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Characterizing LaBr3(Ce) Detector Response for Proton Therapy Applications (student talk)

Sunday, 18 February 2018 11:00 (15 minutes)

In ion beam radiation therapy, charged particles are used to irradiate tumor cells for various malignant diseases, such as cancer. Charged particles deposit most their energy at the end of their range, producing a more sophisticated radiation profile while imparting a minimal dose to healthy tissue compared to standard photon-based radiation treatment. However, new complications emerge with ion beam therapy from the uncertainty in the stopping powers and overall range, making the dose verification for this technique rather difficult.

If a certain isotope is delivered to the tumor, one could take advantage of the fusion-evaporation reactions between the ion beam and the isotope to reproduce the dose distribution administered to the patient. The well-understood mechanisms of fusion-evaporation reactions have been a work-horse in nuclear structure experiments for many decades, and can be applied to medical physics applications. With this experimental technique, the location of the beam in the patient and the dose distribution can be monitored online (during the treatment) instead of offline (post-treatment).

Cerium-doped Lanthanum Bromide (LaBr3(Ce)) scintillators, which are typically used for electronic timing measurements in nuclear physics experiments, are also excellent candidates for measuring ion beam therapy reaction products due to their reasonable energy resolution and radiation hardness. A fast digitizer, such as the CAEN DPP-PSD, is also ideal for ion beam therapy applications as it can accept high count rates and allows to integrate the DAQ logic in a compact and cost-efficient way. The primary focus of this work will be to implement this setup at the proton therapy facility at TRIUMF, Canada's national laboratory for nuclear and particle physics, which is dedicated to treating eye melanomas. There are a number of applications in nuclear structure and nuclear astrophysics research for an auxiliary LaBr3(Ce) detector array coupled to fast-sampling digitizers at TRIUMF, such as fast-timing measurements with TIGRESS at ISAC-II and GRIFFIN and DRAGON at ISAC-I.

Preliminary results will be shown, characterizing timing and energy resolution of LaBr3(Ce) detectors in high-rate applications for both fundamental nuclear structure research and medical physics applications.

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