A layout for a muon test facility at the CERN-PS: the primary proton beam

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Summary

- Beam Parameters
- Geometry/optics
- Hardware
- Conclusion

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Beam parameters I

Two different proton beams could be used for the muon test facility, namely:

- Low intensity
  - $\mathrm{p} = 26\ \mathrm{GeV}/c$
  - $I_\mathrm{p} \approx 5 \times 10^{11}\ \mathrm{p/bunch}$
  - $1 \leq N_\mathrm{b} \leq 16$
  - $\epsilon^*_{h,rms} \approx 1\ \mu\mathrm{m}$
  - $\epsilon^*_{v,rms} \approx 1\ \mu\mathrm{m}$
  - $\sigma_\mathrm{t} \approx 10\ \mathrm{ns}$
  - $\Delta p/p(2\sigma) \approx 1.5 \times 10^{-3}$
- High intensity
  - $\mathrm{p} = 26\ \mathrm{GeV}/c$
  - $I_\mathrm{p} \approx 5 \times 10^{12}\ \mathrm{p/bunch}$
  - $1 \leq N_\mathrm{b} \leq 4$
  - $\epsilon^*_{h,rms} \approx 10\ \mu\mathrm{m}$
  - $\epsilon^*_{v,rms} \approx 10\ \mu\mathrm{m}$
  - $\sigma_\mathrm{t} \approx 14\ \mathrm{ns}$
  - $\Delta p/p(2\sigma) \approx 1.5 \times 10^{-3}$

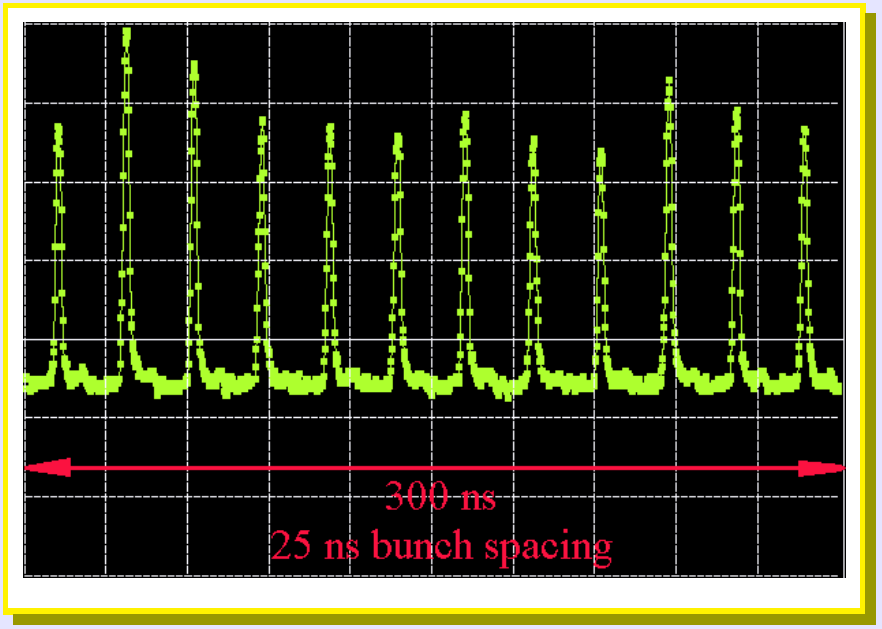
Remark: It is possible to perform a bunch rotation to decrease σ_t by a factor two.

The beam is fast extracted towards the target.

Beam parameters II

Another possibility would be to use an LHC-type beam. In this case the 40 MHz structure imposed by the cooling principle would be already present.

