Developments on IR baseline design

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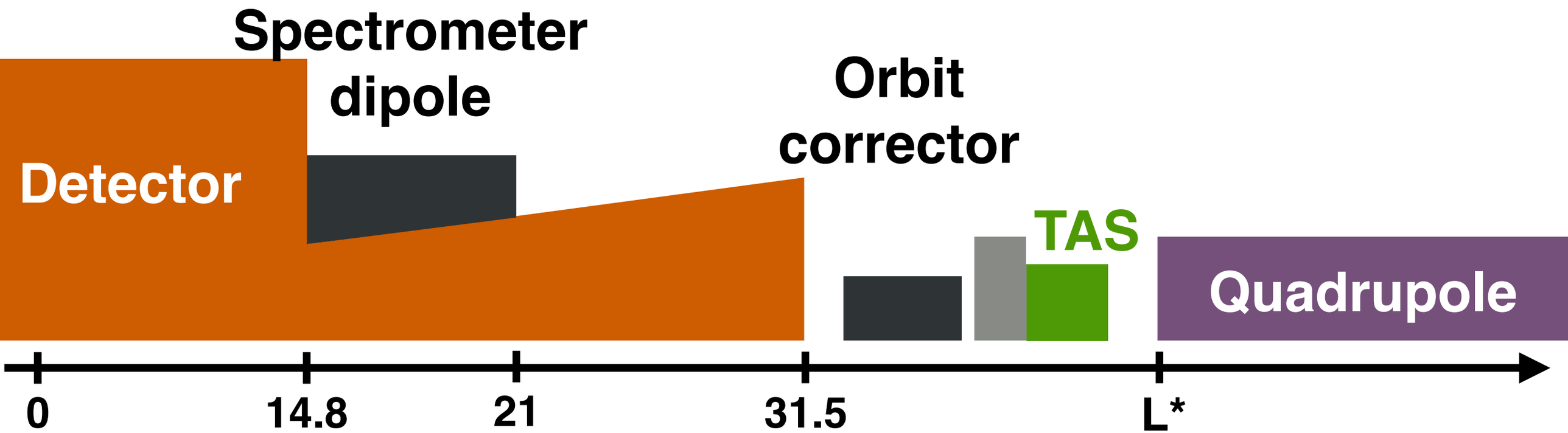
Conclusions from β* reach study

- Choose **smallest** L* that does not restrict detector design
- **Increase triplet length** until DA becomes a problem

— R.Martin in FCC Week 2016, "Beta* reach studies"

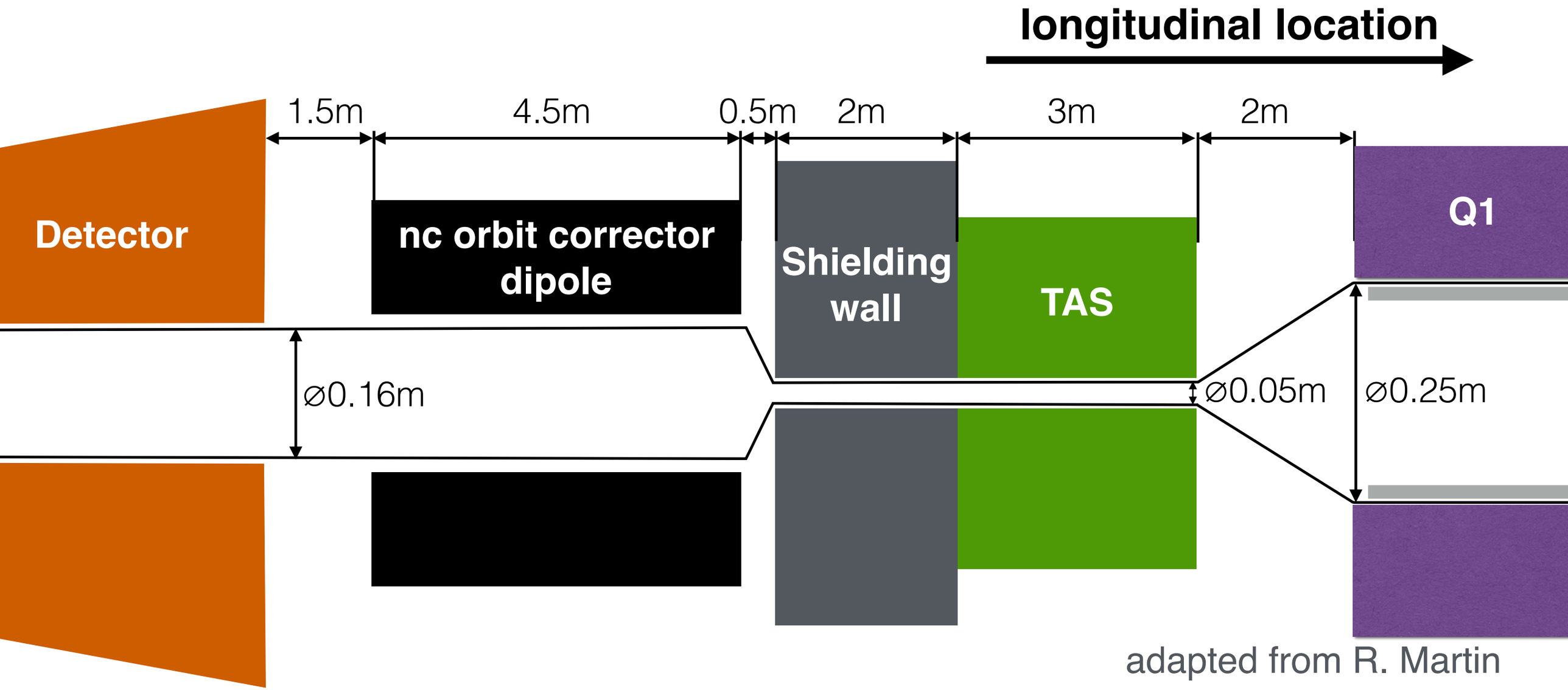
IR layout



- Detector with forward region
  - Includes 10 Tm spectrometer dipole
- Need space for orbit corrector, shielding from TAS (~2m), TAS (~3m) + interconnections before triplet magnets

