A novel beam optics concept to maximize the transmission through cyclotron-based proton therapy gantries

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Currently used PSI’s Gantry-2 beam optics with 1:1 imaging

Figure 1: (a) Shows the PSI’s Gantry 2 layout, with three dipoles (elements A) and seven quadrupoles (elements Q). (b) Shows the 2-sigma beam envelope and the dispersion (dashed line, dp/p=0.7%) along the gantry with 1:1 imaging. (The lower half shows beam envelope in X-plane (bending plane) and the upper half shows envelope in Y-plane.)
Proposed gantry beam optics with 3:1 imaging

Currently used 1:1 beam optics

Proposed 3:1 beam optics

Large beam size and low divergence
Transmission through gantry with different imaging
Conclusion

• We have shown that the transmission of the beam through PSI’s Gantry 2 can be increased by 40% using alternative beam optics imaging.

• This has been achieved by increasing the beam size and decreasing the beam divergence at the gantry entrance, in combination with novel beam optics, which de-magnifies the image of the beam entry at the isocenter by a factor of 3.

• Since the optics of PSI’s Gantry 2 is comparable to other gantries, the presented improvement could also be of advantage in other gantries.
Thank You