^{19}F(^{8}He,^{20}Ne) 2022Ca10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	K. Setoodehnia, J. H. Kelley, J. E. Purcell	ENSDF	28-September-2023

(2020CaZW, 2022Ca10): XUNDL dataset compiled by TUNL, 2023: The authors describe the ^{7}H nucleus as an extended pure neutron shell around a ^{3}H core in a $1/2^{+}$ ground state. The neutron pairing makes the ^{7}H nucleus a long-lived and almost-bound resonance.

In this experiment, more than 200 events were assigned to $^{7}H_{g.s.}$ (from the ^{19}F(^{8}He, ^{20}Ne) and ^{12}C(^{8}He, ^{13}N) reactions measured), which is significantly higher than any other measurement. The missing mass spectrum shows a prominent peak corresponding to the resonant formation of ^{7}H with the ^{19}F target with a small contribution from the lower tail of a 3-body non-resonant continuum, as well as a less obvious peak corresponding to the ^{12}C contribution to the production of ^{7}H. The authors deduced the spectrum of ranges (with 16 mm resolution at FWHM) for those recoils whose emission angles were between θ=45°−54° in the laboratory frame. This distribution shows two clear peaks (from ^{19}F and ^{12}C contributions) and was simulated with a Breit-Wigner probability distribution. The mass and width of the ^{7}H resonance were extracted from a log-likelihood minimization between the simulation and the measured range distribution. The result describes ^{7}H as a low-lying, narrow (due to neutron pairing) resonance with a mass of 0.73 MeV *+58−47* above the ^{3}H+4n mass and a width of 0.18 MeV *+47−16*. Owing to the large number of detected ^{7}H events, most of which came from the reactions with the ^{19}F target, the angular distribution of the ^{7}H production with the ^{19}F target was measured. The average production cross-section with ^{19}F is 2.7 mb/sr *5* between $\theta_{c.m.}$=4°−18°. DWBA calculations were performed with the code FRESCO. The data obtained with the ^{19}F target are best fitted assuming the 0^{+} ground state of ^{20}Ne and a $1/2^{+}$ ^{7}H resonance. The scaling factor deduced from normalizing the DWBA differential cross sections to the experimental ones was observed to vary between 4.5 *28* and 12.7 *61*, depending on the nuclear density used for ^{8}He.

^{7}H Levels

E(level)	J^{π}†	Γ (MeV)	L†	Comments
0	$1/2^{+}$	0.18 MeV *+47−16*	0	E_{res}(^{3}H+4n)=0.73 MeV *+58−47* from (2022Ca10). E(level): The missing mass spectrum displayed on Fig. 3 of (2022Ca10) shows two wide peaks corresponding to the production of ^{7}H from the (^{8}He,^{3}He) reactions on the ^{19}F and ^{12}C targets. These peaks are respectively ~5 MeV and several MeV wide at FWHM and are attributed to the contributions from ^{19}F and ^{12}C, respectively. Such a wide range may already include at least the first excited state of ^{7}H, which is not considered in (2022Ca10). It is unclear how (2022Ca10) extracted the energy and width of the $^{7}H_{g.s.}$ from the detector response function, and why they did not include any potential excited states. $d\sigma/d\Omega$=2.7 μb/sr *5* between $\theta_{c.m.}$=4°−18° from (2022Ca10). The spectroscopic factor deduced from normalizing the DWBA cross section to the experimental angular distribution of the ^{19}F(^{8}He, ^{20}Ne)^{7}H reaction was observed (2022Ca10) to vary between 4.5 *28* and 12.7 *61*, depending on the nuclear density used for ^{8}He in the DWBA calculation.

† From L=0 in a DWBA fit to the measured angular distribution of the ^{19}F(^{8}He,^{20}Ne)^{7}H transfer reaction data from (2022Ca10). The L=0 is inferred since the best fit for the DWBA calculation assumes that ^{20}Ne is in its ground state, and that the proton is removed from the ground state of ^{8}He (2022Ca10).