Orbit corrector

- Is 4.5m sufficient for the orbit corrector dipole?
  (assuming 1.5 T normal conducting magnet -> 6.75Tm)

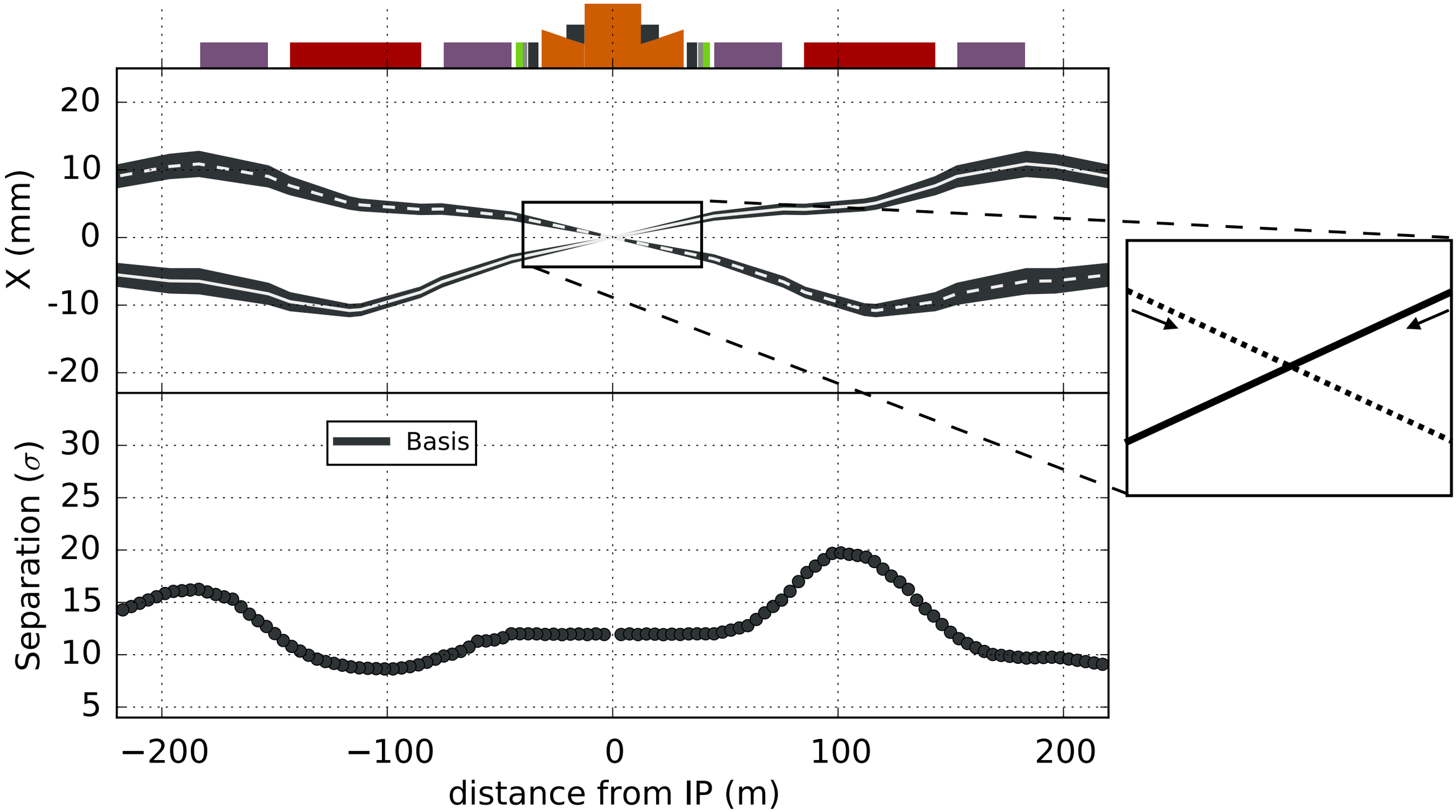


adapted from R. Martin

- Alternative study case of a combined TAS + orbit corrector is being considered as well and could allow for smaller L*