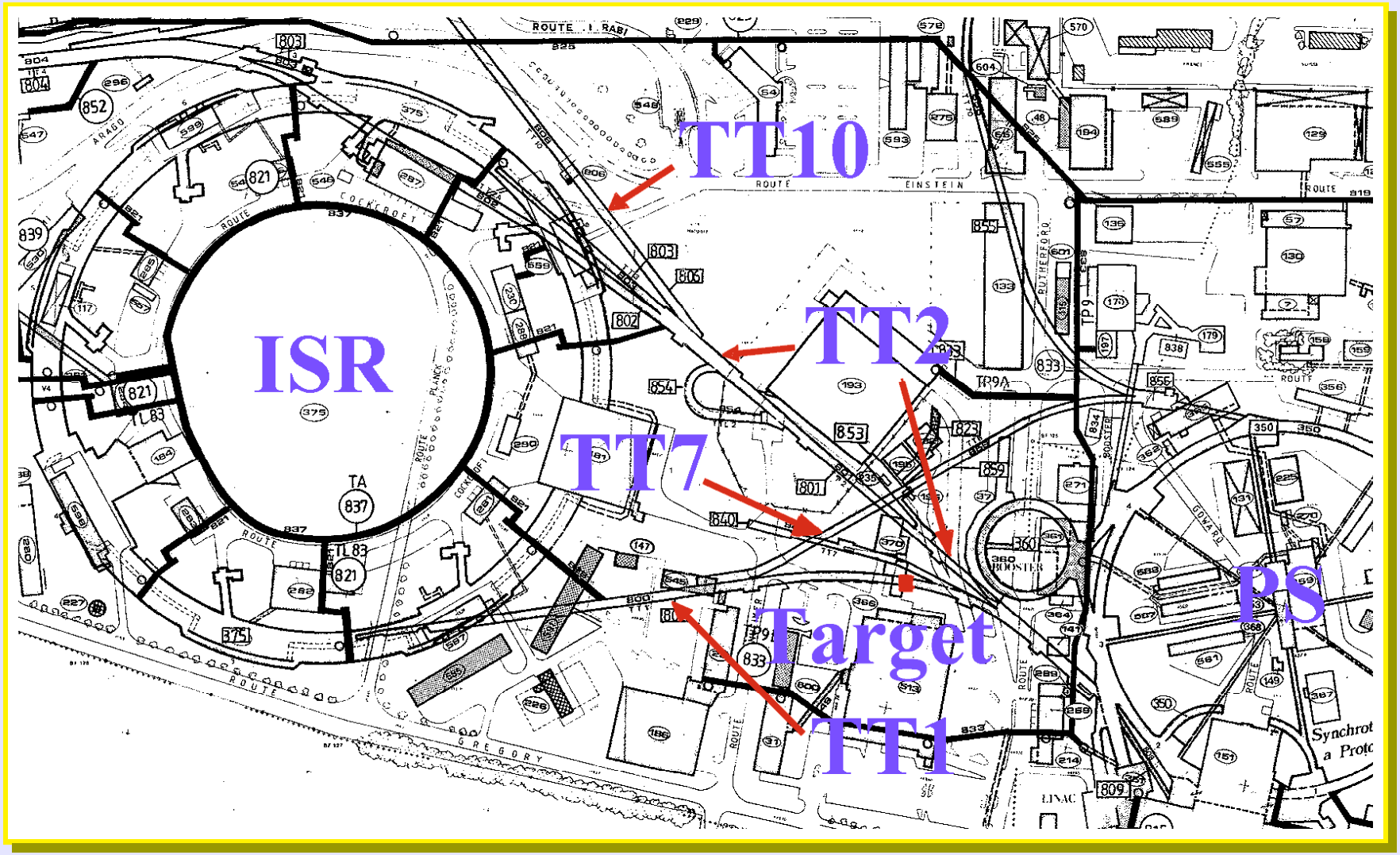
- Low intensity
  - $\mathrm{p} = 26$ GeV/c
  - $I_{\mathrm{p}} \approx 1.1 \times 10^{11}$ p/bunch
  - $1 \leq N_{\mathrm{b}} \leq 72$ (N_{b} is multiple of 12).
  - $\epsilon^*_{h,rms} \approx 3$ μm
  - $\epsilon^*_{v,rms} \approx 3$ μm
  - $\sigma_{\mathrm{t}} \approx 1$ ns
  - $\Delta p/p(2\sigma) \approx 2.5 \times 10^{-3}$



