AbstractID: 4585 Title: Image-guided IMRT and very high energy electrons (VHEE)

Purpose: To evaluate the feasibility of very high-energy electron beams (VHEE, 150 - 300 MeV) for radiotherapy. The specific goal is to exploit fast scanning capabilities of pencil VHEE beams for better targeting of moving tumor tissue and moving sensitive organs in 4D image guided intensity modulated radiation therapy (IGIMRT).

Method and Materials: VHEE have dosimetric characteristics comparable, and for some applications superior, to photon beams. The dosimetry of the VHEE treatments can be verified by means of Monte Carlo simulations. The dosimetry of the VHEE treatments for moving tissues requires the knowledge of body geometries in subsequent phases of cyclical motions of regions of patient body that undergo treatment. The mutual interaction of doses delivered at different phases allows for optimal treatment in 4D radiation therapy. Therefore, optimization of 4D radiation therapy involves calculating jointly the set of all intensities at all phases of the cyclical tissue motion. This in turn means that optimal 4D IGIMRT plans require delivery of intensity maps that appropriately distribute given fractions of intensity maps over particular phases of moving tissues. Existing delivery systems for IMRT therapy (step and shoot IMRT and/or DMLC IMRT) are not capable of efficient delivery of predetermined by 4D IGIMRT planning “intensity map rates”. In contrast, fast scanning beam of VHEE electrons provides ideal tool for 4D IGIMRT delivery.

Results: A sequence of dose calculations for representative VHEE beams are presented and compared with traditional photon beam irradiations. Examples illustrating VHEE intensity rate maps for delivery of optimal 4D IGIMRT are presented and their delivery discussed in the context of MLC and electromagnetic pencil beam scanning capabilities of radiation devices.

Conclusion: VHEE devices, capable to provide fast, electromagnetic scanning of pencil beams, are capable to efficiently deliver “intensity rate maps” of truly optimized 4D IGIMRT treatments.