effect. The compensators being close to the patient and interfering with the beam is a source of concern as it may be the source for secondary cancers in the patient. The use of scanned proton beams however avoids this problem. We have recently introduced a magnetic scanning option to the Sumitomo proton system. The current abstract covers the description of this system and reports the first measurements.
Materials and Methods: A set of scanning magnets, positioned downstreams of the bending magnet, scans the beam in the x- and y-direction. The system is capable of several techniques for scanning the beam, i.e. spot scanning, line scanning as well as variable scanning. A maximum field size of 30x40 cm can be generated with a dedicated nozzle. The characteristics of the scanning system have been verified in a clinical setting using line scanning with a proton pencil beam having dimensions of σ_x=3.6 mm and σ_y=4.0 mm.
Results: The maximum range in water is 32 g/cm^2 and the dose rate is limited to 1 Gy/min/litre irradiated volume, regardless of depth. For a simple field the dose uniformity is 2.5 % inside 80 % of the field size using the line scanning delivery mode. The lateral penumbra is 8.5 mm at 230 MeV.
Conclusions: The proton scanning system is capable of replacing the scattered beam delivery mode effectively. High dose rate and fast layer switching is used for optimal conformity. The full field can be delivered with many re-paintings at all layers, even within one breath-hold. To utilize the full extent of the scanning beam system a treatment planning system should be used for the purpose of optimizing the dose distribution using the various parameters that can be optimized.

PO-0888
Patient positioning in a heavy ion gantry
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Purpose/Objective: At the Heidelberg Ion-Beam Therapy Center (HIT) patients are treated with scanned protons and carbon ions. Until fall 2012, the facility had two treatment rooms in operation and more than 1000 patients were treated. The fixed horizontal beam lines in these rooms limit the available beam directions. To overcome this, in summer 2012 the world's first heavy ion gantry was commissioned for patient treatment. The gantry allows rotation of the beam line in 360°, offering the same beam directions available in conventional radiotherapy gantries. First patients were treated with the gantry on November 19th. The gantry carries the complete beam line for high energy ions (large bending magnets, vacuum, imaging, IT and cooling systems) and has a total mass of 670t. Furthermore, the treatment room is built into the gantry structure and rotates during therapy. This leads to structural deformations at different gantry angles, which affect all devices related to patient position. To achieve the precise positioning required for ion-beam therapy, position deviations had to be assessed and an overall concept for patient positioning hat to be developed and verified.
Materials and Methods: To determine the range and reproducibility of position deviations, the motion of treatment table, lasers and imaging system was measured at different gantry angles. Using a tracking laser interferometer, positions of the respective devices were measured in a fixed coordinate system unaffected by gantry motion. Cross checks were done with a three axis translation stage. Based on these measurements, appropriate corrections were introduced to the patient positioning and ion-beam adjustment. Their correct application was verified using geometric phantoms (both commercial and in-house-developed).
Results: The co-rotating laser system was not reliable at angles different from 0°. During gantry rotation, the treatment table showed reproducible translations below ±1 mm and negligible rotations. The imaging system showed a reproducible misalignment of up to 1.2 mm and 0.5°. These deviations were outside our specifications. After implementation of corrections, verification measurements showed positioning errors within our tolerance limits of ±0.5 mm and 0.5°.
Conclusions: In the course of commissioning, the relative movement of each component relevant to patient positioning was measured after gantry rotation. Based on these results a procedure for gantry angle dependent positioning was conceived, where the patient defines the isocenter:
- Lasers indicate the isocenter only during setup at gantry angle 0°.
- The ion beam follows the gantry angle dependent motion of the treatment table and patient via angle dependent calibration of the beam monitoring system.
- Misalignment of X-ray imagers and detectors is corrected by applying an angle dependent 6 degrees of freedom correction to the patient's CT dataset during position verification.

These procedures allow a positioning of the patient at the beam isocenter with an overall accuracy of ±0.5 mm.

PO-0889
Clinical use of an add electron MLC in radiotherapy of skin and breast cancer
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Purpose/Objective: Electron radiotherapy is being revived by the fact that add-on electron multileaf collimators (EMLC) are faster and more efficient than common applicators and customized cut-outs in shaping the beams, thus achieving more efficient dose delivery. This work presents the results of some clinical applications of a commercial add-on EMLC. In particular, the simplified workflow is described for clinically prescribed electron treatments of skin lesions. Additionally, plan comparisons with conventional applicators are presented for common cases of shallow tumours.
Materials and Methods: The EMLC consists of 60 separately calibrated and controlled brass leaves with a physical leaf width of 0.6 cm, placed 16 cm above the isocenter. Their positioning is performed using a portable computer. Prior to clinical applications, the EMLC was implemented in our treatment planning system and accurately commissioned. In this work, two cases of patients with skin lesions are presented to describe the simplified workflow when electron field shapes are prescribed clinically. The first patient was treated a few hours after surgical removal of keloids, while the second case shows the re-irradiation of a patient affected by mycosis fungoides. Moreover, treatment plans of two patients with shallow tumours calculated for the EMLC are presented here and compared to those obtained with conventional applicators. The first plan is the one of a patient with a rib metastasis, treated with 12 MeV electrons. The second plan concerns a patient receiving whole-breast photon irradiation of both breasts and a boost in the tumour bed with 10 MeV electrons. The Monte Carlo treatment plans were calculated by using Oncentra Masterplan (Version 3.3.1.3).
Results: For both ad-hoc patients, six electron fields were shaped inside the treatment room shortly before irradiation, keeping the overall treatment time below one hour. The dose prescription for these irregular fields was verified after the first fraction with Gafchromic Films and the maximum discrepancy between expected and measured dose was approximately 5%. In the case of breast irradiation, the applicators and the EMLC generate comparable PTV dose coverage, although the mean dose produced with the EMLC is about 4% lower. The EMLC mean dose to the lungs is about 20% higher than the one with the applicator. Also in the case of the rib metastasis, the dose conformance obtained with the EMLC was comparable to the one generated by the common applicator. In both plans, due to a larger penumbra, the margins for defining the aperture with the EMLC were about 3 mm broader than those used for conventional cut-outs.
Conclusions: We conclude that the simplified workflow in the clinical routine and the satisfactory tumour coverage encourage the use of the EMLC for fixed-beam electron therapy. These results represent a first step towards the clinical implementation of electron IMRT.

PO-0890
MRI-guided stereotactic body radiation therapy for liver
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Purpose/Objective: To develop an MRI-guided procedure for the treatment planning and patient setup verification of liver SBRT tailored for a hybrid linac-MR on rails system.
Materials and Methods: At our institution, an MR-guided therapy system consisting of a Varian TrueBeam 6X linac and a 1.5T Siemens Espree MR scanner is under development and scheduled to become operational next year. The MR scanner can travel on rails (solution by IMRIS, Canada) between the MR suite (purpose: simulation/planning) and the immediately adjacent linac vault (purpose: patient setup verification), the two rooms being separated by radiation shielding doors. In the treatment room, the patient is transferred between the MR and linac isocenters via a robotic couch. The operation of the system is designed to be sequential: a) the MR moves to a pre-defined location, in the close proximity of the linac (parked and in stand-by), imaging is performed and the MR returns to the simulation room, and b) the patient couch translates to the linac which resumes its operation (imaging and/or treatment delivery). One of the expected applications of the MR-linac system is for liver patients. The MR imaging can provide daily excellent soft-tissue contrast (compared to CBCT) and the full quantification of organ and tumor motion. To