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Linac-to-Booster Transfer Line

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PIP-II Collaboration Meeting
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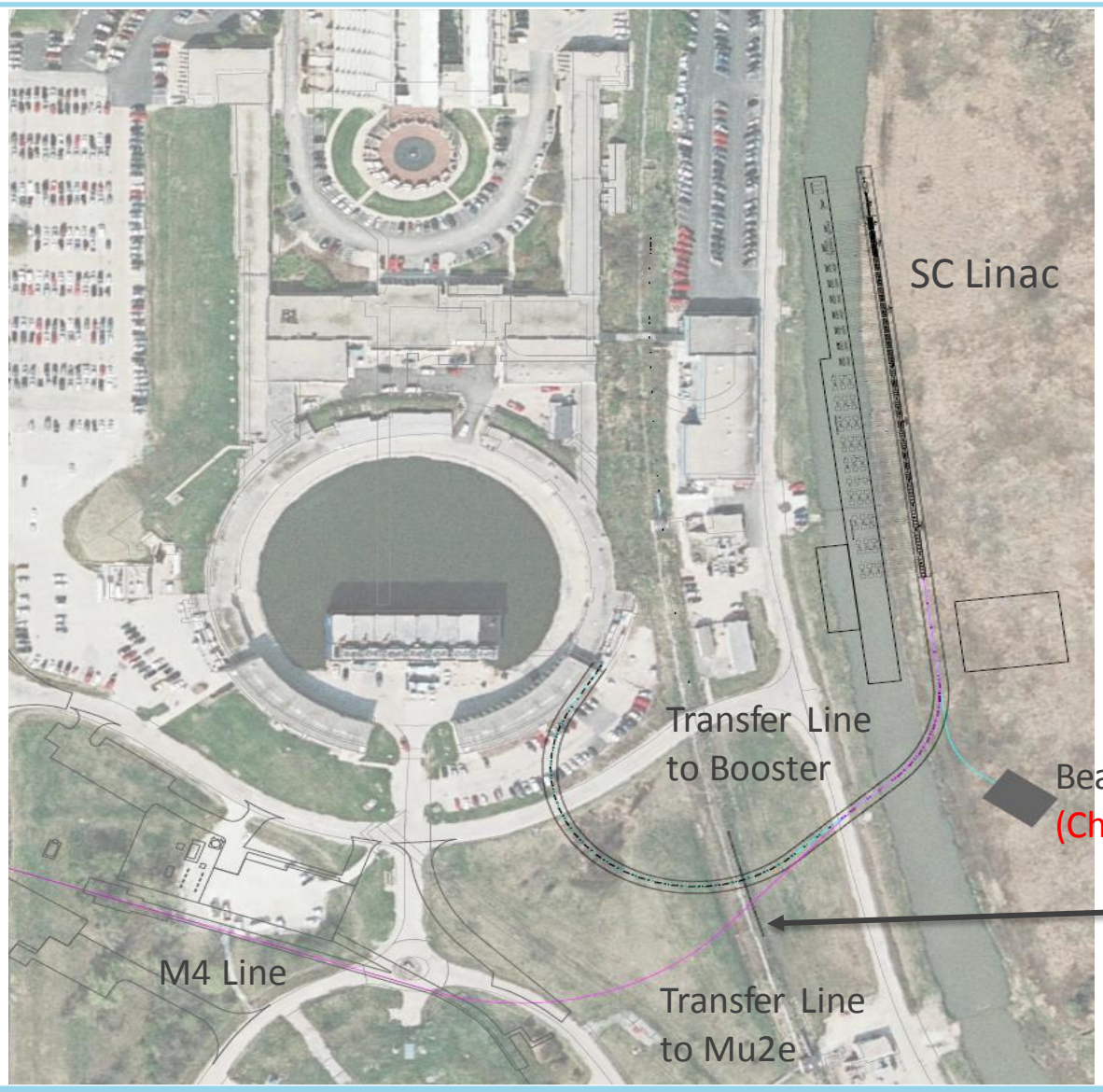
Outline

