In-vitro Beam Line

LhARA CDR Meeting

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Imperial College London

LhARA v2

END STATION
Where the cells will be irradiated. The beam will be delivered vertically from below the cell sample container.

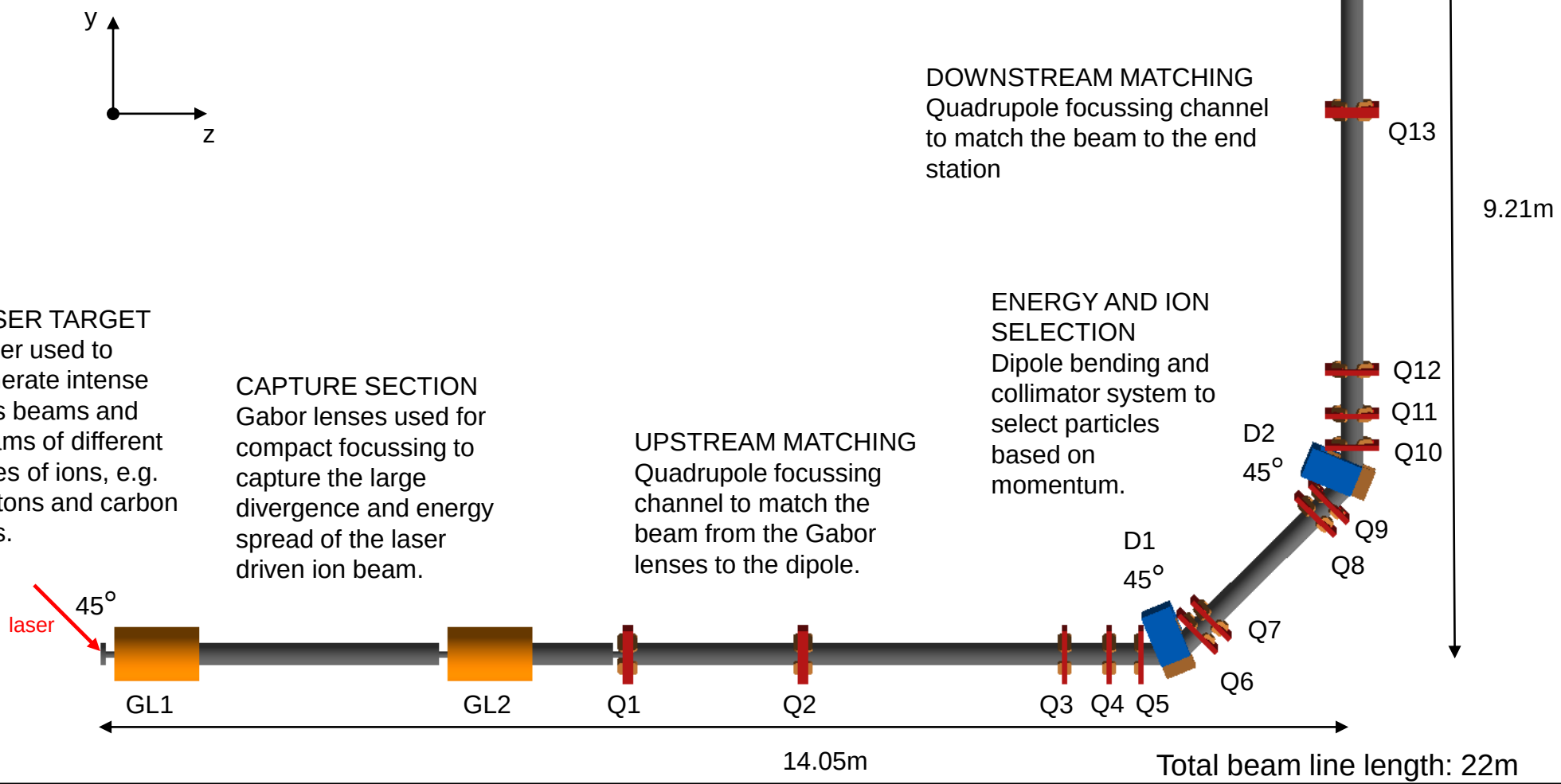
DOWNSTREAM MATCHING
Quadrupole focussing channel to match the beam to the end station

LASER TARGET
Laser used to generate intense ions beams and beams of different types of ions, e.g. protons and carbon ions.

