Purpose:
Ion beam therapy is a highly precise form of radiotherapy, which offers the potential for higher dose to the tumor, while better sparing of healthy tissue as compared to photons. Currently, dose calculations, patient positioning verification and diagnostics are based on X-ray radiography or computed tomography. However, there are several predicted advantages for ion radiography in comparison to X-ray imaging. Ideally, the stopping power of the particles traversing through the patient can be measured directly, which would improve the treatment planning accuracy (Med. Phys. 32(1), 2005). Furthermore, ion radiographies may be used for on-board patient positioning verification with very low dose to the patient (Med. Phys. 22(4), 1995) and for cancer diagnostics due to the high soft tissue contrast (Investigative Radiology 13(2), 1978). To exploit these possibilities, we are currently investigating an amorphous silicon flat-panel detector (RID256L by Perkin Elmer, Inc. Wiesbaden, Germany) for radiographic imaging with ions.

Methods:
In this contribution we investigate detailed studies on soft tissue contrast and direct measurement of water-equivalent path length (WEPL). 10 mm thick soft tissue-equivalent rods (Gammex 467- Phantom), embedded in PMMA, have been irradiated with protons and carbon ions at the Heidelberger Ion-Beam Therapy Center (HIT), Germany. Additional slabs of PMMA were placed between the phantom and the detector to measure the contrast in different depths.

Results:
The high tissue contrast reached in the ion radiographies enables to differentiate between all six soft tissue equivalent inserts, ranging from adipose to liver, even in high penetration depths. By comparing the measured signal with reference measurements in depth of PMMA, the water-equivalent thickness of the inserts could be determined with an accuracy better than 0.5% of the known thickness.

Conclusions:
Our measurements show that the investigated flat-panel is promising for patient diagnostic ion imaging and direct WEPL measurements.

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