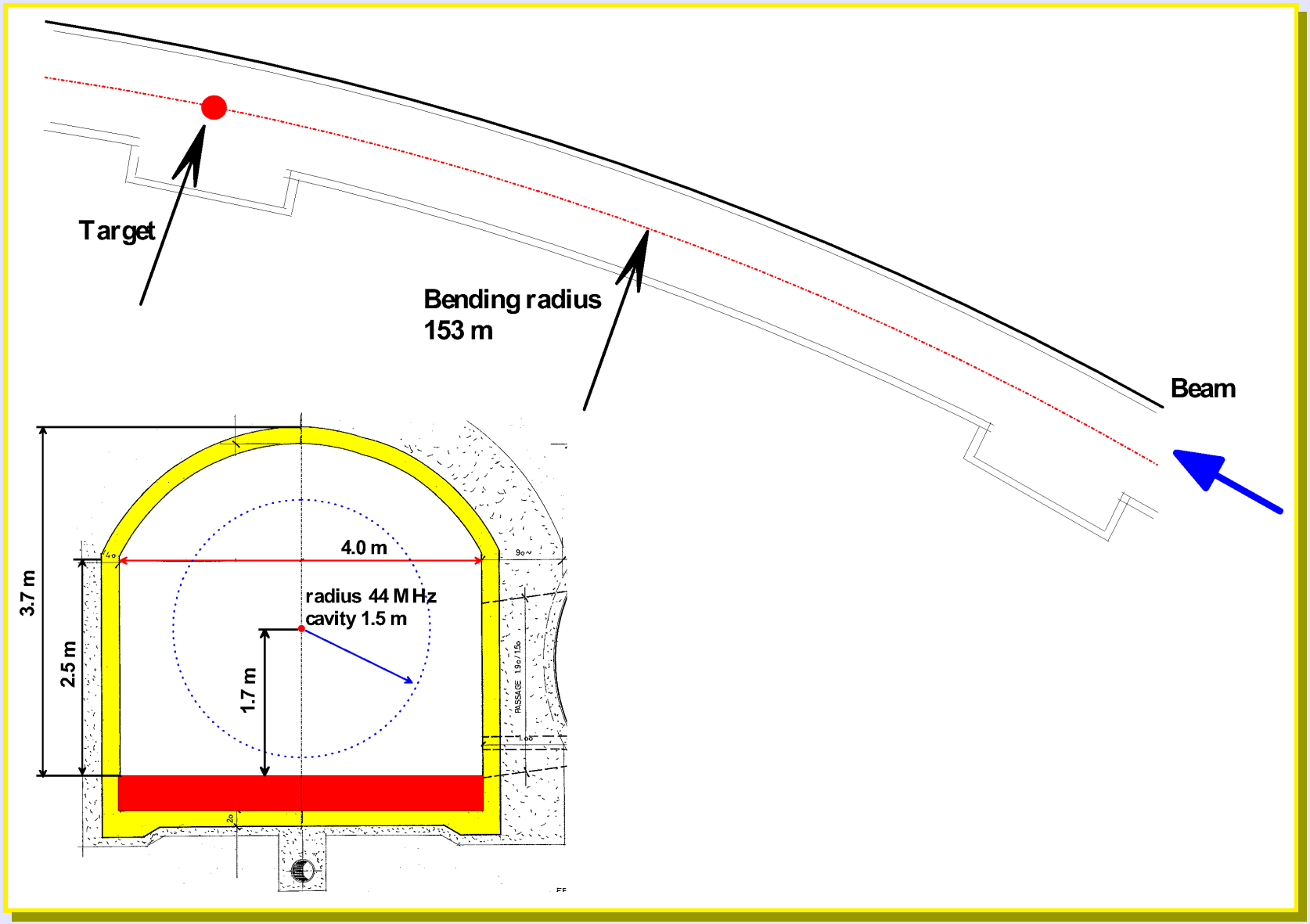
The beam is fast extracted towards the target.

Geometry I

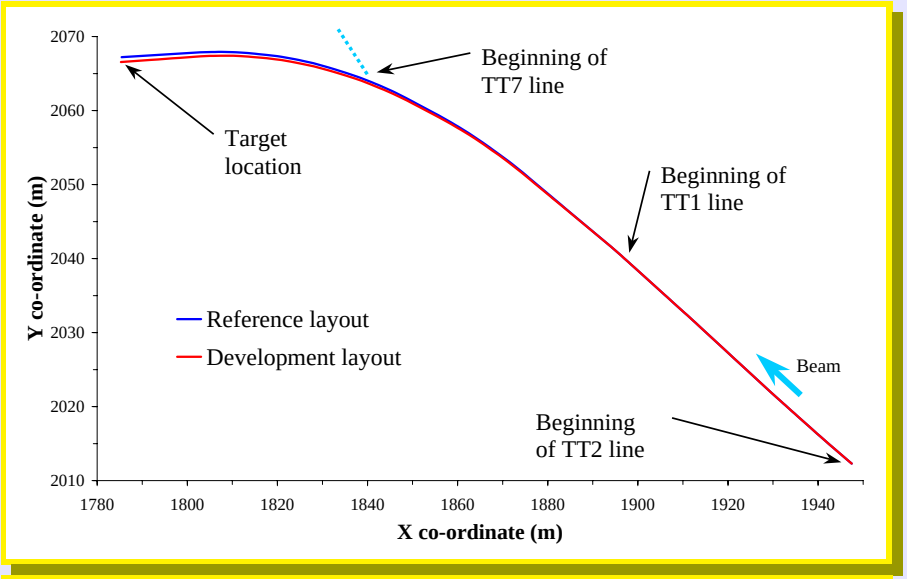
The new transfer line is located in the TT1 tunnel (former ISR injection line).