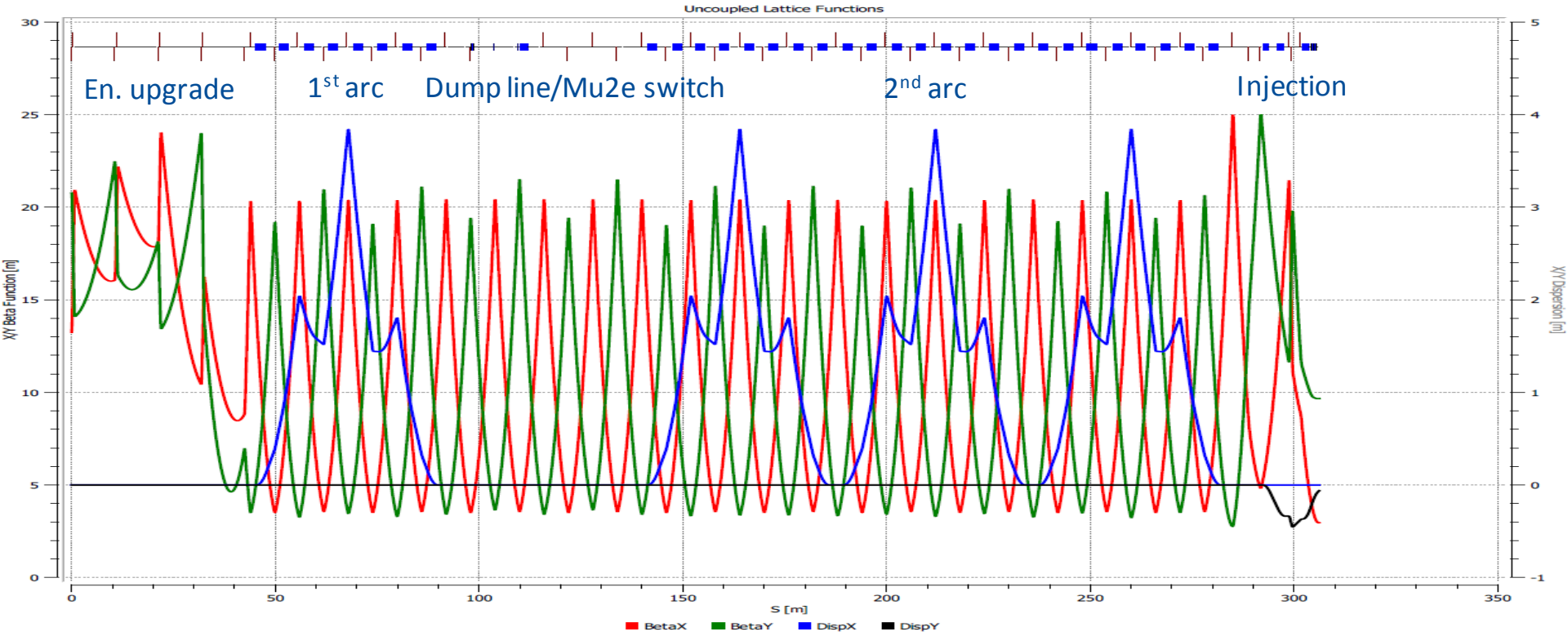
- Transfer Line footprint
- Dump/Mu2e line switch
- Dump line design
- Main Ring intersection options
- Lattice design
- Conclusion

Transfer Line footprint (July 2015)



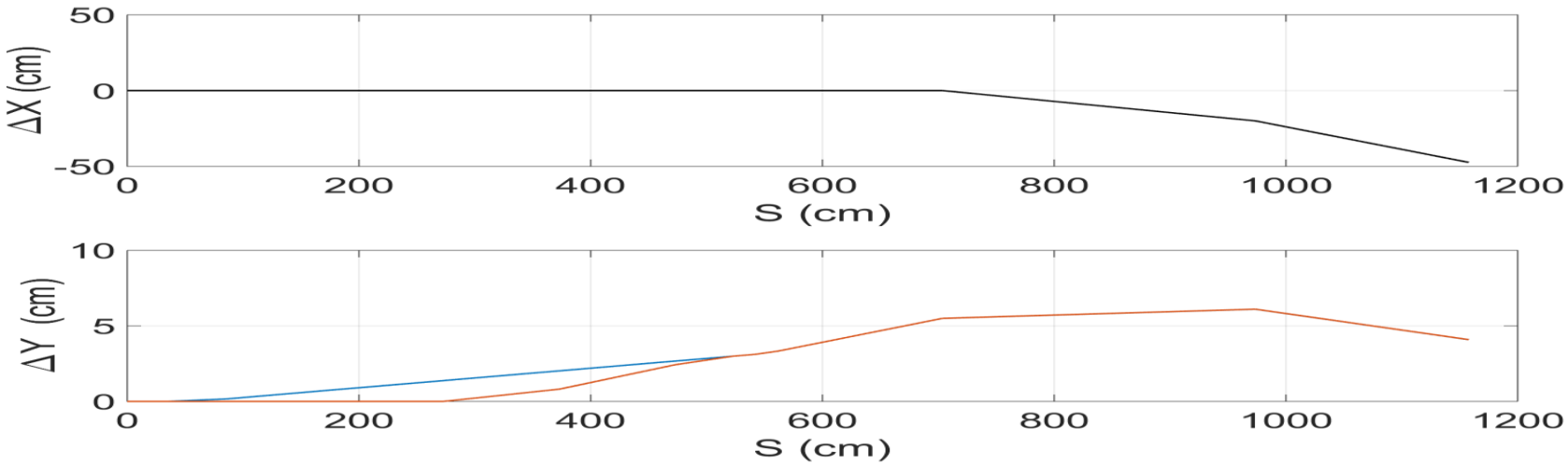
Transfer Line optics (July 2015)

