^{1}H(^{8}B,P) 2007Ro01,2019Ho14

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, B. Grees	ENSDF	31-July-2020

2007Ro01: Measured the elastic scattering of ^{8}B on protons using the TwinSol radioactive nuclear beam (RNB) facility at University of Notre Dame. A 29 MeV/nucleon ^{8}B beam, produced via ^{3}He(^{6}Li,^{8}B) reactions, impinged on a 9 mg/cm^{2} stopping thickness CH_2 target. Scattered protons, emerging in the forward direction were detected using a set of two ΔE-E Si detectors placed at θ=7.7°. The data were analyzed using standard thick target inverse kinematics techniques to obtain the p+^{8}B excitation function for $E_x(^{9}C)$≈1.9-4.5 MeV.

An R-matrix analysis was implemented to interpret the excitation function. In addition to the $J^{\pi}=1/2^{-}$ E_x=2.22 MeV first excited state, inclusion of a $J^{\pi}=5/2^{-}$ state at E_x=3.6 MeV *2* with Γ=1.4 MeV *5* was necessary to produce agreement between the experimental data and the fit. This $J^{\pi}=5/2^{-}$ state has a single-particle nature with a spectroscopic factor of S=0.77 *25* which is consistent with theoretical predictions. The fit was somewhat improved with the inclusion of an additional $J^{\pi}=3/2^{-}$ state at E_x≈4.1 MeV having Γ≈1.3 MeV; the followup work (2019Ho14) by the same group does not support the existence of this state.

A continuum shell model analysis of the (2007Ro01) data is presented in (2009Vo03).

2019Ho14: Studied level structure of ^{9}C using $^{8}\beta^{+}$p resonant elastic scattering using the TexAT detector at Texas A&M. A ^{8}B beam was produced via ^{6}Li(^{3}He,n)^{8}B reaction and scattered from target methane gas (CH_4). An R-matrix analysis of the E_x= 1.8-6.3 MeV excitation function was carried out, but the data couldn′t be reproduced with only the inclusion of previously reported levels. The data does not support existence of the suggested $J^{\pi}=3/2^{-}$ state at E_x=4.1 MeV (2007Ro01) nor does it support the existence of the E_x=3.30 MeV *5* state (1991Go13). In addition to the E_x=2.2 and 3.6 MeV states reported in (2007Ro01), a new $5/2^{+}$ state at E_x=4.3 MeV 3 with Γ=4.0 $^{+2.0}_{-1.4}$ MeV was observed. This new state determines the location of the 2*s* shell in the α=9, T=3/2 system. The R-Matrix fit is also improved with the inclusion of a $J^{\pi}=7/2^{-}$ state at E_x≈6.4 MeV; however, since this lies outside of the measured excitation function this suggestion remains tentative.

Related experimental studies: A study of the the reaction, via the inverse Coulomb dissociation reaction was carried out ar RIPS/RIKEN using a 65 MeV/nucleon ^{9}C beam on a Pb target. The results are analyzed to estimate the astrophysical S-factor (2000MoZP, 2002HiZZ, 2003Mo23, 2003Mo28, 2003MoZY). See other relevant theoretical discussion in (2005Ty02, 2012Fu07).

Theory:

The reaction rates for the astrophysical *hot p-p chain reactions*, ^{8}B(p,γ)^{9}C and ^{9}C(α,p)^{12}N, are estimated in (1989Wi24).

A microscopic cluster model analysis of the E1 and E2 components of ^{8}B(p,γ)^{9}C and ^{8}Li(n,γ)^{9}Li is given in (1999De03).

A potential model was developed in (2003Mo12) to analyze the ^{8}B(p,γ)^{9}C and ^{8}Li(n,γ)^{9}Li capture cross sections.

In (2002Tr14, 2006Tr07) the ^{9}C 1-proton removal data of (1997Bl08)(C, Al, Sn, Pb targets) is analyzed to obtain the Asymptotic Normalization Coefficients, $C^2(p_{3/2})$ + $C^2(p_{1/2})$=1.22 fm^{-1} *13*, and then evaluated the astrophysical S-factor. See also (2003Tr09).

In (2005Gu29, 2005Li35) the ^{2}H(^{8}Li,p) reation was measured to obtain the ^{9}Li→^{8}Li+n ANC; this value was used to estimate the ANC for ^{9}C→$^{8}\beta^{+}$p, and the astrophysical S-factor was analyzed. See additional comments in (2008Ti09, 2010Ti04, 2011No03, 2013Ti05).

A single-particle potential model was developed in (2010Hu11) to analyze ANCs and spectroscopic factors in a broad range of capture reactions.

^{9}C Levels

E(level)	J^{π}	Γ	L[#]	S	Comments
2218[†]	$1/2^{-}$[†]	52 keV	1		Γ: From (2017Br07), the R-matrix analysis was found to be rather insensitive to the width parameter.
3.6×10^{3}[‡] *2*	$5/2^{-}$[‡]	1.1 MeV *7*	1	0.8 *2*	Γ: From (2019Ho14). The standard deviation is 300 keV; see further discussion in the text including discussion on the ^{9}Li analog state. An earlier analysis in (2007Ro01) found Γ=1.4 MeV *5*. S: From (2007Ro01, 2019Ho14); see further discussion in (2009Ti11).
4.3×10^{3}[#] *3*	$5/2^{+}$[#]	4.0[#] MeV *+20−14*	0		
≈6.4×10^{3}?[#]	$7/2^{-}$[#]	≈1.1[#] MeV	1		

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^{1}H(^{8}B,P) 2007Ro01,2019Ho14 (continued)

^{9}C Levels (continued)

† From (1974Be66).
‡ From (2007Ro01).
# From (2019Ho14).