Science and Technology Facilities Council

nuSTORM facility

UK Muon Collider and nuStorm - 7th Aug 2020

J.B. Lagrange
ISIS, RAL, STFC

Contents

- Primary proton beam
- Target and pion beam line
- Decay ring

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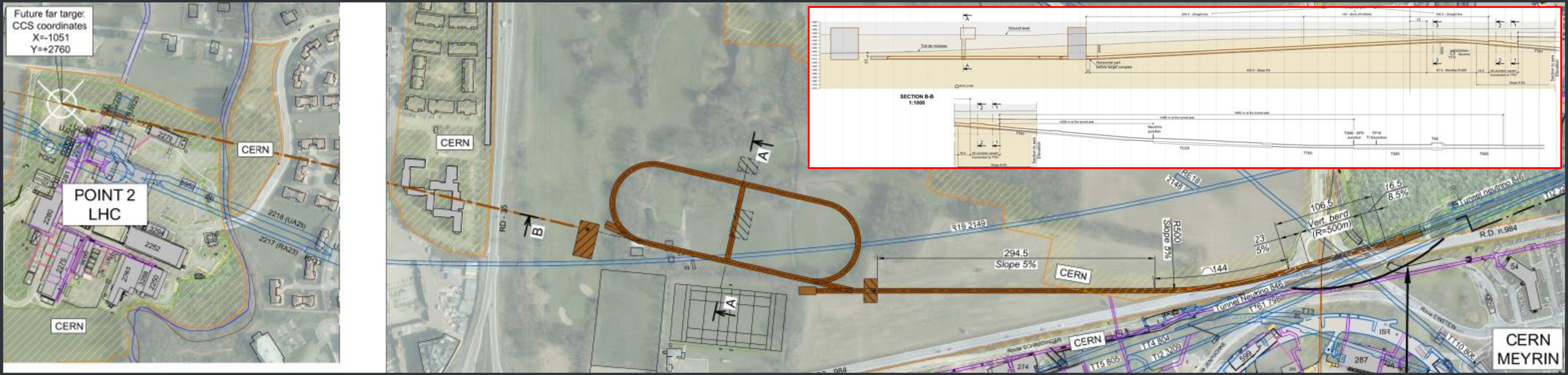
Primary proton beam



- 100 GeV protons from SPS
- Fast extraction at LSS6
- Use of existing facilities, no show stopper identified
- Extraction system upgrade needed to meet POT goal (4×10^{19} protons/year)

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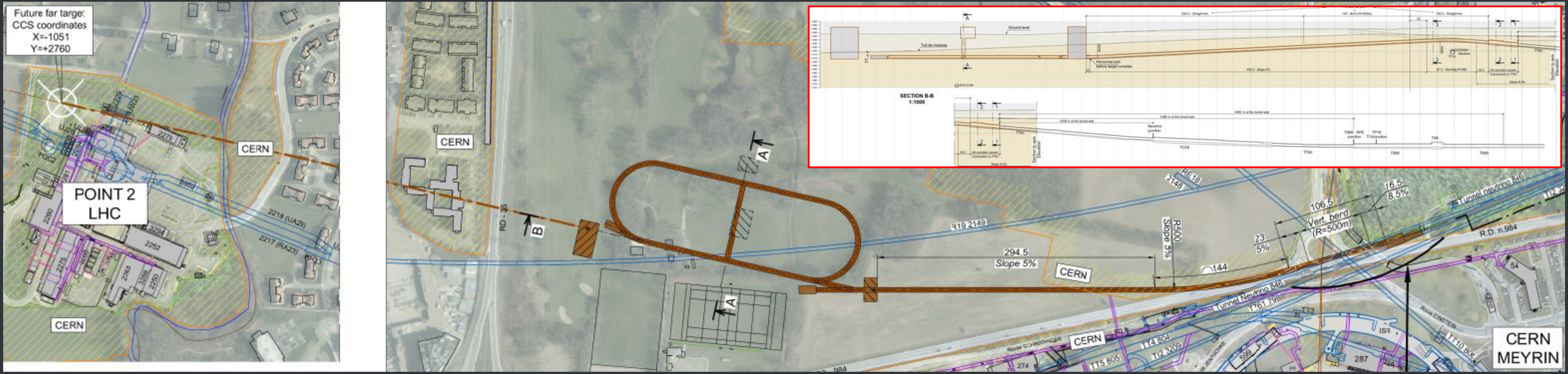
Proton beam transfer line



