

# BT-BTP line status

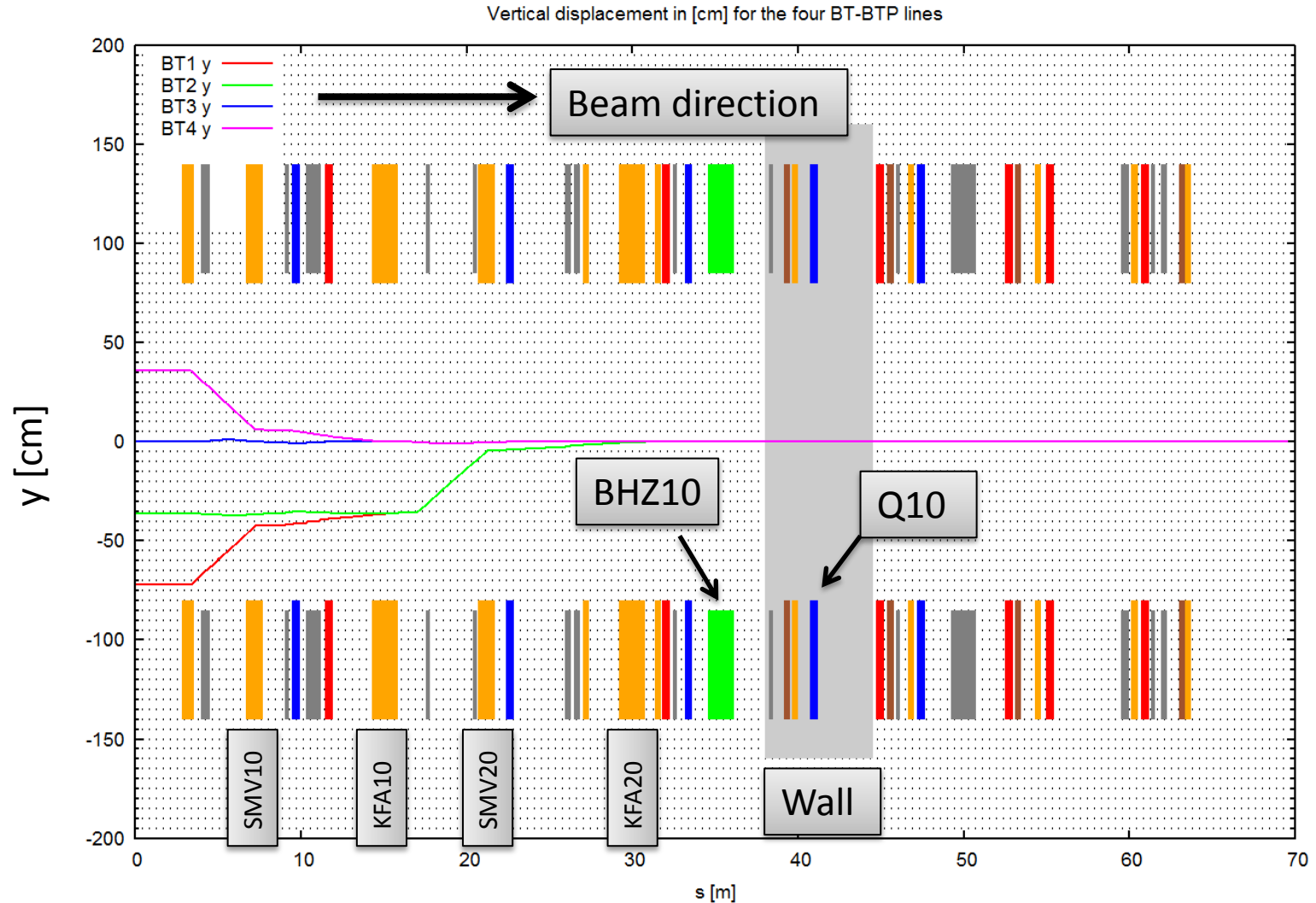
W. Bartmann, J. Borburgh, B. Goddard

LIU-PSB-Meeting, 6-Oct-11

# Outline

- Present line
- BHZ10
- New/moved elements
- Optics matching for LHC and HI beams
- Quadrupole gradients
- Conclusion
- Next steps