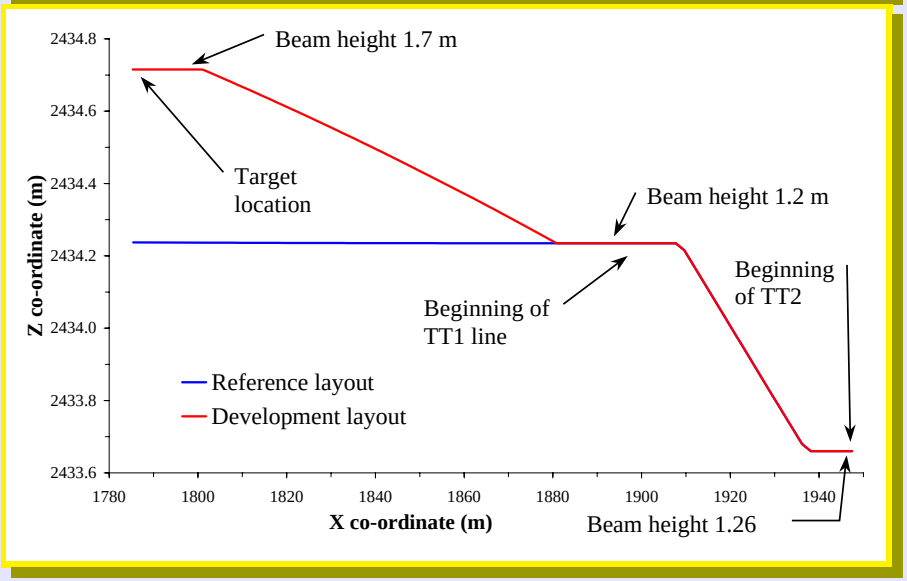


Geometry II


Target
Bending radius
153 m
Beam
4.0 m
radius 44 MHz
cavity 1.5 m
3.7 m
2.5 m
1.7 m