- FODO beam transfer line (875 m) to target
- Use of existing tunnels TT60 and TT61
- New cavern and tunnel (585 m) to be constructed

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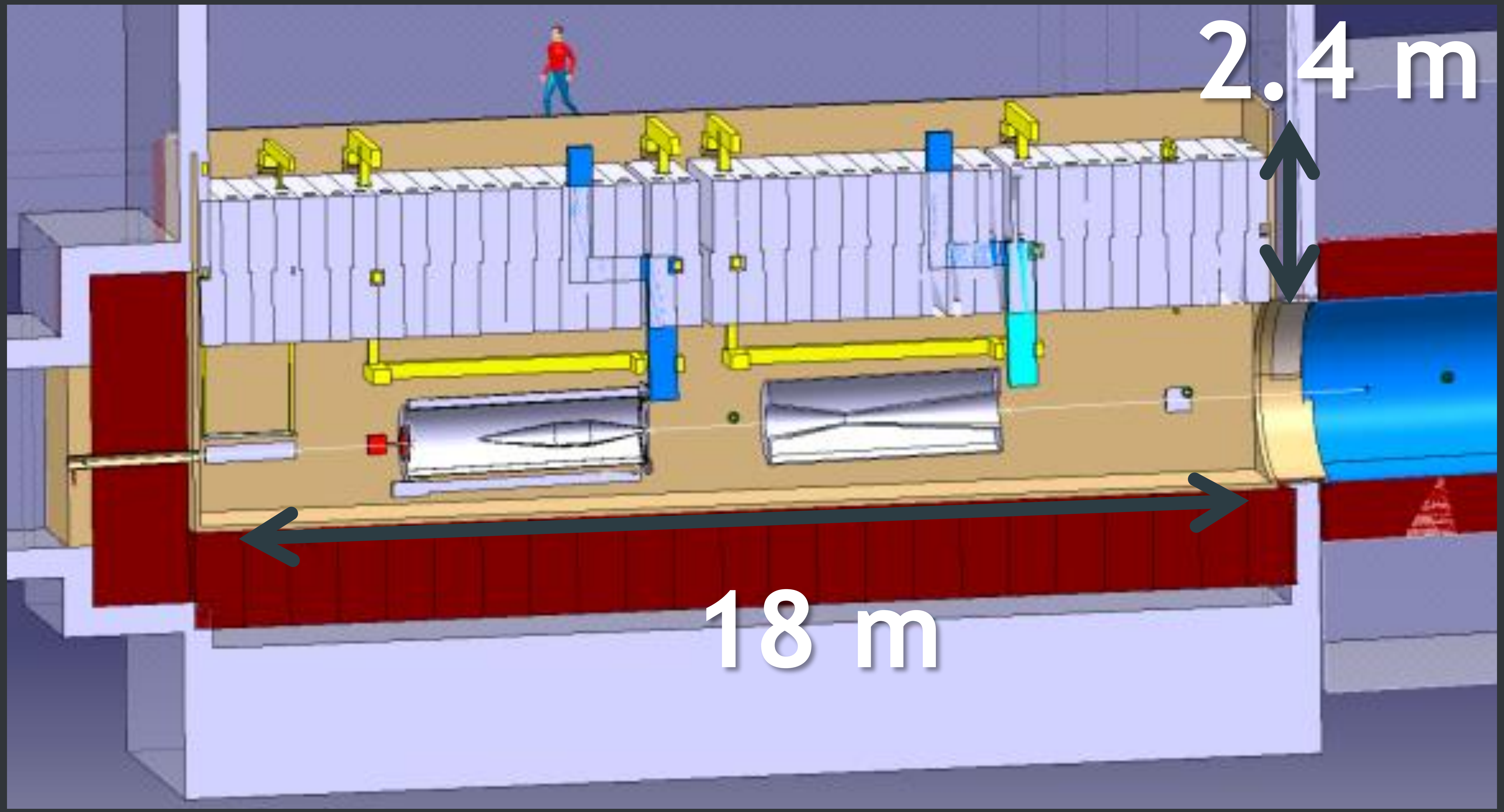
Proton target