# Present line status

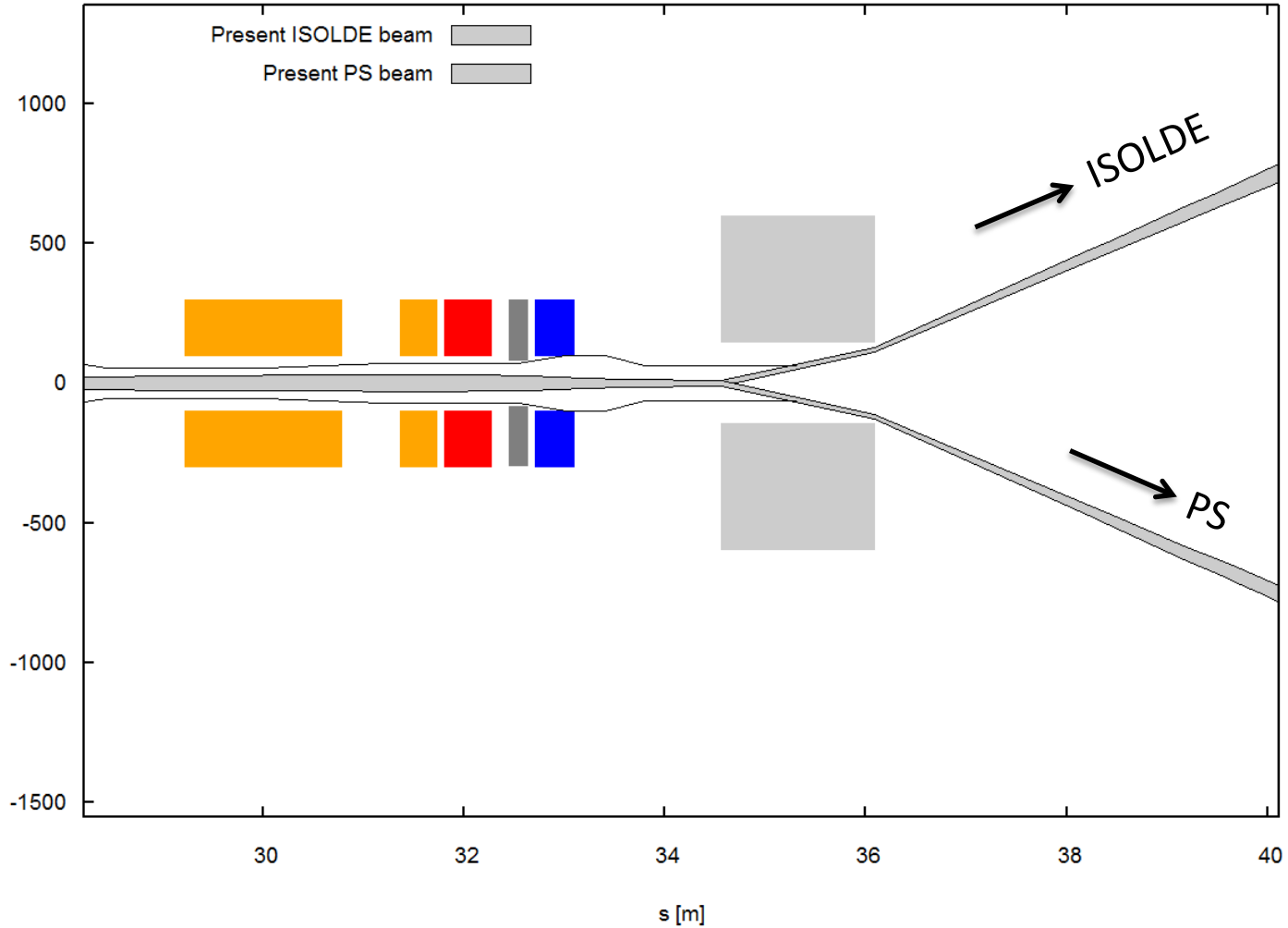


# Main goals

- Optics:
  - Match BTP optics in horizontal plane to PS optics for LHC beams
  - Keep vertical dispersion mismatch as low as possible
  - Reduce beam size at injection for HI beams
- Include/improve hardware:
  - Alternative solution for BHZ10 (switching dipole ISOLDE/PS)
  - 2 GeV beam stopper (in PSB zone)
  - Collimators in h/v to protect SMH42
  - Don't use wall equipment