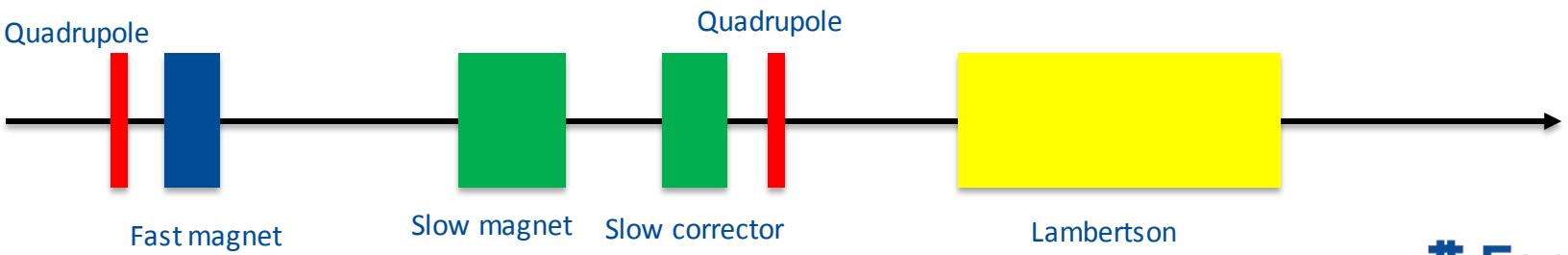
- 4 slots for additional cryomodules available for SC Linac upgrade (1.2 GeV)
- FODO cells with 90° phase advance per cell (H-V)
- 2 arcs of 32 horizontal bends (8+24)
- Straight section with dump and Mu2e line switches
- Vertical injection into the Booster (3 vertical bends)
- 54 quadrupoles (18 families, possible reduction of family number)



