Design and tuning of a fast beam energy selection control system for CYCIAE-230 cyclotron beamline

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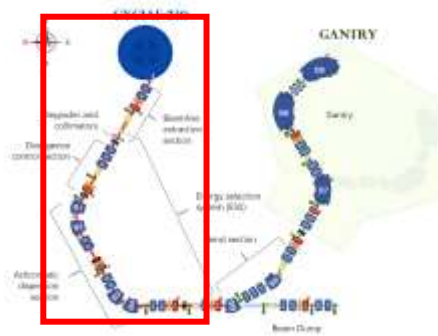
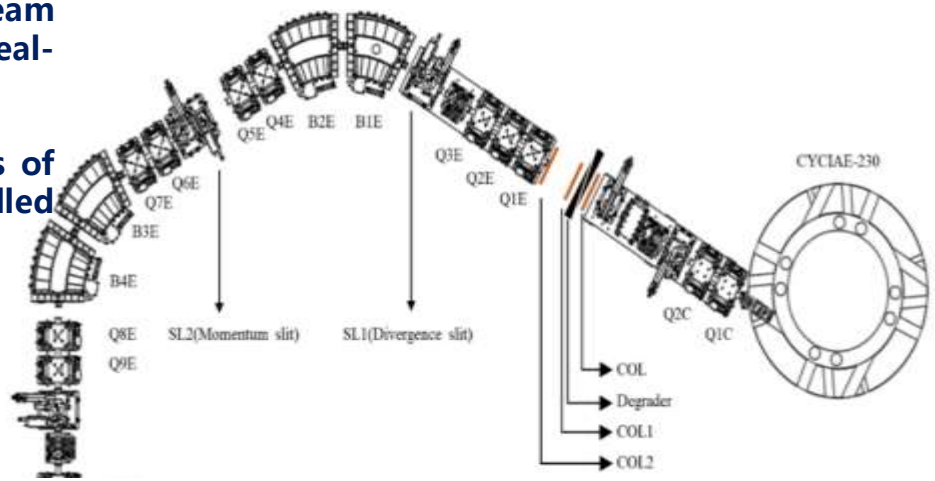
CYCIAE-230 and its beamline

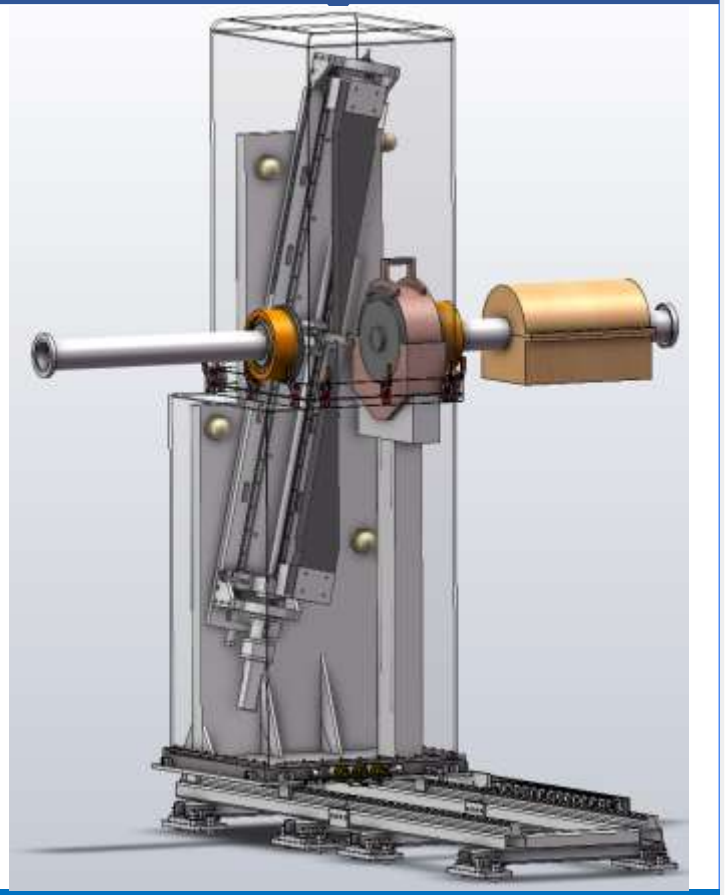


- The ESS must control beam energy accurately and in real-time to target tumor.
- The remaining components of the beamline will be controlled according to the ESS.



