

Vertexing and tracking in hadrontherapy

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Hadrontherapy represents a remarkable example of the interdisciplinary collaboration between nuclear physics and medicine. Proton and carbon ion beams are used in the clinical practice for external radiotherapy treatments achieving, for selected indications, promising and superior clinical results with respect to X-ray based radiotherapy. At the same time, the accurate dose delivery is more sensitive to the patient positioning and to anatomical variations with respect to photon therapy. In order to fully exploit the advantages of ion beams in the clinical practice, the development of novel techniques to monitor the beam range and the dose release during the patient treatment is highly demanded. Several non-invasive monitoring strategies based on tracking and vertexing of secondary radiation exiting the patient have been proposed, \textit{e.g.}, prompt gamma, charged secondaries and beta+ emitters, and will be reviewed together with future directions.

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