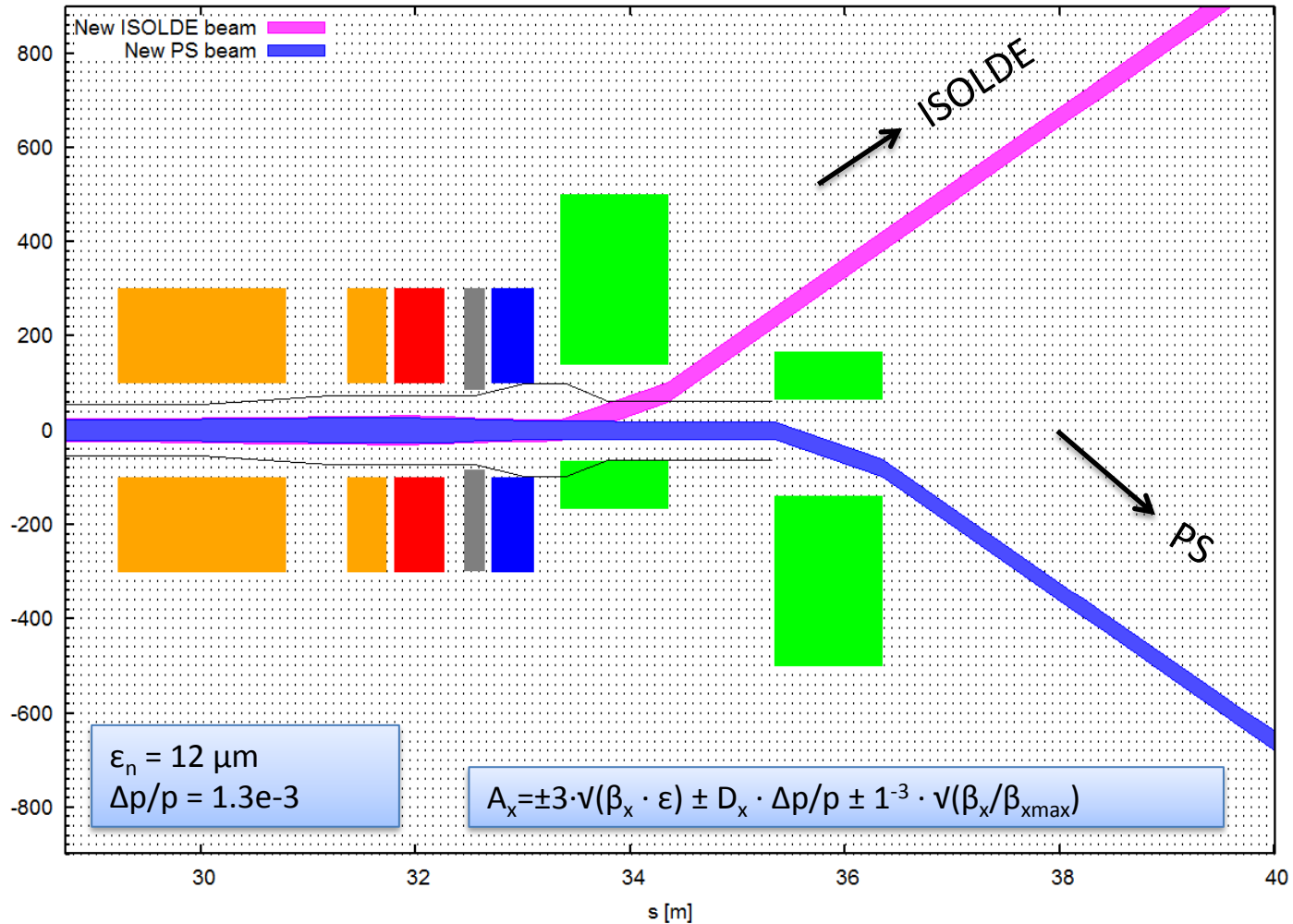
# BHZ10 as present

BT-BTP4: Beam envelopes in [mm] from Booster extraction to PS injection

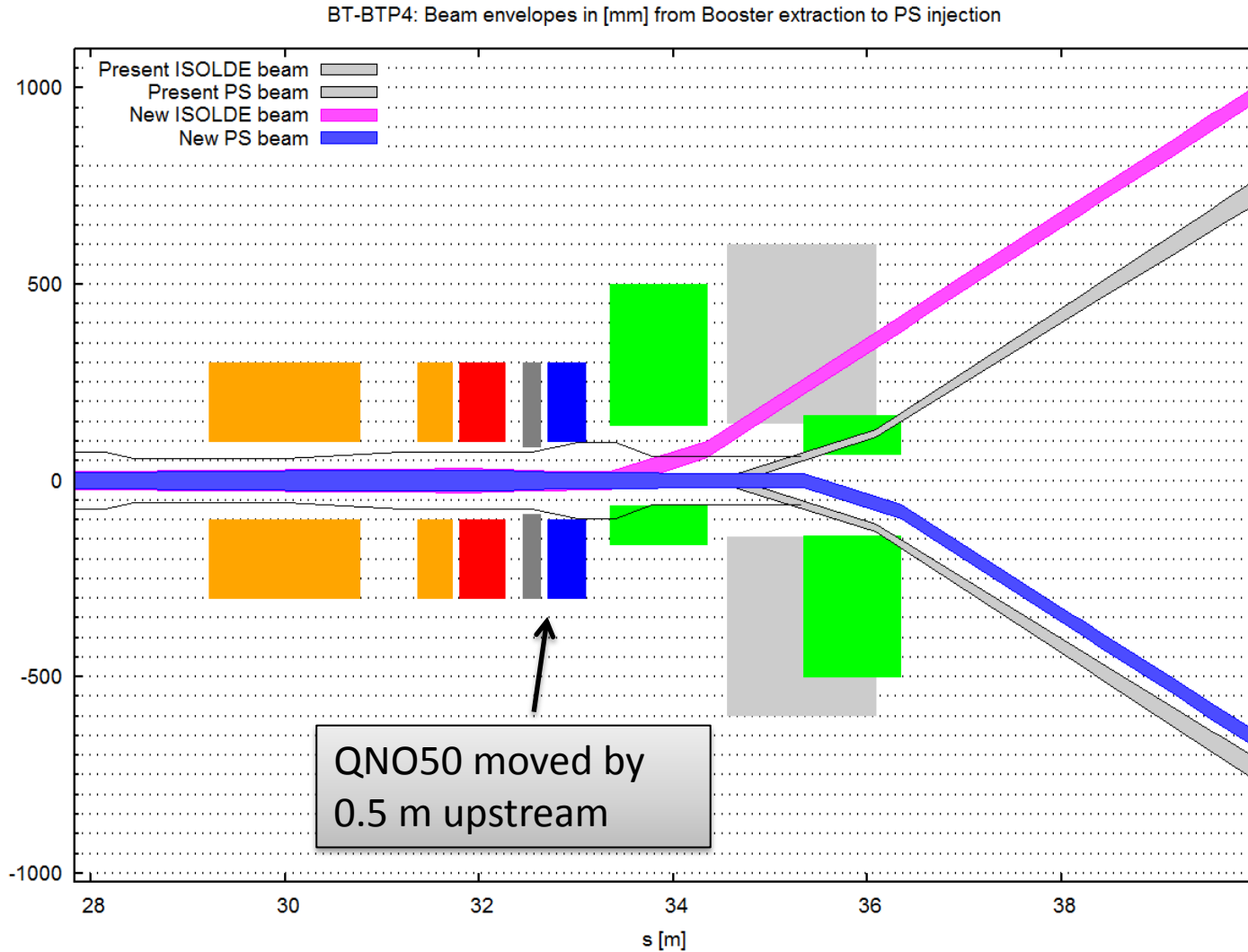


# BHZ10 split option

BT-BTP4: Beam envelopes in [mm] from Booster extraction to PS injection



# BHZ10 comparison



# BHZ10 split specs

- Split option with two identical C-shaped magnets
- Aperture
  - full vertical beam acceptance: 130 mm
  - full horizontal beam acceptance: 205 mm
- Dimensions:
  - One sided width: 100 mm
  - Magnetic length: 1000 mm
- Kick strength
  - BHZ101 (to ISOLDE): 160 mrad
  - BHZ102 (to PS): 160 mrad
- B.dl@2GeV
  - 1.485 T.m

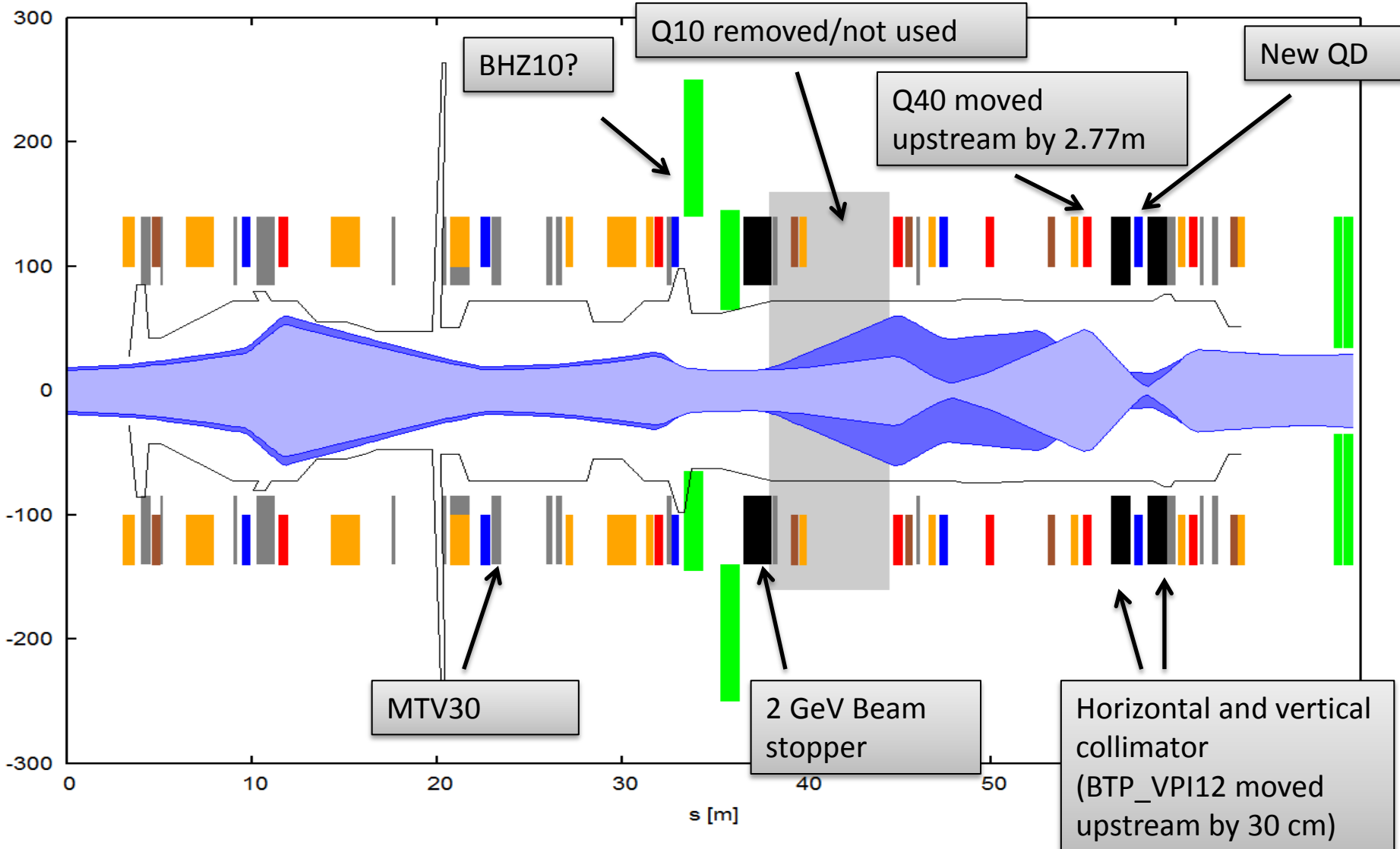


# BHZ10 “as present” specs

- Same magnet as now with increased field
- Apertures as present
- Kick strength
  - +/- 160 mrad
  - $B \cdot dl @ 2 \text{ GeV} = 1.485 \text{ Tm}$
- Available space in lattice: 3 m

