

# HICAT-HD

## Hospital-based Ion Cancer Therapy Project in Heidelberg

**HICAT-HD-01** Status Report of the HICAT/HIT-Project  
Authors: Eickhoff, H.; Haberer, T.  
Keywords: medical accelerator; gantry

**373**



## Status Report of the HICAT/HIT-Project

H. Eickhoff and T. Haberer for the GSI Project Group of the HICAT-Facility

### 1) Abstract

Major progress of the Heidelberg Ion Cancer Treatment facility (HICAT /HIT=Heidelberg Ion Therapy) took place in 2004 .

After the orders for all technical systems of the accelerator had been launched to ten industrial firms in 2003, the construction and manufacturing process had been started; in parallel the building activities started near the end of 2003.

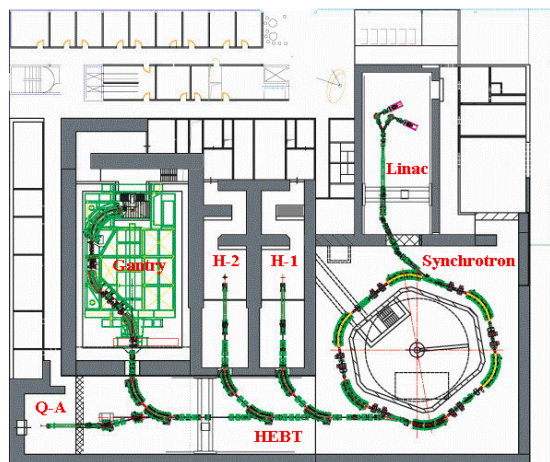
The tender for the treatment technique took place in March 2004; the contract between the clinics and Siemens-Med for this system was signed in Oct. 2004.

In parallel to these investment activities preparations for the operating phase took place.

### 2) Overall project status

#### a) Status of the building activities

Fig. 1 shows the first underground floor of the building, that houses the accelerator sections (Linac, Synchrotron, HEBT) and the 2 horizontal treatment areas (H-1, H-2), the Gantry and the 'quality assurance place' (Q-A) (for details of the facility see ref. [1]).



**Fig. 1:** Layout of the first underground floor, housing the accelerator complex

Fig. 2 shows the present status [2] of the building, performed by the firms STRABAG in cooperation with M+W Zander. As shown, the structure of the facility and the main areas can be clearly identified; concerning the schedule a delay of about 8 months took place, compared to the original one, that stated a finish of the accelerator areas in Feb. 2005; therefore at present the start of the accelerator assembly is scheduled for Oct. 2005. At this time, the building sections of the accelerator parts will be nearly completed, and the technical infrastructure (e.g.

watercooling-systems, electric supply, assembly-tools), necessary for commissioning of the individual accelerator sections, will be installed.



**Fig. 2:** Status of the Building (Dec., 2004)

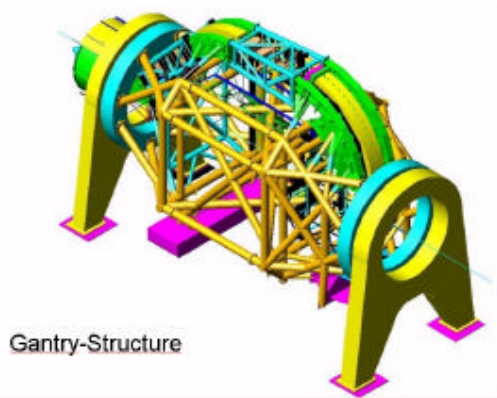
#### b) Status of the accelerator systems

The accelerator subsystems (magnets, power-supplies, etc.) were ordered in 2003 from about 10 international suppliers. The construction phase for most of these subsystems is nearly finished and the manufacturing process had been started; for most of the components the production will be finished in 2005. The delivery of magnets and vacuum components to GSI has been started. These components will be preassembled at GSI and stored on the GSI-area until the building is ready for starting the assembly work in Heidelberg from Oct., 2005.

Major achieved milestones are:

- The acceptance tests of the ECR ion sources, delivered by CANBERRA-EURYSIS have been started.
- At the IAP at Frankfurt University a proton beam could be successfully accelerated with the RFQ, that had been manufactured by this institute; further measurements of the beam properties, e.g. exact measurements of the acceleration energy, are under way.
- The IH-Linac-structure was finished at PINK (the supplier of the vacuum system); first RF-measurements were successful. The IH-quadrupole triplets, manufactured by DANFYSIK, will be delivered soon and the copperplating process of the IH-structure will start within the next two months.
- The specified beam diagnostic systems for the Linac-section were manufactured by GSI and the acceptance tests were successfully performed.
- The design of the controls system, ordered from ECKELMANN was finished; first control boards with test software were delivered to GSI.