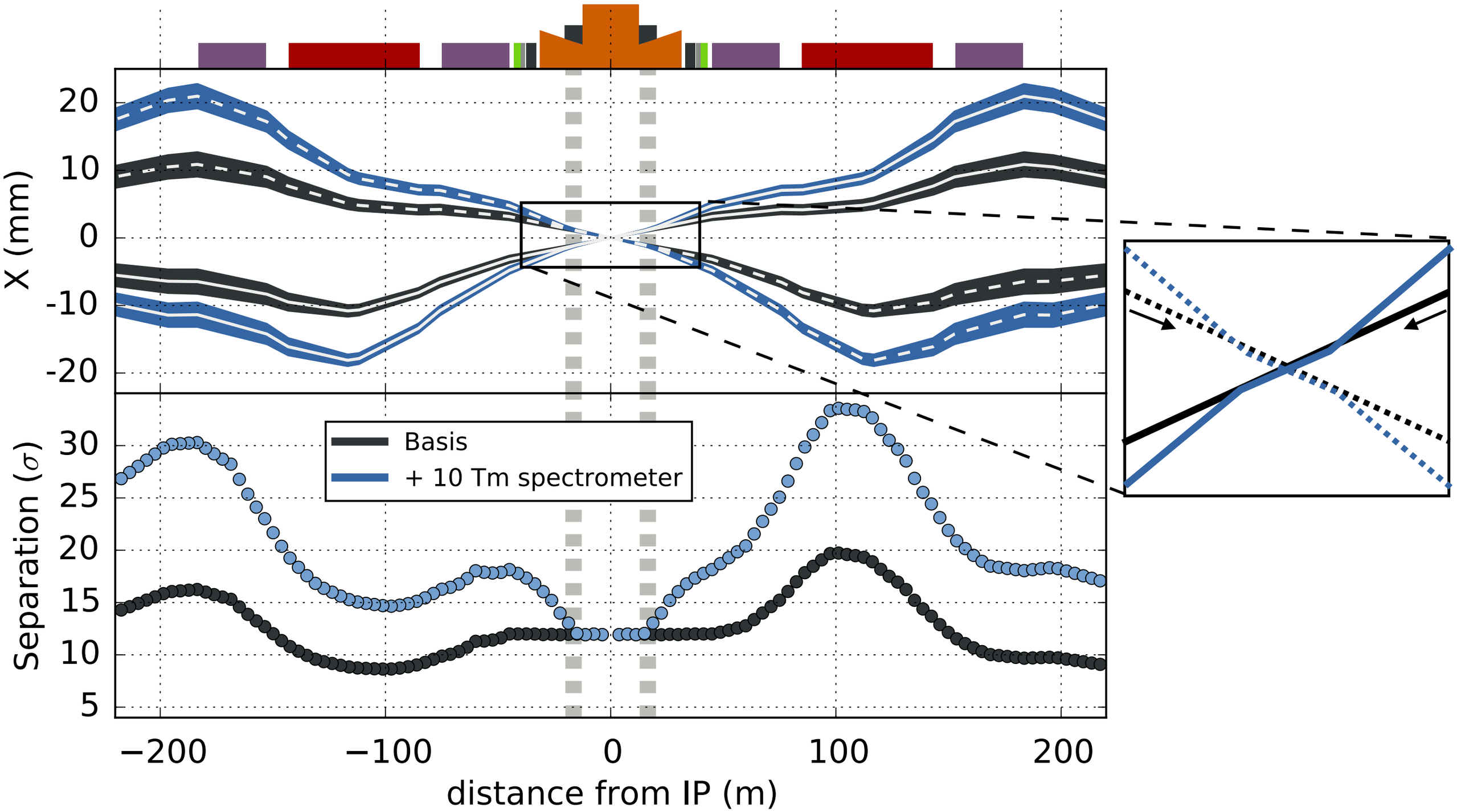
Aperture and beam-beam considerations

- Spectrometer dipole and orbit corrector are off



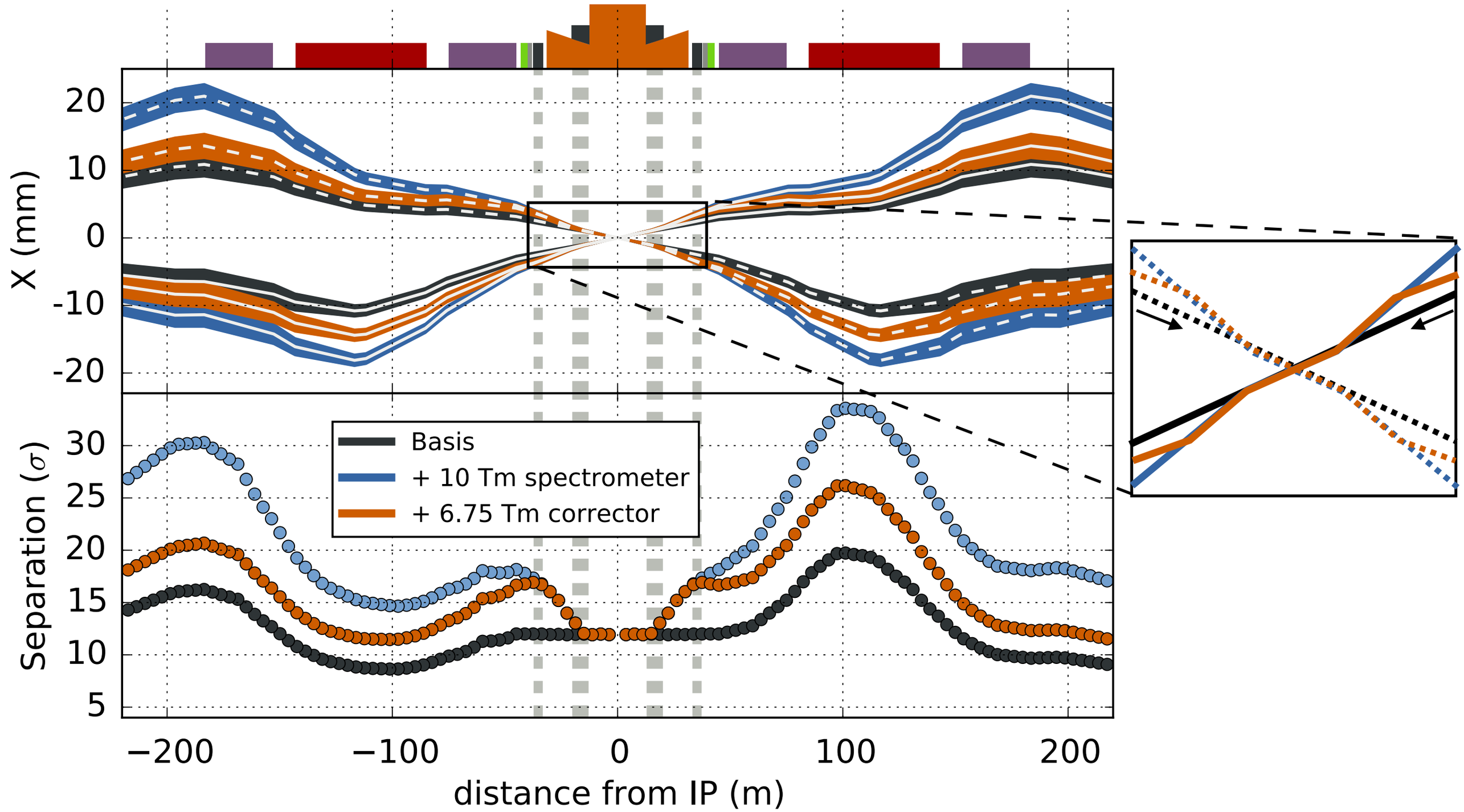
Aperture and beam-beam considerations

- Spectrometer dipole switched on



Aperture and beam-beam considerations

