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Investigations on physical and biological range uncertainties in Krakow proton beam therapy centre

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The physical and biological range uncertainties are limiting the clinical potential of proton beam therapy (PBT). Our research activities aim at developing software tools and detector instrumentation to tackle the problem of beam range uncertainties in the clinic. We will present research activities performed by our group within national and international collaborations in the perspective of recent advances in the field of proton therapy medical physics.

We will report on our development and pre-clinical application of a GPU-accelerated Monte Carlo (MC) simulation toolkit FRED. The MC based recalculation of patient treatment plans with variable radiobiological effectiveness is an essential input for medical doctors and physicists and can support PBT treatment planning. Taking advantage from the FRED time performance we aim to improve quality assurance efficiency in Krakow PBT facility. The software tools and procedures developed are currently integrated into the cancer patient treatment procedures to fully exploit the advantages of proton beams in the clinic.

We will report on our investigations of plastic scintillator based PET detectors for monitoring of particle therapy delivery. We study the feasibility of Jagiellonian-PET detector technology for proton beam therapy range monitoring by means of MC simulations of the β^+ activity induced in a phantom using proton beams. The experimental validation and image reconstruction activities are ongoing.

Using a GPU-accelerated Monte Carlo simulation toolkit FRED and plastic scintillator based PET detectors we aim to improve patient treatment quality with protons.

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