AbstractID: 12768 Title: Determination of average LET of therapeutic proton beams using Al2O3:C optically stimulated luminescence (OSL) detectors

Purpose: To measure the linear energy transfer (LET) of therapeutic proton beams using the optically stimulated luminescence (OSL) properties of commercial Al_2O_3:C dosimeters (OSLDs). **Method and Materials:** We irradiated Al_2O_3:C dosimeters at the M. D. Anderson Cancer Center passive scattering nozzles with unmodulated and spread-out Bragg peak (SOBP) beams. The irradiations with unmodulated beams provided data to determine an LET calibration curve; and the irradiations with SOBP beams tested our LET calibration curve. The OSLDs were readout at Oklahoma State University using a Risø TL/OSL-DA-15 reader. We normalized our OSL decay curves to their initial intensities and defined the Γ factor as the area under the normalized OSL decay curve, which characterized the shape of the OSL decay curve. A validated MCNPX model of the passive scattering beam nozzle was used to determine the average LET of the proton beams. To determine the LET calibration curve, OSLDs were irradiated with various beam qualities, and the Γ factor was obtained for each irradiation condition. To test the proposed technique, we irradiated OSLDs in various depths of clinical SOBP fields. We analyzed the OSLDs and obtained the Γ factor for each irradiation condition and then we used the LET calibration curve to determine the average LET of the fields to which the detectors were irradiated. We calculated the average LET using MCNPX under the same irradiation conditions. **Results:** Average LET measurements and simulations agreed within 24% and 14% for 140 MeV and 250 MeV SOBP fields, respectively. This was the first time that such agreement was obtained using any luminescence detectors (OSLDs and TLDs). **Conclusion:** The LET dependence of the OSL decay curve's shape from Al_2O_3:C dosimeters can be used to define an LET calibration curve which in turn can be used to measure average LET of therapeutic proton beams.