

State-of-the-art and physics research opportunities in ion beam therapy

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Owing to the favorable physical and biological properties of swift ions in matter, their application to radiation therapy for highly selective tumour treatment is rapidly spreading worldwide. To date about 70 ion therapy facilities are treating patients, predominantly with proton beams, and about the same amount is under construction or planning. In Germany, already 3 proton therapy facilities and 2 combined proton and carbon ion beam therapy centers are operational.

Over the last decades considerable developments have been achieved in accelerator technology, beam delivery and medical physics to enhance conformation of the radiation dose to complex shaped tumour volumes, with excellent sparing of surrounding normal tissue and critical organs. Nevertheless, full clinical exploitation of the ion beam advantages is still challenged especially by uncertainties in the knowledge of the actual dose delivery during the fractionated course of treatment, thus calling for continued multidisciplinary research in this rapidly emerging field.

This talk will review the state-of-the-art in ion beam therapy, giving particular emphasis to remaining challenges with related opportunities for a broad spectrum of ongoing physics-based research activities, spanning from computational modeling to detector developments and imaging methods for beam characterization and in-vivo visualization.