}H exists as a bound state, but a resonant state near the ^{3}H+4n threshold with Jπ=1/2$^+$ seems likely. Such a state would likely decay either into five outgoing particles (^{3}H+4n) or two particles (^{3}H+^{4}n) if the tetraneutron exists.

An early shell model calculation (1985Po10) obtained Jπ=1/2$^+$ for the ^{7}H ground state in two different models. Calculations using the hyperspherical functions method (2002Ti05,2004Ti02) predicted a ^{7}H resonance several MeV above the ^{3}H+4n threshold. A coupled channels calculation is reported in 2004Ao05 treating ^{7}H as a combination of both a triton plus four neutrons and as a proton plus three dineutrons. The calculated ground state binding energy is about 1.5 MeV, which is about 7 MeV above the ^{3}H+4n threshold. A calculation reported in 2009Ao03 using the generator coordinate method that included basis states with a triton and two dineutrons as well as basis states with a triton and 4 neutrons obtained a ^{7}H ground state with a binding energy of about 3 MeV, which is about 5.5 MeV above the ^{3}H+4n threshold. Four neutron emission by ^{7}H is discussed in 2011Gr13.

Note: Present observations indicate a ^{7}H ground state that lies near the ^{3}H+4n threshold; this threshold corresponds to a binding energy of about 8.5 MeV. In the following reactions, resonance energies in ^{7}H are given relative to the ^{3}H+4n threshold.

^{7}H Levels

Cross Reference (XREF) Flags

A	^{1}H(^{8}He,pp)	D	^{9}Be(π^-,pp)
B	^{2}H(^{8}He,^{3}He)	E	^{11}B(π^-,p^{3}He)
C	^{7}Li(π^-,π^+)	F	^{12}C(^{8}He,^{13}N)

E(level)	J$^\pi$	Γ	E$_{res}$(^{3}H+4n)(MeV)	XREF	Comments
0	(1/2$^+$)	0.09 MeV *+94−6*	0.57 *42*	A EF	Decay mode not specified. Decay is either to ^{3}H+4n or to ^{3}H+^{4}n. E(level): From E$_{res}$(^{3}H+4n)=0.57 MeV *+42−21*. Using E$_{res}$=0.57 MeV *+42−21* and assuming the observed resonance is the ^{7}H ground state, the ^{7}H mass excess is ΔM=47.81 *+42−21* MeV; this compares with ΔM=49.14 *100* MeV given in 2017Wa10. The corresponding binding energy is E$_b$=7.91 *+21−42* MeV. Using Γ=0.09 MeV *+94−6*, the half life is 0.51×10^{-20} *+152−4* s; this compares with T$_{1/2}$=0.500×10^{-21} s given in 2016 NUBASE (2017Au03). J$^\pi$: Given that ^{9}Li with 3 protons and 6 neutrons has Jπ=3/2$^-$ and ^{11}B with 5 protons and 6 neutrons also has Jπ=3/2$^-$ as expected for two s 1/2 protons and one and three p 3/2 protons respectively, it is reasonable to assume that ^{7}H ground state with 1 proton and 6 neutrons would have Jπ=1/2$^+$.
15×10^3?		2 MeV	16	D	
20×10^3?		5 MeV	21	D	

^{1}H(^{8}He,pp) 2003Ko11,2003Ko68

2003Ko11,2003Ko68: A kinematic reconstruction of the 2p momenta permitted a reconstruction of the ^{7}H excitation spectrum; a resonant state is found near the ^{3}H+4n threshold.
This is the first report of a resonant state in ^{7}H.

^{7}H Levels

E(level)	J^{π}	$T_{1/2}$	Comments
0	$(1/2^{+})$	23×10^{-24} s *6*	$T_{1/2}$: from estimated (by 2003Au02) Γ=20 MeV *5* from figure 5 of 2003Ko11.

^{2}H(^{8}He,^{3}He) 2004Go26,2010Ni10

2004Go26: Deduced that the lower limit for the ^{7}H breakup energy is 50-100 keV above the ^{3}H+4n threshold.
2007Te12: Structure in missing mass spectrum includes possible ^{7}H state in 0-3 MeV range.
2007GoZY: No clear evidence for ^{7}H resonances is seen.
2010Ni10,2010NiZT: The missing mass spectrum exibits a shoulder at around 2 MeV, relative to the ^{3}H+4n threshold, as well as a maximum around 10.5 MeV.

