HITRI plus
Heavy Ion Therapy Research Integration

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ARCHITECTURAL MODEL OF AN ACCELERATOR CONTROL SYSTEM FOR MULTI-ENERGY OPERATION

DECADES OF EXPERIENCE IN ACCELERATOR DESIGN, CONSTRUCTION AND OPERATION FOR MORE EFFICIENT ION BEAM DELIVERY

DESCRIPTION

A survey of ion beam therapy facilities reveals a common challenge: treatment duty cycles are limited by the time needed to change beam parameters between irradiations.

Multi-energy operation offers a solution by reusing leftover particles, improving facility duty cycles. This requires precise tuning of accelerator devices and a robust data supply model.

A sophisticated accelerator control system and enhanced data infrastructure are essential for enabling multi-energy extraction in the synchrotron. Upgrades to existing systems are necessary to handle the increased calculation and storage demands.

CNAO, MedAustron, and HIT plan to implement multi-energy operation, following the success of HIMAC (Heavy Ion Medial Accelerator in Chiba). HIT's streamlined accelerator control model calculates control data online during the synchrotron cycle, eliminating the need for extensive pre-calculation.

CHALLENGE

When irradiating a tumour, the raster scanning dose delivery method targets slices of its volume, each represented by a predefined beam energy. A new synchrotron cycle starts for each energy level. However, the particles available in the synchrotron often exceed those needed to irradiate a slice, resulting in unused particles being dumped.
This dumping process, along with subsequent injection and acceleration of new ions, leads to downtime in the treatment room, increasing treatment time and costs.

SOLUTION

With multiple-energy extraction, the ion beam can be accelerated or reaccelerated to the next energy level instead of being dumped.
To achieve this, an architectural model of an accelerator control system is designed to operate in multi-energy mode.

VALUE

With multiple energy extraction mode, irradiation time can be reduced by up to 50%, leading to significant time, energy, and cost savings. Patients will benefit from shorter treatment times, enhancing their overall experience. The capability to transition between different energies and extract will be unique to the architectural model. Previously, only HIMAC has been able to perform multiple-energy extraction, starting at the highest energy and descending stepwise before extraction.

Multi-energy operation will be a key feature of the next-generation accelerator control system at heavy ion centres.