Title: High-precision dosimetry for ultra-short, high dose-rate irradiation sources

Brief description: The projects aims at developing and testing new methods for high-precision dosimetry in a novel regime of irradiation of biological samples, with the final aim of establishing a new scheme for radiotherapeutic cancer treatment.

Laser-driven electron and photon beams can access unprecedented regimes of cell response to radiation, with the clear potential to provide significant benefit to patients undergoing radiotherapeutic treatment. In particular, we have demonstrated the possibility of delivering Gy-scale irradiations over ultra-short temporal scales, tuneable from tens of picoseconds down to tens of femtoseconds, resulting in ground-breaking dose rates in the range of 10^11 – 10^14 Gy/s, well beyond the recently discovered FLASH effect. Notably, preliminary work carried out by our group has demonstrated novel features in the response of both healthy and tumour cells, with a significant increase in sparing of healthy tissues and increase in cell killing for tumour cells.

In order to continue work in this direction, and precisely establish the effects of ultra-short irradiation on cells, it is mandatory to have precise measurements of the dose delivered to both in-vitro and in-vivo samples. While dosimetric techniques and diagnostics are well established for relatively long irradiation times, detailed work must be done to establish techniques for precise dosimetry at the sub-picosecond level.

The successful student will be jointly supervised by myself and Prof. Schettino at the National Physics Laboratory (NPL) and, while they will be based for the majority of their time at QUB, they will have placements at NPL. This work at the frontier of both radiation generation and applications will allow the student to gain expertise in a wide range of cutting-edge physical and engineering techniques, such as generating laser-driven ultra-fast radiation sources, characterising them, and developing dosimetric techniques.

Details of funding (source, confirmed/conditional): EPSRC case studentship for the duration of 3.5 years, confirmed.