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Indirect Study of Alpha Capture on 17O for Determining the Impact of 16O on the s-Process

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Approximately half of the heavier-than-iron elements in the solar system today were made in the s-process. Of those elements, most between Iron and Strontium were made in massive stars. S-process nucleosynthesis in massive stars is driven by the reaction 22Ne(α,n)25Mg, the rate of which is enhanced by rotational mixing of 12C into the H-burning shell. However, 16O is a strong neutron poison, through the reaction 16O(n,γ)17O, and competes with the s-process. The relative rate of subsequent alpha-induced reactions on 17O has been shown to determine the efficiency of s-process nucleosynthesis in this site. However, lack of information on several resonances important to the 17O(α,n)20Ne and 17O(α,γ)21Ne reactions is a major source of uncertainty in nucleosynthesis modelling.

A series of experiments have been conducted at several laboratories around the world, aiming to measure parameters, such as spin-parities and partial widths, of the energy levels that give rise to the resonances of astrophysical interest in the two α+17O reactions. A 17O(7Li,t)21Ne experiment has been conducted at TRIUMF, using the EMMA recoil mass spectrometer and the TIGRESS gamma-ray spectrometer. The choice of a (7Li,t) measurement complements other studies by aiming to determine which energy levels contribute significantly to the 17O(α,γ)21Ne reaction and to determine their associated alpha widths. The overall goal of this experiment is the reduce the uncertainty on the estimated rate of the 17O(α,γ)21Ne reaction. Preliminary results from the analysis of this experiment, along with a summary of the current status of the other experiments shall be presented.

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