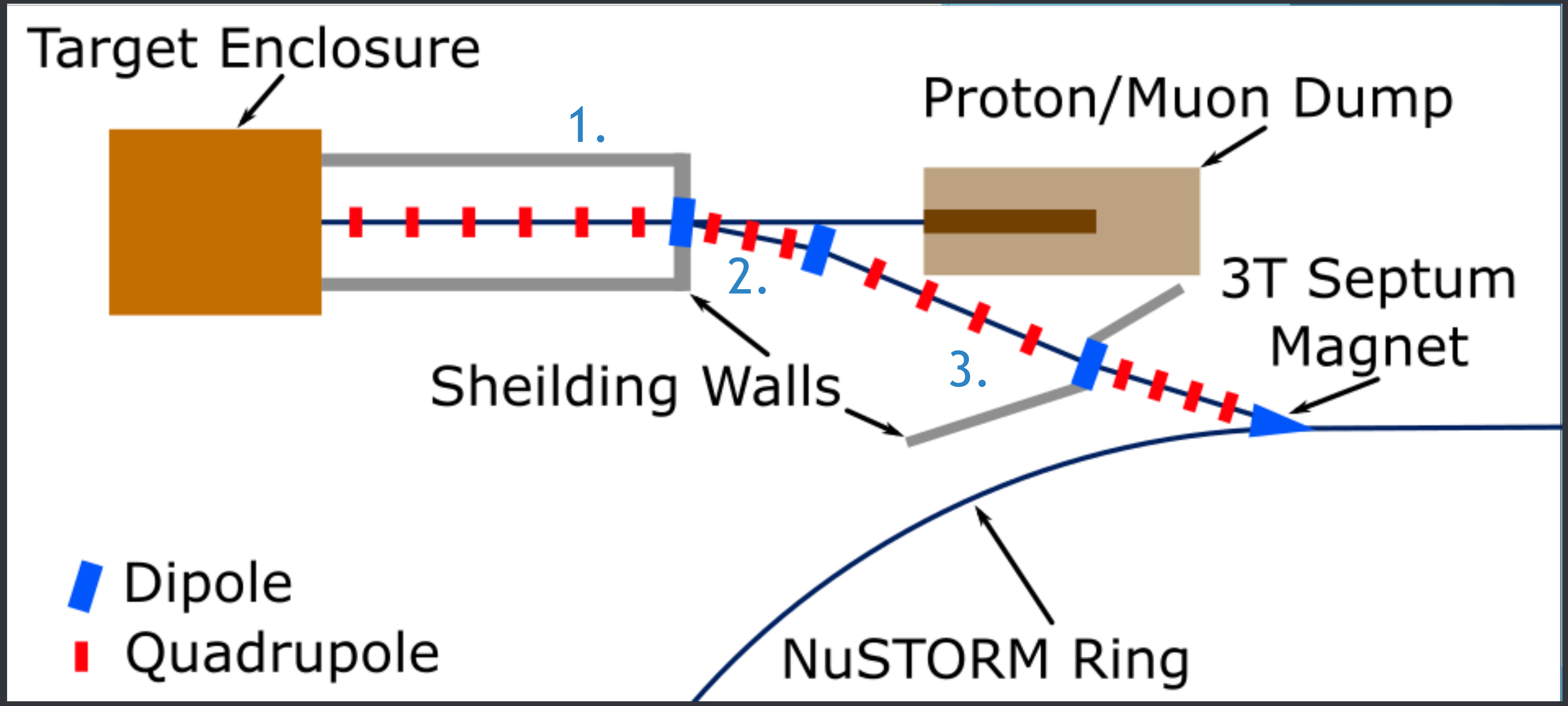
- Similar scheme than FNAL proposal
- ~200 kW proton beam power
- Magnetic horn focusing system
- Graphite target
- Expertise at CERN (CENF, BDF, AD)
- Target-horn configuration to be optimised
- Radiation protection study needed