- Orbit corrector compensates the deflection from spectrometer dipole

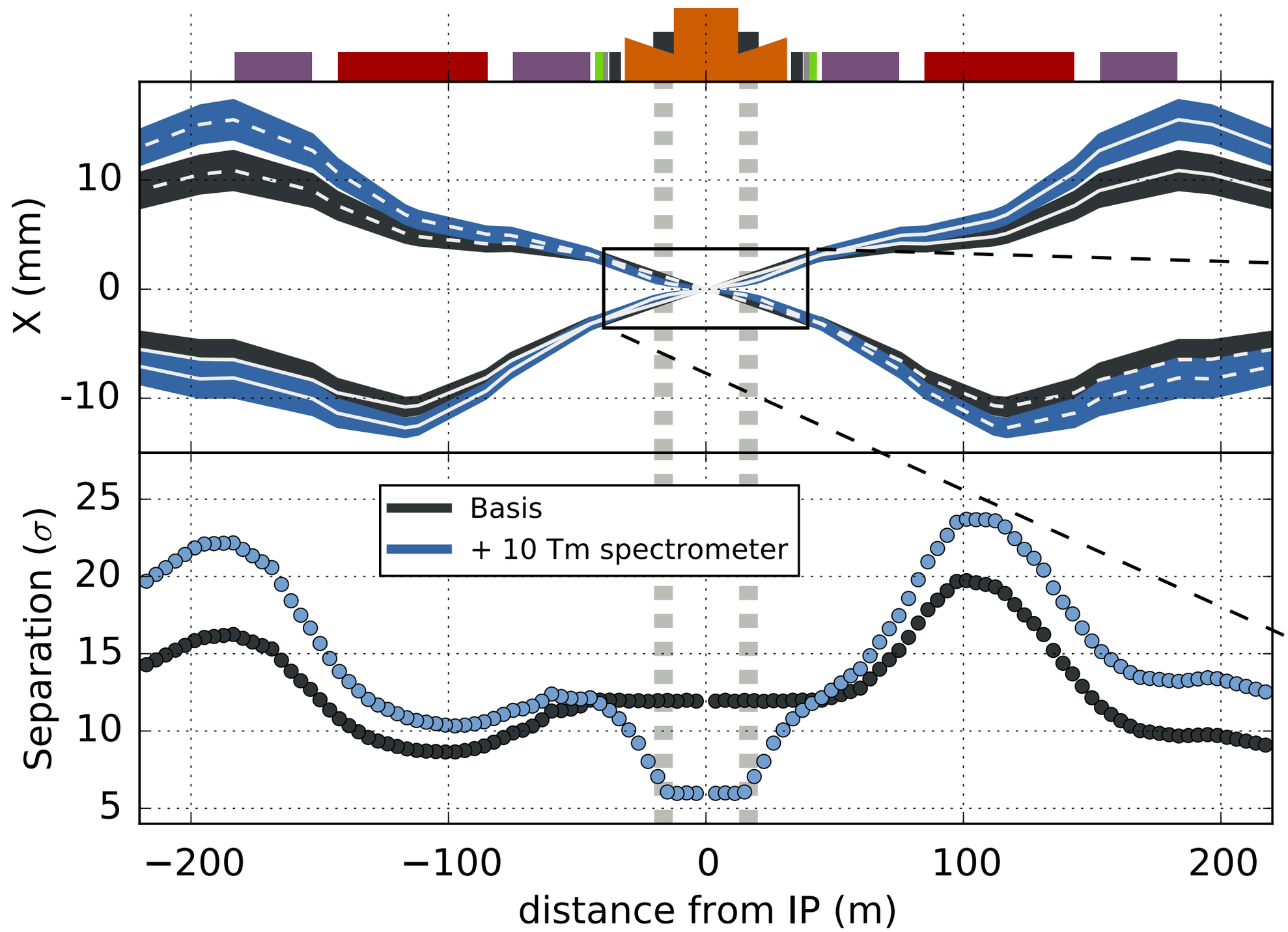


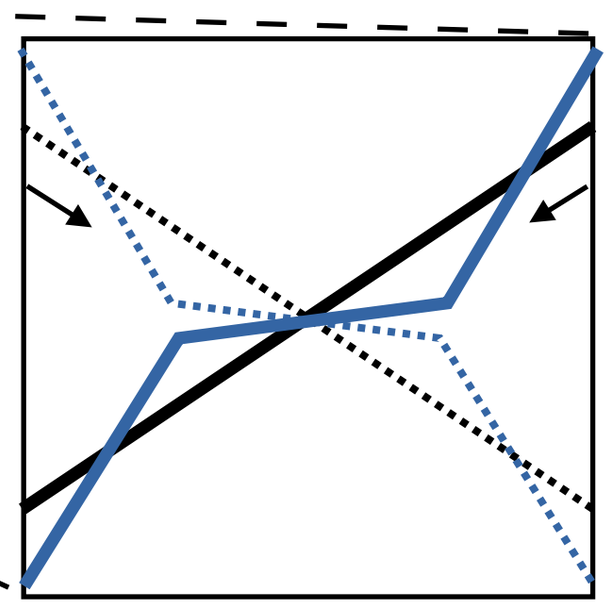
Aperture and beam-beam considerations

- Varied the crossing angle to keep beam-beam effect constant (1st order)
- Smaller crossing angles possible

