



nuSTORM RFFAG solution

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Outline

- Doublet solution
- Triplet solution
- Injection
- Improvements



Outline

● Doublet solution

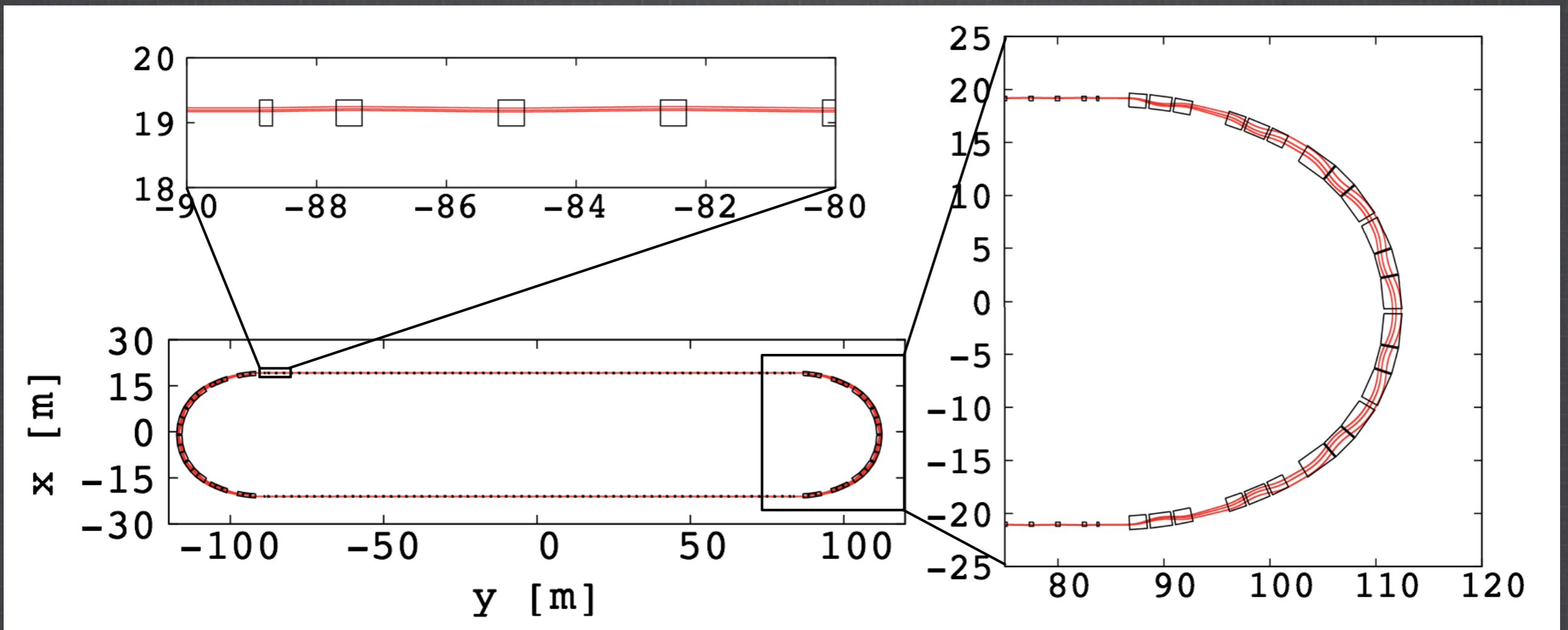
● Triplet solution

● Injection

● Improvements

Doublet solution

Straight: 175 m, maximum scallop angle: 12 mrad



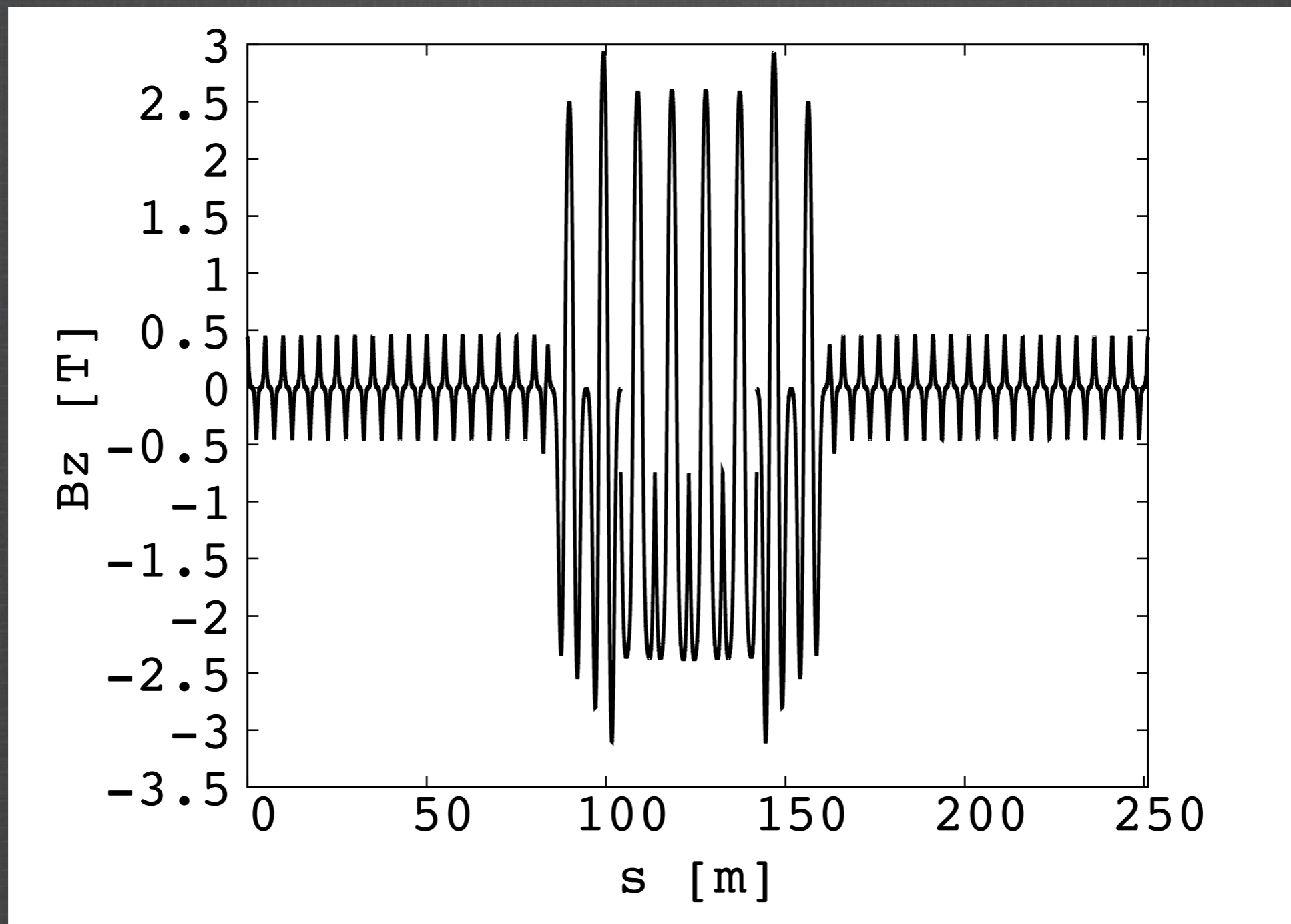
Doublet solution

Cell parameters

	Circular Section	Matching Section	Straight Section
Type	FDF	FDF	Doublet
Cell radius/length [m]	17.6	36.2	5
Opening angle [deg]	30	15	
k-value/m-value	6.043	25.929	5.5 m^{-1}
Packing factor	0.92	0.58	0.16
Maximum magnetic field [T]	2.5	3.3	1.5
horizontal excursion [m]	1.3	1.1	0.4
Full gap height [m]	0.45	0.45	0.45
Average dispersion /cell [m]	2.5	1.3	0.18
Number of cells /ring	4×2	4×2	35×2

