AbstractID: 9120 Title: Feasibility of MRI guided proton therapy: magnetic field dose effects.

Modern radiotherapy aims to escalate the dose to the tumour while minimising the dose to the surrounding organs at risk. This requires two major steps: 1) bringing radiotherapy fully under image guidance by using anatomical images in the whole radiotherapy cycle: treatment preparation, treatment delivery, treatment response assessment and treatment follow up. 2) Optimise the spatial dose distribution using IMRT or protons.

Proton therapy leads to a lower integral dose and is especially advantegeous for small tumours and tumours close to critical organs. However, it still requires imaging for the whole cycle of radiotherapy. One may even argue that image guidance is more important when the Bragg peak of proton therapy is maximally exploited to generate high dose gradients. Then the actual depth of the tumour relative to the patient's surface is crucial since small deformations in the anatomy can lead to large dose differences.

MRI offers optimal soft-tissue contrast for guidance. Clearly, integrating a proton accelerator and MRI faces technical hurdles. From preceeding research on combining a 1.5 T MRI and a conventional accelerator we know that the impact of the magnetic field on the dose distribution is one of the hurdles to take. This paper addresses the magnetic field dose effects for proton irradiation in the presence of a 0.5T transverse magnetic field.

Geant4 simulations show that the dose distribution at 0.5 T is not affected seriously. In homogeneous tissue, the beam is tilted slightly, due to the Lorentz force on protons. At tissue-air interfaces, returning secondary electrons cause a major dose effect for photon therapy. However, for protons, this effect does not exist due to the very low (<2 keV) energy of the secondary electrons.

In summary, proton therapy can benefit from MRI guidance and the dose distribution is not seriously hampered by the magnetic field.