^{7}Li(π^-,π^+) 1981Ev01,2007Fo05

1981Ev01: In this early study of the ^{7}Li(π^-,π^+)^{7}H reaction no evidence of resonances in ^{7}H was seen in the spectrum of outgoing π^+, but the histogram of the outgoing π^+ favored a final state as a triton + ^{4}n (tetraneutron) over a triton+4 neutrons or a proton+six neutrons.

2007Fo05: Some structure in the cross section is reported, but there is no explicit mention of ^{7}H states.

^{9}Be(π^-,pp) 2009Gu17

2000Ko46,2007Gu24,2009Gu17: The missing mass spectrum did not show a resonance near zero but showed evidence of two possible broad resonances near 16 and 21 MeV, with Γ=2 and 5 MeV, respectively.

^{7}H Levels

E(level)	Γ	E_{res}(^{3}H+4n)(MeV)
15×10^{3}?	2 MeV	16
20×10^{3}?	5 MeV	21

^{11}B(π^-,p^{3}He) 2007Gu24,2009Gu17

2007Gu24,2009Gu17: The missing mass spectrum shows a possible ^{7}H resonance just above threshold.

^{7}H Levels

E(level)
0?

^{12}C(^{8}He,^{13}N) 2008Ca22

2007Ca28,2007Ca47,2008Ca22: Using a , The ^{12}C(^{8}He,^{13}N)^{7}H proton transfer reaction was studied by impinging an E(^{8}He)=15.4 MeV/nucleon beam on a C_4H_{10} gas target. The ^{13}N and tritium (from ^{7}H decay) charged reaction products were detected in coincidence mode. Seven events were associated with ^{7}H. The energy of the ground state ^{7}H resonance was determined to be E_{res}=0.57 *+42−21* MeV above the ^{3}H+4n breakup threshold with a width of Γ=0.09 MeV *+94−6*. The uncertainties in E_{res} and Γ are large because of the small number of observed events.

^{7}H Levels

E(level)	Γ	E_{res}(^{3}H+4n)(MeV)	Comments
0	0.09 MeV *+94−6*	0.57 *42*	E(level): The resonance at 0.57 MeV *+42−21* above the ^{3}H+4n threshold. Γ: Γ=0.09 MeV *+94−6* gives half-life of 0.44×10^{-21} s to 15×10^{-21} s. $d\sigma/d\Omega$=40 μb/sr *+58−31*.

REFERENCES FOR A=7

1981Ev01 V.S.Evseev, V.S.Kurbatov, V.M.Sidorov, V.B.Belyaev et al. - Nucl.Phys. A352, 379 (1981).
Experimental Study of π^- Double Charge Exchange with ^{7}Li.

1985Po10 N.A.F.M.Poppelier, L.D.Wood, P.W.M.Glaudemans - Phys.Lett. 157B, 120 (1985).
Properties of Exotic p-Shell Nuclei.

2000Ko46 A.A.Korsheninnikov, M.S.Golovkov, A.Ozawa, E.A.Kuzmin et al. - Phys.Scr. T88, 199 (2000).
Excited State of ^{7}He and Its Unique Structure.

2002Ti05 N.K.Timofeyuk - Phys.Rev. C65, 064306 (2002).
Shell Model Approach to Construction of a Hyperspherical Basis for A Identical Particles: Application to hydrogen and helium isotopes.

2003Au02 G.Audi, O.Bersillon, J.Blachot, A.H.Wapstra - Nucl.Phys. A729, 3 (2003).
The NUBASE evaluation of nuclear and decay properties.

2003Ko11 A.A.Korsheninnikov, E.Yu.Nikolskii, E.A.Kuzmin, A.Ozawa et al. - Phys.Rev.Lett. 90, 082501 (2003).
Experimental Evidence for the Existence of ^{7}H and for a Specific Structure of ^{8}He.

2003Ko68 A.A.Korsheninnikov - Nucl.Phys. A722, 157c (2003).
Recent studies of exotic nuclei in Dubna and RIKEN.