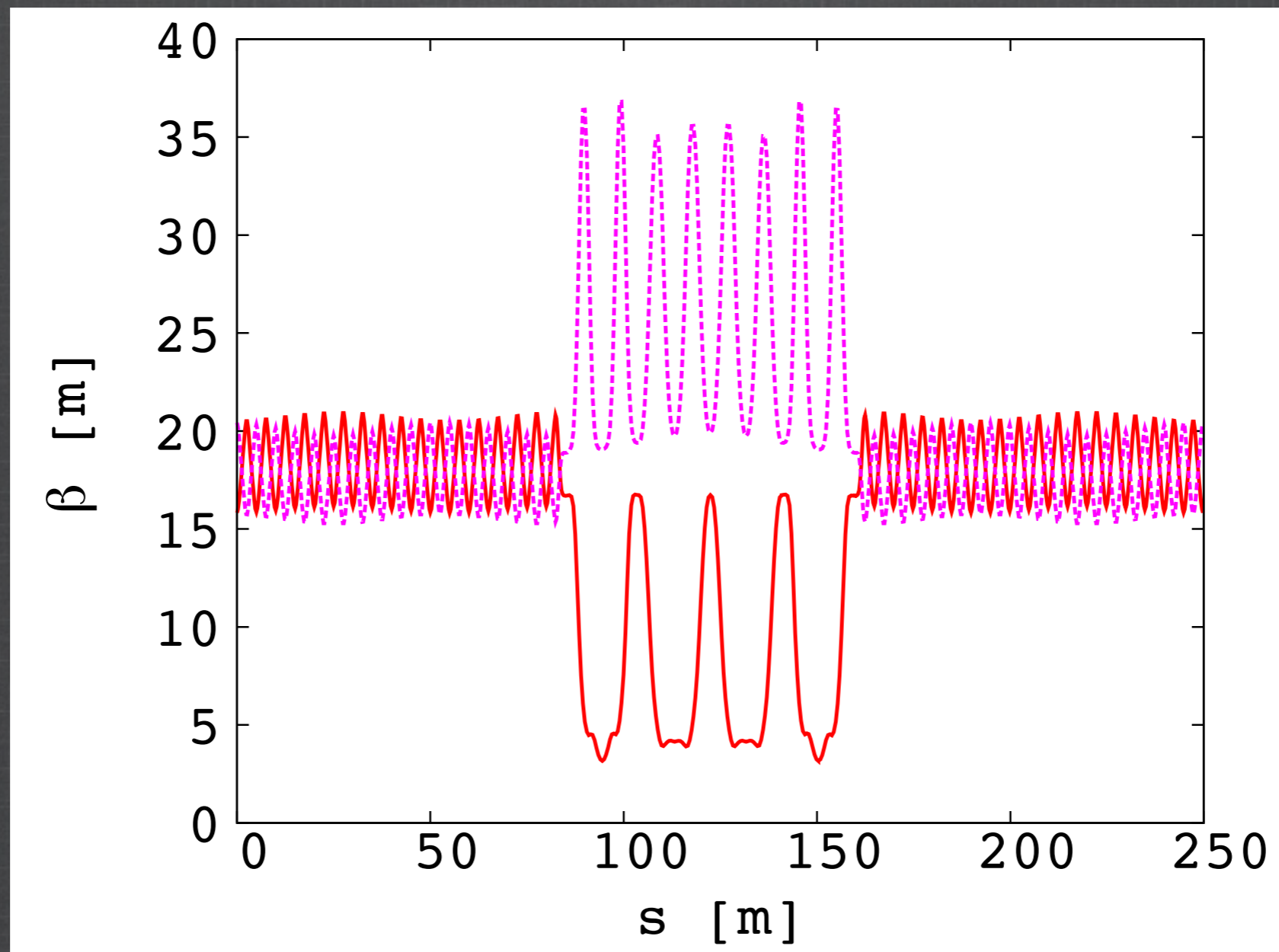
Doublet solution

Magnetic field for P_{\max} (+16%)



Doublet solution

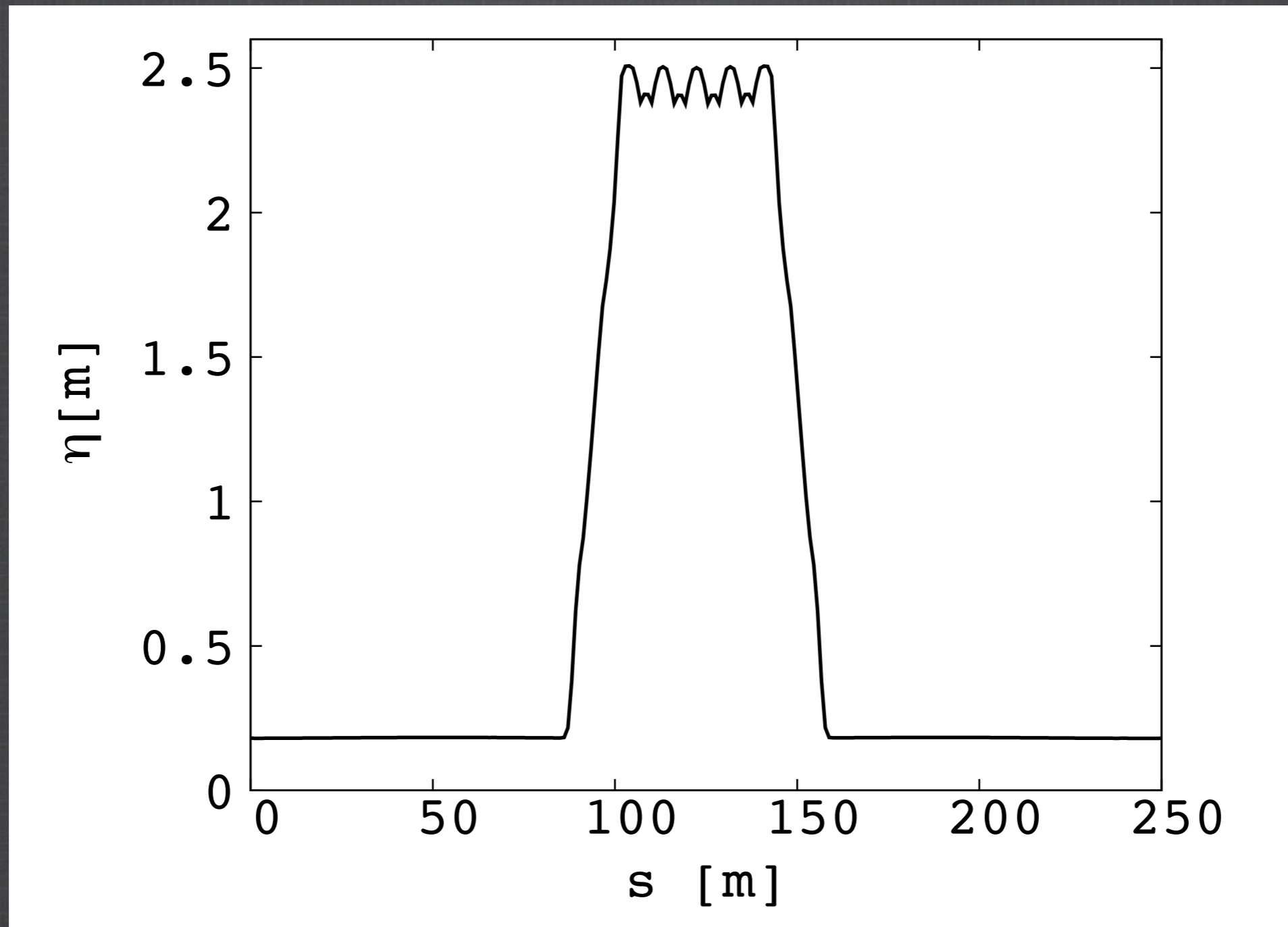
Beta-functions at matching momentum



Horizontal (plain red) and vertical (dotted purple) betafunctions for half of the ring.

