

How much better are carbon beams ?

In 2004 hadron therapy celebrated its 50th anniversary and between 1954 and 2004 nearly 40'000 patients were treated with protons and about 4500 with heavier particles (mainly helium, carbon and neon). Especially within the last decade, hadron therapy has gained increasing interest. In mid 2004, 22 proton facilities were operational and about half of all patients treated with protons received their treatment within the last 5 years. There are currently 3 facilities treating patients with carbon ions, two of them in Japan within a clinical setting. In Germany, a research therapy facility is in operation at the German heavy ion research Laboratory GSI (Darmstadt) since 1997. Currently, the construction of a new hospital based facility at the Heidelberg University hospital is ongoing and the facility is scheduled to start clinical operation in late 2007. Furthermore, an Italian facility is under construction and Austrian and French projects have been approved recently.

The Heidelberg facility will be the first one worldwide that will be equipped with an isocentric scanning gantry. The facility will offer proton and carbon ions beams and thus will enable a direct comparison of treatment outcome applying both modalities using the same beam delivery system. The Heidelberg facility is designed to produce also beams of other ions like Helium or Oxygen and thus offers a large research potential to investigate which ion is best suited for which application.

An outline of the current potential of ion radiotherapy will be given and some open questions will be addressed. This includes a description of passive and active beam shaping systems, as well as their implications for treatment planning and dosimetry. The potential of ions will be compared against IMRT and radiotherapy with proton beams on the basis of their physical and radiobiological properties. A short comparison of patient treatment plans for the various modalities will also be presented. The current clinical results gained with ions in Japan and Germany will be reviewed and an outlook on the clinical program in Heidelberg will be given.