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Applied physics in the clinic: monitoring radiation doses delivered to cancer patients

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There is a long tradition of using applied physics to improve medicine. Over the years, several new treatments and new diagnostic tools have been developed by physicists. However the clinical world is much different from the laboratory. Thus, even if there are numerous opportunities for physicists in the field of medicine it can sometimes be challenging to seize them.

In this context, this paper will present how physicists can make a meaningful contribution in the clinic by illustrating the feasibility by focussing on a single clinical challenge: the precise monitoring of radiation doses delivered to cancer patients. Radiation treatments have substantially improved in recent years. It is now technically possible to irradiate a small tumor to high doses while preserving healthy tissues surrounding the tumor. However, these high conformity treatments can be taxing for the delivery equipment. Furthermore, patients are rarely static; a patient's movement or anatomical changes could cause a treatment to miss its intended target. Thus, there is a need to verify that doses are delivered accurately and exactly as planned. Three strategies for monitoring dose received by patients will be presented: (1) development of a new instrument (a multipoint scintillation dosimeter) to measure radiation on the patient; (2) an image processing and data analysis workflow to track the evolution of a patient's morphology during treatments and (3) a purely clinical, retrospective analysis to assess potential side effects of radiation treatments. In each case, the physicist's role varies greatly. However, in all three strategies, a close collaboration between physicists and clinicians, as well as industrial partners, is necessary for success.

By looking at concrete examples of applied physics for medical applications, I hope to help demystify the clinical world and show how physicists can work to improve patient care.

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