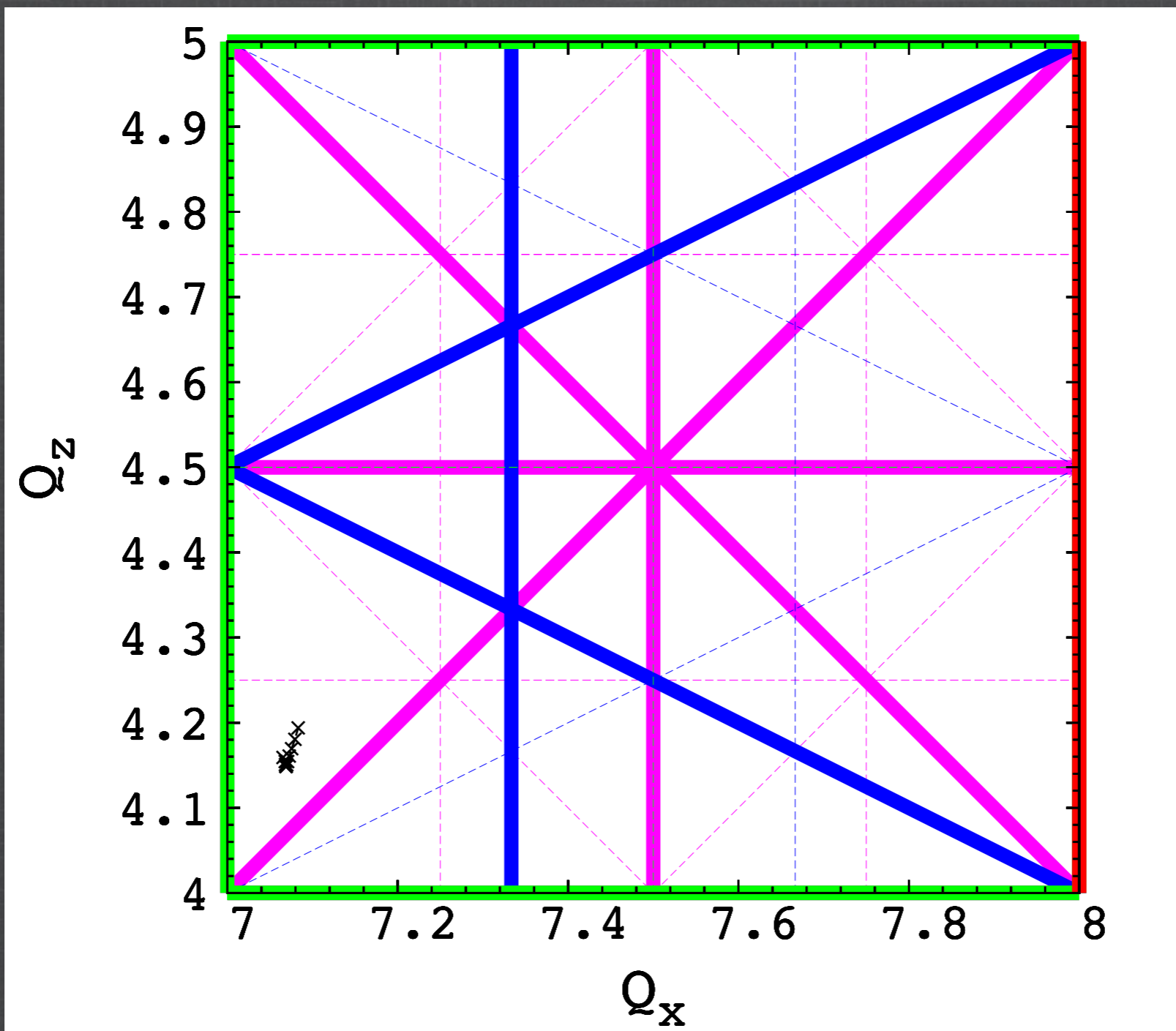
Doublet solution

Dispersion function at matching momentum



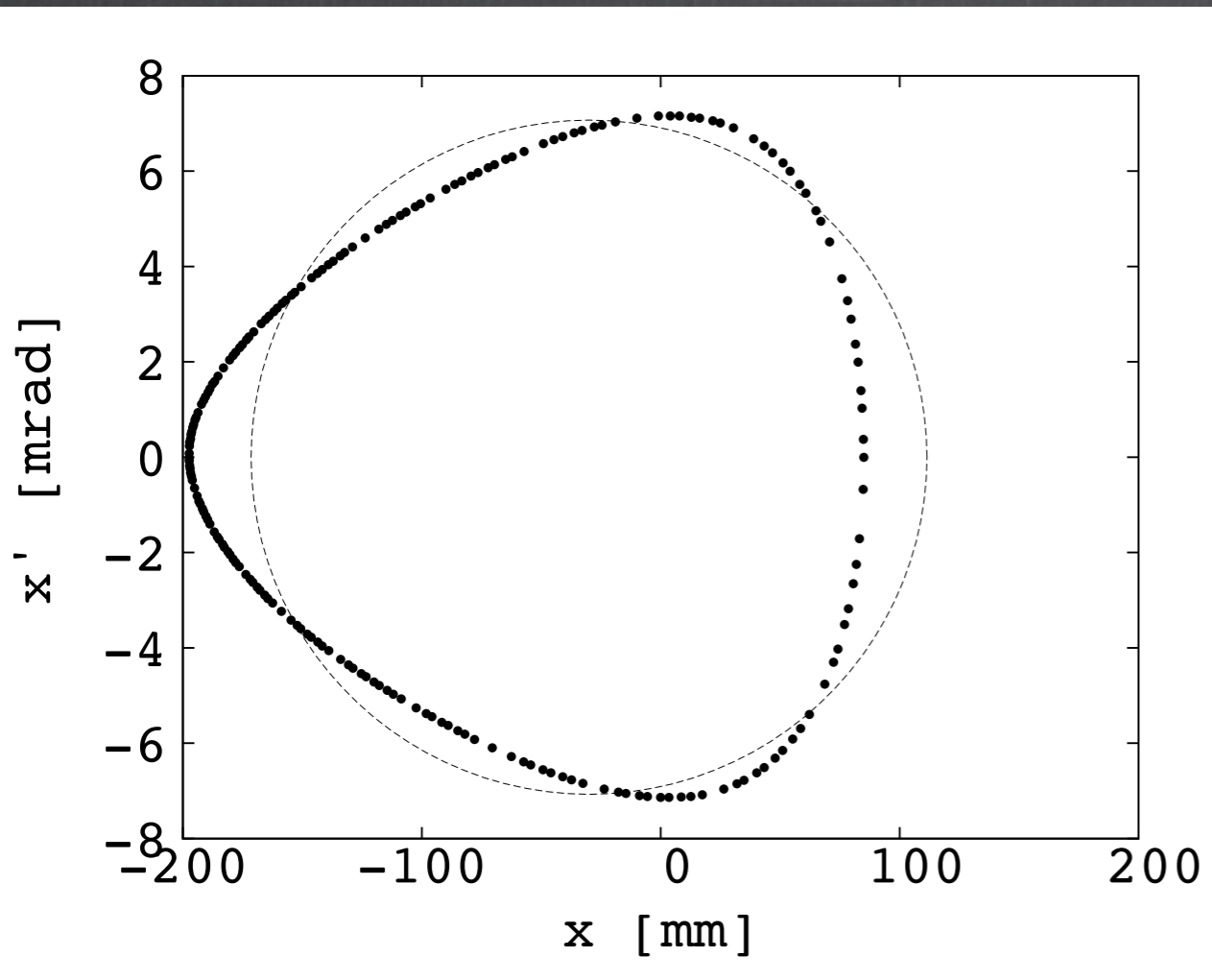
Doublet solution

Tune diagram $\frac{\Delta P}{P} = \pm 16\%$

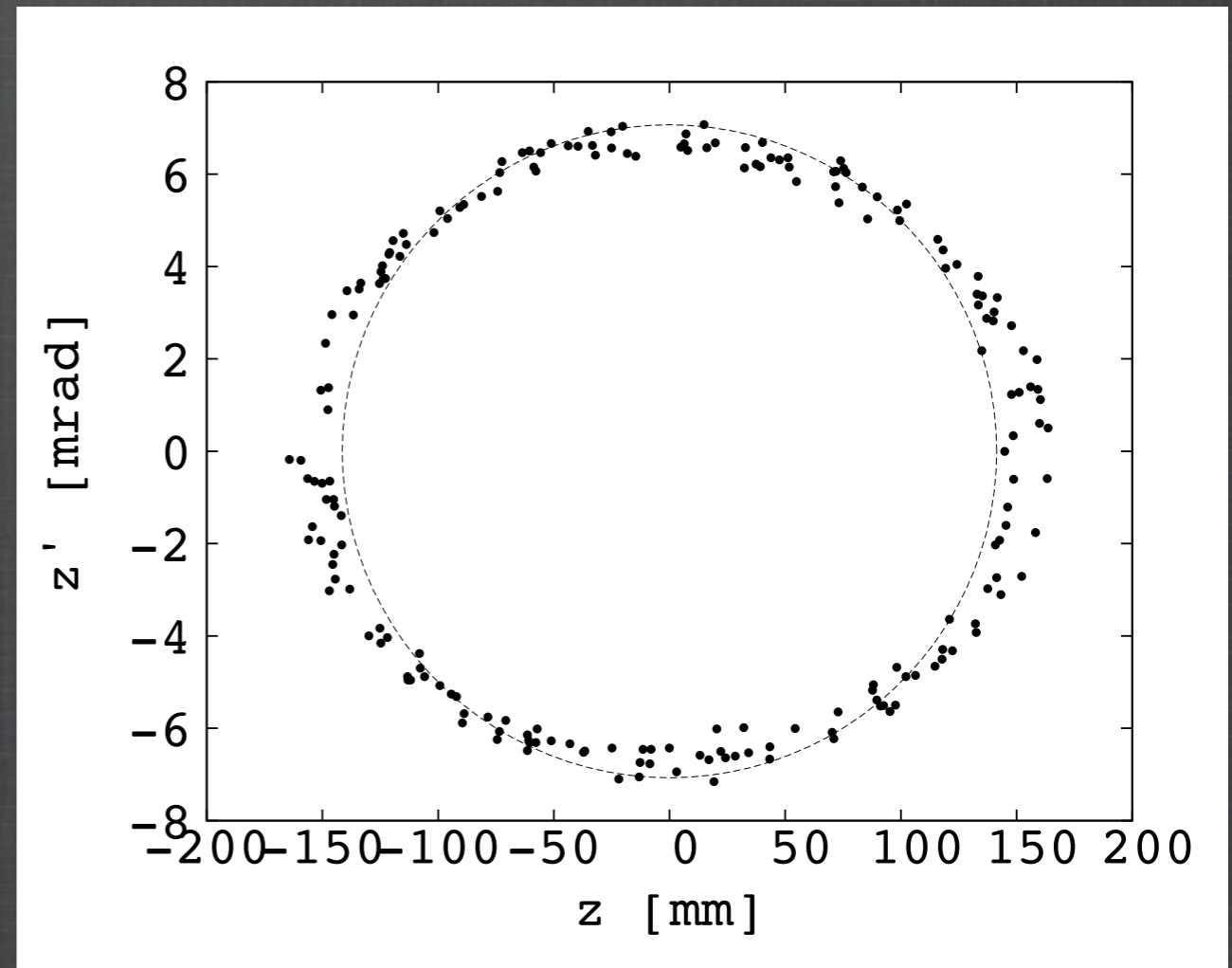


Doublet solution

Transverse acceptance



Maximum horizontal stable amplitude over 100 turns



Maximum vertical stable amplitude over 100 turns



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Motivations

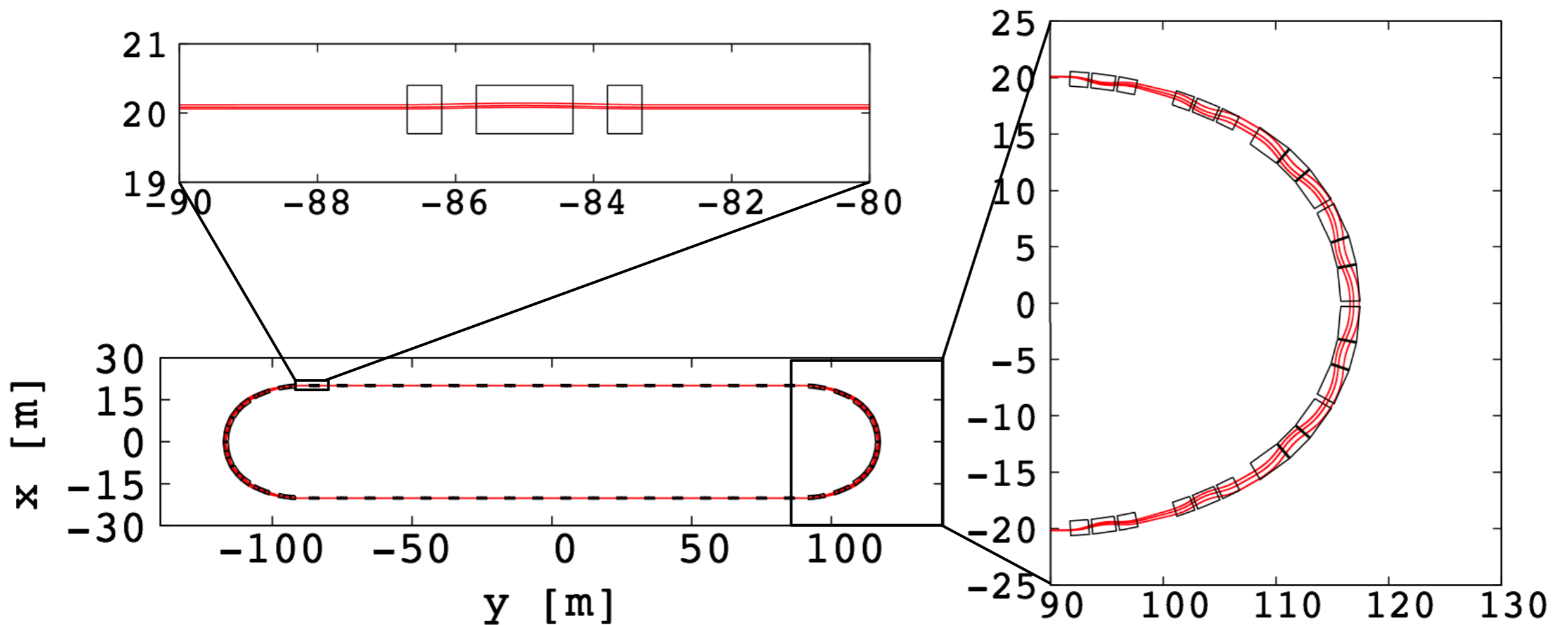
1300 km decay scenario incompatible with scallop of the closed orbit.