LAGUNA-LBNO project

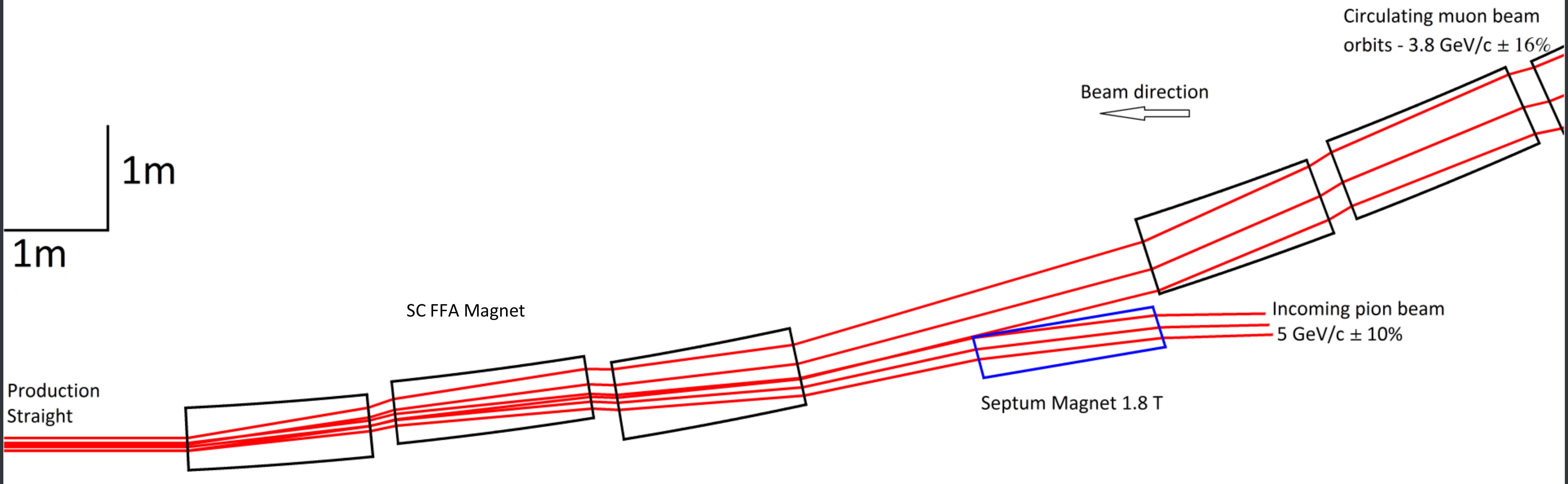
Pion beam transport line

- Short pion beam line from target to the decay ring
- Capture, transport and match of the beam
- Minimise residual dose in main cavern
- Beam line to be optimised



(C. Hunt, 22/10/19, CERN)

Injection in decay ring



- Stochastic injection (D. Neuffer's concept, 1980)
- Pions injected without kicker

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Decay ring

- Several options considered
  - FODO solution
  - FFA solution
  - Hybrid solution

