GSI – **SEMINAR**

Im KBW - Hörsaal

Darmstadt, Planckstraße 1

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“3D range-modulator for scanned particle therapy: development, Monte Carlo simulations and experimental evaluation“

Pencil beam scanning is the state-of-the art in particle therapy and leads to dose distributions with high level of conformity and homogeneity. However, it hasn’t yet established in the treatment of moving targets, due to the large number of different iso-energy layers and the associated long irradiation time. The combination of only one energy and a so-called 3D range-modulator results in a tremendous decrease in irradiation time, thus making delivery of homogeneous dose to moving targets (e.g. lung cancer) more reliable.

As a proof of concept, a 3D range-modulator was developed for a spherical target volume with a diameter of 5 cm, placed at a depth of 25 cm in a water phantom. It consists of a large number of thin pins with a well-defined shape and different lengths to modulate the necessary shift of the Bragg peak. The 3D range-modulator was manufactured with a rapid prototyping technique.

The FLUKA Monte Carlo package was used to simulate the modulating effect of the 3D range-modulator and the resulting dose distribution. For that purpose, a special user routine was implemented to handle its complex geometrical contour. Additionally, FLUKA was extended with the capability of intensity modulated scanning. To validate the simulation results, dose measurements were carried out at the Heidelberg Ion Beam Therapy Center with a 400.41 MeV/u ^{12}C beam. The high resolution dosimetric measurements show a good agreement between simulated and measured dose distributions. Irradiation of the monoenergetic raster plan took 3 seconds, which is approximately 20 times shorter than a comparable plan with 16 different energies. The combination of only one energy and a 3D range-modulator leads to a tremendous decrease in irradiation time. “Interplay effects”, typical for moving targets and pencil beam scanning, can be immensely reduced or disappear completely, making the delivery of a homogeneous dose to moving targets more reliable. Combining high dose conformity, very good homogeneity and extremely short irradiation times, the 3D range-modulator is considered to become a clinically applicable method for very fast treatment of lung tumours.

Einladender: Dr. Michael Scholz

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