AbstractID: 10834 Title: Dose uncertainty due to motion-induced depth changes in energy-stacked proton beams

Purpose: To measure the dose uncertainty due to motion-induced depth changes in energy-stacked proton fields. **Method and Materials:** In energy-stacked proton beams the spread-out Bragg peak (SOBP) is generated by delivering the energy layers sequentially. In the presence of motion the depth of a point can change between the different energy layers, generating uncertainty compared to the planned dose. The magnitude of the uncertainty depends on the time-structure of the dose delivery, and the frequency and amplitude of the depth variations. We add wax strips to the outside of a 4D Dynamic Thorax Phantom (CIRS). The strips are 1.5cm wide and 0.5 or 1.0cm thick. A cc04 ionization chamber (IBA Dosimetry) is moved perpendicularly behind the strips, at various amplitude and frequency. The proton field is delivered using both energy-stacking and 'quasi-instantaneous' for comparison. For each combination of motion and field delivery the dose is measured ten times to determine the statistical variation. A Matlab program determines the expected error in dose based on the time-structure of both the motion and dose delivery. **Results:** Motion at 5.0cm depth behind 0.5cm strips, at a frequency of 0.25Hz, in a field with a range of 8.0g/cm2, modulation width of 6.0g/cm2, dose rate of 2Gy/min, total dose of 50cGy, gives a maximum error in dose of 7.4%. Decreasing the dose rate to 1Gy/min reduces the error to 5.3%. **Conclusion:** Motion-induced variations in depth can lead to clinically significant dose uncertainties.