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Radiation Protection for Particle Therapy Facilities

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During last years the construction of clinical proton and ion accelerators for applications in tumour therapy makes great strides. Based on encouraging results for tumour treatments in particle therapy in the past more and more facilities are presently installed worldwide.
Due an enumeration of particle therapy facilities given by the PTCOG (Particle Therapy Cooperative Group) 44 facilities are in operation or under construction and 8 facilities are planned in 16 countries (February 2010). The objective of this contribution is to give a summary of radiation protection related issues of particle therapy facilities. This comprises the discussion of radiation sources in different kind of facilities, cyclotron and synchrotron installations as well as the description of various types of beam forming systems (passive and active) and its shielding. Neutron radiation sources – the crucial radiation component - are described in terms of positions in the facility of intended and undesir-able, but unavoidable, beam depositions. Neutron energy distributions are quoted for various particle target combinations in the energy range of interest. Characteristics and differences of source distributions with impact on the architectural shielding design for diverse beam types (essentially for proton and carbon ion beams) are discussed.
Depending on the stage of the project different kinds of methods for the estimation of radiation levels outside the shielding are applied. An outline for the so called line-of-sight models, which are often used for the first architectural shielding layout (for instance) for cost estimates, will be given. Models for carbon ion beams are stressed. Examples for the more elaborated but more exact method of Monte Carlo radiation transport calculations are presented. Shielding layouts based on combined materials, high Z and low Z, are shown for cases when space for shielding is limited which is quite common for treatment facilities. Examples for particle treatment facilities including its shielding conception are presented for both, proton and carbon ion installations with an emphasis for the distinction of the architectural shielding layout of both installation types.
Furthermore radiation protection issues have to be considered as e.g. the exposure of per-sonal working at and with activated components during maintenance and shut-down periods. Finally it will be reported on new accelerator developments which might play an important role in future particle therapy as e.g. laser driven particle accelerators.

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