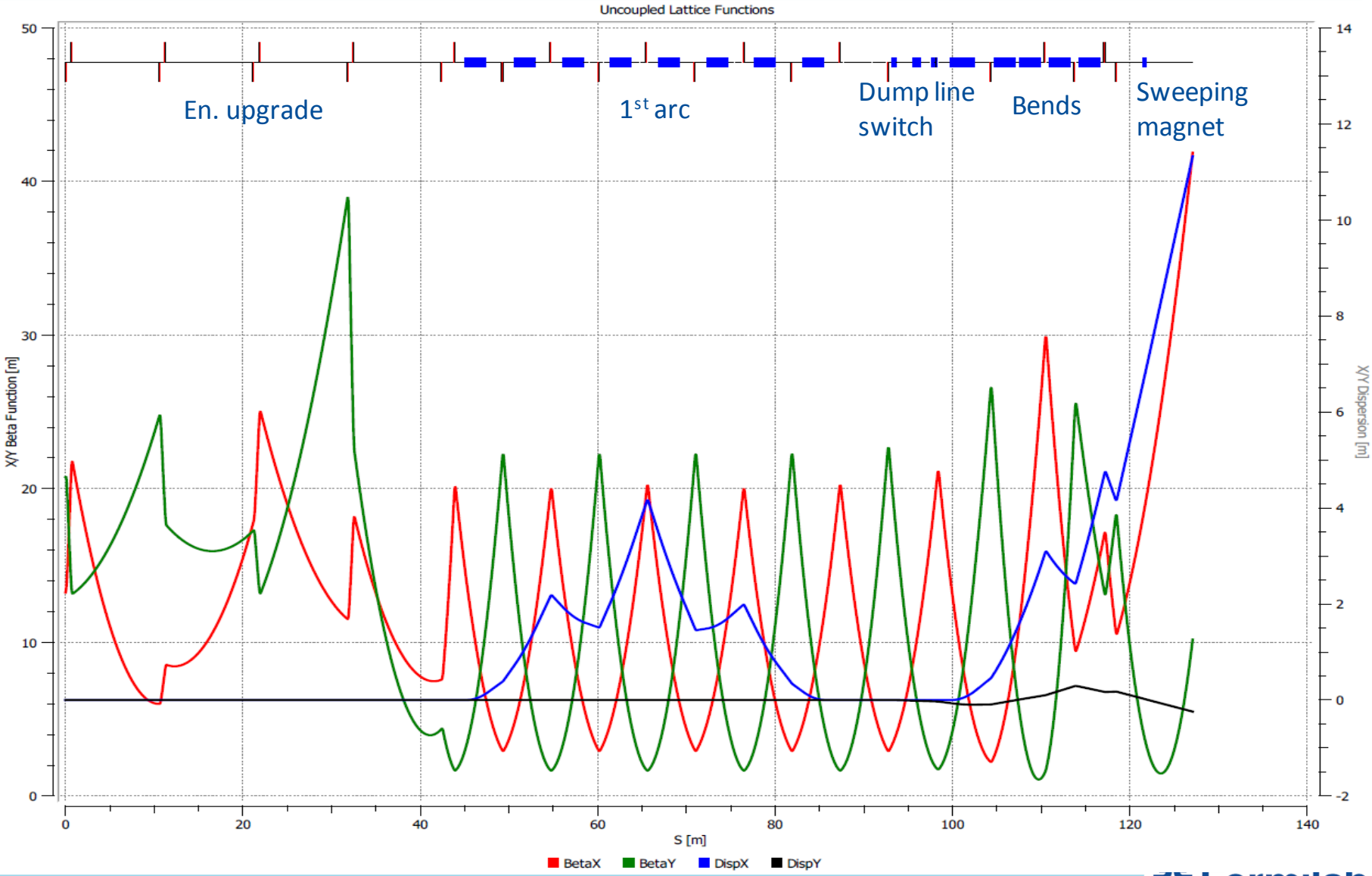
Dump line switch design

- Fast and slow switch needed for dump line.
- Fast switch used for energy stabilization. Fast switch time (few μs) and short flat-top (~20 μs) required.
- Slow switch will be used for commissioning, tuning and machine study.
- Dump line moved to straight section area for better access to the beamlines, equipment transport, radiation clearance in energy upgrade area, energy measurement in 1st arc.
- Dump for ~50 kW beam power. >10 m clearance needed for radiation shielding.