Doublet in the straight section cannot be used.

→ Triplet in the straight section.

Triplet solution

Straight: 180 m, maximum scallop angle: 24 mrad



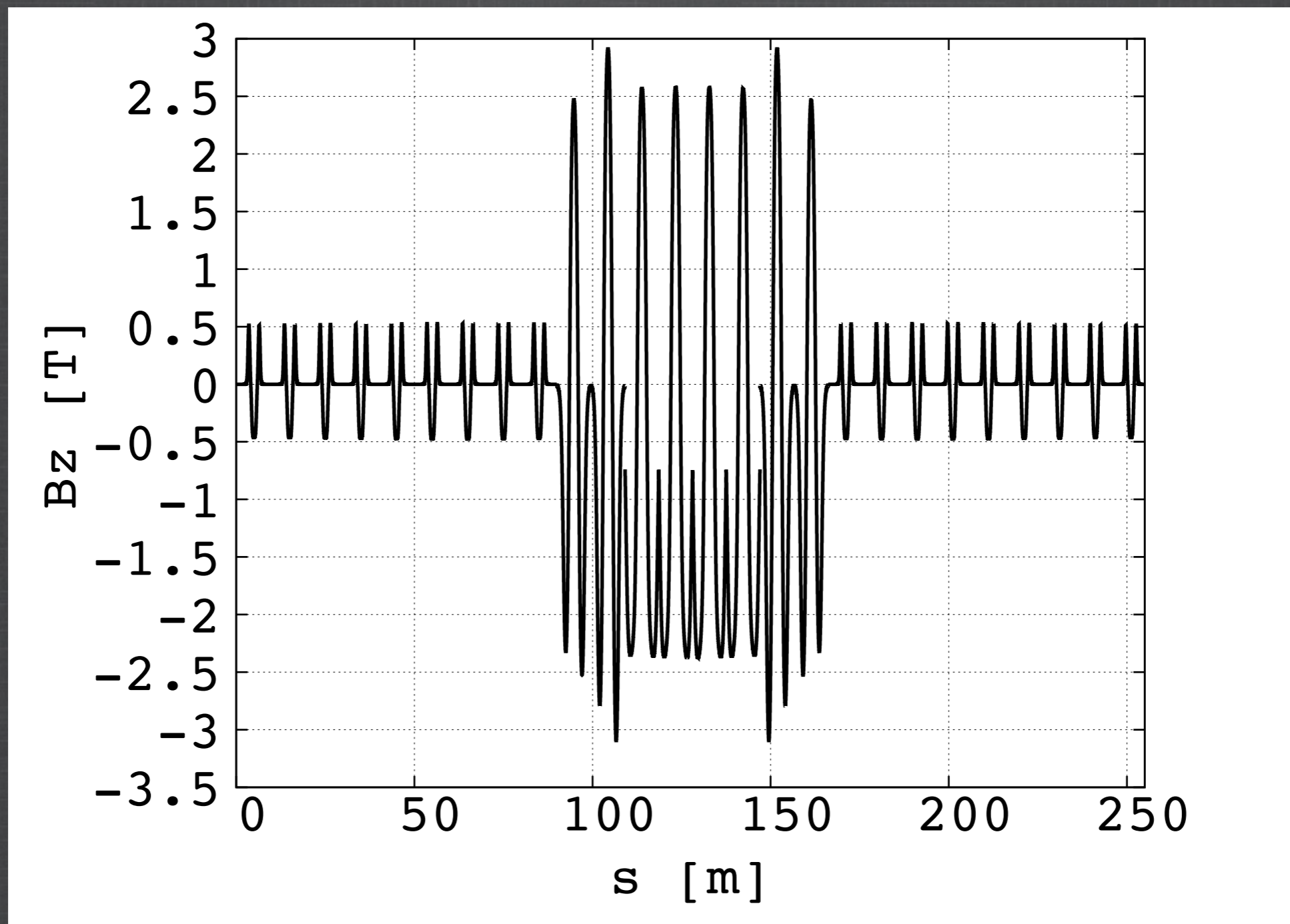
Triplet solution

Cell parameters

	Circular Section	Matching Section	Straight Section
Type	FDF	FDF	DFD
Cell radius/length [m]	17.6	36.2	10
Opening angle [deg]	30	15	
k-value/m-value	6.057	26.	5.5 m ⁻¹
Packing factor	0.92	0.58	0.24
Maximum magnetic field [T]	2.5	3.3	1.5
horizontal excursion [m]	1.3	1.1	0.6
Full gap height [m]	0.45	0.45	0.45
Average dispersion /cell [m]	2.5	1.3	0.18
Number of cells /ring	4 × 2	4 × 2	36 × 2

