ST 8: Radiation therapy II

Time: Thursday 11:00–12:00 Location: ST-H4

ST 8.1 Thu 11:00 ST-H4

Development of an end-to-end verification method for Gamma Knife treatments — Irenäus Adamietz[2,3], Jan Boström[2,3], Moritz Budde[3], •Feline Heinzelmann[1], and Kevin Kröninger[1] — [1]TU Dortmund University, Department of Physics, Dortmund, Germany — [2]University Hospital at Ruhr-Universität Bochum, Gamma Knife Zentrum, Bochum, Germany — [3]Marien Hospital Herne, University Hospital at Ruhr-Universität Bochum, Clinic for Radiotherapy and Radiation Oncology, Herne, Germany

Gamma Knife is a stereotactic radiosurgery (SRS) instrument using Cobalt-60 radiation sources to treat malign and benign brain tumours and other skull base disorders. With the introduction of inverse radiation planning, which has recently been adopted in Gamma Knife treatment, dose verification is recommended for Gamma Knife radiosurgery. Such plan verification is already standard practice for other teletherapies. For plan verification in Gamma Knife therapy, a new SRS phantom based on film dosimetry and an end-to-end verification protocol has been developed and implemented. The gamma analysis is used to evaluate the conformance between the measured dose distribution and the dose distribution calculated by the radiation planning system. The focus of this lecture is on the adaptations of the standardized plan verification method to stereotaxy and the associated challenges such as the small target volumes and the high applied dose, which demand high accuracy.

ST 8.2 Thu 11:15 ST-H4

Simulations of silicone-tungsten shieldings for ruthenium eye applicators — •Justine Gemmecke[1], Henning Manke[1], Michelle Stroth[1], Saskia Müller[1], Dirk Flühs[2], and Bernhard Spaan[1] — [1]Experimental Physics 5, TU Dortmund — [2]Department of Radiotherapy, University hospital Essen

Brachytherapy with Ruthenium-106 eye plaques is a standard treatment modality for ocular tumours. A silver calotte with an integrated Ruthenium-106 layer is attached to the patient's eye for a calculated duration, applying the prescribed dose in order to destroy the tumour tissue. Surrounding healthy tissue and high-risk organs should be spared as much as possible.

To optimize the protection of healthy tissue, precision fit shieldings made of a silicone-tungsten mixture, fixed to the eye plaque surface, are currently being developed. Their dosimetric properties are investigated by means of both simulations in Geant4 and measurements in a water phantom. Simulations based on real patient data also allow retrospective estimation of the dose distribution to the tissue, measuring dose-volume histograms of the irradiated area and an evaluation of the effect of the shielding under clinical conditions.

When developing patient individual shieldings, two main aspects have to be considered. First, the highest possible tungsten fraction in the shieldings has to be determined in order to achieve the maximal protection of the healthy tissue. Second, an easy manufacturing process has to be developed to apply this technique to the clinical routine.

ST 8.3 Thu 11:30 ST-H4

A combination of Brachy- and X-ray-therapy as a novel concept for intraocular tumors — •Henning Manke[1], Dirk Flühs[2], Justine Gemmecke[1], Saskia Müller[1], Michelle Stroth[1], and Bernhard Spaan[1] — [1]Experimental Physics 5, TU Dortmund — [2]Department of Radiotherapy, Essen University Hospital

Eye plaque brachytherapy with the beta emitter Ruthenium-106 is applied to a large fraction of ocular tumors. Due to the emitted particles' steep dose gradient, there is a limitation to the clinically treatable tumor height. Depending on the indications, eyes affected by a tumor larger than the maximum height have to be enucleated in many cases, especially if located close to the posterior pole. As this massively impairs the patients' quality of life, a novel concept to treat such tumors is currently investigated.

External photon irradiation through insensitive parts of the eye can be used to enhance the applied dose at the tumor apex. A confocal irradiation concept results in a low exposure of healthy tissue while the tumor control dose can be reached in all parts of the target volume. The X-ray therapy can be performed while the Ruthenium-plaque is positioned on the eye. Therefore the plaque itself, which is mainly made of silver, can be used as a beam stopper. This leads to an additional significant reduction of dose in the healthy tissue behind the tumor.

This contribution presents the general concept of the combined therapy, our methods to examine the physical and radiobiological properties and first results.

ST 8.4 Thu 11:45 ST-H4

Monte Carlo simulations of a combination of brachytherapy and external X-ray irradiation for the treatment of intraocular tumors — •Michelle Stroth[1], Henning Manke[1], Justine Gemmecke[1], Saskia Müller[1], Dirk Flühs[2], and Bernhard Spaan[1] — [1]Experimental Physics 5, TU Dortmund — [2]Department of Radiotherapy, University hospital Essen

Brachytherapy with ruthenium-106 eye plaques is a standard modality for the treatment of intraocular tumors. In order to ensure a sufficient tumor apex dose even in larger tumors without exceeding dose limits at neighboring organs at risk, the concept of combining eye plaque brachytherapy with an external beam from a precisely positioned X-ray tube is currently being investigated.

For this purpose, a generic eye model is created using the CAD software Fusion 360 and adapted to the data of real patient cases. The area of the exit window of the X-ray tube is created for various positions depending on the tumor apex, so that different directions of photon irradiation are simulated. A decomposition of the model into many sub-volumes and their implementation in a Monte Carlo simulation in Geant4 allows the analysis of local dose profiles and dose-volume-histograms in organs at risk and the tumor.

This presentation shows the setup of the simulation and first results of combining brachytherapy with external X-ray irradiation.