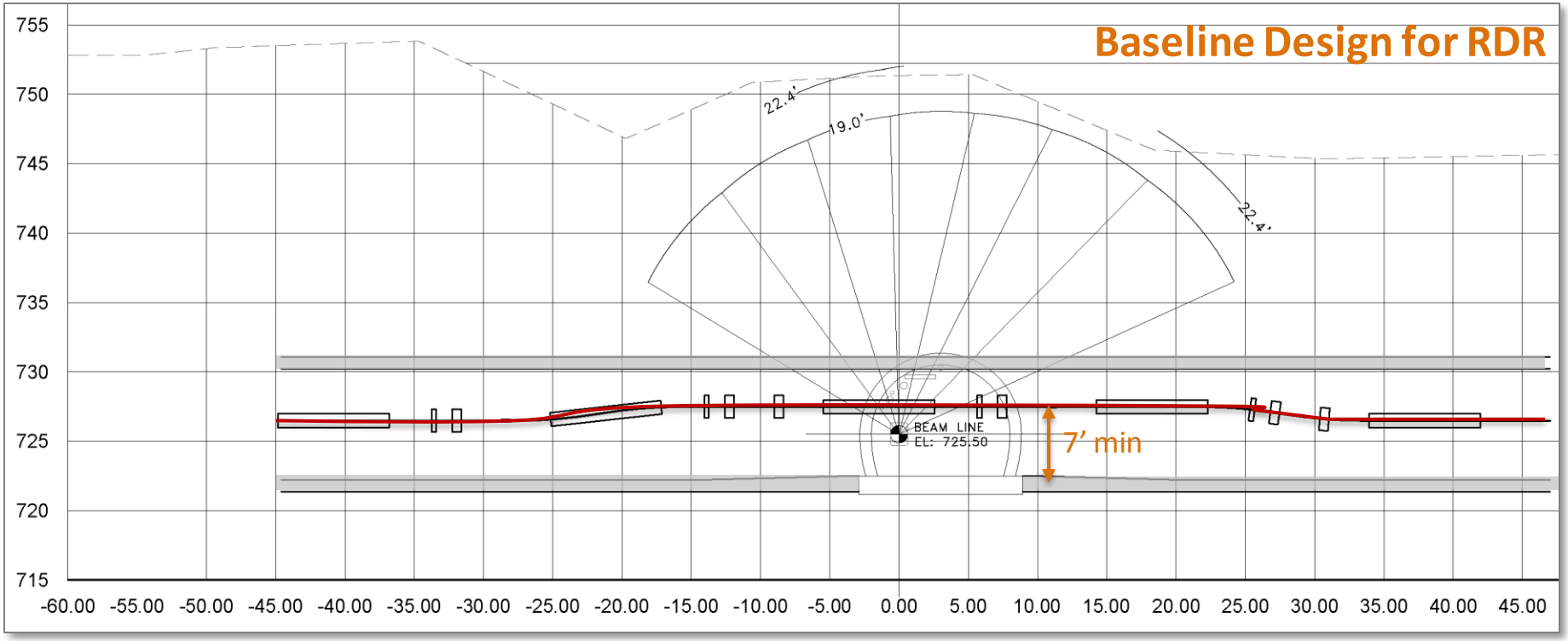


Dump line optics



Main Tunnel intersection Option 1

Crossing at Main Ring Elevation



Pros

- Smaller Beamline Change
- Less Change to Baseline Design

Cons

- Requires Relocation of beamline equipment/utilities in Main Ring
- Clearance Issues
- Equipment Transport
- HVAC Isolation

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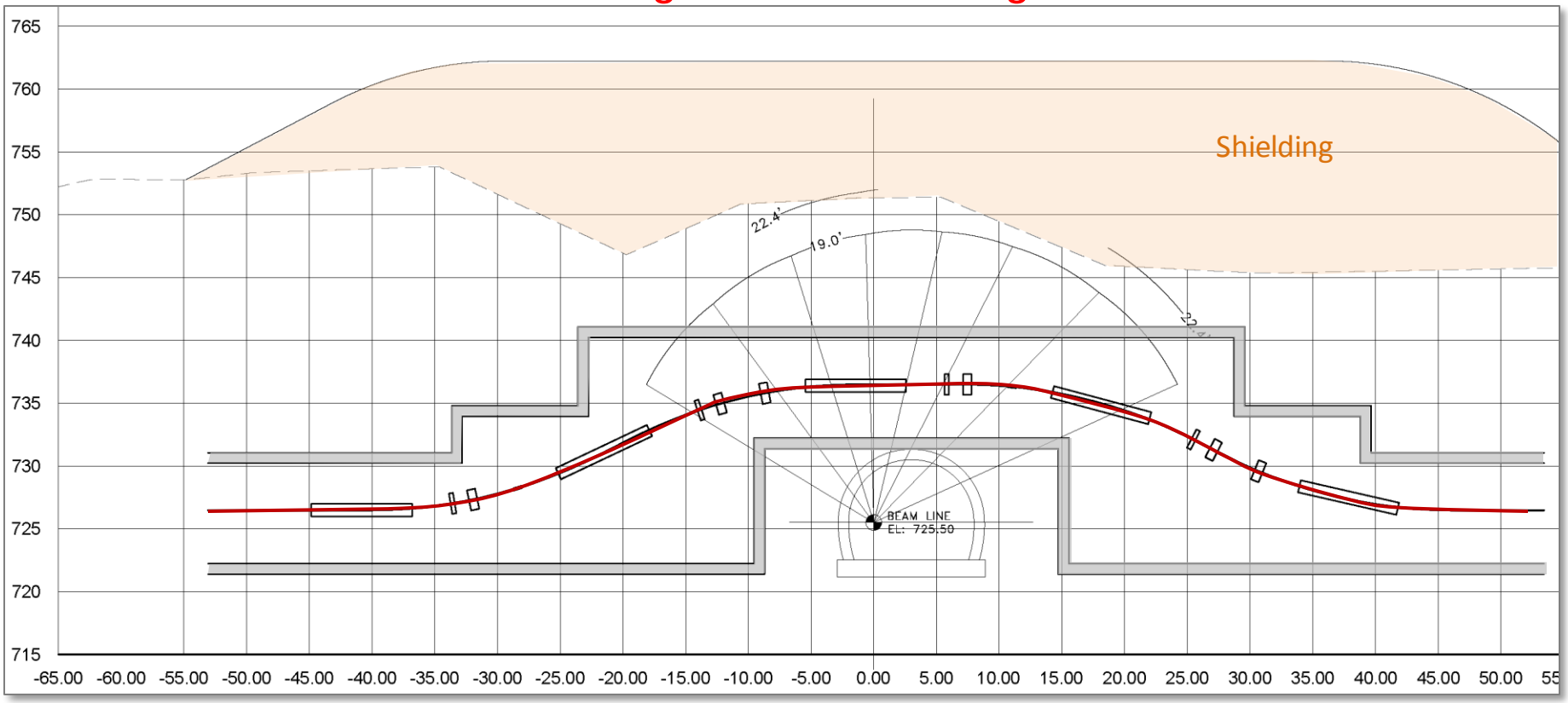
Main Tunnel intersection Option 2