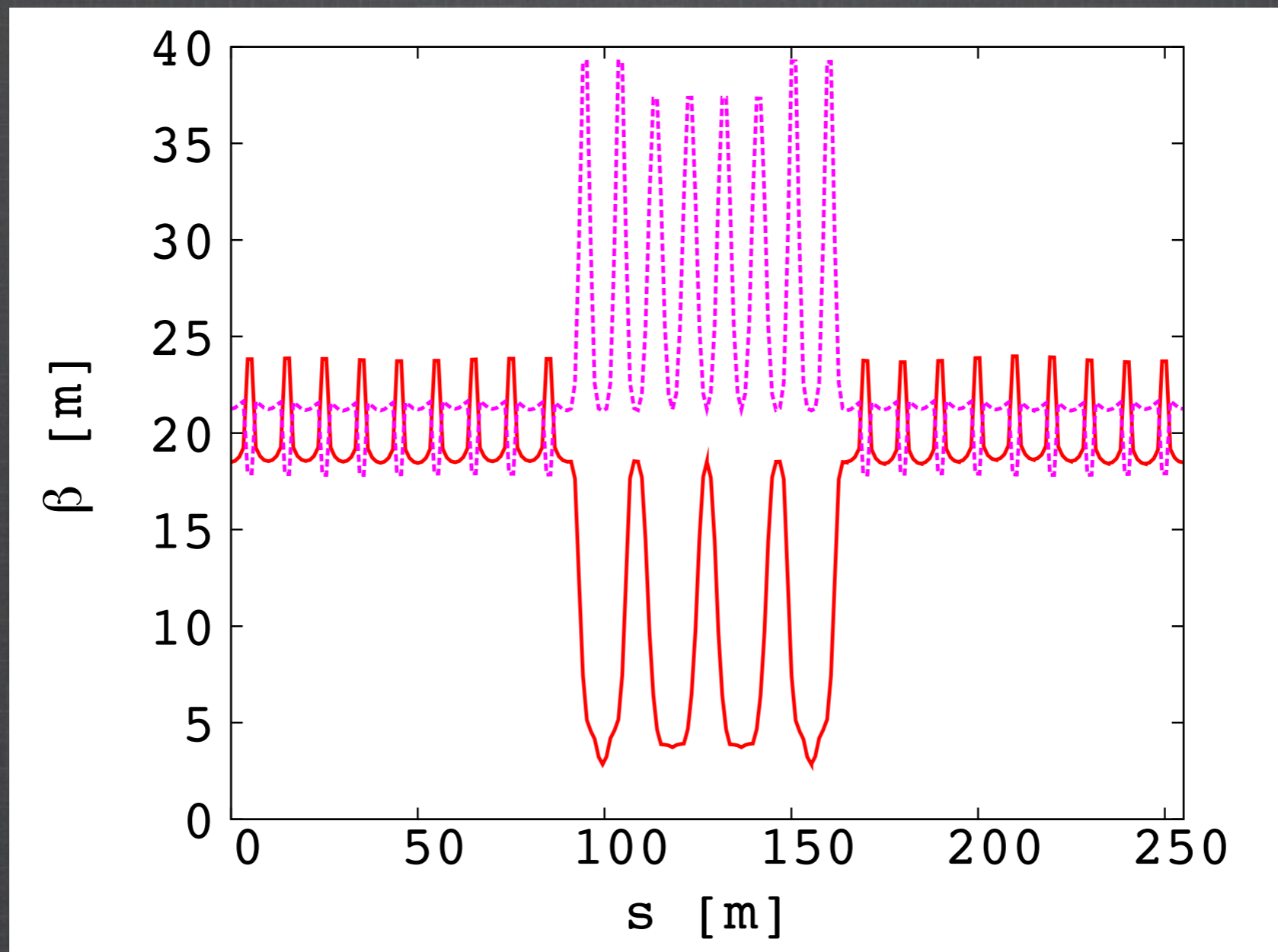
Triplet solution

Magnetic field for P_{\max} (+16%)



Triplet solution

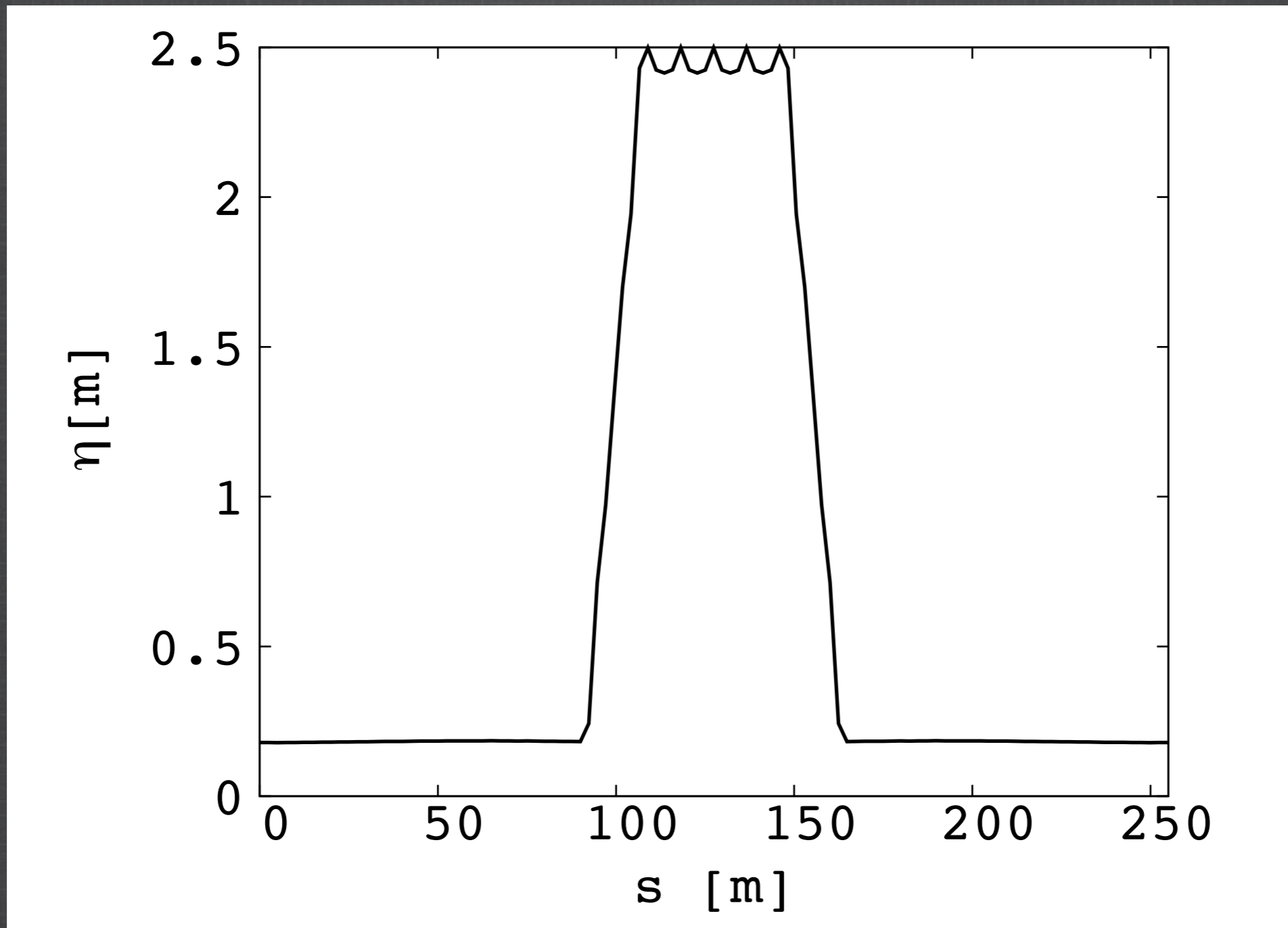
Beta-functions at matching momentum



Horizontal (plain red) and vertical (dotted purple) betafunctions for half of the ring.

