AbstractID: 7243 Title: Using multi-element detector arrays for commissioning active wobbling and energy-stacking proton beams

Multi-element detector arrays were constructed to characterize the properties of active wobbling and energy-stacking proton beam commissioning. A multi-layer ionization chamber (MLIC) array measured depth doses, and a multi-pad ionization chamber (MPIC) array measured lateral profiles. The MLIC consists of 122 chambers with 1.82mm spatial resolution and has an effective physical density about 60% that of water. The MPIC consists of 128 chambers arranged in two 38cm long orthogonal lines with spatial resolution of 5mm within 10cm radius and 7mm outwardly. During performance tests on the MLIC and MPIC, good collection efficiency with superior reproducibility and linearity were achieved. The relative variation on the sensitivity for each individual chamber was carefully calibrated before use for proton beam characterization. The relatively small charge collection area (6mm in diameter) and volume (0.3 cm^3) of each chamber has a well guarded lead and allows one to study the effect of field size on depth dose distributions for fields of approximately 2 cm to 10 cm in diameter. The MLIC is calibrated using a pristine proton beam with range 27cm in water. To calibrate the large dimensional MPIC, uniform lateral dose distributions in water within 1% were generated. Analytical functions were applied to fit measured depth dose and lateral distributions in water during the calibrations. With proper calibrations, the uncertainties of measured depth doses and lateral profiles with these multi-element detector arrays were within 1% with respect to ones measured point by point with an ion chamber in a water phantom. Significant time savings for beam measurements were thus achieved.