# New/moved elements

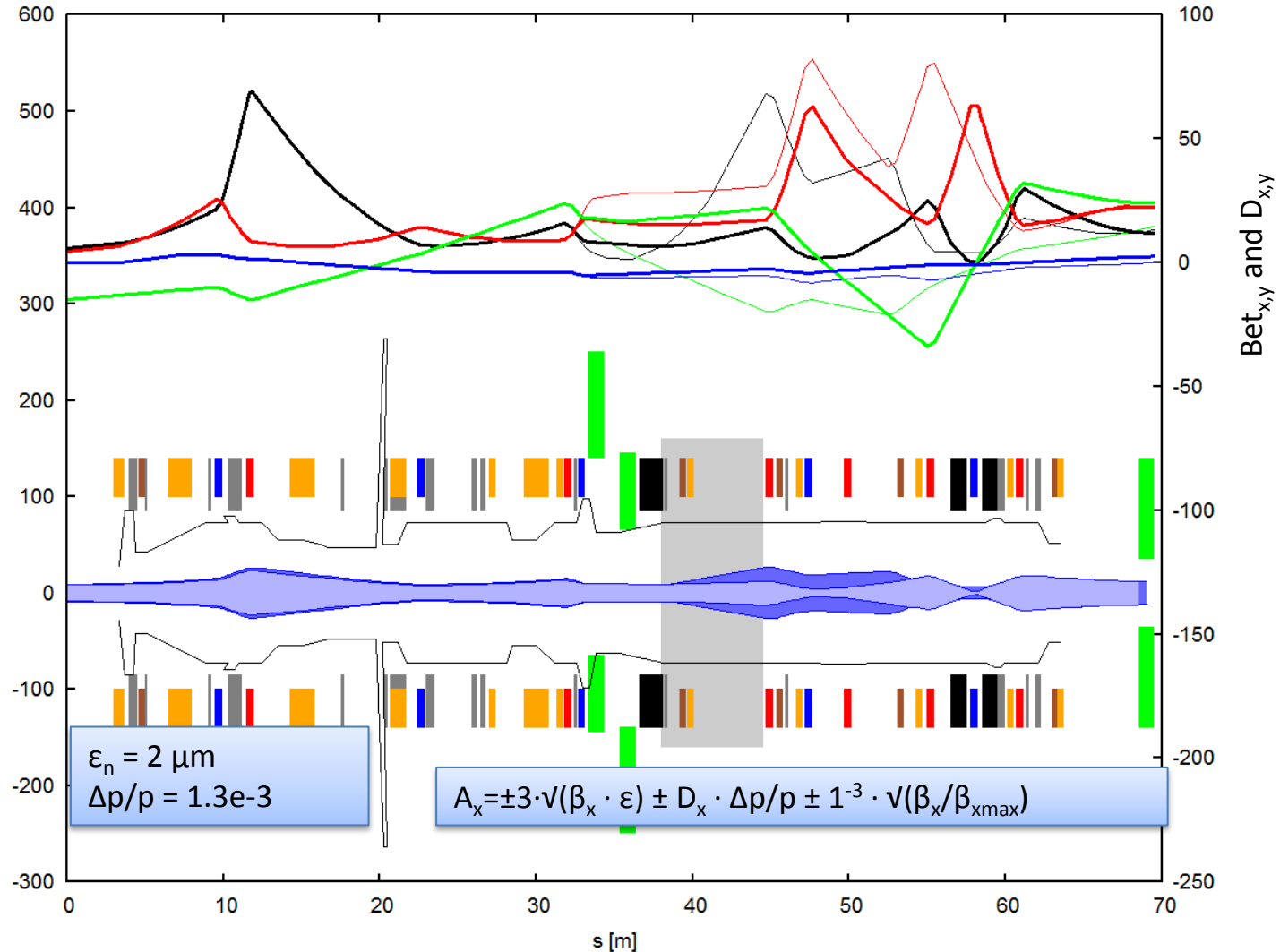
BT-BTP4: Beam envelopes in [mm] and optics in [m] from Booster extraction to PS injection



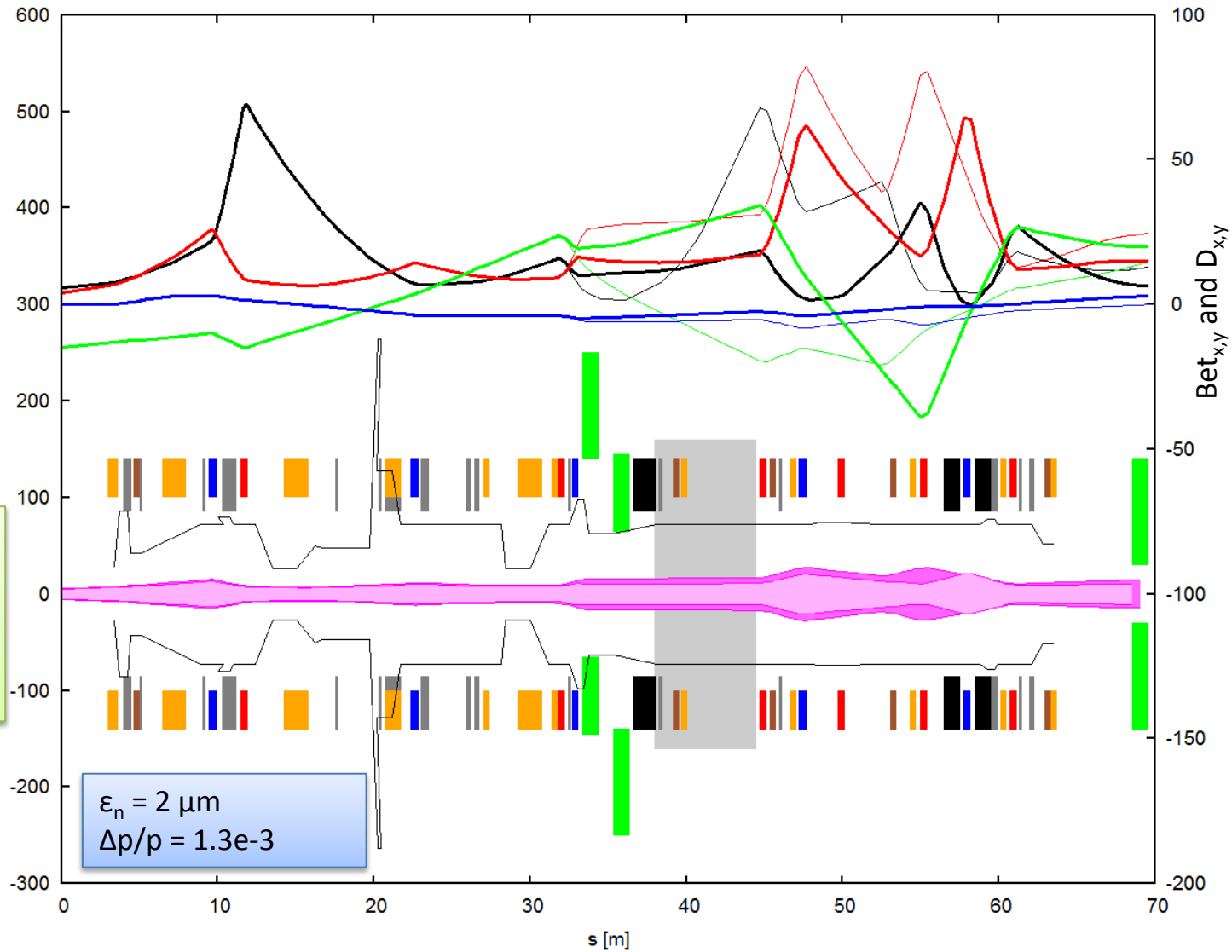
# Optics: LHC beam matched to PS inj

BT-BTP4: Beam envelopes in [mm] and optics in [m] from Booster extraction to PS injection

- betx-present —
- bety-present —
- 10\*dx-present —
- 10\*dy-present —
- betx —
- bety —
- 10\*dx —
- 10\*dy —
- Present 1.4 GeV 3 sig HI beam envelope —
- New 2 GeV 3 sig HI beam envelope —
- Hor aper —