Crossing Above Main Ring



Pros

- Less Impact to MR components
- Good Solution for HVAC

Cons

- Increased Shielding
- Equipment Transport (monorail)
- Structurally Complex

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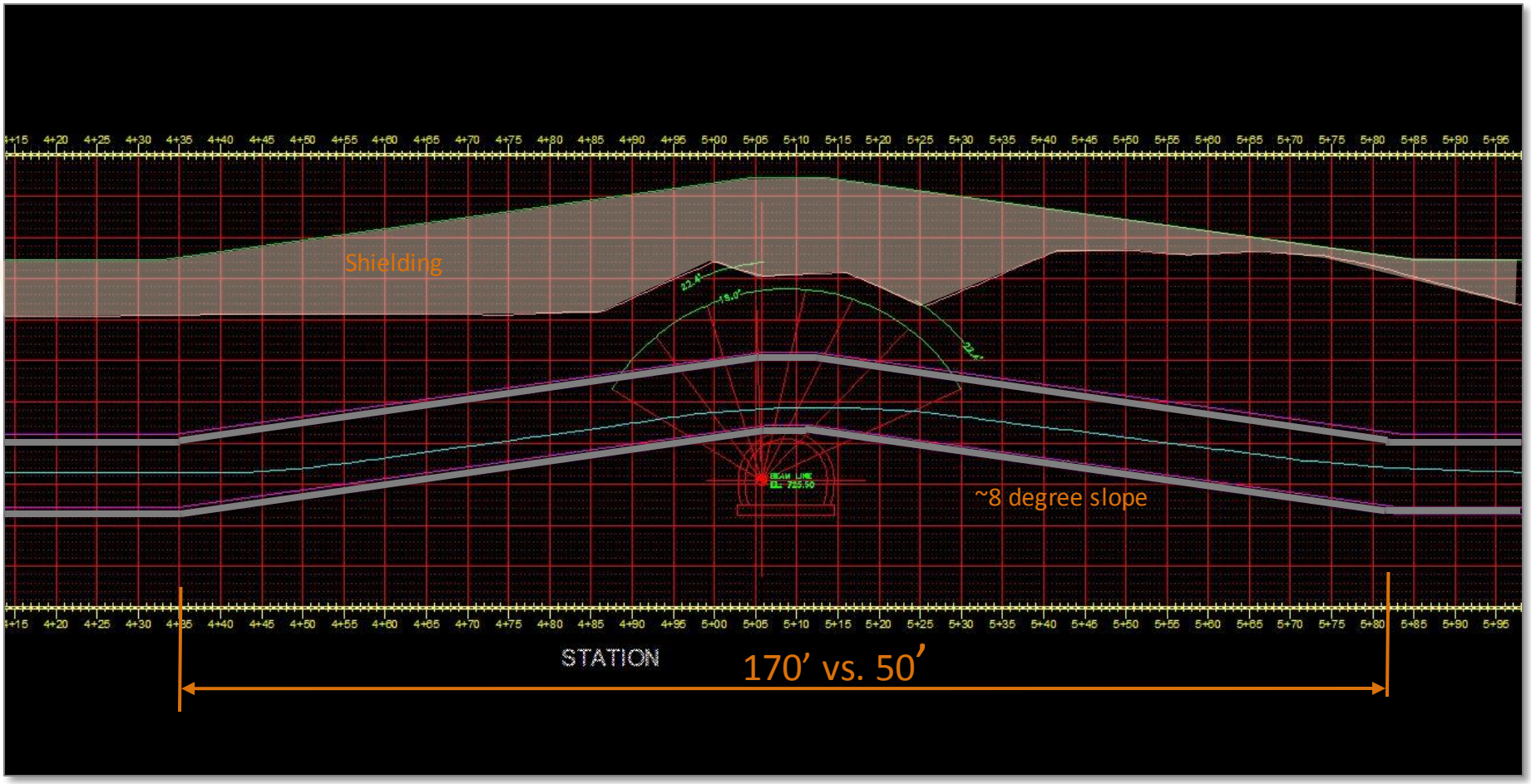
Main Tunnel intersection

