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Radiation detectors for advanced particle therapy

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New detection systems for microdosimetry and FLASH therapy have been developed and successfully tested at the Orsay Proton Therapy Center (CPO, France) and the National Metrology Institute (PTB, Germany) respectively. They are based in novel silicon 3D-cylindrical microdetectors and silicon carbide (SiC) designed and manufactured at the Centro Nacional de Microelectrónica (IMB-CNM, CSIC) in Barcelona, Spain.

On the one hand, the former has a cylindrical shape with a size comparable to that of the nuclei of human cells (20 µm-thick, 25 µm-diameter). On the other hand, the SiC is a very promising material for hard radiation detectors, as those required in FLASH therapy. Both detectors have been specifically customized for being used in particle therapy, overcoming some of the technological challenges in this domain, namely the low noise capability, well-defined sensitive volume, high spatial resolution and pile-up robustness.

We present here the results of the first dosimetry measurements performed with both detectors in standard proton therapy and FLASH conditions. Both systems can have a positive impact in clinical treatments: the Si microdosimeters can reduce the radiobiological uncertainties in the normal tissue surrounding the target by allowing for further RBE calculations; the SiC detectors aim to be the first active dosimeter working at ultra-high dose rates. Additionally, it can be employed for commissioning accelerators and radiation protection for spacecraft, i.a.

Abstract

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