

A study of alpha knockout processes in alpha conjugate nuclei

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Alpha clustering in nuclei has long been a topic of interest. Numerous works, both theoretical and experimental, shown evidence for cluster behavior [1-3]. Our group has performed a series of measurements on alpha conjugate nuclei in which we have shown that alpha conjugate nuclei have a propensity to break into alpha particles or other alpha conjugate nuclei [4-6].

We have embarked on a new experiment to further elucidate alpha clustering in alpha conjugate nuclei. We employ 60 MeV/u α -particles on various alpha conjugate nuclei and search for α - α elastic collisions in the reactions. We achieve this by searching for α - α coincidences where the summed energy of two α -particles traveling at 180° in the α - α center of mass frame (identical to the nucleon-nucleon center of mass frame, $\frac{1}{2}v_p$) is equal to the beam energy. Such processes would indicate that the impinging α -particle is, indeed, colliding with an alpha particle in the target nucleus. The experiment is similar in nature to a study reported many years ago [7].

The experiment is done using NIMROD [8], a 4π array composed of Silicon detectors and CsI crystals with photomultiplier readout having angles ranging from 3.6° to 170° . Particle identification is achieved using pulse shape discrimination. For the purpose of this experiment, only the CsI detectors in the angular range of 3.6° to 90° are used. Simulations have shown that the back to back alpha particle events of interest will populate detectors in the angular region of $15 < \theta_{lab} < 90$. The detectors at the more forward angles will be read in as extra particle production may give further insight into the reaction mechanism. For example, the incoming alpha particle may knock out one alpha particle from the ^{12}C leaving an ^8Be which would subsequently decay.

We began a first survey experiment in which we bombarded the 60 MeV/u alpha particles on a ^{12}C target as well as a cellulose ($\text{C}_6\text{H}_{10}\text{O}_5$) target. The statistics are expected to be such that further beam time is necessary. The analysis of these data is in progress in order to gain a sense of the level of statistics achieved as well as to refine the experiment if necessary.

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