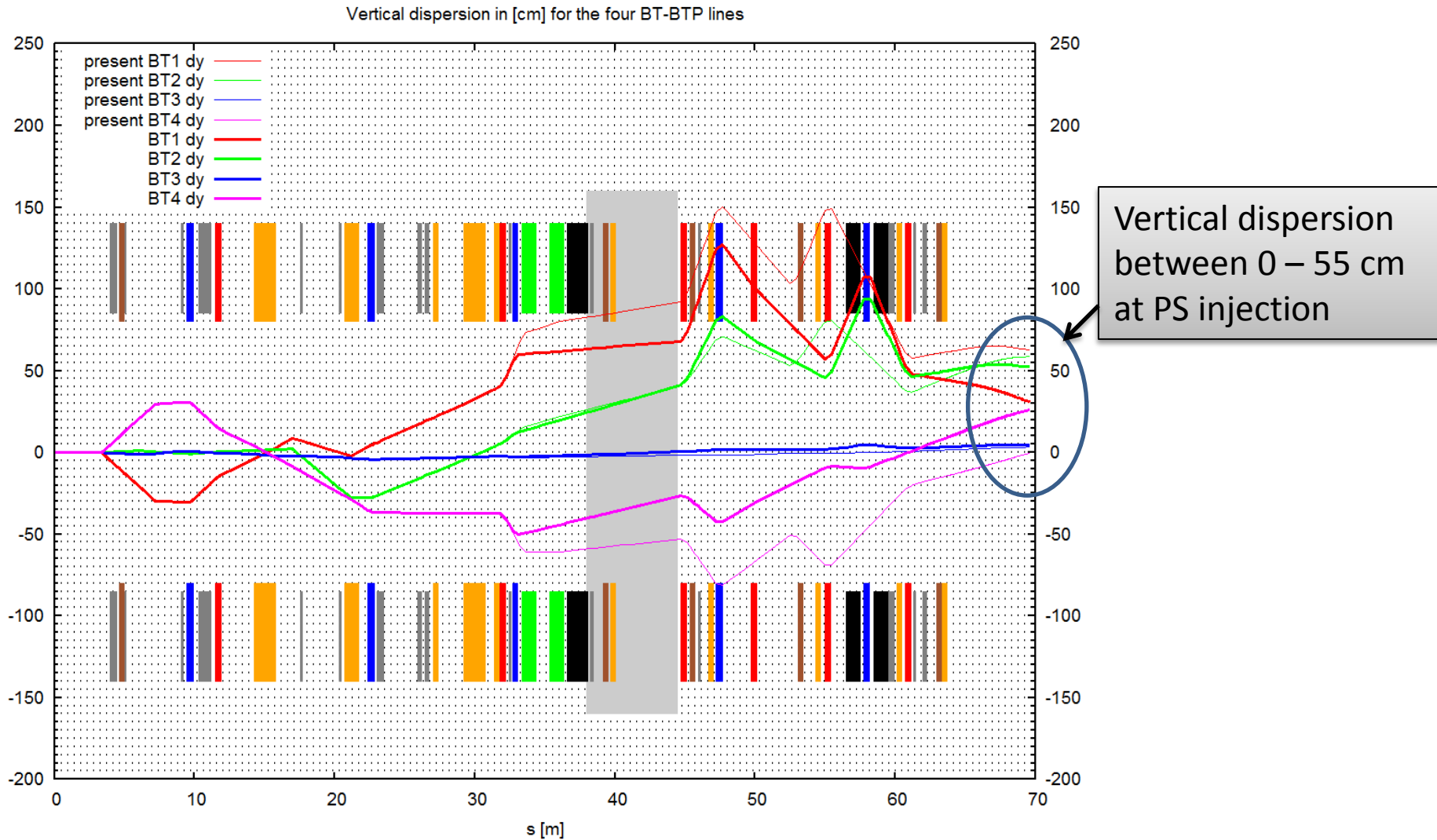


# Optics: LHC beam matched to PS inj



Envelopes throughout the line well within the aperture

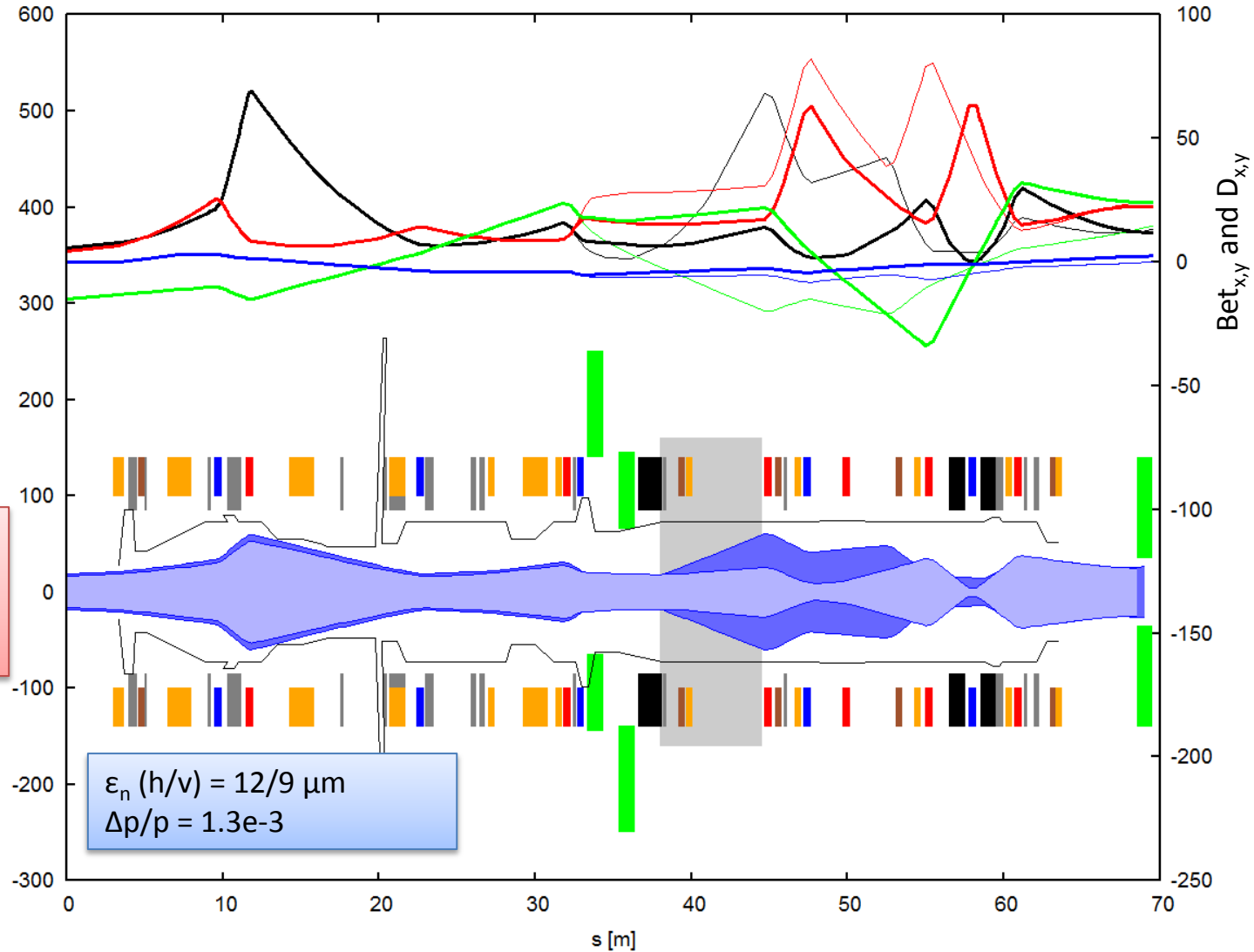
