ST 6: Heavy Ion Therapy and Related Basic Research II

Time: Tuesday 11:30–12:45 Location: H 2033

ST 6.1 Tue 11:30 H 2033

Particle-induced visual sensations in heavy-ion tumor therapy — •Oksana Kavatsyuk[1,2], Dieter Schardt[1], and Michael Krämer[1] — [1]Gesellschaft für Schwerionenforschung (GSI), Darmstadt, Germany — [2]National T. Shevchenko University of Kyiv, Ukraine

Many patients with tumours located in the skull base reported visual sensations ("phosphenes") during radiation therapy with ^{12}C ions at GSI Darmstadt. These effects, mostly described as streaks moving through the field of vision, occur only during well-defined time-phases of the raster-scan irradiation and they are related to the actual position and stopping range of the pencil-like ion beam. An attempt was made to correlate the phosphene observations with temporary local dose deposition near the eyes or sensitive structures of the visual system. First results based on a pushbutton study with a total of 39 patients indicate that phosphenes are mainly stimulated by local dose deposition in the eye or substructures in the eye (presumably the retina). No phosphenes were observed in a number of cases, where the optic nerves were located partly in the treatment volume but the eyes were clearly outside the radiation field.

ST 6.2 Tue 11:45 H 2033

Evaluation of motion tracking by cell survival measurements — •Alexander Schmidt[1], Christoph Bert[1], Nami Saito[1], Naved Chaudhri[1], Cläre von Neubeck[1], Gheorghe Iancu[1], Dieter Schardt[1], and Eike Rietzel[1,2] — [1]GSI, Abt. Biophysik, Planckstr. 1, 64291 Darmstadt, Germany — [2]Siemens Medical Solutions, Particle Therapy, Hofmannstr. 26, 91052 Erlangen, Germany

At GSI patients with stationary tumors are treated with a raster-scanned carbon ion beam. For moving targets interplay possibly deteriorates the dose distribution because target motion and scanner motion interfere. Several motion mitigation techniques are proposed to solve this problem (see Bert et al., this conference). We use a fully integrated 3D online motion compensation system (see Saito et al., this conference) to track target motion of phantoms which includes adaptation of the Bragg peak position.

To validate motion tracking with biological systems we conducted a series of repetitive experiments with hamster cells grown in wellplates. The wellplates were placed on a sliding table to induce lateral as well as longitudinal motion. Irradiations were performed with stationary wellplates and by tracking moving wellplates. Multiple samples were irradiated to gain statistics.

As a result, we observed no significant difference in cell survival between the motion compensated measurements in comparison to a stationary reference irradiation. We conclude that our motion compensation system allows correct delivery of the biologically effective dose to moving phantoms.

ST 6.3 Tue 12:00 H 2033

Precision measurements of Bragg curves of light-ion beams in water — •Peter Steidl[1], Dieter Schardt[1], Uli Weber[1,2], Gheorghe Iancu[1], and Michael Krämer[1] — [1]Gesellschaft für Schwerionenforschung, Planckstr. 1, D-64291 Darmstadt, Germany — [2]Rhön-Klinikum AG, Baldingerstraße, D-35043 Marburg, Germany

Depth-dose distributions in water (Bragg curves) are of key importance for validation of the physical models used for treatment planning in tumor therapy with high-energy light-ion beams. A new series of precision measurements of pristine (unmodified) Bragg curves was carried out for protons, ^{3}He, ^{7}Li, ^{12}C and ^{16}O beams at energies from 100 to 400 MeV/u delivered by the heavy-ion synchrotron SIS18 at GSI Darmstadt. The relative ionization was measured as a function of water depth using two parallel-plate ionization chambers placed upstream (for normalization) and downstream of a computer-controlled water absorber of variable thickness. The experimental Bragg curves are compared to calculations performed with the treatment planning code TRiP [1, 2]. The stopping power calculations used in TRiP are based on the code by Salamon [3]. Slight modifications were applied in order to improve the agreement with the measured absolute positions and widths of the Bragg peaks for ^{12}C therapy beams which are used for patient treatments at GSI.

[1] M. Krämer et al., Phys Med Biol. 45(11):3299-3317 (2000)
[2] M. Krämer et al., Phys Med Biol. 45(11):3319-3330 (2000)
[3] M.H. Salamon, LBL Report 10446 (1980)

ST 6.4 Tue 12:15 H 2033

Fragment distributions of plasmid DNA analyzed by AFM - Local Effect Model for a freely jointed chain of monomers — •Thilo Elsässer[1], Katarzyna Psonka[2], Michael Scholz[1], Ewa Gudowska-Nowak[2], and Gisela Taucher-Scholz[1] — [1]Gesellschaft für Schwerionenforschung, Biophysics, Planckstr. 1, 64291 Darmstadt — [2]Marian Smoluchowski Institute of Physics, Jagiellonian University,

The investigation of fragment length distributions of plasmid DNA gives insight into the influence of localized energy distribution on the induction of DNA damage, particularly the clustering of double strand breaks. We present an approach that determines fragment length distributions of plasmid DNA by using the Local Effect Model applied to a freely jointed chain of monomers as the traget model. We find a good agreement of our simulations with experimental fragment distributions derived from Atomic Force Microscopy (AFM) studies by including experimental constraints typical for AFM into the model calculations. The results of the model calculations can be used to determine the optimal parameters for future experiments. Additionally, we compare the results of our model for two different plasmid geometries.

ST 6.5 Tue 12:30 H 2033

Development of new techniques to arrange and recognise cells for radiobiological ion micro beam experiments — •Torsten Koal, Marcus Hohlweg, Tilo Reinhard, and Tilman Butz — Universität Leipzig, Inst. Exp. Phys. II, Linnéstr. 5, 04103 Leipzig, Germany,

Up to a few references the signal ways of the cell-cell-communication (Bystander effects) in micro beam experiments are still unknown. There exist possibilities for both, direct cell-cell-communication via gap junctions as well as a media-provided cell-cell-communication. A promising beginning for the investigation of the communication ways is the compartmentalization of Petri dishes. The compartmentalization allows spatially separated cell-subpopulations to communicate indirectly via medium born factors only. Therefore, Agar, a polysaccharide, was spin coated on Mylar or silicon nitride (Si_3N_4) irradiation windows. The compartmentalization was realized by proton beam writing on the cell repellent substrate Agar. Then the irradiated areas are soluble in water. It could be shown that cells exclusively grow in the Agar depleted areas.

For future targeted irradiation of defined grown cells, a recognition software named Cellcognition is being developed and will be tested in the next time.