Proton Radiography yields anatomic information that x-ray radiography does not offer. Proton radiographs give a direct measure of the water equivalent path length (WEPL) across the radiation field in beam’s eye view and can therefore detect daily anatomic changes prior to treatment that may affect the depth of the Bragg peak in the patient. These changes in proton range cannot be detected with x-ray radiography.

The schematic shown on the right shows an example of a change in proton range due to an anatomical change. The black arrow represents the proton path to the orange target volume. If the grey box changes density between fractions, it may cause the proton to undershoot the orange target volume and overdose normal tissues.

**Introduction:**

Proton radiography system mounted in a treatment room with pencil beam scanning is shown on the left. It contains one 40x40 cm<sup>2</sup> X-Y scintillating fiber tracking plane upstream and one downstream of the phantom and a 40x40x13 cm<sup>3</sup> scintillating block to measure the residual proton energy after passing through the phantom. This system collects data that is used to calculate the water-equivalent path length in each pixel in the 2D image plane.

**Proton Radiography:**

A proton radiograph of a Catphan Line Pair phantom and calculation of the modulated transfer function shows spatial resolution of 0.83 mm.

**Spatial Resolution:**

Good spatial resolution is needed to detect WEPL variations in small regions. Proton scatter degrades spatial resolution compared to x-ray radiography. However, x-ray radiography does not have the capability to detect proton range changes.

**Conclusion:**

Proton radiographic images can be used to detect anatomical changes prior to treatment. Difference maps between radiographs show changes in proton range as low as 0.6 mm can be detected. Calculation of the modulated transfer function shows spatial resolution of 0.83 mm.

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