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Implementing an ancillary detector for DESCANT to determine neutron energies

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The study of neutron rich nuclei far from the valley of stability has become an increasingly important field of research. One of the decay mechanisms that opens when the decay Q value becomes sufficiently large is that of β-delayed neutron emission and the probability of its occurance, P_n, is important when studying the astrophysical r-process [1]. β-delayed neutron spectroscopy can also provide structural information being sensitive to the angular momentum in the process and the final state wave functions. The utilization of large scale neutron detector arrays in future experiments is imperative for these kinds of studies. One of such array is DESCANT (DEuterated Scintillator Array for Neutron Tagging) [2], designed to be coupled with the large-scale gamma spectrometers GRIFFIN [3] and TIGRESS [4] at the TRIUMF-ISAC and ISACII facilities, allowing for the study of both beta decay and reaction experiments, respectively.

The initial design of DESCANT was for the intended use as a neutron-tagging detector for fusion evaporation reactions [2] and thus obtaining precision on the neutron energy was not considered a priority. This limitation could be overcome through the use of thin plastic scintillators position in front of the DESCANT detectors. The energy of the neutrons can then be determined via the time of flight technique, similar to that implemented in the VANDLE array [5]. To investigate the viability of this augmentation, GEANT4 will be used to simulate and optimize the experimental design. A series of tests will also be performed using a single DESCANT detector and a plastic scintillator to verify the improvement in performance. The progress of both the simulations and the tests using the DESCANT detector will be discussed.

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[5] Peters, W.A., et al. Nucl Instrum Methods Phys Res A 836 (2016) 122–133.

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