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(G*) Simulating DAEMON: A new complementary neutron detector for the GRIFFIN decay station

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The study of neutron rich nuclei far from the valley of stability has become an increasingly important field of research within nuclear physics. One of the decay mechanisms that opens when the decay Q value becomes sufficiently large is that of beta-delayed neutron emission. This decay mode is important when studying the astrophysical r-process as it can have a direct effect on theoretical solar abundance calculations. In addition, by extracting data on the excited states of the nucleus via the neutron kinetic energies, structural information of nuclei can be obtained through beta-delayed neutron spectroscopy. The utilization of large-scale neutron detector arrays in future experiments is therefore imperative in order to study these beta-delayed neutron emitters.

The deuterated scintillator array, DESCANT, was designed to be coupled with the large-scale gamma-spectrometers GRIFFIN and TIGRESS at the TRIUMF ISAC-I and ISAC-II facilities, respectively. However, DESCANT was originally intended to be a neutron-tagging array for fusion evaporation reactions, and a precise measurement of the neutron energy was not considered a priority over neutron detection efficiency. This limitation could be overcome through the use of thin plastic scintillators, possibly positioned in front of the DESCANT detectors, allowing for a more in-depth analysis of beta delayed neutron emitters at the GRIFFIN decay station. Plastic scintillators are ideal for this enhancement due to their timing properties, customizability, and overall cost effectiveness. The energy of the neutrons can then be determined via the time-of-flight technique, improving the current precision of the neutron energy with the existing setup significantly. To investigate the viability of this augmentation, GEANT4 will be used to simulate and optimize the experimental design, the progress of which will be discussed.

Authors: BIDAMAN, Harris (University of Guelph); Dr GARRETT, Paul (University of Guelph); Dr BILDSTEIN, Vinzenz (University of Guelph); RADICH, Allison (University of Guelph)

Presenter: BIDAMAN, Harris (University of Guelph)

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