HITRI*plus*
Heavy Ion Therapy Research Integration

www.hitriplus.eu

GANTRY SYSTEM DESIGN

DECADES OF EXPERIENCE IN ACCELERATOR DESIGN, CONSTRUCTION AND OPERATION. EXPERTISE AND KNOW-HOW OF GANTRY SYSTEM DESIGN

CHALLENGE

Designing a gantry enables rotating the treatment beam around the patient. Among the twenty global treatment rooms using carbon ions for cancer treatments, only three have rotating beam lines, allowing irradiation from any direction. The rest rely on fixed beam lines, easier to implement but requiring patient movement, impacting access to the tumour, treatment time, and patient comfort.
Challenges in gantry implementation involve size, power consumption, and costs. Currently, only one commercial solution exists outside of Europe - Toshiba's HIMAC superconducting gantry.
In Europe, HIT operates a heavy normal-conducting gantry.

SOLUTION

Adopting superconductivity for the gantry promises higher magnetic fields, leading to significant improvements in size, weight, energy consumption and cost.
This initiative focuses on two magnet configurations: a conventional "cosine-theta" design and the innovative "Canted-Cosine Theta" (CCT) system pioneered by HITRI*plus*.
A preliminary engineering design aims to empower European industry to compete effectively against other ambitious R&D programmes.

VALUE

A 360-degree treatment angle saves processing time for centres compared to fixed beamlines and allows for increased patient comfort.

A reduction in gantry weight, dimensions, and cost is achieved due to the use of curved superconducting magnets in the mechanical structure.
The construction target size is 13·16·19 m^3 (internal volume), representing a significant reduction compared to the HIT gantry.

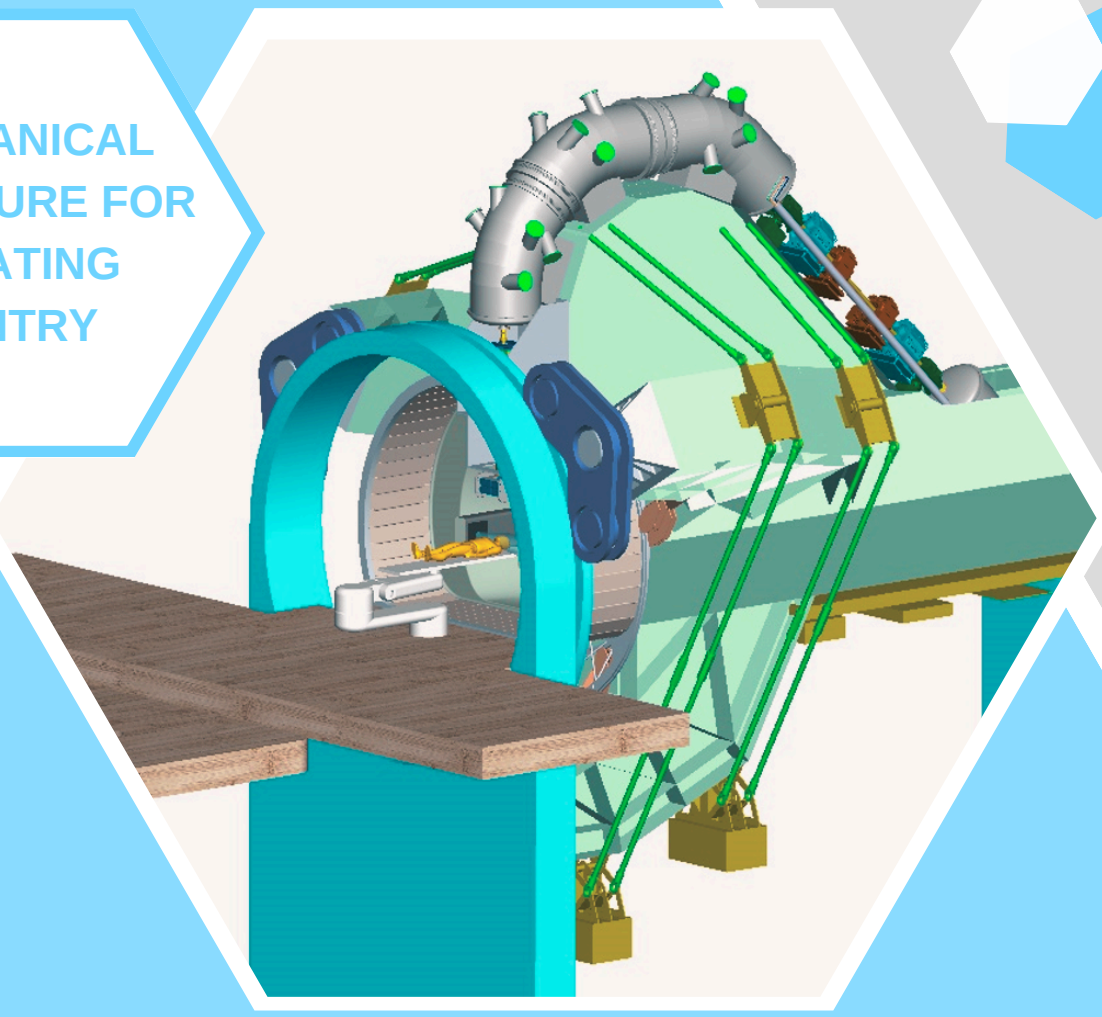
The target weight is 150 tonnes, a substantial decrease compared to the HIT gantry (600 tonnes) and the Yamagata gantry (200 tonnes).

An improved ecological footprint and optimized energy consumption are achieved in terms of cryogenics, transfer line magnets, accelerator magnets, and gantry motion.

FULL TURN GANTRY

- A balanced structure supported at each end, driven by off-axis friction rollers, coupled to an electric motor
- The design covers a full turn, minimizing bed couch movements
- A treatment angle range of ±180° is achievable
- Construction volume is 13·16·19 m^3 (internal)
- Rotating mass is approximately 120 tonnes
- Moment of inertia around the rotation axis is 700 tonnes·m^2

MECHANICAL STRUCTURE FOR ROTATING GANTRY



VALUE

The gantry structure is designed to provide robust support for the cold masses, or superconducting magnets, during rotation, ensuring smooth and reliable operation throughout the treatment process.

The Frequency Scanning Interferometry (FSI), a cutting-edge measurement tool developed by CERN, is integrated into the system. This technology detects the position of cold components during the entire cool-down process, ensuring accuracy and reliability.

The effects of mechanical tolerances and assembly errors are meticulously studied to enhance beam performance. By improving accuracy and repeatability, the system guarantees the highest standards of treatment precision for optimal patient outcomes.