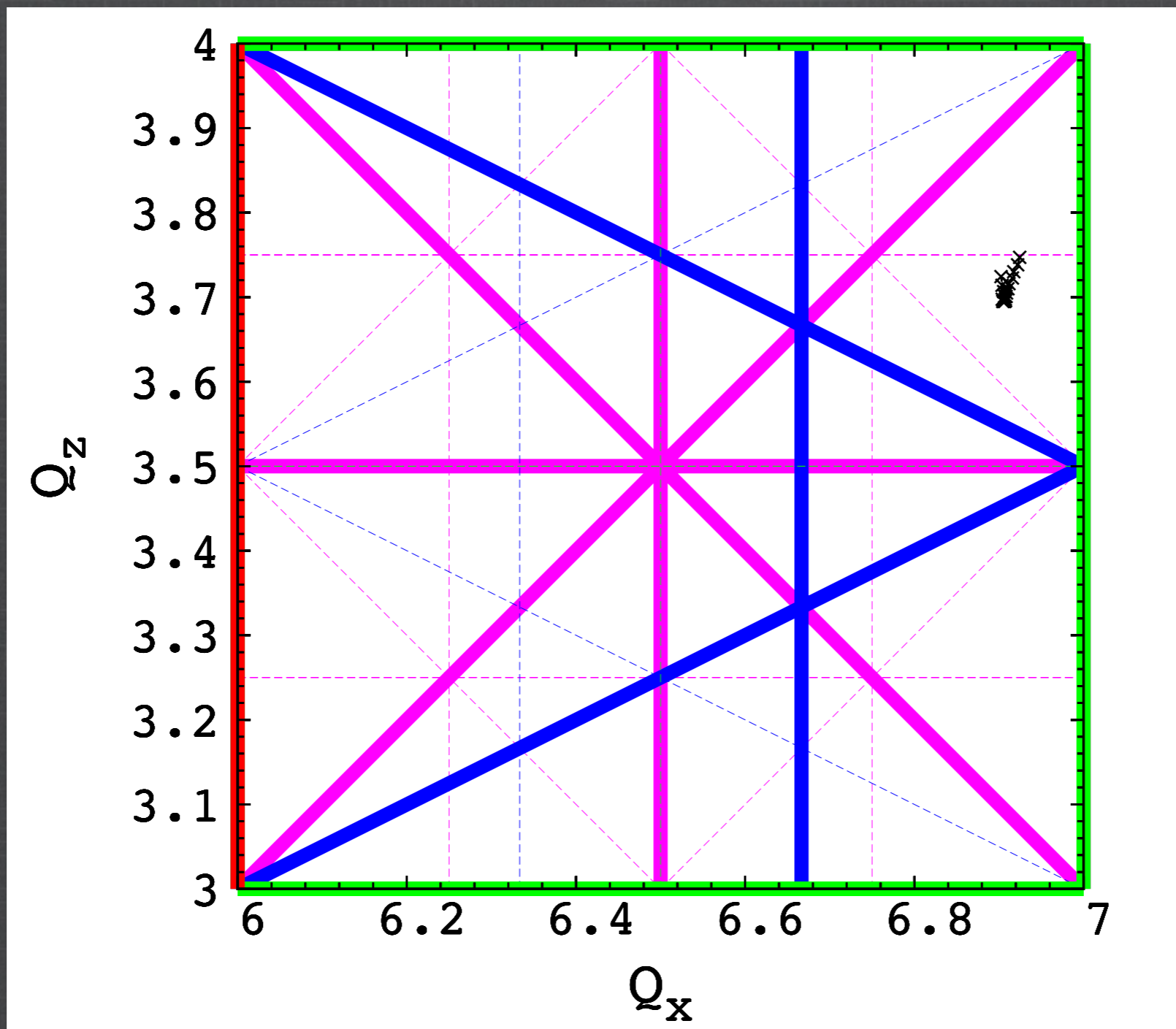
Triplet solution

Dispersion function at matching momentum



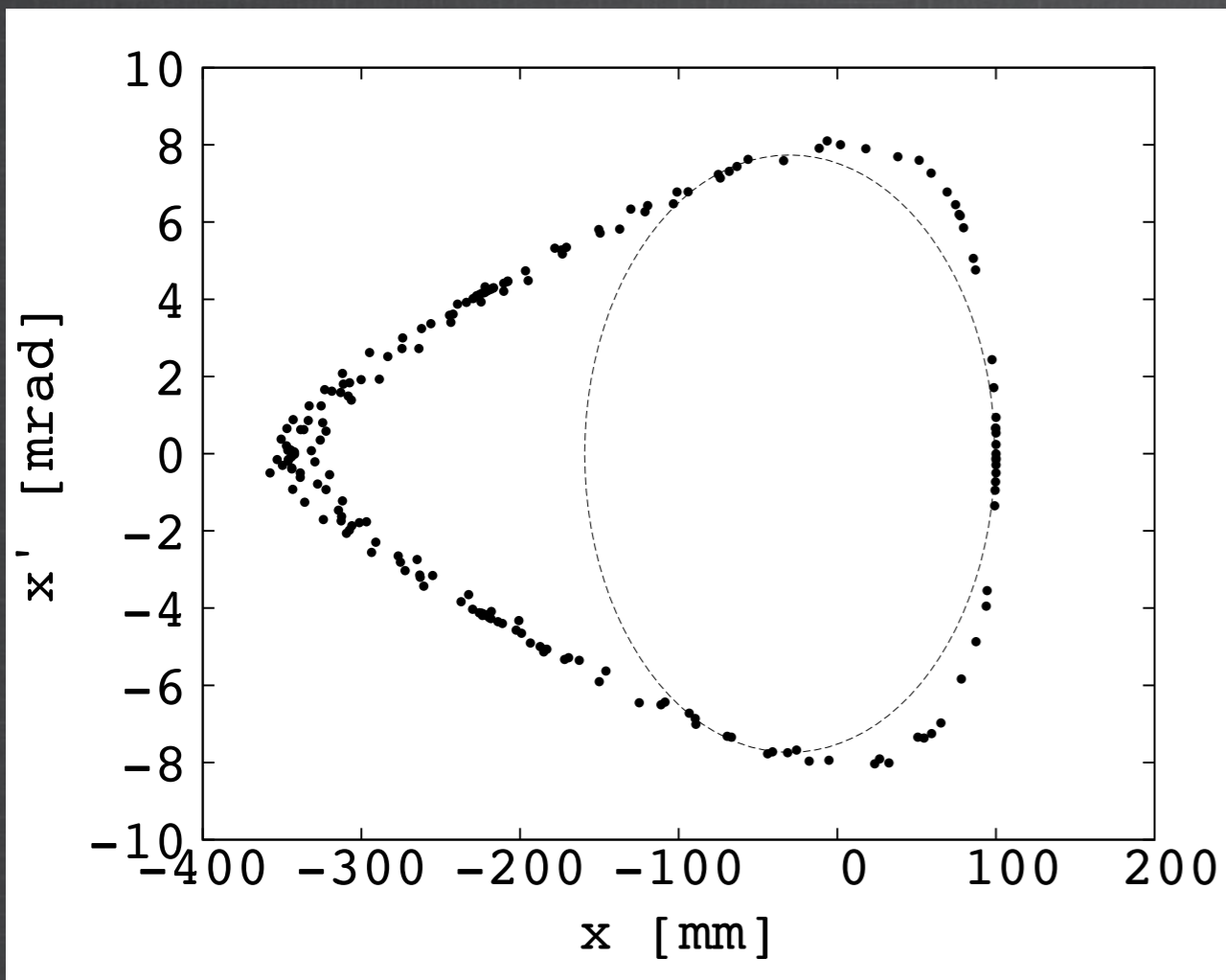
Triplet solution

Tune diagram $\frac{\Delta P}{P} = \pm 16\%$

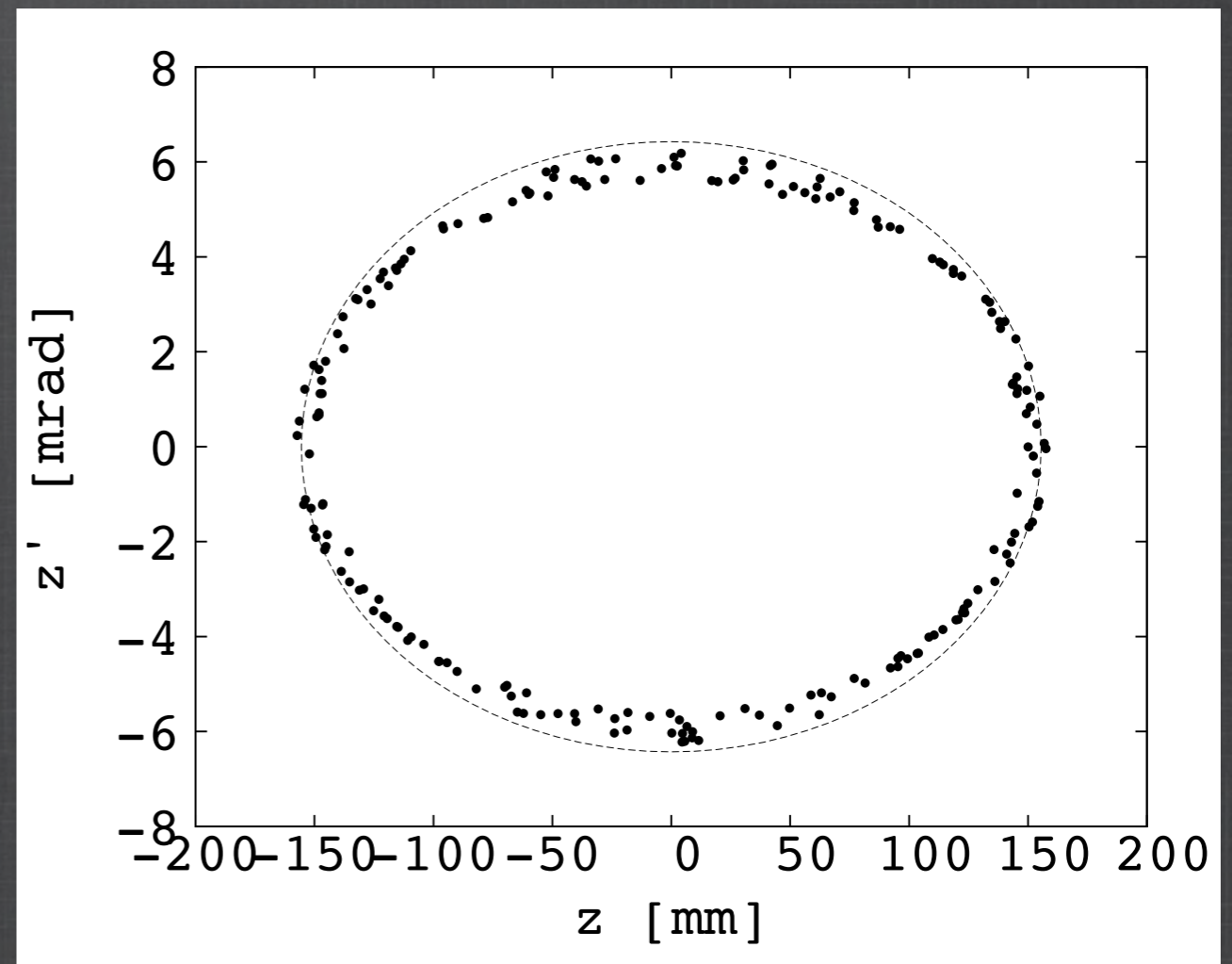


Triplet solution

Transverse acceptance



Maximum horizontal stable amplitude over 100 turns