2004Ao05 S.Aoyama, N.Itagaki - Nucl.Phys. A738, 362 (2004).
Systematic analyses on H- and He-isotopes by using and extended AMD approach.

2004Go26 M.S.Golovkov, L.V.Grigorenko, A.S.Fomichev, Yu.Ts.Oganessian et al. - Phys.Lett. B 588, 163 (2004).
Estimates of the ^{7}H width and lower decay energy limit.

2004Ti02 N.K.Timofeyuk - Phys.Rev. C 69, 034336 (2004).
Hyperspherical harmonics with orthogonal symmetry in the shell model approach and its application to light nuclei.

2007Ca28 M.Caamano, D.Cortina-Gil, W.Mittig, H.Savajols et al. - Phys.Rev.Lett. 99, 062502 (2007).
Resonance State in ^{7}H.

2007Ca47 M.Caamano, D.Cortina-Gil, W.Mittig, H.Savajols et al. - Eur.Phys.J. Special Topics 150, 9 (2007).
The search for ^{7}H.

2007Fo05 W.Fong, J.L.Matthews, M.L.Dowell, E.R.Kinney et al. - Phys.Rev. C 75, 064605 (2007).
Inclusive pion double charge exchange in light p-shell nuclei.

2007GoZY M.S.Golovkov, L.V.Grigorenko, A.S.Fomichev, V.A.Gorshkov et al. - Proc.Intern.Symposium on Exotic Nuclei, Khanty-Mansiysk, Russia, 17-22 July, 2006, Yu.E.Penionzhkevich, E.A.Cherepanov, Eds. p.32 (2007); AIP Conf.Proc. 912 (2007).
First Results of a ^{8}He+d Experiment.

2007Gu24 Yu.B.Gurov, B.A.Chernyshev, S.V.Isakov, V.S.Karpukhin et al. - Eur.Phys.J. A 32, 261 (2007).
Search for superheavy hydrogen isotopes ^{6}H and ^{7}H in stopped π^- absorption reactions.

2007Te12 G.M.Ter-Akopian, A.S.Fomichev, M.S.Golovkov, L.V.Grigorenko et al. - Eur.Phys.J. Special Topics 150, 61 (2007).
Neutron excess nuclei of hydrogen and helium at ACCULINNA.

2008Ca22 M.Caamano, D.Cortina-Gil, W.Mittig, H.Savajols et al. - Phys.Rev. C 78, 044001 (2008).
Experimental study of resonance states in ^{7}H and ^{6}H.

2009Ao03 S.Aoyama, N.Itagaki - Phys.Rev. C 80, 021304 (2009).
Di-neutron correlations in ^{7}H.

2009Gu17 Yu.B.Gurov, S.V.Lapushkin, B.A.Chernyshev, V.G.Sandukovsky - Physics of Part.and Nuclei 40, 558 (2009).
Search for superheavy hydrogen isotopes in pion absorption reactions.

2010Ni10 E.Yu.Nikolskii, A.A.Korsheninnikov, H.Otsu, H.Suzuki et al. - Phys.Rev. C 81, 064606 (2010).
Search for ^{7}H in ^{2}H+^{8}He collisions.

2010NiZT E.Yu.Nikolskii, A.A.Korsheninnikov, H.Otsu, H.Suzuki et al. - Proc.Intern.Symposium Exotic Nuclei, Sochi, (Russia), 28 Sept.–2 Oct.2009, Yu.E.Penionzhkevich, S.M.Lukyanov, Eds., p.47 (2010); AIP Conf.Proc. 1224 (2010).
Search for ^{7}H at RIKEN.

2011Gr13 L.V.Grigorenko, I.G.Mukha, C.Scheidenberger, M.V.Zhukov - Phys.Rev. C 84, 021303 (2011).
Two-neutron radioactivity and four-nucleon emission from exotic nuclei.

2017Au03 G.Audi, F.G.Kondev, M.Wang, W.J.Huang, S.Naimi - Chin.Phys.C 41, 030001 (2017).
The NUBASE2016 evaluation of nuclear properties.

2017Wa10 M.Wang, G.Audi, F.G.Kondev, W.J.Huang et al. - Chin.Phys.C 41, 030003 (2017).
The AME2016 atomic mass evaluation (II). Tables, graphs and references.