Abstract ID: 16777 Title: Development and characterization of a prototype compact microbeam radiation therapy device based on carbon nanotube field emission x-ray source technology

Purpose:
The use of spatially fractionated, ultra high flux arrays of microplanar X-ray beams (MRT) has been shown by research groups at various synchrotron facilities to cause significant damage to radioresistant brain tumors while leaving normal tissue relatively unscathed. We wish to show that our development of a compact MRT device using carbon nanotube (CNT) field emission X-ray technology has the capability to produce dose distributions in phantoms similar to that of synchrotron-generated microbeams while maintaining a reasonably high dose rate.

Methods:
CNT Cathodes were arranged in a linear array and electrostatically focused onto a reflection type tungsten target held at 160kV. A microbeam collimator assembly perpendicular to the anode plane was used to select a slice of the resulting wedge shaped radiation pattern. The collimated microplanar beam was projected onto a cylindrical phantom, slicing through it at 10 degrees. Two orthogonal dosimetric films were placed in the phantom to measure percentage depth dose and microbeam profile.

Results:
With initial limitations caused by an inadequate power supply, an instantaneous microbeam dose rate of 12Gy/min was achieved . This translates to continuous dose rate of 21Gy/min at full power and maximum duty cycle. The microbeam profile showed a 350um FWHM with initial calibration and sub-optimal system configuration. With further optimization, we expect to be able to achieve a smaller beam profile and double the dose rate.

Conclusions:
Based on the initial data, we strongly believe that we will be able to deliver high enough doses in microbeam distributions for preliminary biological studies with this first generation device. Finally, based on lessons learned during the construction of this first small-scale MRT irradiator, we have already started designs of a first revision with which we hope to produce multiple thinner lines of radiation while maintaining a high enough dose rate for comparison studies.