# Vertical dispersion



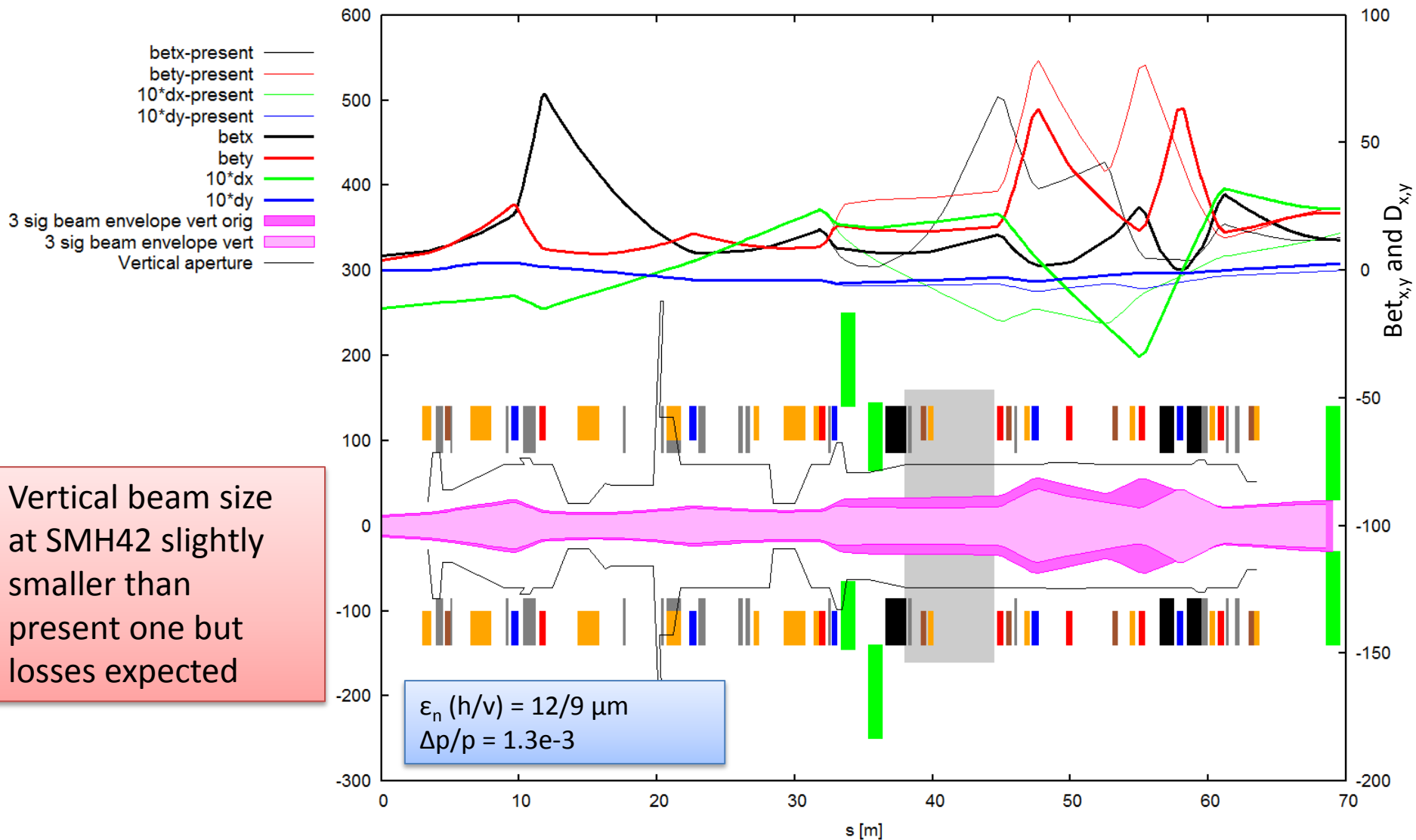
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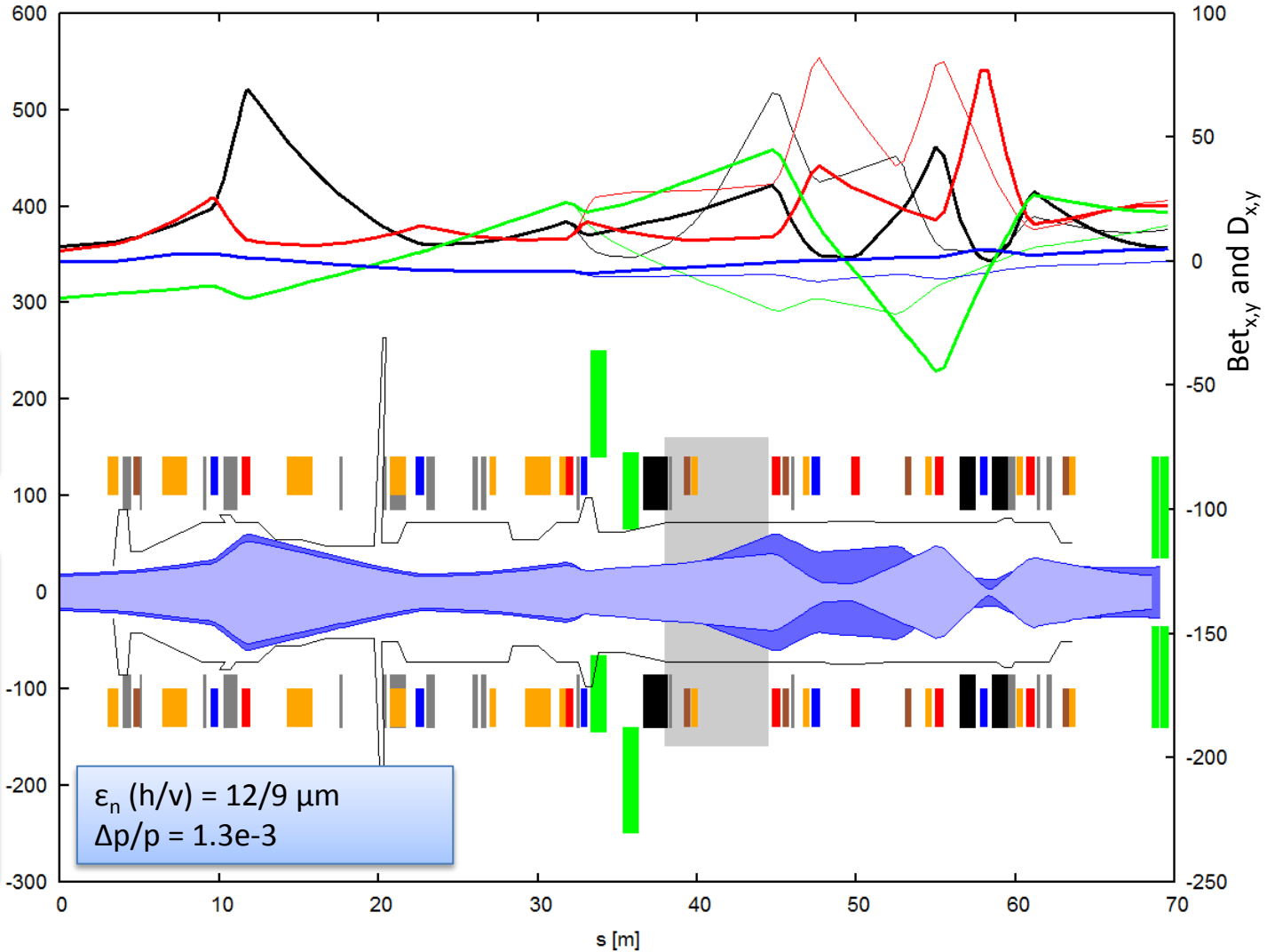
# Optics: HI beam matched to PS inj