$$\sum_i 1/d_i^2$$

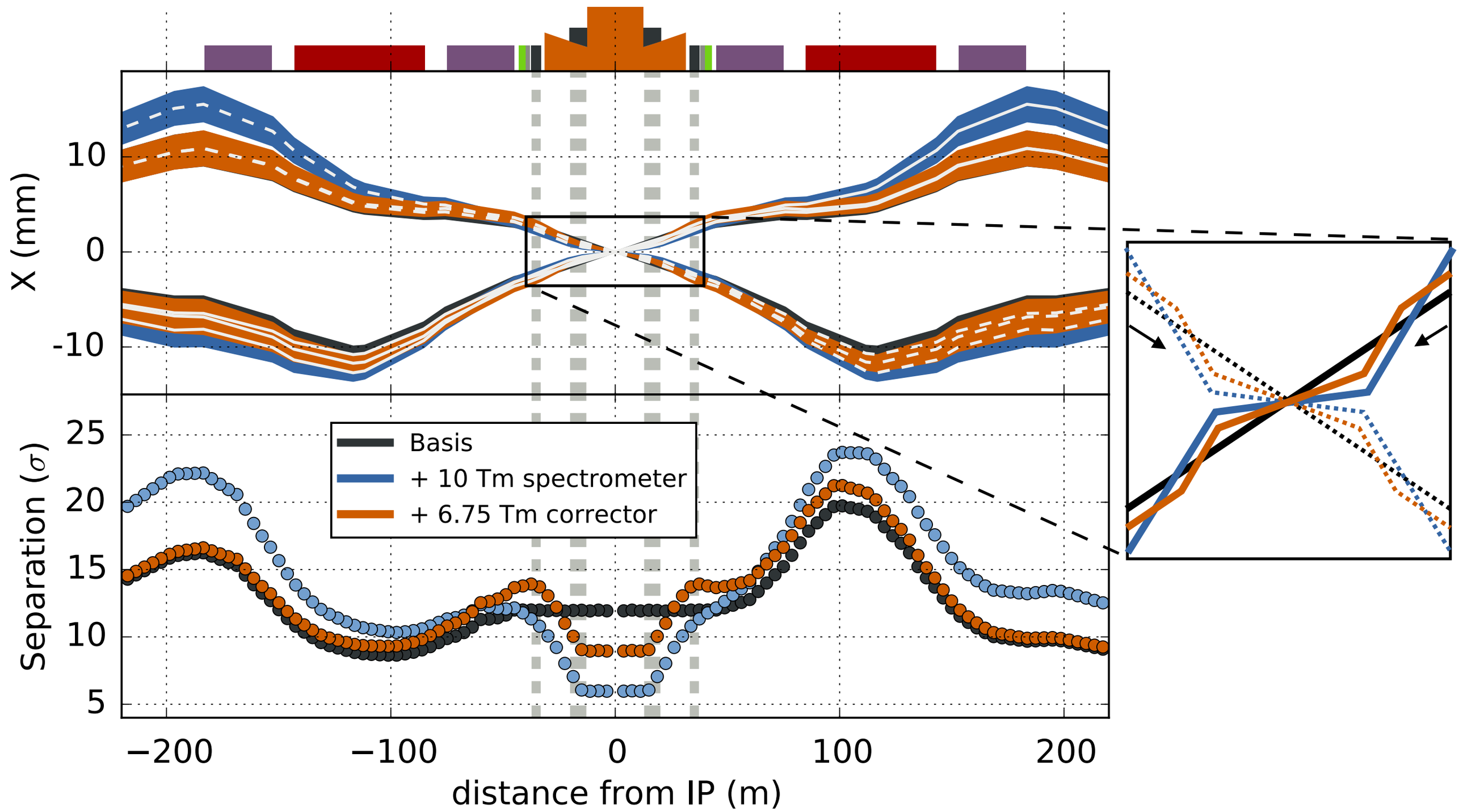
d_i : separation at beam encounter





Aperture and beam-beam considerations

- Corrector magnet allows to keep similar beam separation



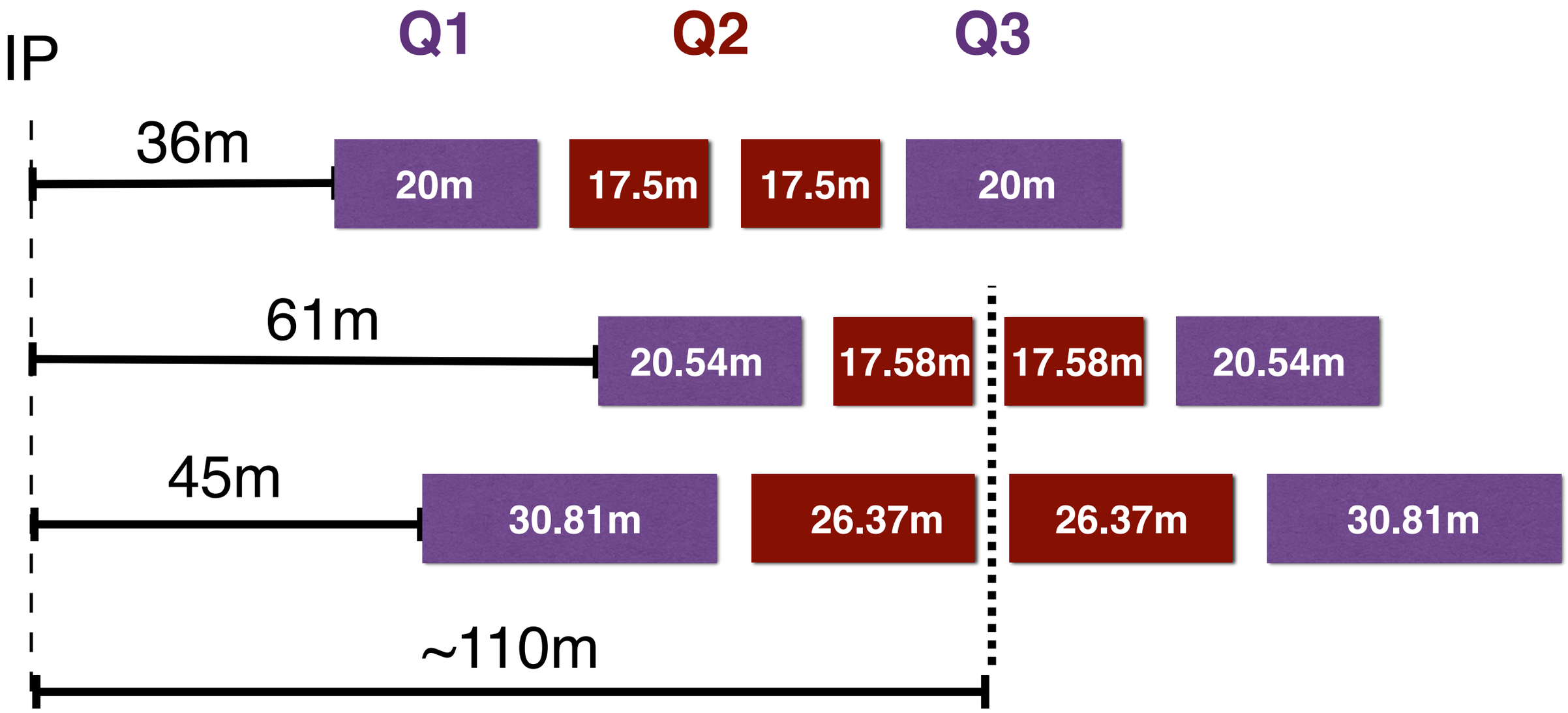
Aperture and beam-beam considerations

- Aperture requirements can in general be satisfied while not deteriorating beam-beam effects
  - 4.5m is enough space for the orbit corrector dipole