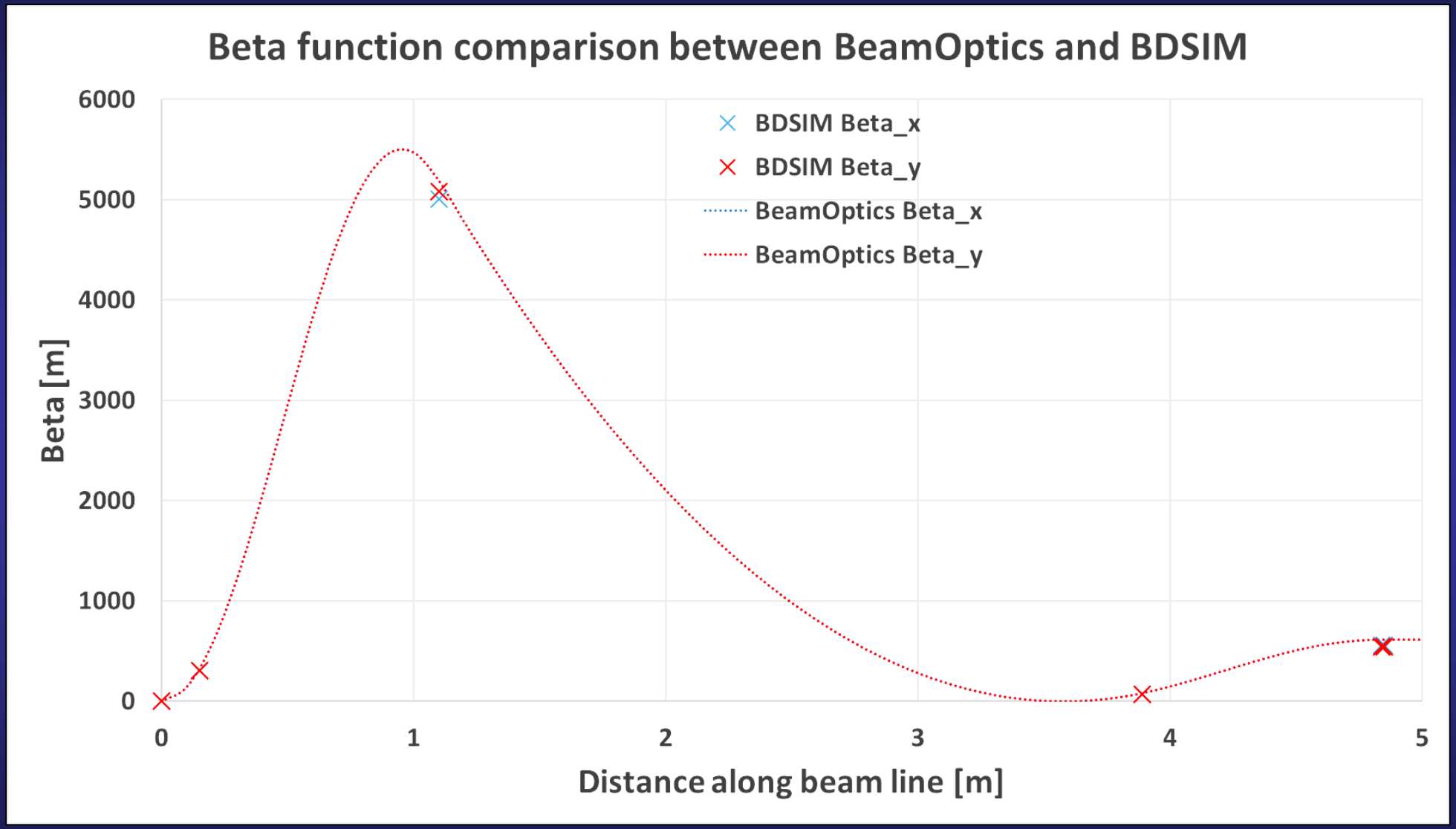
CAPTURE SECTION
Gabor lenses used for compact focussing to capture the large divergence and energy spread of the laser driven ion beam.

