THE UNIVERSITY OF TEXAS MD Anderson Cancer Center

Validation of the Use of OSLD for Carbon Beam Remote Dosimetry

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Purpose/Objective: To describe the commissioning of Aluminum Oxide Optically Stimulated Luminescent Dosimeters (OSLD) for the use in carbon beam remote dosimetry for centers participating in NCI-funded cooperative group clinical trials.

Innovation/Impact: The NRG Oncology cooperative group is developing NCI clinical trials that would include carbon radiotherapy as a treatment modality. As such, carbon therapy centers would be required to undergo remote output checks by the Imaging and Radiation Oncology Core (IROC) Houston QA Center (formerly the RPC). IROC Houston is developing remote audit tools to ensure the comparability of dose delivered at carbon therapy institutions to that delivered at photon and proton therapy institutions participating in clinical trials. The primary focus of this study is the commissioning of IROC Houston's OSLD system for use in remote carbon beam output checks.

Methods & Materials: IROC Houston's OSL dosimetry system has been commissioned for photons, electrons and protons. IROC Houston uses nanoDot OSL dosimeters from Landauer. The dosimeters contain an Aluminum Oxide crystal lattice that is read using UV light. An experiment was designed to commission the same dosimeters for carbon.

Figure 1. Setup for carbon OSLD irradiations, with variable acrylic buildup used for each maximum energy.

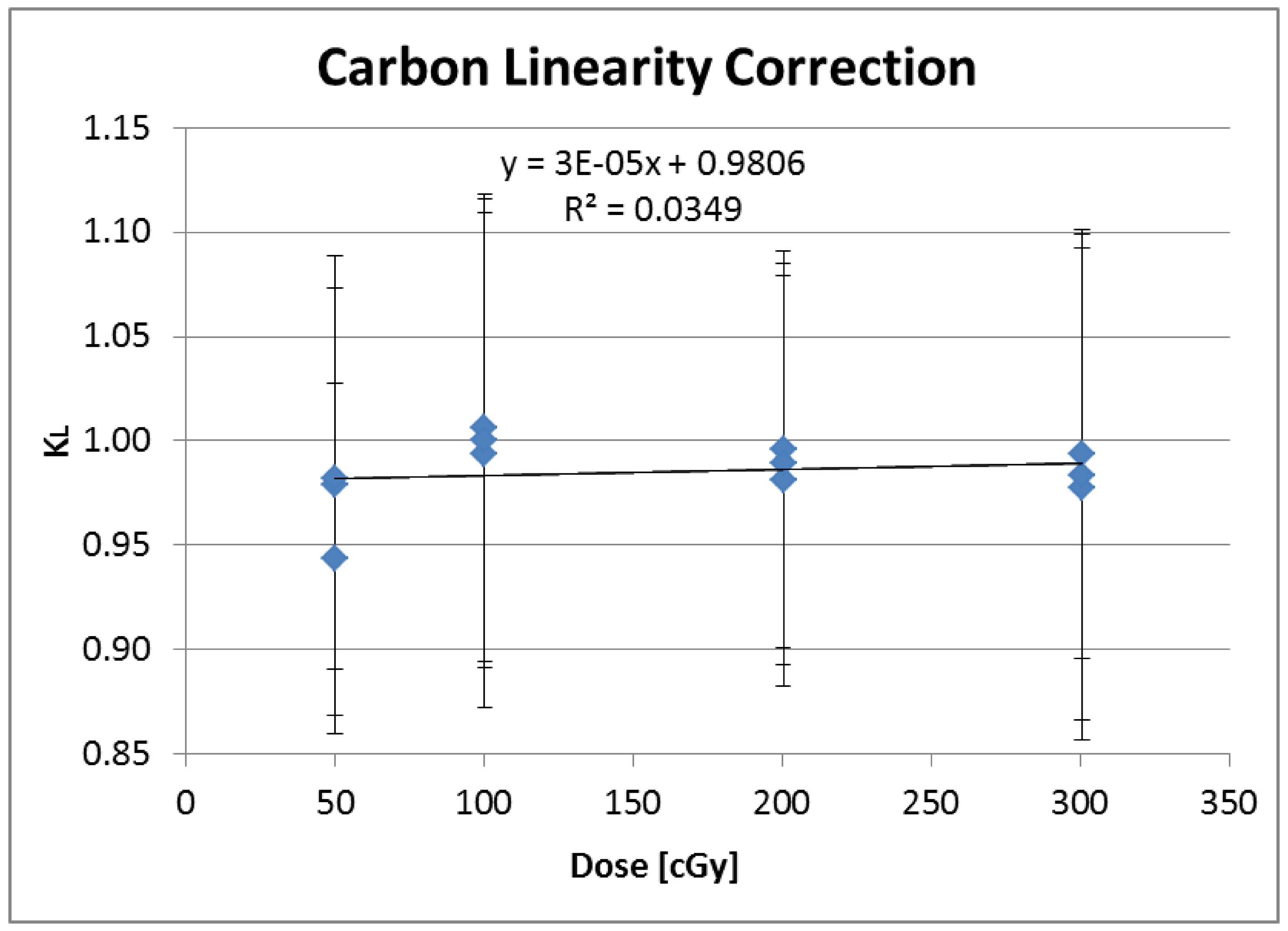

Figure 2. A plot of the linearity correction for OSLD in a carbon beam.