Maximum vertical stable amplitude over 100 turns



Outline

● Doublet solution

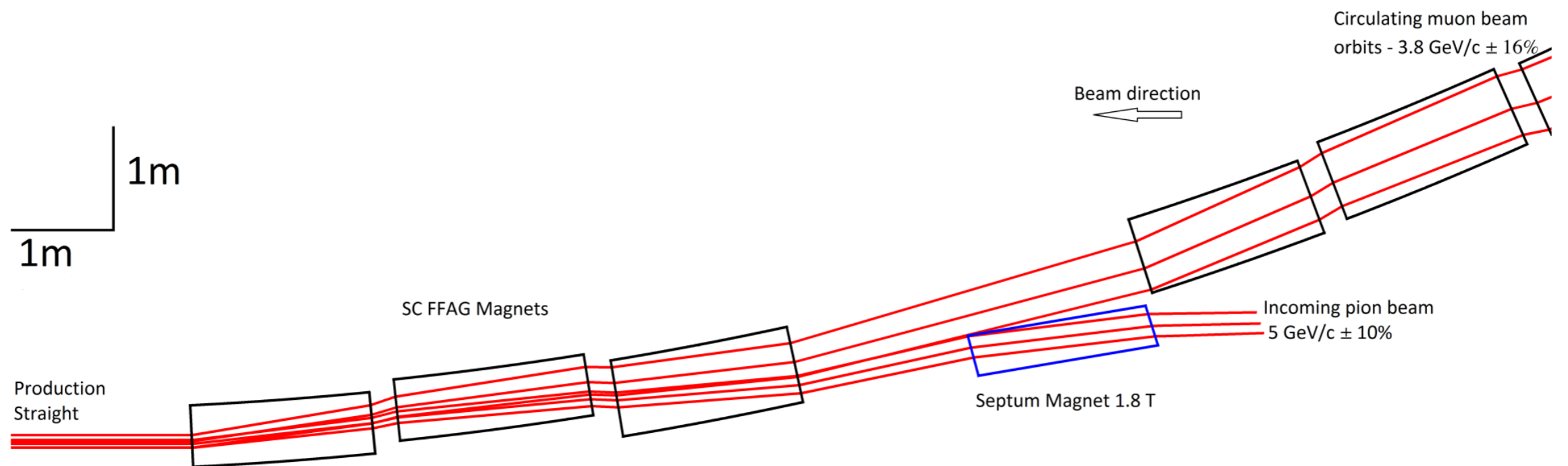
● Triplet solution

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● Improvements



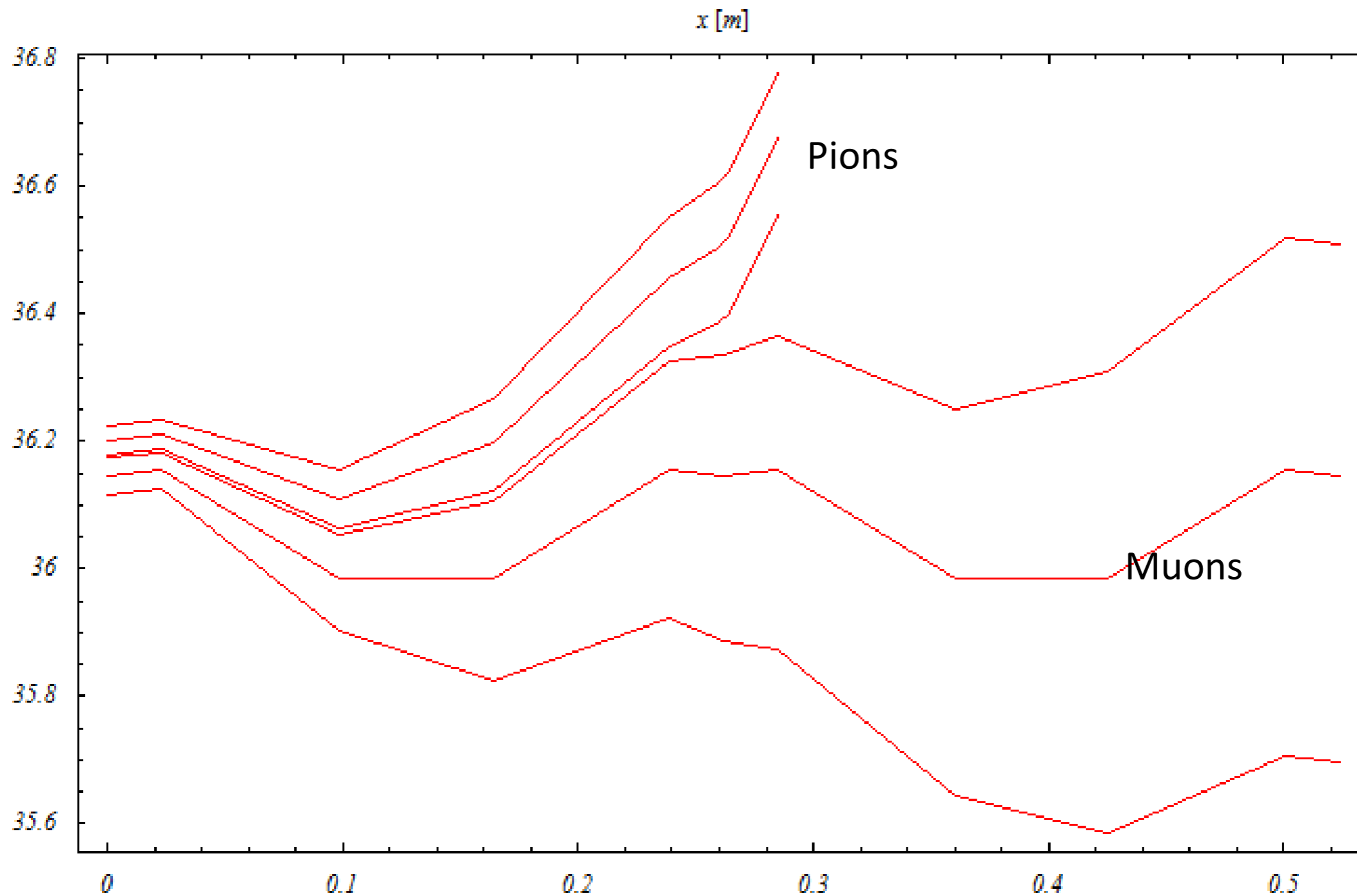
Preliminary Stochastic injection geometry



(J. Pasternak)



