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Integration of medical electron accelerators and MRI scanners: Next generation cancer radiotherapy

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Abstract: MRI-Linac therapy holds the promise of greatly improved cancer treatment outcomes by coupling the exquisite soft tissue contrast, high temporal resolution and functional imaging capabilities of MRI with the established therapeutic gains of radiotherapy. A prototype MRI-Linac system comprising a 1 Tesla superconducting magnet and 6MV bench top accelerator is being constructed at Liverpool Hospital. Realisation of a clinical system requires that a medical linear accelerator (linac) function within close proximity to a superconducting MRI magnet – however, many linac components are not compatible with external magnetic fields. Crucial accelerator components which do not function correctly in an external magnetic field include the linac electron gun and accelerating waveguide.
In this work, 3D computational models of the MRI magnet, electron gun, and accelerating waveguide have been developed using a variety of computational electromagnetic simulation packages. Using these models, the effects of operating an electron accelerator in the fringe field of an MRI were quantified. A first order solution to the problem is to utilise magnetic shielding; however, this introduces perturbations into the MRI field which degrades imaging performance. The design of optimal passive shielding for medical accelerators has been investigated, and its impact on magnet homogeneity studied. A more elegant solution which does not degrade magnet performance would be to redesign the accelerator such that it is inherently robust to the influence of external magnetic fields. We have proposed one such design and shown in-silico that it could be operated in a wide range of field strengths; an experimental version of this system has been constructed at SLAC National Laboratory and preliminary experimental data collected.

Profile: Brendan Whelan is a PhD student under Paul Keall at the University of Sydney's Radiation Physics Lab. His research primarily focuses on quantifying and mitigating unwanted electromagnetic coupling effects in MRI-Linac systems, with a particular emphasis on accelerator physics. He holds a Bachelor degree in Physics and a Diploma in Music from the University of Melbourne, as well as a Masters in Medical Physics from the University of Sydney.

Staff and students at all levels are welcome to attend.

Venue and Time:
This talk will be held on Thursday 6th October at 2 pm at the Campbelltown Campus in Building 21, Lecture Theatre 5 (CA.21.G.03).

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