Geometry III



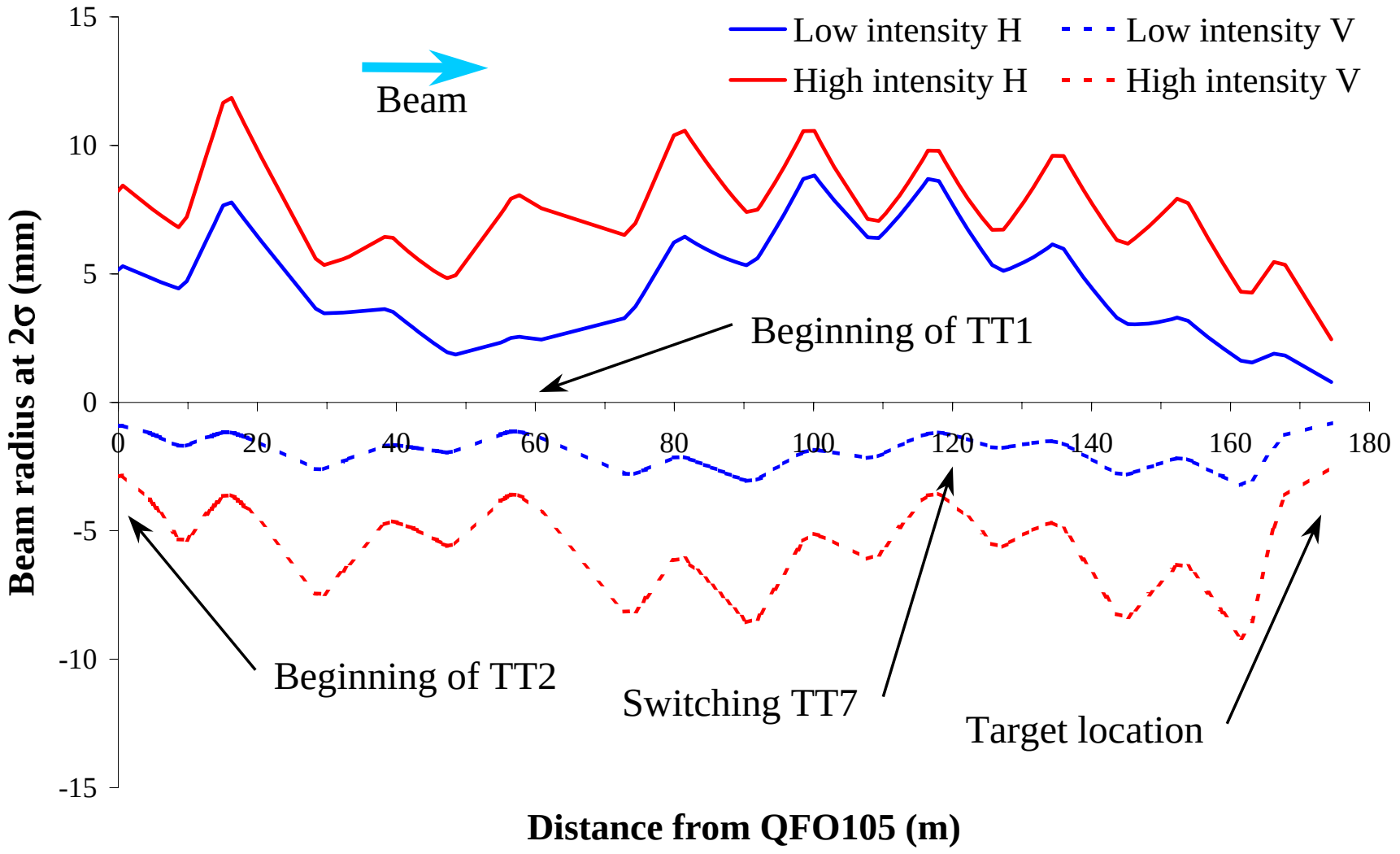


- The TT1 tunnel is bent only horizontally (useful for momentum selection).
- In the horizontal plane the geometry is similar to the ISR injection line.
- In the vertical plane, two dipoles increase the beam height ($1.2\ \mathrm{m} \Rightarrow 1.7\ \mathrm{m}$) to install RF cavities (about 1.5 m radius) downstream of the target.
- A transfer line could branch off the TT1 line to deliver beam in TT7 (test of targets, horns etc.).

Optics I

- The optics is based on the standard $26\ \mathrm{GeV}/c$ optics for fast extraction (in TT2).
- In TT1, a periodic FODO structure is used to focus the beam.
- The final focus is obtained by means of a doublet.
- The beam size at the target location is of the order of:

	Hor. radius 2σ (mm)	Ver. radius 2σ (mm)
Low intensity	0.8	0.8
High intensity	2.4	2.5
LHC-type	1.5	1.5


Low intensity H
Low intensity V
High intensity H
High intensity V
Beam
Beginning of TT1
Beginning of TT2
Switching TT7
Target location
Beam radius at 2σ (mm)
Distance from QFO105 (m)
15
10
5
0
-5
-10
-15
0
20
40
60
80
100
120
140
160
180

Hardware: magnets/power conv./instrumentation

- Magnets: All the magnets needed are available, either from
  - PS stock: Main dipoles (19).
  - FA58: Vertical dipoles (2).
  - LEP dismantling: Main quadrupoles and dipole correctors (12, 10).
- Power converters: Geometry and optics have been designed to reduce the number of power converters (some magnets are connected in series). Most of them have been recuperated from LEP. Six are still missing.
- Remark: the transfer line should operate in DC mode (apart from the switching magnet between TT2 and TT1). The total power dissipated is about 582 kW.
- Instrumentation: Some (four or five) beam profile monitors (OTRs ?) are necessary to steer the beam in H/V planes, while a beam current transformer is needed to monitor the beam intensity on the target.

Conclusion

- The design of the new transfer line is feasible.
- All the magnets are available.
- Six power converters are still missing.
- Civil engineering work is to be foreseen to install the power converters.
- A cost estimate is in preparation. As a preliminary result one can state that:

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Lower bound:  1.5 MCHF
Upper bound:  4.0 MCHF
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