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Geant4 studies of the CNAO facility system for hadrontherapy treatment of uveal melanomas

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The Italian National Centre of Hadrontherapy for Cancer Treatment (CNAO –Centro Nazionale di Adroterapia Oncologica) in Pavia, Italy, has started the treatment of selected cancers with the first patients in late 2011. In the coming months at CNAO plans are to activate a new dedicated treatment line for irradiation of uveal melanomas using the available active beam scan. The beam characteristics and the experimental setup should be tuned in order to reach the necessary precision required for such treatments. Collaboration between CNAO, University of Pavia and INFN has started in 2011 for studying the feasibility of these specialized treatments with the aim of implementing a detailed simulation of the beam-line and comparing the obtained simulation results with the test measurements at CNAO. The goal is to optimize a new dedicated beam-line and to find the best conditions for an optimal patient irradiation. The application studied in this paper describes the simulation with the Geant4 tool of the CNAO setup with the passive/active components on the expected beam-line as well as a modeled human eye with a tumour inside. The simulation tool could be also used to test possible treatment planning systems. The results illustrate the possibility to adapt the CNAO standard transport beam line. With the suggested modifications studied in this paper for dose delivery, uveal melanoma in human eye could be treated by optimizing the positioning of the present passive elements on the standard line and with the addition of new passive elements to better shape the beam for this dedicated study.

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