Diagnostics and Dosimetry for VHEE Applications

Keywords: Physics, Particle Physics, Radiation, Radiotherapy, Detectors, Electronics

In 2020, 145000 people are expected to be diagnosed with cancer in Australia alone. Developing new and effective treatment for the various forms of cancer is the subject of intense research. Recently ultra-high dose rate (UHDR) radiotherapy with Very High Energy Electron (VHEE) beams has been proposed as a potential alternative to proton/hadron radiotherapy with the ability to penetrate deeply due to the inertia of the electrons. Research into quantifying the efficacy of this new modality is and active area of research. One key aspect is the development of VHEE diagnostics and dosimetry under UHDR conditions so that the biological impact can be evaluated. There are a number of projects in this space in characterising existing dosimeters (MOSkin, Alanine, FLASH Diamond, etc) under UHDR conditions, new position or profile diagnostics techniques, more effective shielding techniques or developing practical Monte Carlo particle digital twins (GEANT or FLUKA).

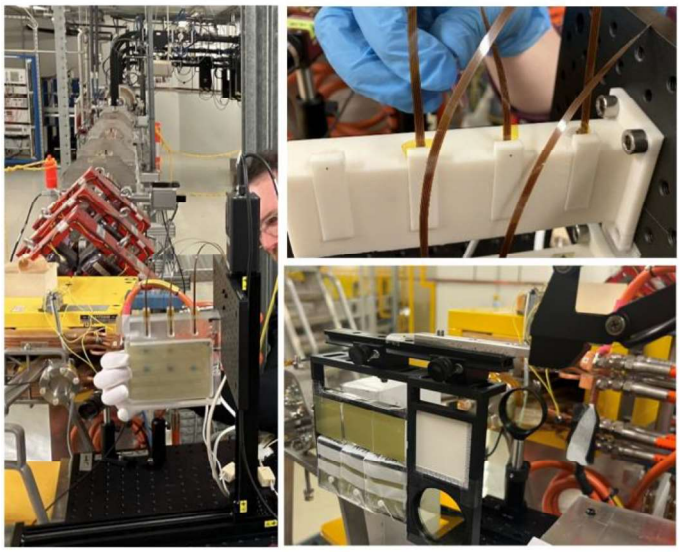

Figure 1: 100 MeV electron Linac (Left). Study of the effects of various detectors and dosimeters and biological samples to UHDR irradiation from an electron beam. Ongoing research to determine if there is electron energy and/or dose independence.

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Dosimetry for VHEE Applications

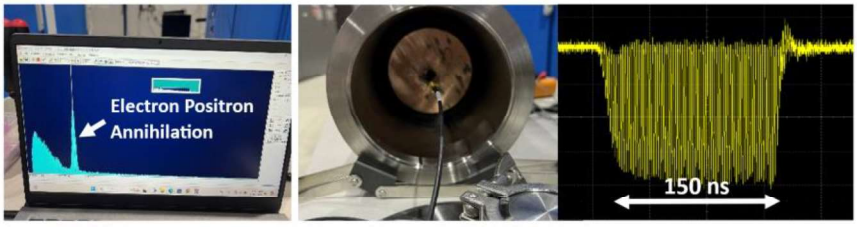

Figure 2: Developing new detection techniques from the study of copper activation (left) to building a 1 GHz BW faraday cup capable of stopping and collecting primary and secondary electrons from a 100 MeV electron beam (right).

Student Opportunities:

The student will have the opportunity to work with the operators/physicists to use PEER to design, build and/or conduct:

- experiments to characterise the MOSkin dosimeter and other varieties of dosimeters (Alanine, etc)
- position/intensity diagnostics based on Cherenkov or secondary radiation
- studies on feasibility of a user-friendly Monte Carlo particle simulator of PEER. Students will have the opportunity to work in collaboration with researchers at the University of Wollongong's Centre for Medical Radiation Physics (CMRP) and/or other universities.

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