

# Exploring beamline momentum acceptance of a medical gantry to deliver optimized tumour tracking plans

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# Exploring beamline momentum acceptance of a medical gantry to deliver optimized tumour tracking plans

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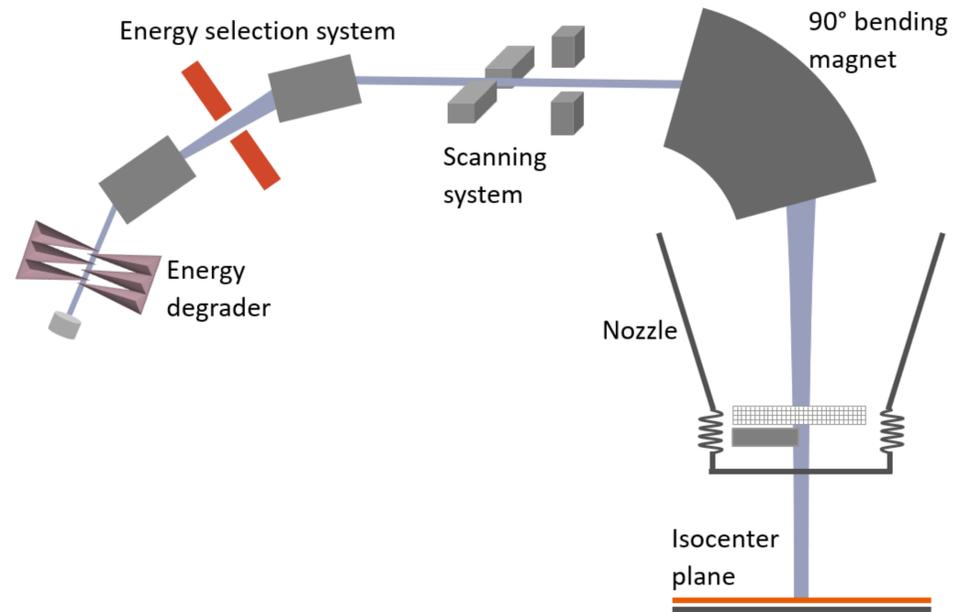
**Background** Tumour tracking is particularly challenging to realise when it comes to proton therapy. Offsetting the treatment settings (beam energy) on-the-fly to follow organ motion is beyond the current capabilities of beam delivery systems.

**Methods** The major limiting factor in performing fast energy changes is the tuning of the large dipole magnets.

Fast energy change  
~ 2 mm WER

- Upstream degrader
- Achromatic beamline design
- Momentum acceptance ( $dp/p=1.2\%$ )

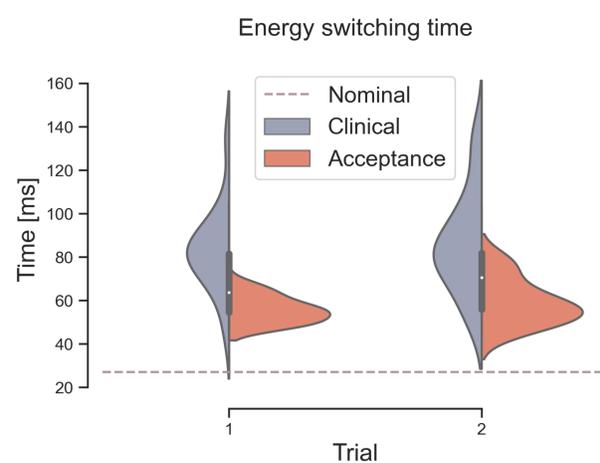
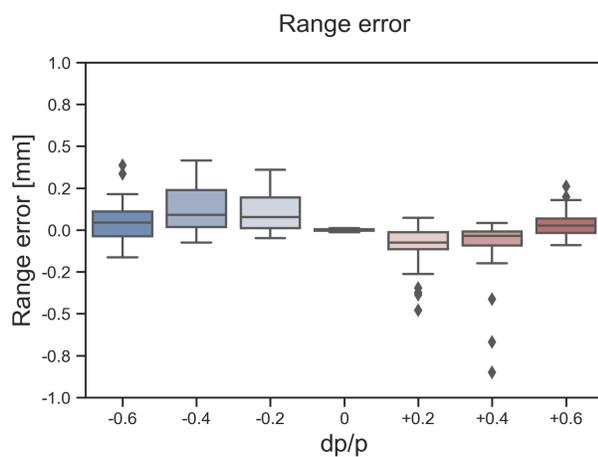
It defines the range of energies around the nominal momentum, which can be transported by the beamline without chromatic aberration.



**Results** Experimental characterisation of beam properties within the momentum acceptance between 150 MeV and 230 MeV.

**Spot position error**  
<1mm (18x12 cm)  
Larger errors at the boundaries of field.

**Range error**  
0.05 mm (median)

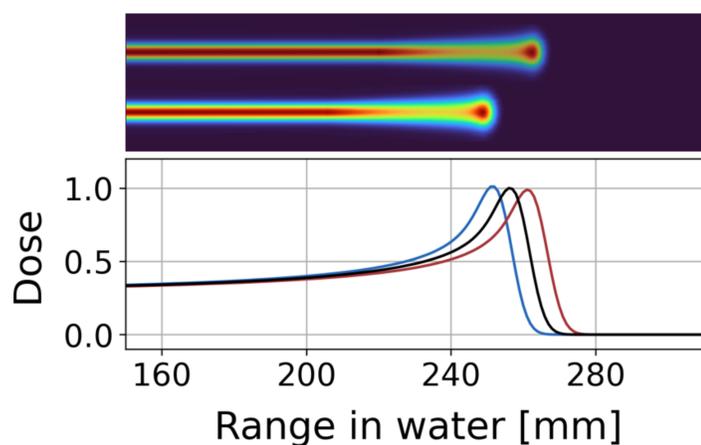


**Energy switching time**  
Nominal latency: 27.9 ms

**Clinical plan delivery:**  
45% time reduction  
compared to clinical  
standard

**Conclusions** Rapid adaptation of beam energy is essential to deliver tumour tracking plan following patients' breathing. Fast energy modulation can be realized within the beamline acceptance preserving clinical level beam quality.

**Outlook** Investigate into energy modulation within momentum acceptance for delivery of breathing-synchronized tumour tracking treatments.



Check out the GIF!

