

Fibre sensors for in vivo dosimetry during radiotherapy

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Radiotherapy is the use of ionising radiation for the treatment of cancer, and it is involved in the treatment of over 40% of cancer patients. Radiotherapy is delivered in the form of external beam radiotherapy, using linear accelerators (linacs), or brachytherapy, which involves the positioning of radioactive sources in, or near to, the tumour. Recent developments in treatment planning require dedicated Quality Control programs of radiotherapy machines in order to estimate correctly the dose delivery. Indeed, knowledge of the radiation dose to critical structures is necessary to ensure that side-effects can be minimised both in case of radiotherapy or brachytherapy, while maintaining an adequate standard of treatment. In particular, current in-vivo measurements of treatment dose are confined to the skin of the patient, either to confirm the radiation dose within the treatment field, or to measure doses delivered to sensitive organs.

In-vivo measurements are made possible by the novel sensor proposed and studied by a collaboration between University of Limerick (Ireland) and University of Insubria (Italy). It consists in a “pointlike” fast scintillator tip integrated in a clear fibre, conveying the light to a Silicon PhotoMultiplier (SiPM). The small dimensions of the optical fibre dosimeter make them suitable for minimally invasive in vivo applications. This would allow the radiation dosimeter to be placed either directly into or in close proximity to the tumour. In the case of a brachytherapy it can be implanted alongside the radioactive sources, in order to provide real-time dosimetric information in close proximity to the implants, in the tumour itself, or critical tissues requiring monitoring.