

Radiotherapy is increasingly dependent on image data for treatment preparation, delivery, response assessment and follow-up. In collaboration with Elekta, Crawley, UK and Philips, Best, The Netherlands, we are constructing a hybrid 1.5T MRI radiotherapy system. This system facilitates real-time, soft-tissue based image guidance during delivery as well as treatment response assessment.

The preceding technical feasibility study led to a design in which the 6MV accelerator can rotate in a ring around the MRI in the mid-transversal plane. The magnet design is adjusted in order to minimise the magnetic interference and to minimise the absorption of the beam.

The prototype is planned for autumn 2008. The aim is to demonstrate MRI guided radiation with sub-mm precision. The prototype will initially be static: the accelerator will be in a fixed lateral position. The treatment room preparation will be discussed including: creation of entrance route in bunker, faraday cage, cooling and electrical connections for in-room MRI peripherals and passive magnetic room-shielding to minimise magnetic interference with neighbouring clinical accelerators.

The current Geant4 Monte Carlo simulations on the accelerator output and radiation dosimetry will be verified in the prototype. Geant4 simulations were also used to find suitable IMRT solutions in the presence of a 1.5T field, these will be evaluated experimentally. System related issues addressed will be the radiofrequency interference between the MRI and the accelerator, the geometric correction of images dedicated for this system and the geometrical coupling of the MRI and accelerator coordinate system. Also the automatic, on-line target definition on MRI and the clinical benefit of MRI guidance will be discussed.