Abstract ID: 16557 Title: Pilot study for the development of clinical microbeam radiation therapy using a carbon nanotube field emission micro-CT scanner

Purpose: The possibilities of microbeam radiation therapy (MRT) up until now have mainly been studied using synchrotron sources due to their high flux (100s Gy/sec) and approximately parallel X-ray paths. We wish to show that both of these advantages are also attainable with the use of carbon nanotube (CNT) field emission based X-ray source arrays, and that by using this type of source a compact MRT system may be possible.

Methods: The study was performed with our CNT micro-CT scanner (100µm focal spot). A microbeam collimator alignment assembly with the capability to collimate and superimpose beams coming from different gantry positions was fabricated and attached to the scanner. Two orthogonal dosimetric films (Gafchromic EBT2) were embedded inside a cylindrical phantom to record the MRT dose distribution. Microbeams were fired at this target from 44 different entry angles to simulate an array of sources. In a separate experiment, phantom translation was used to simulate multiple parallel beams.

Results: Forty-four beams were superimposed in the phantom to produce a single microbeam dose profile with a FWHM of 310µm (expected value was 280µm) indicating proper collimator alignment. A new MRT-specific tube was proposed and commissioned based on the preliminary experimental results and the corresponding Monte Carlo simulations. The estimated dose rate for this proposed tube was calculated to be over 100 Gy/sec from these initial measurements. Also, during the multiple beam simulation, a reasonable peak to valley dose ratio (~12) was found when the translation distance was roughly 4x the beam width.

Conclusions: We have shown that it will not only be possible to create microbeams with our CNT sources, but that the flexibility of these field emission sources will open the field of MRT study to the larger research community and possibly bring effective and compact MRT devices to the clinical environment.