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## The alignment of the energy degrader applied in the proton therapy

A new proton therapy facility based on a 250MeV/500nA superconducting cyclotron has been under construction in Huazhong University of Science and Technology (HUST) in Wuhan, China. Due to the fixed beam energy extracted from the cyclotron, an energy degrader is essential for the proton beam with variable energy to reach various tumor depth in human body. Because of the interaction between the protons and the energy degrader material, the beam emittance and the energy spread will be increased while the beam current will be significantly decreased. The alignment accuracy will have an obvious impact on the performance of the degrader. This paper will discuss how the beam energy, beam emittance and beam losses are influenced by the alignment accuracy including the positional accuracy, the angular accuracy, the coaxiality and others. Moreover, the detailed alignment program will be proposed.

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