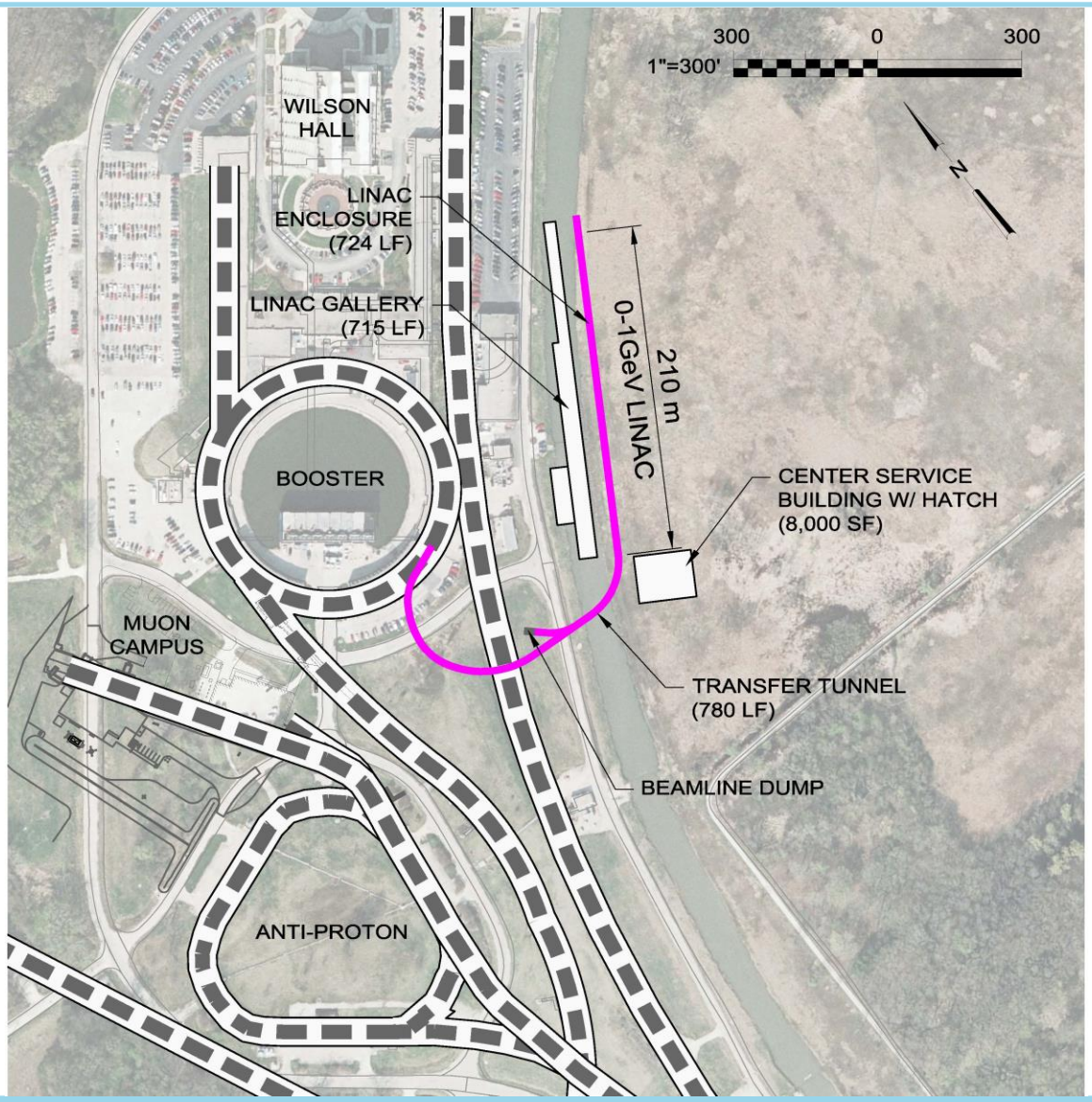
- Option 3 (Crossing Below Main Ring) would require deep excavation and structure complexity overcoming all the benefits.
- Option 2 would not guarantee complete independence of the beamlines since not enough shielding can be used between the enclosures.
- Final decision will depend on ongoing detailed civil engineering evaluation and cost estimate.