Energy Selection System(ESS) consists of a degrader, an apochromatic magnet system, a divergence slit, and a momentum slit

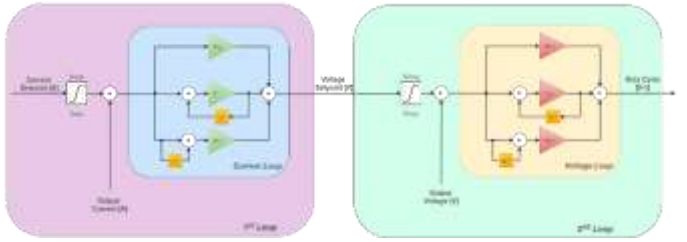
Dual-wedge degrader

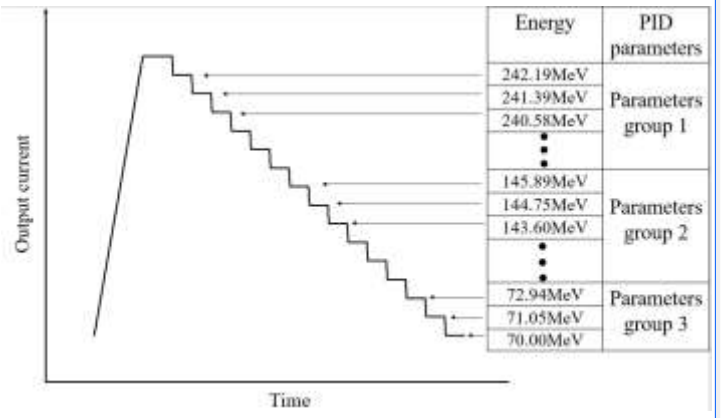


A significant moment of inertia, making it difficult to achieve fast control

A fast energy selection control system has been developed by CIAE

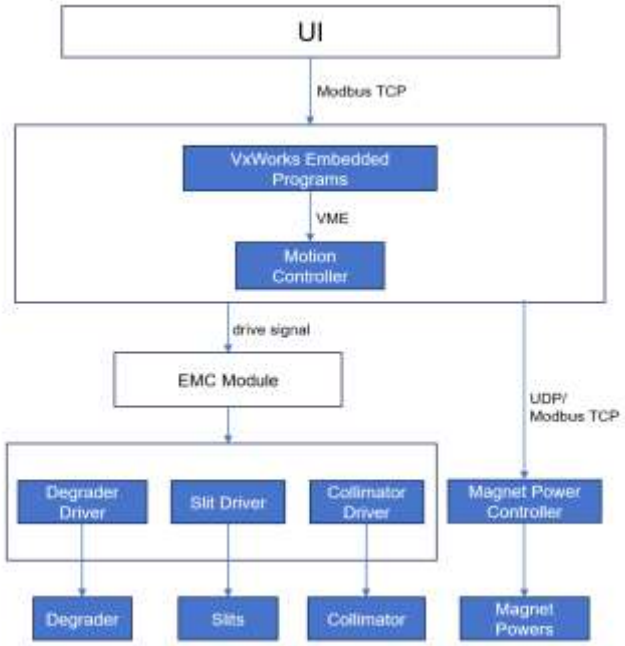
Optimization of magnet supplies





Uses the current and voltage double closed-loop PID algorithm, and segmented PID control

Energy selection control system

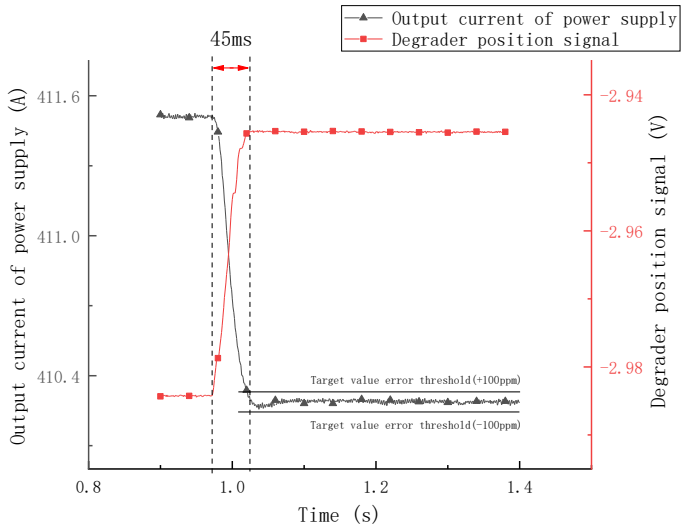


The VxWorks real-time OS, multi-task scheduling to control the degrader and magnet supplies

DDS middleware to provide the databus

Switching time verification

The energy degrader potentiometer signal and the current signal of the first dipole magnet was recorded.



The system can achieve a single layer(2mm in water) switch of beam energy in 50 milliseconds.