

Search for the $0^+ 5$ alpha cluster state in ^{20}Ne

Multi-alpha particle clustering in light nuclear matter has received much attention from recent theoretical investigations [1,2]. This topic of research has profound implications to the fields of both nuclear structure and nuclear astrophysics [3,4].

The primary aim of this experimental investigation was to search for the elusive $0^+ 5$ alpha cluster state in ^{20}Ne , which is expected to be found at a few hundred keV above the threshold for 5 alpha breakup in ^{20}Ne ($E_x = 19.17$ MeV) [5]. It would be an analogue to the Hoyle state in ^{12}C , which has a well established 3 alpha cluster structure [1,6]. The secondary aim was to search for new low spin states at high excitation energy in ^{20}Ne . During four weekends between April and July of 2012, the $^{22}\text{Ne}(p,t)^{20}\text{Ne}$ reaction was investigated with the iThemba LABS K600 light ion spectrometer. A 60 MeV proton beam impinged upon a ^{22}Ne gas target at lab angles of $\theta_{\text{LAB}} = (0^\circ, 7^\circ, 16^\circ, 27^\circ)$.

Performing this experiment at 0° with the (p,t) reaction provides a selective, background-free probe with adequate resolution to search for the low spin states of interest. Measurements at larger angles were necessary to characterize the spin-parities of the observed states.

Preliminary results from the analysis of these data will be presented.

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Summary

Alpha cluster models predict that ^{20}Ne will have a $0^+ 5$ alpha cluster state above the threshold for 5 alpha breakup at 19.17 MeV. The primary aim of this experiment was to search for this state using the $^{22}\text{Ne}(p,t)^{20}\text{Ne}$ reaction at 60 MeV, employing the zero degree mode of the iTL K600 spectrometer. A ^{22}Ne gas cell target was used.

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