Methods & Materials cont'd: The OSLD were irradiated in a carbon therapy beam produced by the Siemens synchrotron at the Heidelberg Ion Therapy facility in Heidelberg, Germany. The OSLD were placed in acrylic phantoms, imaged with a CT scanner, and plans were developed using the Siemens treatment planning system. The OSLD were irradiated in uniform fields designed in the Siemens Syngo® RT Planning system, version VC11B. The fields were planned with maximum energies of 216, 301, and 402 MeV and at dose levels of 50, 100, 200 and 300 cGy. For each irradiation, the OSLD block was loaded with four dosimeters (Figure 1). Acrylic slabs were used to achieve the desired buildup so that all four dosimeters were within the uniform dose region.

Results: OSLD dose calculations typically required a linearity correction to account for the change in response relative to the change in dose delivered. However, the response of the OSLD in the carbon beam was found to be independent of the dose level; thus the linearity correction is 1.00 (Figure 2).

Key Results: Irradiations of OSLD in the carbon therapy beam at the Heidelberg Ion Therapy facility showed a large correction factor for carbon beams relative to the reference data of Cobalt-60. This "energy" correction factor was shown to be 1.85 (Figure 3). The energy correction for this same batch of OSLD for various photon and electron energies ranges from 1.01–1.05. The energy correction for this batch of OSLD for protons is 1.10.

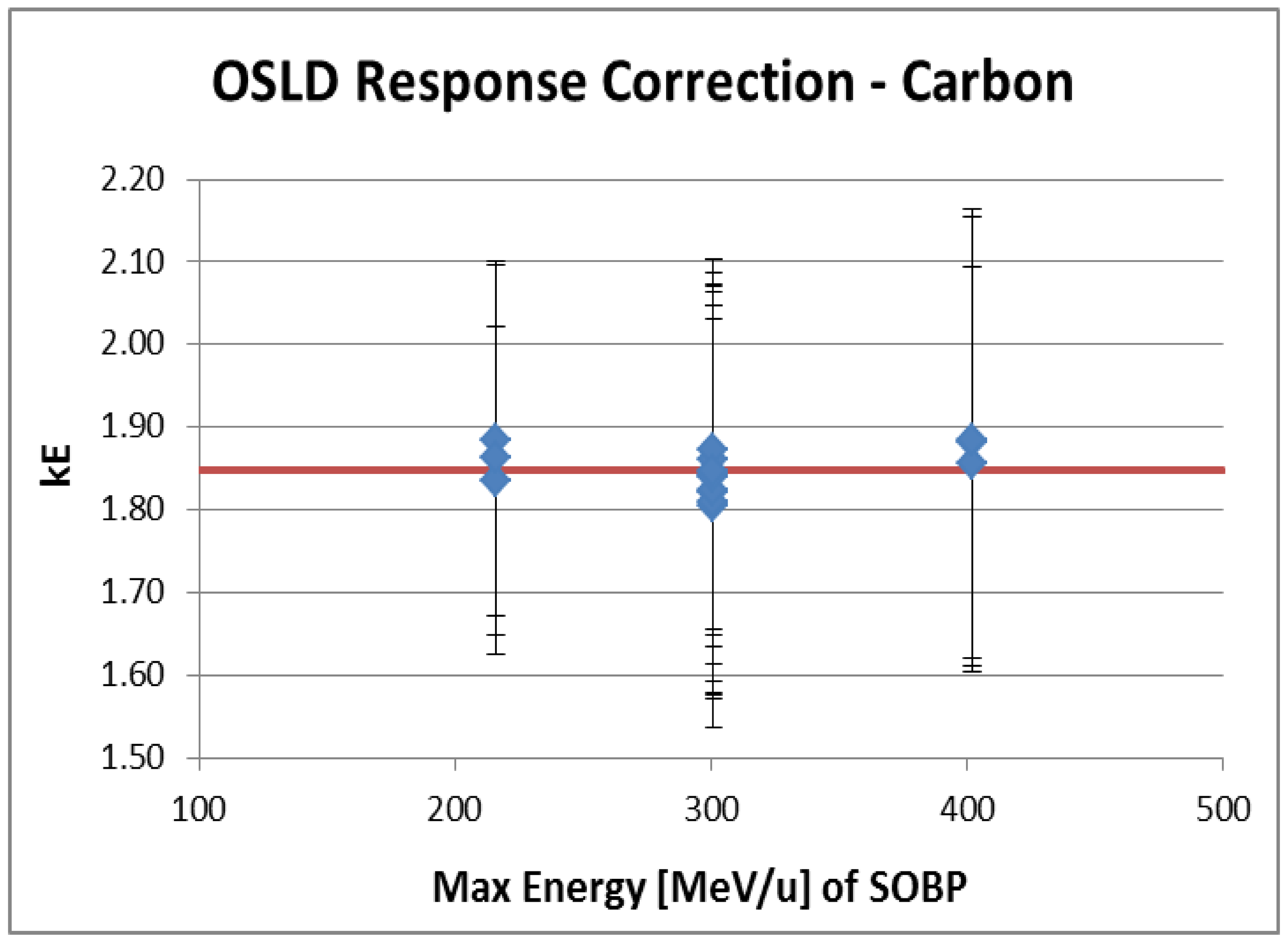

Figure 3. The energy correction factor for OSLD in a carbon beam.

Conclusion: IROC Houston has commissioned OSLD for the use of remote output checks for carbon therapy facilities to help ensure consistency across clinical trial participants. Further work will be done to examine the response of these OSLD in non-uniform fields and in anthropomorphic phantoms that are part of IROC Houston credentialing.

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