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## The energy levels of 21Ne and the s-process in rapidly rotating metal poor stars

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Observations of Ultra Metal Poor stars such as HD 221170 [1] show that the abundances of elements heavier than silver can be reliably predicted by models of nucleosynthesis. However, elements between iron and silver have much higher observed abundances than predicted by models which only consider the 'normal' r- and s-processes. A potential solution for these underestimates is an extension of the s-process to rapidly rotating metal poor stars. Whether or not these stars contribute significantly to the abundances of the lighter heavy elements depends on several nuclear reactions; of specific interest is the ratio of  $17O(\alpha,n)20Ne$  to  $17O(\alpha,\gamma)21Ne$  [2]. This ratio is important as it determines the efficiency of the s-process in these stars. However, the cross section is too low to measure directly which means we must calculate the rate based on the parameters of the relevant states.

When calculating the rates of these reactions, the spin-parities of nuclear energy levels are important as rates of reaction depend upon them. Several states within the Gamow window in neon-21 have unknown spinparities and this is a significant source of uncertainty in the model predictions [3]. In order to address this, an experiment in direct kinematics was conducted using the Enge split-pole spectrograph at the Triangle Universities Nuclear Laboratory (TUNL) [4]. A second experiment was later carried out in inverse kinematics at Argonne National Laboratory (ANL) using the HELIOS spectrometer. The aim of these experiments was to determine the unknown spin-parities relevant for nuclear astrophysics as well as constraining the neutron widths of the relevant states, via a study of the 21Ne(d,p) reaction; in both direct and inverse kinematics. The angular distribution for each state was determined and compared with Distorted-Wave Born Approximation predictions. The astrophysical motivation behind the experiment, results of the TUNL experiment and details of the ongoing analysis of data from HELIOS will be presented.

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