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## FLASH Radiotherapy: New Paradigm, New Challenges

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Proton beam therapy (PBT) is a more advanced form of radiotherapy that allows dose to be delivered more precisely, sparing healthy tissue. In recent years there has been increasing interest in a new high dose rate form of radiotherapy called FLASH. In FLASH radiotherapy, extremely high dose rates above 40 Gy/s and delivery times below 100ms have shown exceptional reduction in damage to healthy tissue with similar tumour control to standard radiotherapy. In addition, such short delivery times have the potential to eliminate dose delivery inaccuracy related to patient movement during treatment. Research is currently underway to develop the first clinical systems capable of delivering therapeutic beams at FLASH rates with protons, electrons and photons.

Two key challenges exist in the development of FLASH PBT:

- 1) The development of accelerator systems fast enough to deliver spot-scanned PBT beams within a suitably short time frame to elicit the FLASH effect;
- 2) The improvement of diagnostic and Quality Assurance (QA) detectors capable of making dosimetric measurements at FLASH rates.

A background to PBT and the advantages over conventional radiotherapy is presented. A brief history of FLASH radiotherapy is given with a focus on progress in delivering FLASH PBT. The challenges in both accelerator and diagnostics development are outlined. Finally, the UCL QuARC project to develop a FLASH-ready QA detector for fast proton range measurements is described, with experimental results of the first clinical tests of the prototype detector system.

### Collaboration

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