Contribution ID: **19** Type: **not specified**

Search for the 0+ 5 alpha cluster state in 20Ne

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 ²⁰Ne, which is expected to be found at a few hundred keV above the threshold for 5 alpha breakup in ²⁰Ne (Ex = 19.17 MeV) [5]. It would be an analogue to the Hoyle state in 12C, 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 20Ne. During four weekends between April and July of 2012, the ²²Ne(p,t)²⁰Ne reaction was investigated with the iThemba LABS K600 light ion spectrometer. A 60 MeV proton beam impinged upon a ²²Ne gas target at lab angles of θLAB = (0°, 7°, 16°, 27°) .

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 20Ne 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 22Ne(p,t)20Ne reaction at 60 MeV, employing the zero degree mode of the iTL K600 spectrometer. A 22Ne gas cell target was used.

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