Option 2 lattice design strategy

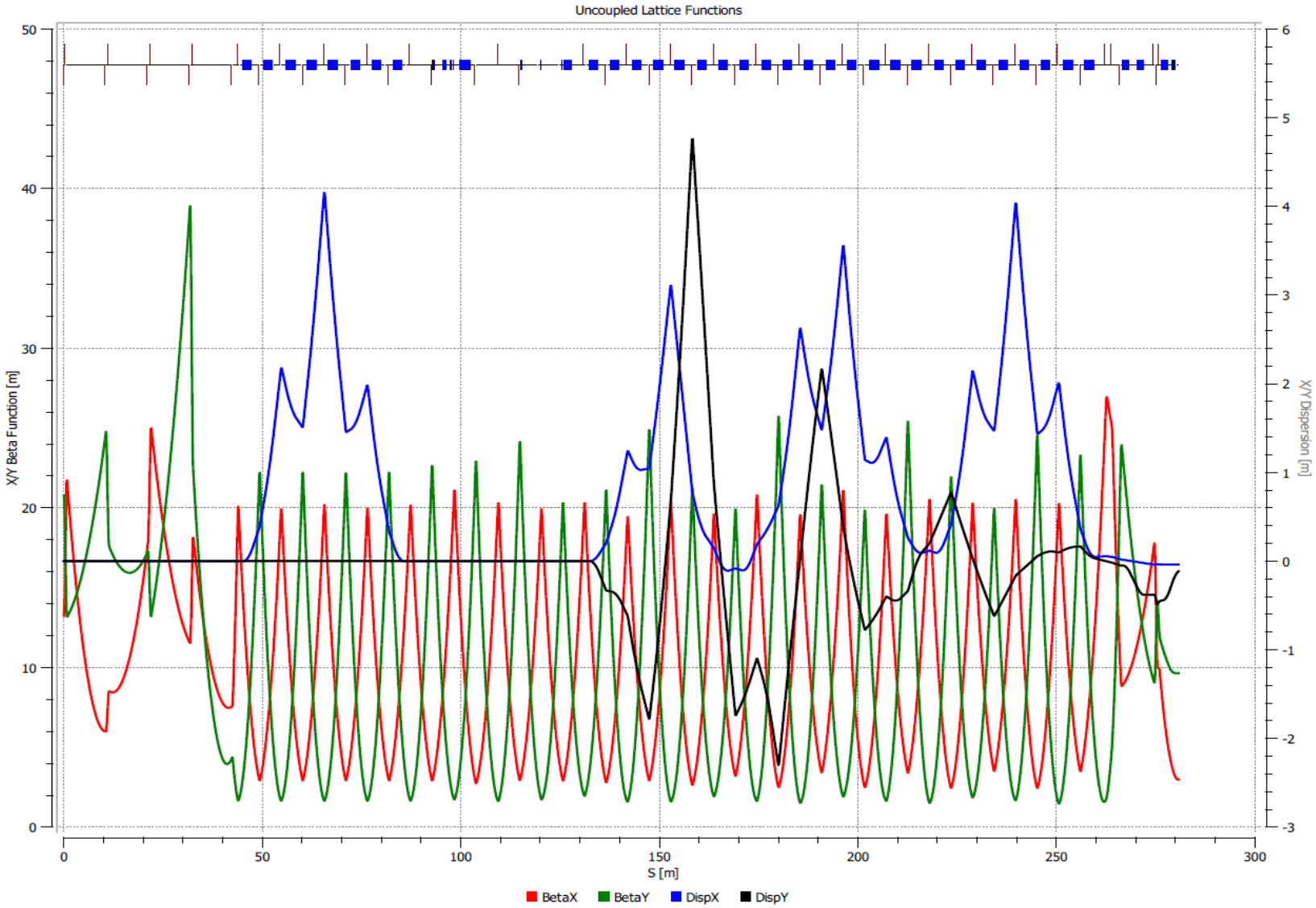
- Elevation of the beamline obtained by rolling existing bends without adding new magnets.
- Change of phase advance per cell (H-90°,V-120°) for easier dispersion cancellation.
- Rolling of the remaining bends to cancel dispersion (H-V).
- Beamline slope below 15% to allow equipment transport in the enclosure.



Transfer Line footprint (Oct. 2015)



Transfer Line optics (Oct. 2015)



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Conclusions

- Design of the transport line have been realized for the 2 options of main ring intersection considered. Both designs fulfill requirements. The final decision will be made after construction risk evaluation and cost estimation.
- Dump line has been designed according to the specifications with fast and slow systems for directing the beam to the dump. The switch for the Mu2e line will be realized similarly to the fast system for the dump line.
- Draft design of the elements of the beamline with their FRS is ongoing.