  - L*=45m is feasible

Detector spectrometer	crossing plane	crossing angle
off	H or V	89 μrad
on	H	110 μrad / 71 μrad
on	V	85 μrad

- Detailed beam-beam studies will optimise crossing angles

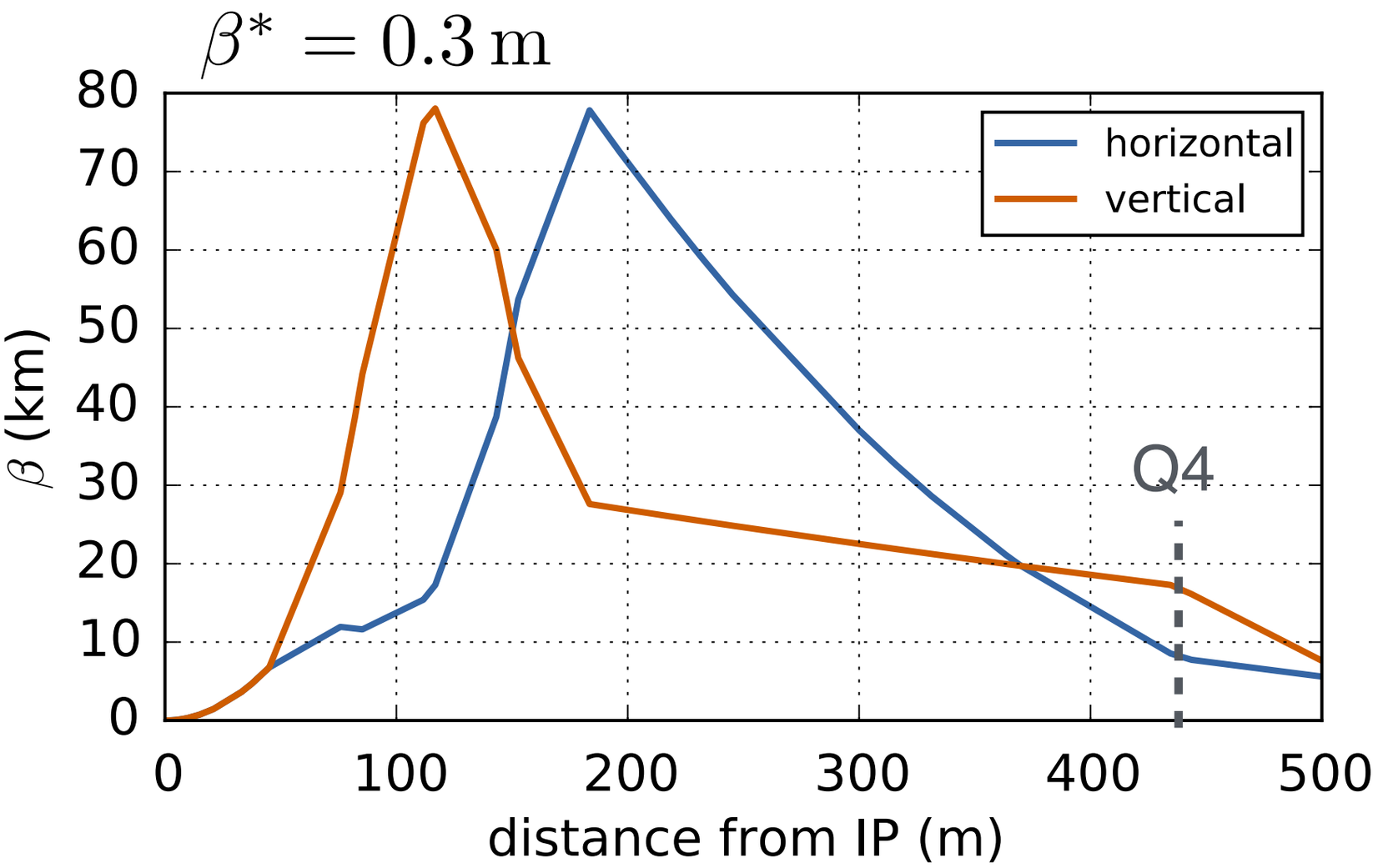
Triplet design comparison



45m triplet design (compared to 61m design):

- Increased length of each triplet magnet by 50%
- Kept a similar distance from IP to the centre of the triplet