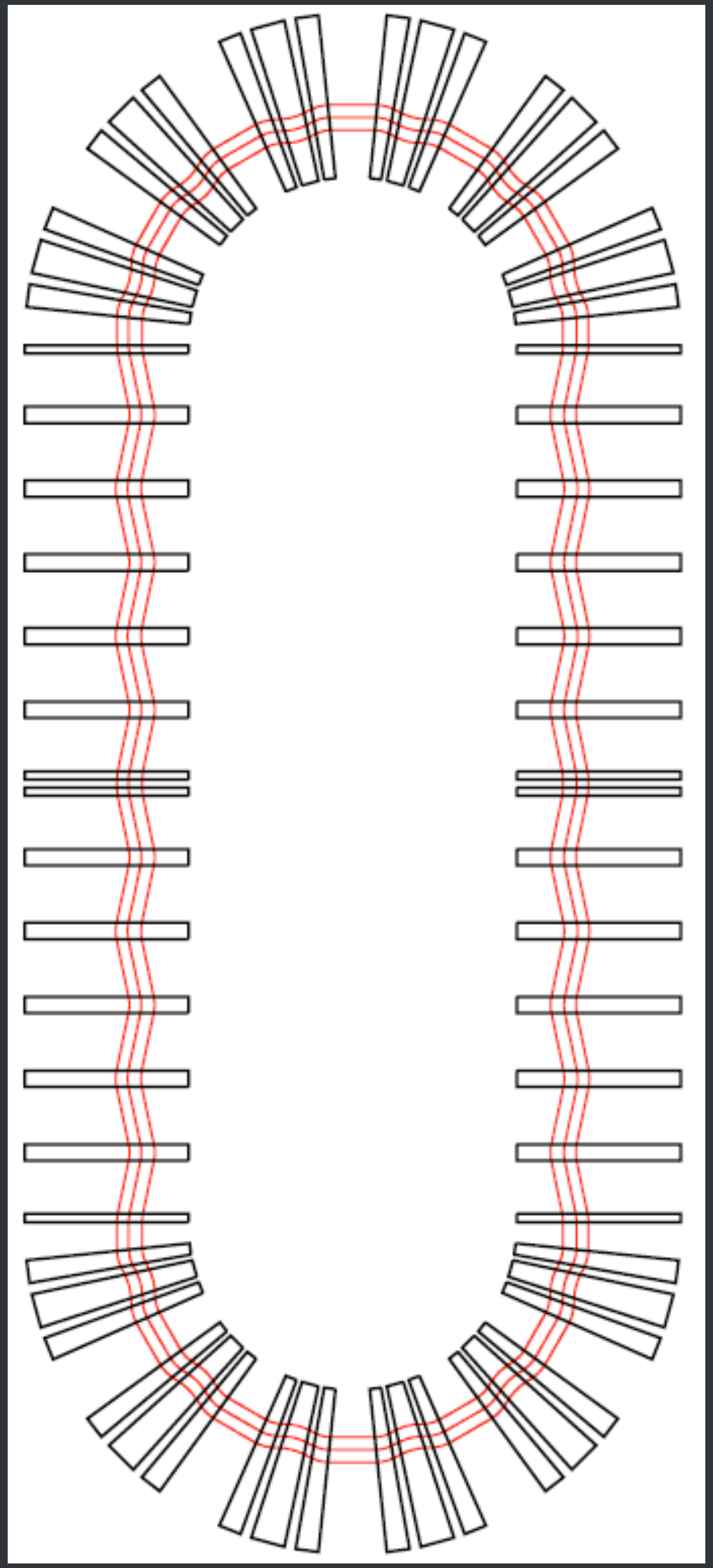
FODO decay ring

- Pros:
  - Straight forward solution: large bore conventional magnets, no R&D required
  - Large transverse acceptance (limited by magnet size)
- Cons:
  - Small momentum acceptance (limited by beam dynamics)
  - Large and uncontrolled losses

    Addition of carefully adjusted sextupoles in the arcs: ~10% improvement

FFA decay ring

- Pros:
  - Very large momentum acceptance with zero-chromaticity (limited by magnet size)
  - Large transverse acceptance (limited by beam dynamics and magnet aperture)
- Cons:
  - Larger magnets
  - Superconducting combined function magnets: R&D required
  - Scallop in production straight
  - Dispersion in production straight (reduced pion capture)



