Novel Silicon-based Beamline Monitors for Medical Accelerators

Roland Schnuerer
Cockcroft Institute and University of Liverpool, Warrington, UK

Cancer is a major societal problem, and it is the main cause of death between the ages 45-65 years. In the treatment of cancer, radio therapy (RT) plays an essential role. RT with hadrons (protons and light ions), due to their unique physical and radiobiological properties, offers several advantages over photons for specific cancer types.
Online beam monitoring in medical accelerators is essential in assuring patient's safety as well as high quality and efficacy of cancer treatment. Charged particle beams deposit the highest energy transfer at the end of their path in the patient's tissue. Hence, beam energy and energy spread; position and lateral profile of the beam as well as the beam current have to be precisely determined and recorded.

A new non-invasive method for dose online monitoring is presented. It is based on the silicon multi-strip sensor LHCb VELO (VErtex LOcator), developed originally for the LHCb experiment at CERN. The semi-circular detector geometry offers the possibility to measure beam intensity through halo measurements without interfering with the beam core. For the envisaged integration of VELO into a medical beamline, changes in the original design were necessary and are discussed. The stand-alone system was recently tested at a 40 MeV proton beamline and initial results are shown.

Further planned measurements at the 60 MeV proton Eye therapy Clatterbridge Cancer Centre (CCC) will allow to establish a halo-dose correlation data base and is used for benchmarking beam tracking simulations. Additionally to the VELO detector, a Medipix^3 solid state hybrid X-ray pixel detectors will be used, providing complementary information about the beam's properties.
The aim is to combine these highly advanced sensor techniques into one comprehensive monitoring solution for proton and heavy ion beams in treatment beamlines, effectively reducing quality assurance times and allowing the treatment of more patients.