UPSTREAM MATCHING
Quadrupole focussing channel to match the beam from the Gabor lenses to the dipole.

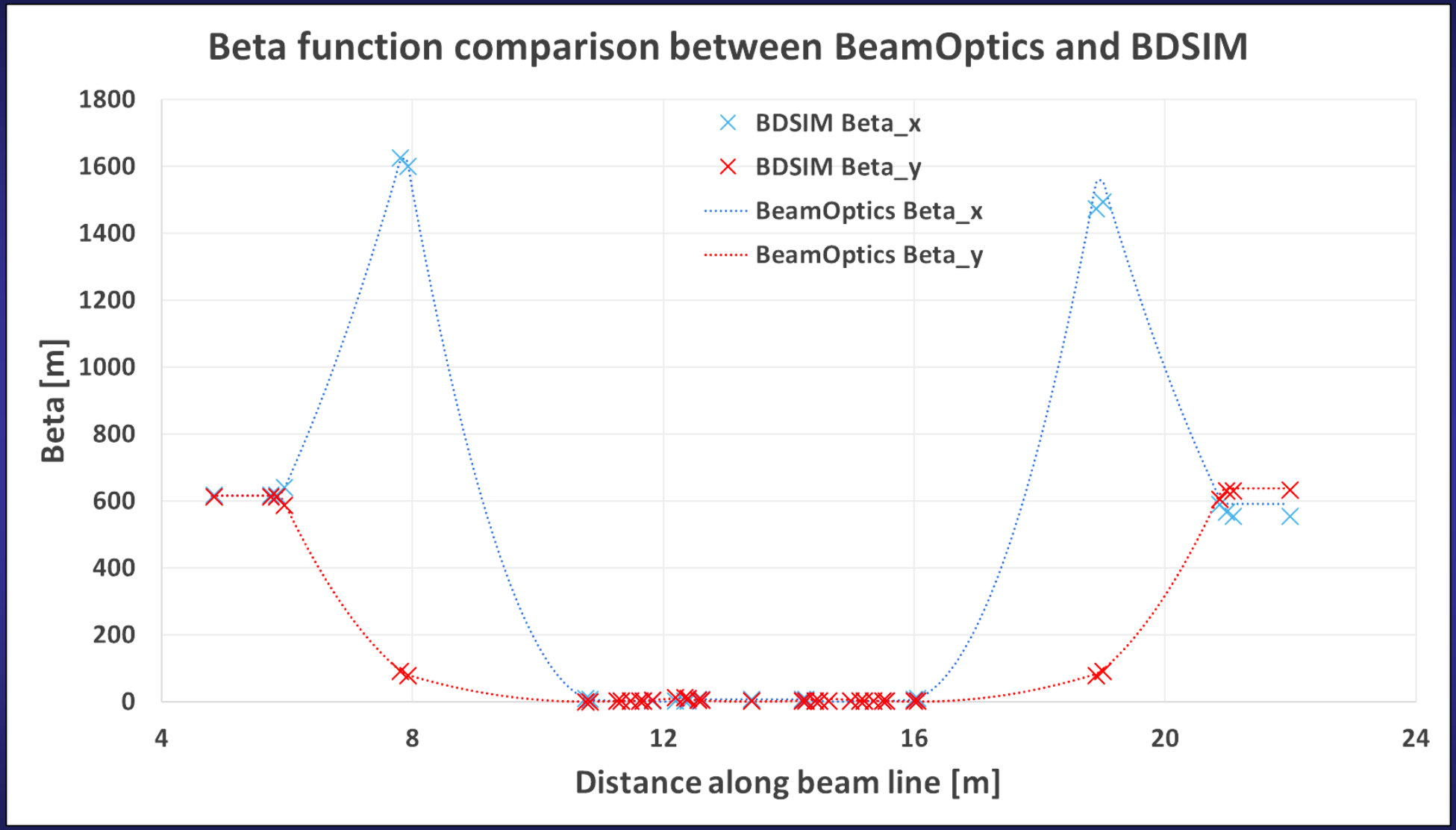
ENERGY AND ION SELECTION
Dipole bending and collimator system to select particles based on momentum.