Hybrid decay ring

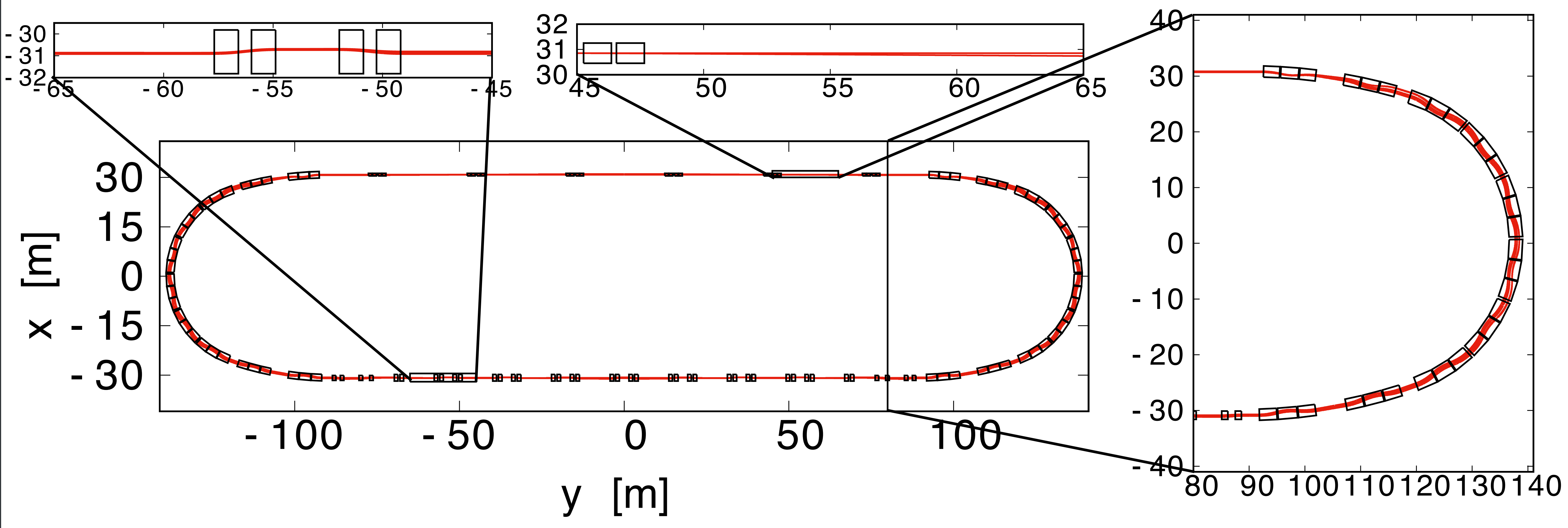
FODO solution in production straight, FFA magnets in the rest of the ring

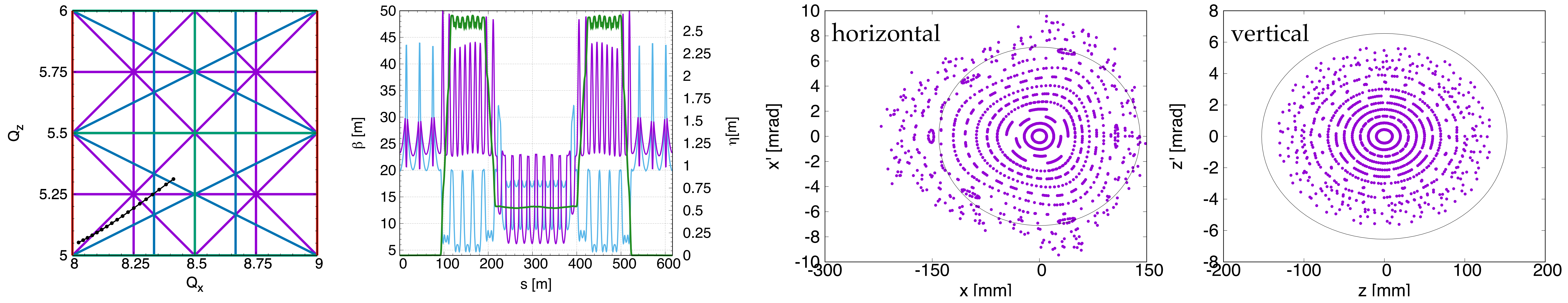
- No scallop in production straight
- Efficient pion capture (zero-dispersion in production straight)
- Large momentum acceptance (small chromaticity in the ring)
- Large transverse acceptance (same than FFA solution)

But

- Large magnets
- Superconducting combined function magnets: R&D required

Hybrid decay ring





±16% momentum acceptance

Summary

- nuStorm facility has no show stoppers
- Significant work already done, limited but critical remaining R&D
- Technology demonstration platform towards a muon collider facility