# Optics: HI beam with reduced beam size

BT-BTP4: Beam envelopes in [mm] and optics in [m] from Booster extraction to PS injection

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Horizontal beam size at SMH42 reduced

Optics detuning from (present values)

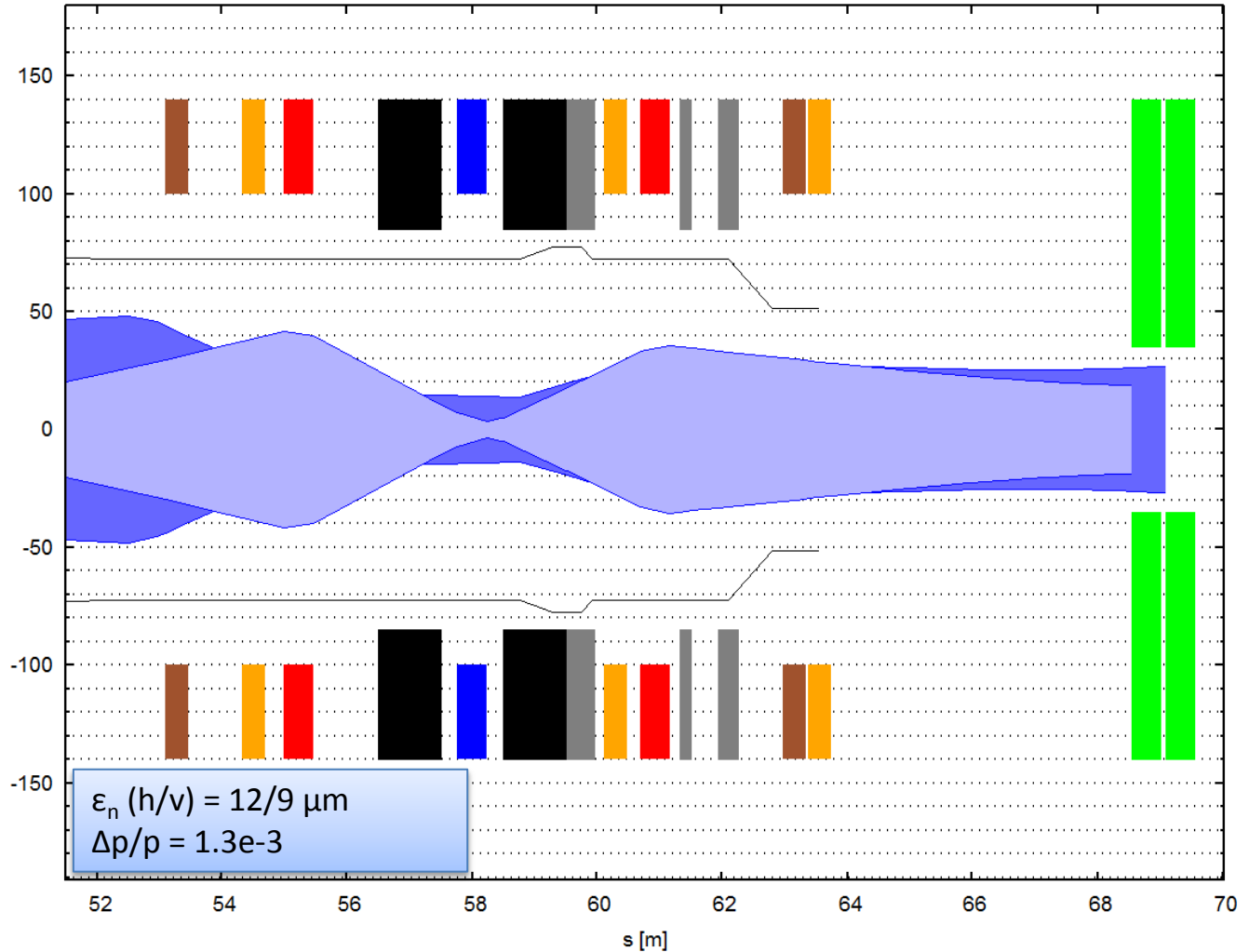
$\beta_x = 6.4 \text{ m (11.9 m)}$   
 $\beta_y = 15.0 \text{ m (22.5 m)}$   
 $D_x = 2.0 \text{ m (2.4 m)}$   
 $D_y = 0.3 \text{ m (0 m)}$



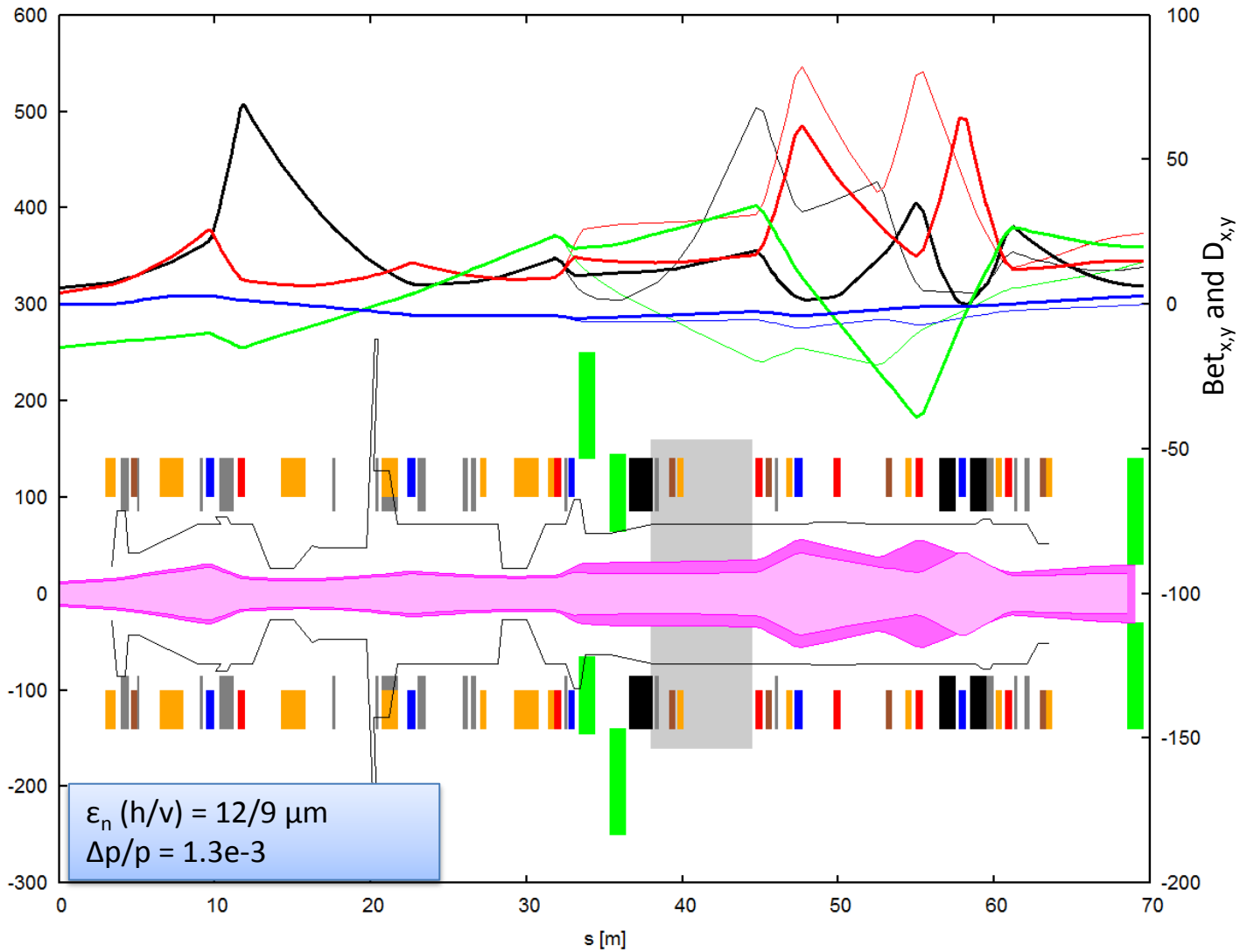
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# Optics: HI beam with reduced beam size



