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A new experimental setup to measure the astrophysical 15O(α,γ)19Ne reaction rate in inverse kinematics

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The process that drives nucleosynthesis in x-ray bursts is known to be the rp-process, however questions still remain regarding the mechanism through which breakout from the HCNO cycle into the rp-process occurs. It has been suggested that breakout may occur via the ^{15}O(α,γ)^{19}Ne reaction [1]. Hydrodynamic simulations of x-ray bursts have also shown that the rate of this reaction has a significant impact on both the light curve and final isotopic abundances [2]. Consequentially, measuring this reaction rate represents a key challenge for explosive nuclear astrophysics. It has been shown that the reaction rate is dominated by a 3/2+ excited state at 4.033 MeV in ^{19}Ne [3]. For the contribution from this state to be determined, the alpha branching ratio needs to be measured precisely. However, this has proved extremely challenging due to how small the alpha branching ratio is (B˜10^{-4} [4]).

It has been shown that the ^{21}Ne(p,t)^{19}Ne reaction preferentially populates the 4.033-MeV excited state [5,6], hence this reaction was chosen to study the states in ^{19}Ne. This experiment was conducted at the Cyclotron Institute, Texas A&M. A 840-MeV, ^{21}Ne beam was impinged onto a CH_2 target and reaction tritons were detected in a silicon telescope. The recoiling heavy ions then entered the MDM spectrometer and were detected in coincidence with a new focal plane detector, consisting of two PPACs and a phoswich.

Presented here are preliminary results from the full setup experiment, as well as a test experiment of the new focal plane detector. Both the focal plane detector and Si telescope show good particle identification. This allows for the detection of both ^{15}O-t and ^{19}Ne-t coincidences, and hence, the all-important alpha branching ratio of the 4.033-MeV state in ^{19}Ne to be measured.

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