Injection with matched dispersion



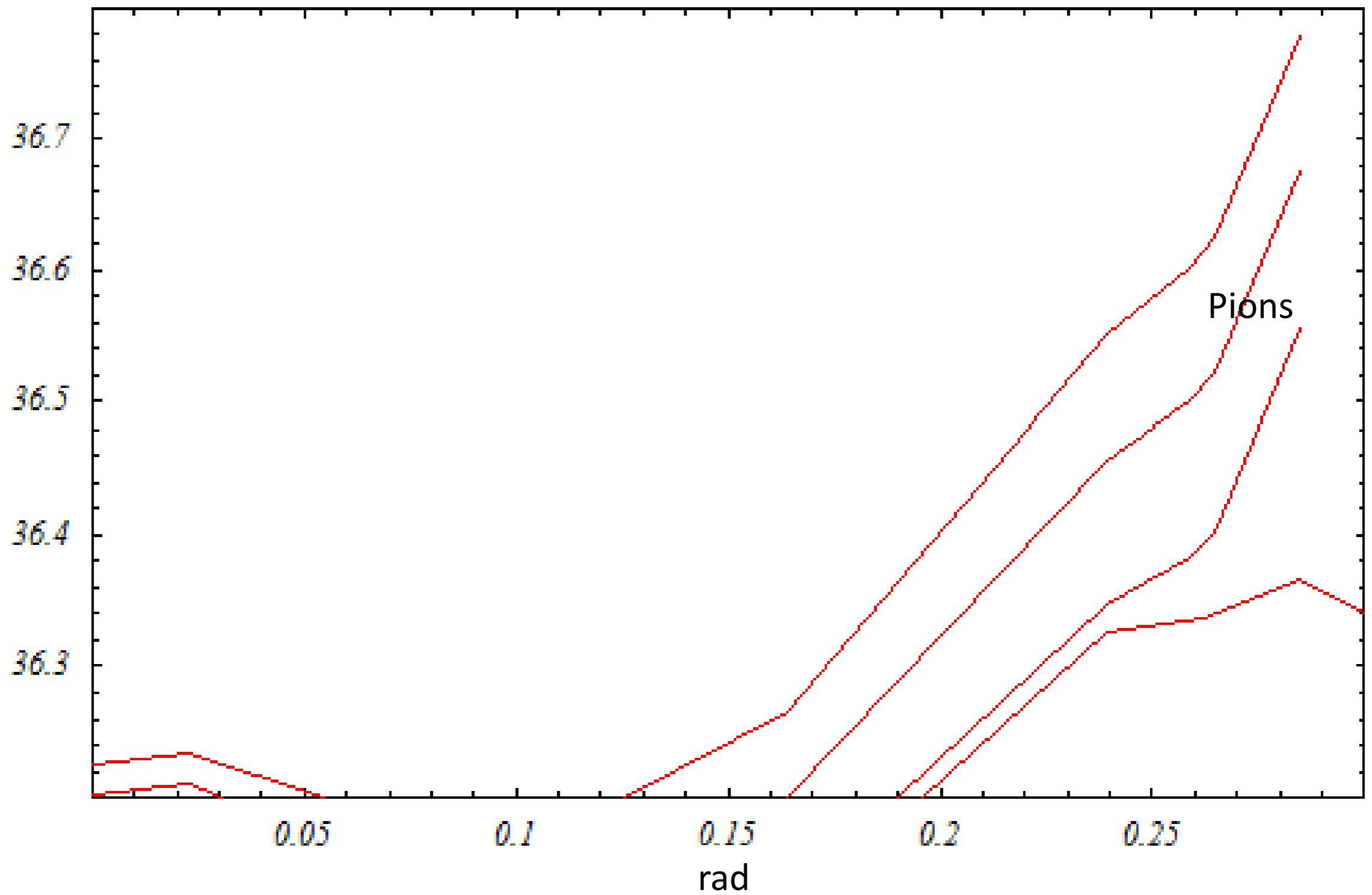
(J. Pasternak)

Injection parameters with matched dispersion

- Septum field 1.4 T (room temperature)
- Septum thickness/length $\sim 2\text{cm}/\sim 72\text{cm}$
- It requires SC dipole/septum of 4 T and 6 cm thickness to be placed upstream (72 cm in length)
- It gives 20 cm beam clearance at the upstream FFAG magnet.
- Alternatively we could use $\sim 2\text{cm}/164\text{ cm}$ SC septum with 1.8T (results are pretty the same)

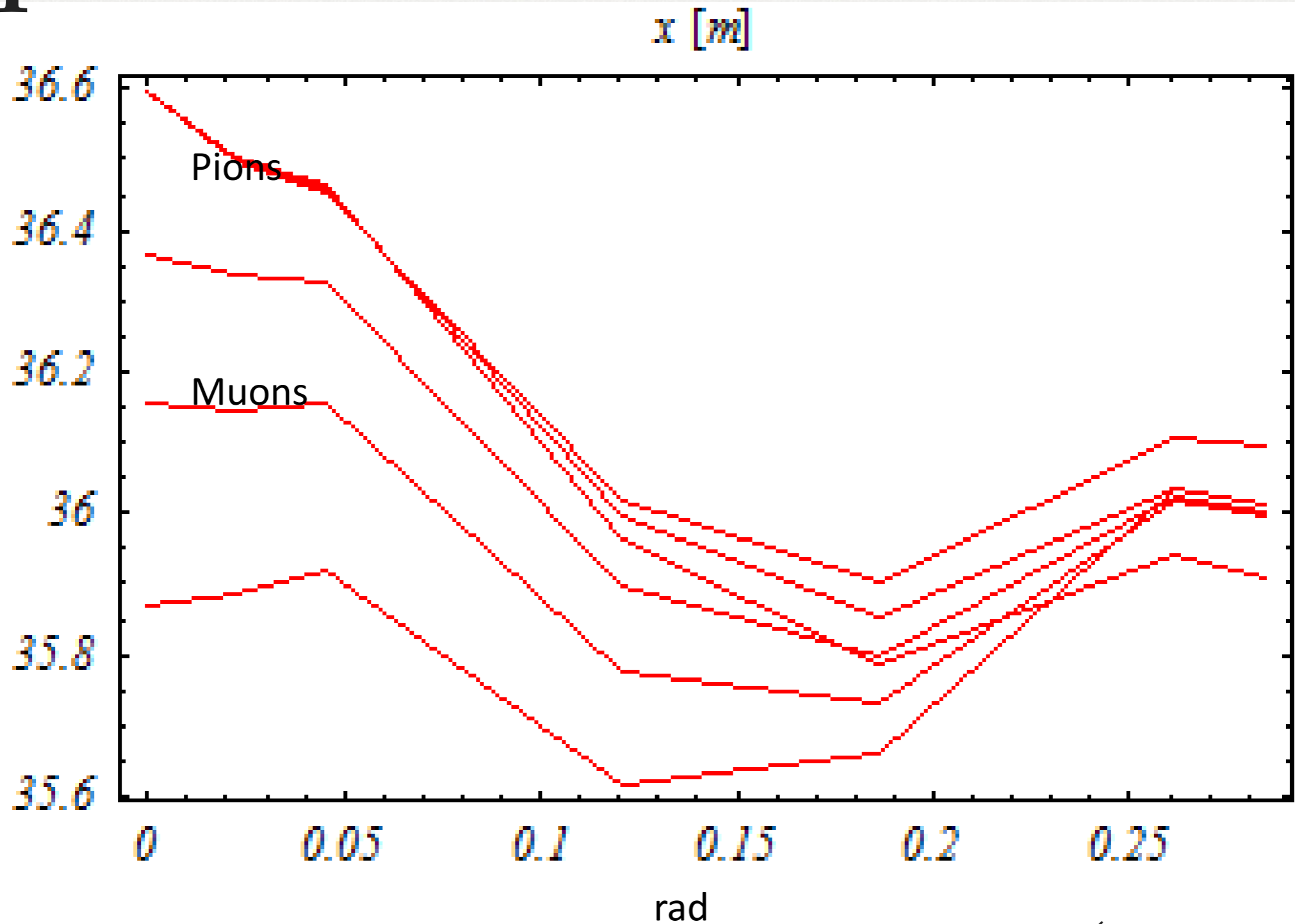
(J. Pasternak)

Zoom in



(J. Pasternak)

Injection with no dispersion (reversed direction)



(J. Pasternak)

Injection parameters with no dispersion

- Septum field 0.8 T (room temperature)
- Septum thickness/length $\sim 2\text{cm}/\sim 164\text{cm}$
- It gives 20 cm beam clearance at the upstream FFAG magnet.
- The pion orbits will oscillate in the decay section. We need to evaluate, how this affects the muon collection efficiency.



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Future improvements

- Small scallop angle in the straight: reduce the portion of the straight cell with scallop.
- Larger DA: smaller gradient (m-value) in the straight section
- Smaller magnets in the arcs: reduce the maximum dispersion in the arcs (> 1.3 m necessary for injection).
- Neutrino flux estimation from pion & muon decay for doublet and triplet lattice, and comparison with FODO (see D. Adey's talk).

Thank you for your attention