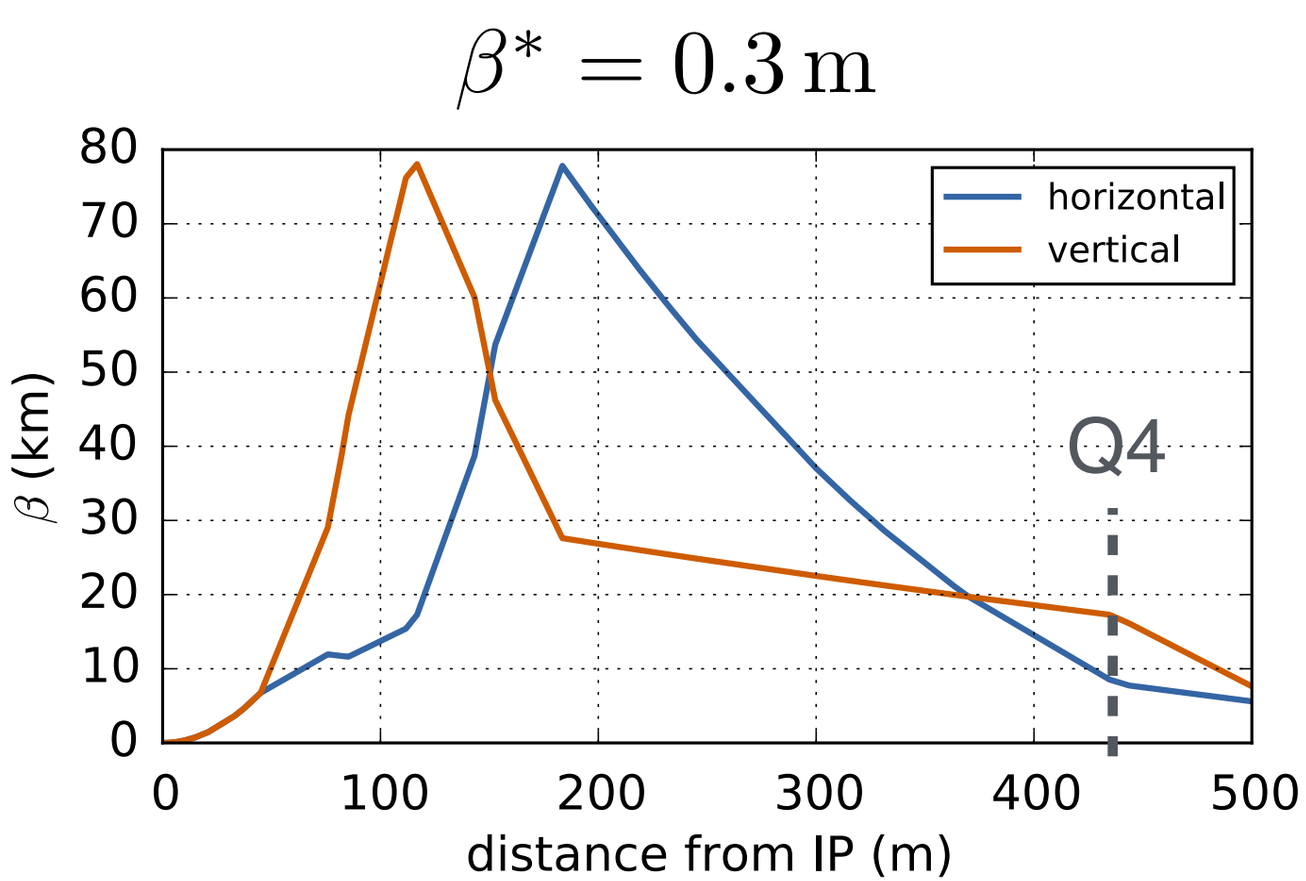
Triplet matching

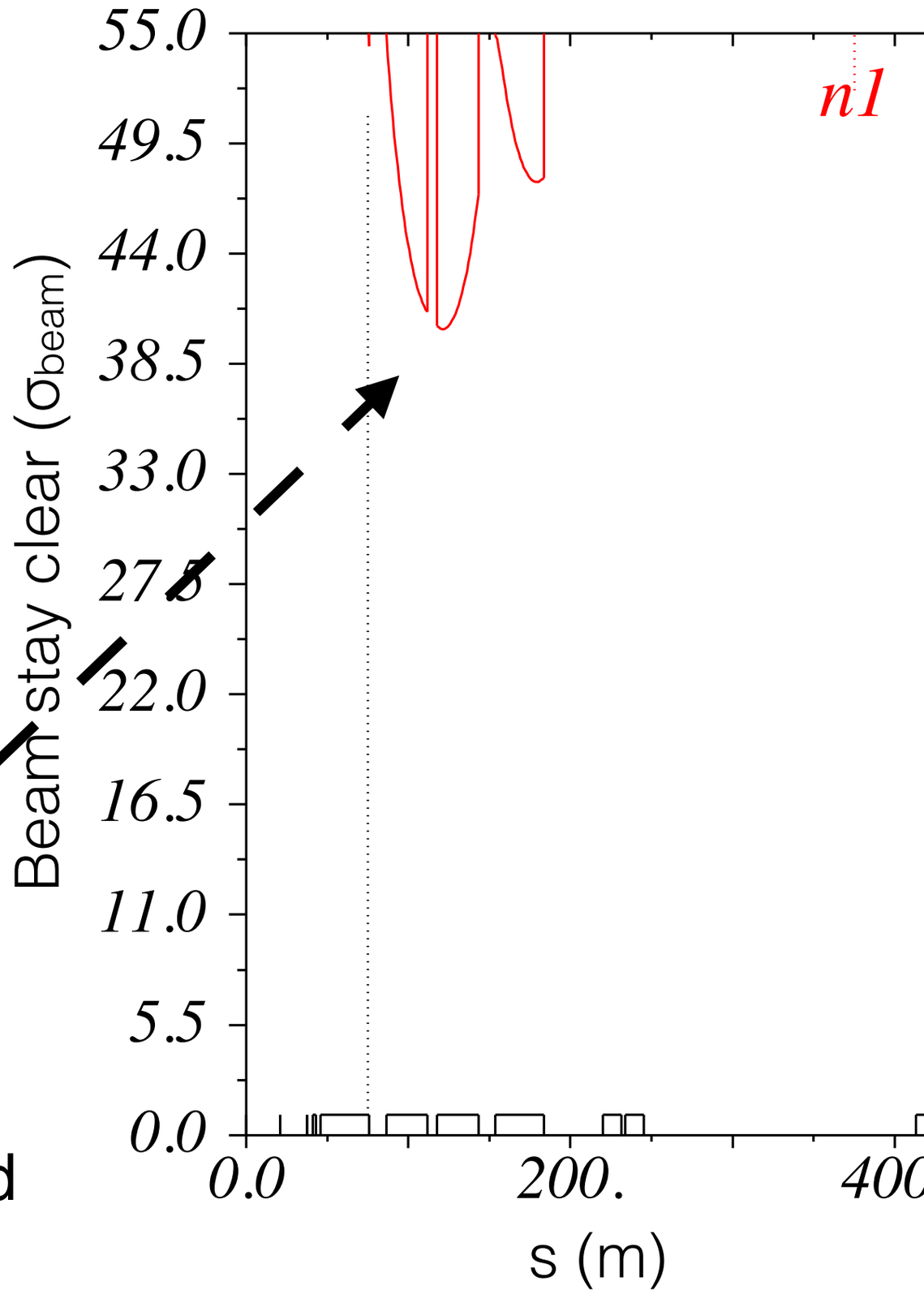


- Triplet aperture: 125 mm radius (conservative value)

To be subtracted	
Cold bore	7 mm
Absorber	15 mm
Liquid helium	1.5 mm
Kapton Insulator	0.5 mm
Beam Screen + insulation	4.05 mm
Closed orbit uncertainty	2 mm

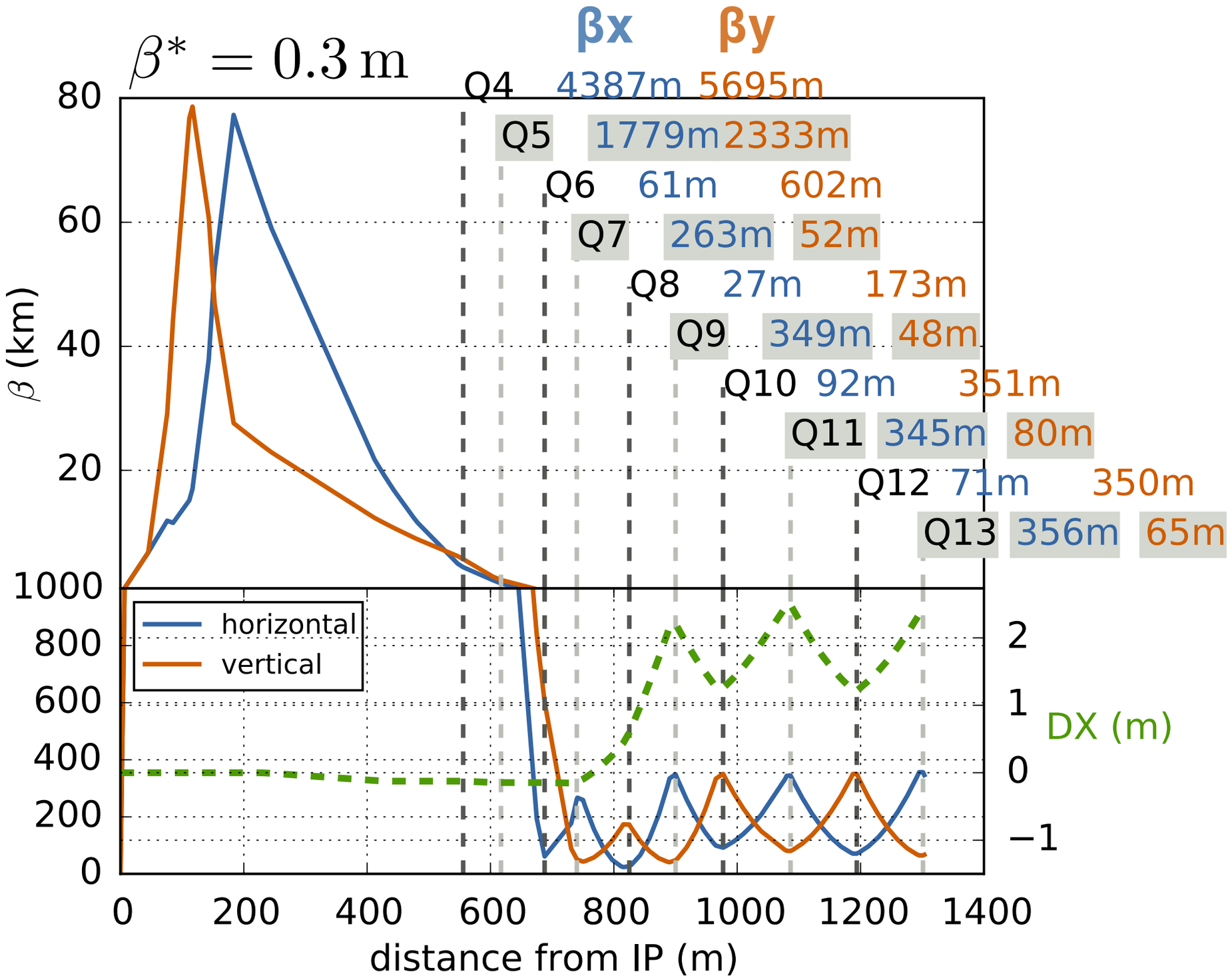
Triplet matching





- Triplet aperture increased to 40σ
  - compared to 17σ for L*=61m
- Aperture for D1/D2 magnets not fixed yet

Triplet matching and lattice integration



- Q4 to Q7 were moved further away from IP
- Total length increased to 1500m (100m longer than envisaged)
- Needs further iterations to reduce the length

Conclusions / Outlook

- New baseline IR design with L*=45m
  + 50% increased triplet length
    - Leaves enough space for a detector with forward physics region
    - Compatible with spectrometer dipole
- Significantly increased triplet aperture due to longer length
    - Beta* of 10cm possible, goal to reach even 5cm
      (cf. R.Martin in FCC Week 2016, "Beta* reach studies")
- Triplet magnets need to be further split (L_{max} ~ 15m)
- Need iteration for the matching section to reduce total length