Beta functions comparison for the capture section



Beta functions comparison for the matching and arc sections

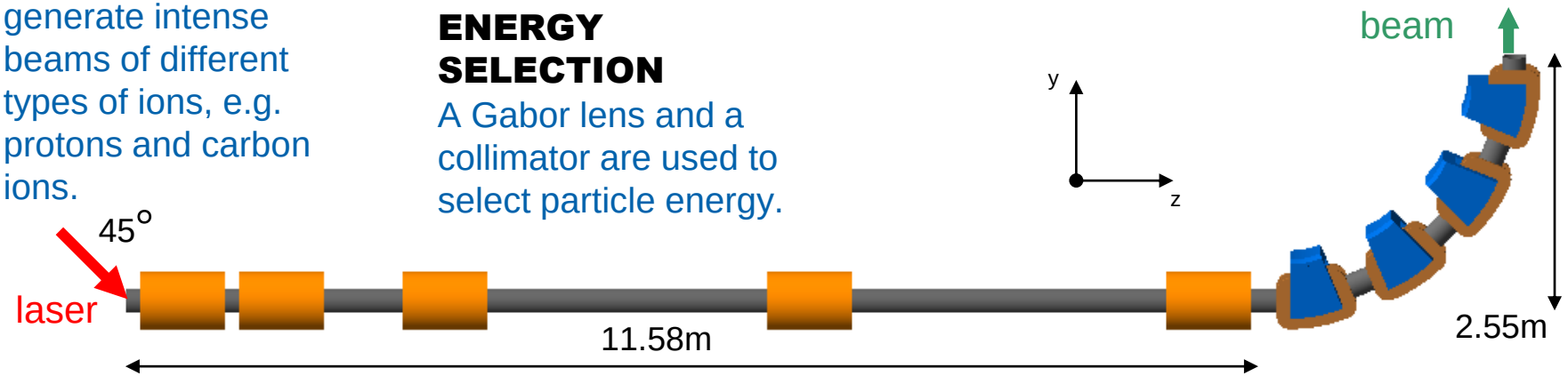


LhARA v4

LASER TARGET
Laser used to generate intense beams of different types of ions, e.g. protons and carbon ions.

ENERGY SELECTION
A Gabor lens and a collimator are used to select particle energy.

END STATION
Where the cells will be irradiated. The beam will be delivered vertically from below the cell culture plate.