- In December 2004 acceptance tests of Linac-magnets, supplied by SIGMAPHI, took place.
- The design of the synchrotron dipoles, ordered from TESLA, is finished. After the delivery to GSI will start in the first half of 2005 the magnetic measurements and shimming labour will be performed for all 6 dipoles.
- The construction and manufacturing of the 3 amplifier systems for the Linac RF-supply, ordered from THALES, is in progress.
- The complete synchrotron accelerating system was ordered from HITACHI; the factory acceptance test of this subsystem is foreseen for July 2005.



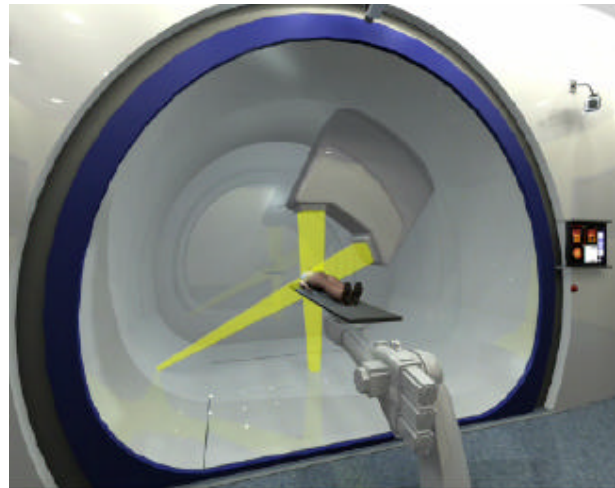
**Fig. 3:** Gantry structure (Courtesy of MAN Technology)

• The mechanical construction of the gantry-structure (see Fig. 3), ordered from MAN-MT is finished; the manufacturing process has started. The detailed construction of the gantry patient room, covering all aspects of the treatment components and subsystems, delivered by Siemens AG, has started.

c) Status of the irradiation technology systems

In March, 2004 the tender for the irradiation technology, i.e. the beam scanning controls and monitoring equipment, the patient positioners, the x-ray systems and the IT/workflow software platform, was launched. In Oct. 2004 the contract with Siemens AG, Medical Solutions as a general contractor was signed.

HICAT will be equipped both at the two horizontal treatment places and at the gantry treatment room with state of the art patient positioning and position verification modalities. The combination of a robotic patient positioner with large-area flat-panel x-ray imagers allows for a feedback procedure of the image analysis result. A fast matching algorithm calculates a multi-dimensional displacement vector of the actual setting relative to digital reconstructions derived from the planning CT that represents the basis of irradiation course. Figure 4 shows the planned configuration of the medical equipment at the scanning ion gantry. Two flat-panel imagers mounted directly near the exit of the final large-aperture bending magnet, arranged under 60-degrees, are used to check the patient immobilization in the treatment position.



**Fig.4:** View into the nozzle region of the scanning ion gantry for a position verification x-ray exposure (the x ray-beams shaded in yellow). (Courtesy of Siemens AG, Medical Solutions)

**3) Organization aspects**

Besides the coordination and supervision labour of the various technical aspects also activities have started in preparation of the commissioning and operation phase of the facility. The Heidelberg Clinics have founded an operation department for the facility and employed first members of the technical operation staff; these members are presently trained at the GSI accelerator complex. As the total facility is classified according to the medical device directive a certification organization ('notified body') was appointed by the Clinics to prepare the activities requested to achieve the patient treatment permission.

Tab. 1 shows the present project schedule with the major activities until the handing over to clinical operation.

Time (Year)	Activities
2005/6	assembly of the accelerator-systems
2006/7	overall commissioning
2007	patient treatments (horizontal places)
2008	patient treatments (gantry)

**Tab. 1:** Present overall Schedule

**4) References**

- [1] H. Eickhoff et al., HICAT-The German Hospital-Based Light Ion Cancer Therapy Project; EPAC 2004
- [2] Internet web-cam: [www.arqe-sit.de](http://www.arqe-sit.de)