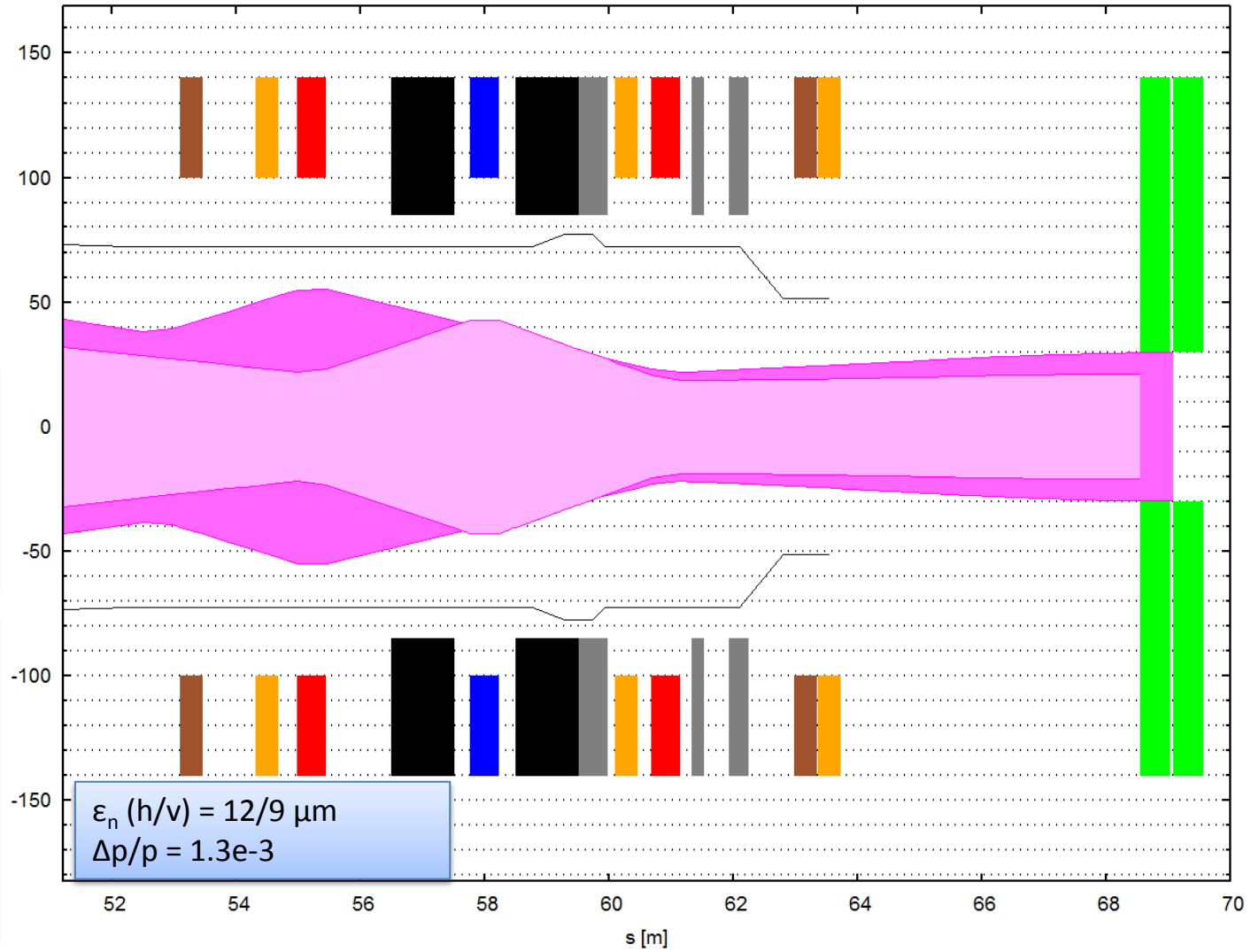
Vertical beam size at SMH42 reduced wrt to LHC and present settings

Optics detuning from (present values)

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# Optics: HI beam with reduced beam size

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- 10\*dy-present —
- betx —
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Vertical beam size at SMH42 reduced wrt to LHC and present settings

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# Quadrupole gradients

Quadrupole	Unit	LHC settings	HI settings
bt_qno40	T/m	7.80	6.68
bt_qno50	T/m	8.34	7.53
btp_q20	T/m	6.84	6.53
btp_q30	T/m	5.68	5.31
btp_q35	T/m	0.56	0.11
btp_q50	T/m	10.19	9.93
btp_q55	T/m	7.77	8.03
btp_q60	T/m	8.16	9.16

BT\_QNO50 has larger aperture (200mm vs 150 mm) and a limit of 6.93 T/m

For the TRIUMF magnets (150 mm aperture) the limit is 10.07 T/m

# Conclusions

- BHZ10 options:
  - As existing but for 30% higher  $B\rho$
  - Split version with two 1 m long C shaped magnets
- LHC Optics
  - Horizontally matched without Q10
  - Vertical dispersion mismatch reduced for BT1/2, same for BT3 and increased for BT4
  - Envelopes and expected losses OK
- HI optics
  - With LHC settings too big envelopes (also for 2 GeV beam)
  - Optics detuned to squeeze HI beam into SMH42
  - SMH42 losses should be significantly reduced
  - Can the PS injection optics digest this?
- Quadrupole gradients
  - iteration needed for large aperture quad BT\_QNO50 and BTP\_Q50

# Next steps

- Decide on BHZ10 options
- Clarify position of BTP\_Q20 (quad after wall) and all elements downstream!!!
- Iteration on quad strength
- Check what is digestable on optics detuning from PS side
- Move correctors from wall