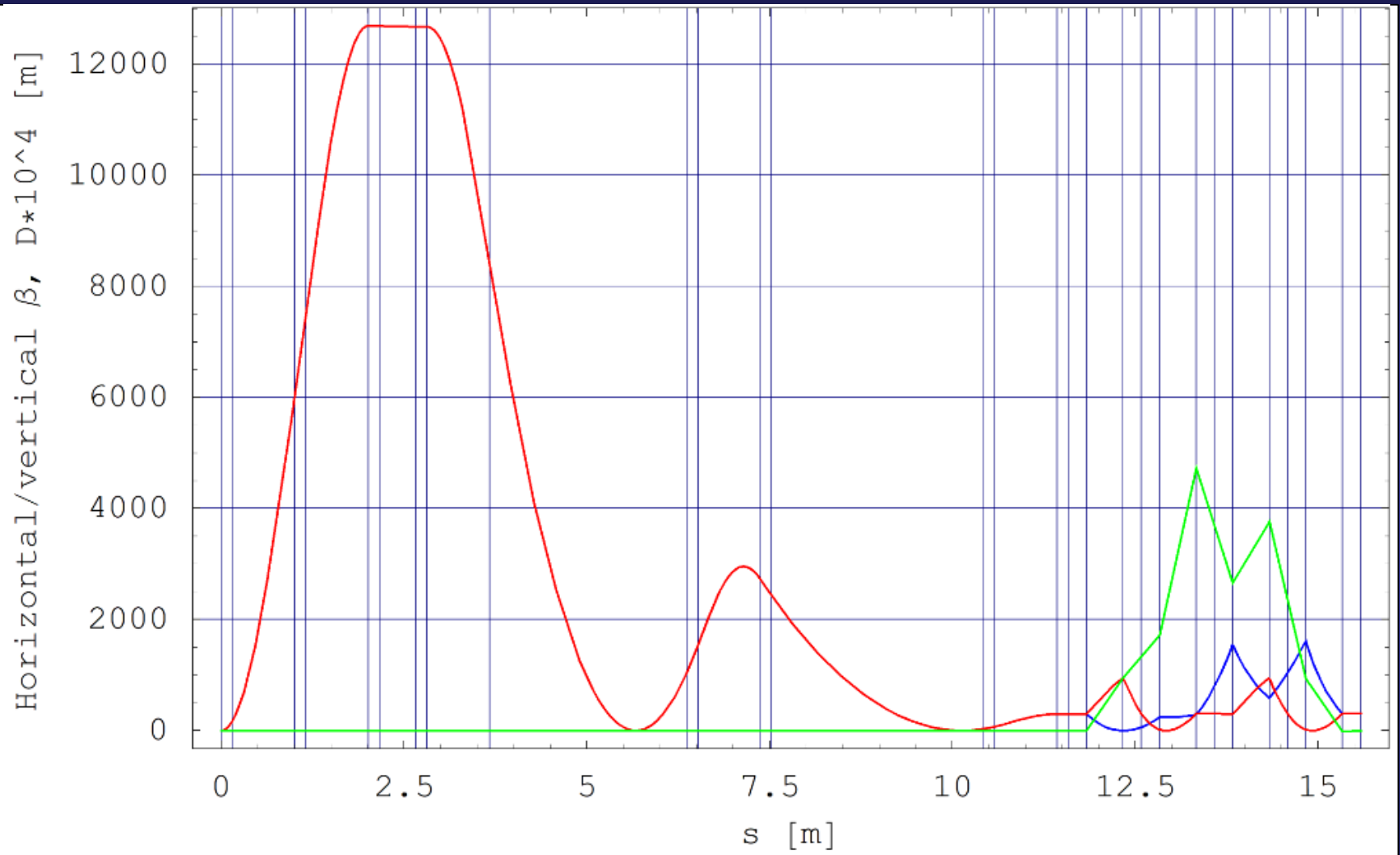


CAPTURE SECTION
Gabor lenses used for compact focussing to capture the large divergence and energy spread of the laser-driven ion beam.

MATCHING
Two Gabor lenses are used to adjust the beam size and divergence in the end station.

90° VERTICAL BEND
Combined function magnets deliver the beam vertically to the end station.

Beta functions and dispersion



Vertical (red) and horizontal (blue) betatron functions, and dispersion (green, scaled by 10^4) of LhARA Stage I.

Arc section

- LhARA v2 used the 90 degree bend to do energy and momentum selection.

- LhARA v4
  - Combined function magnets similar/identical to FFA post-accelerator magnets.
  - Conventional magnet solution, using quads and dipoles.
    - Recent updates from Jaroslaw and Theo (summer student).

Simulation

- LhARA v2 mainly used BDSIM. MADX to verify Jaroslaw's BeamOptics calculation.

- LhARA v4
  - Plans to simulate in BDSIM (need to update version of BDSIM).
  - Theo has run simulations using GPT.
    - Space charge.