Status of the interaction region layout for FCC-eh

R. Martin

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Thanks to:
E. Cruz-Alaniz, M. Hofer, R. Tomás

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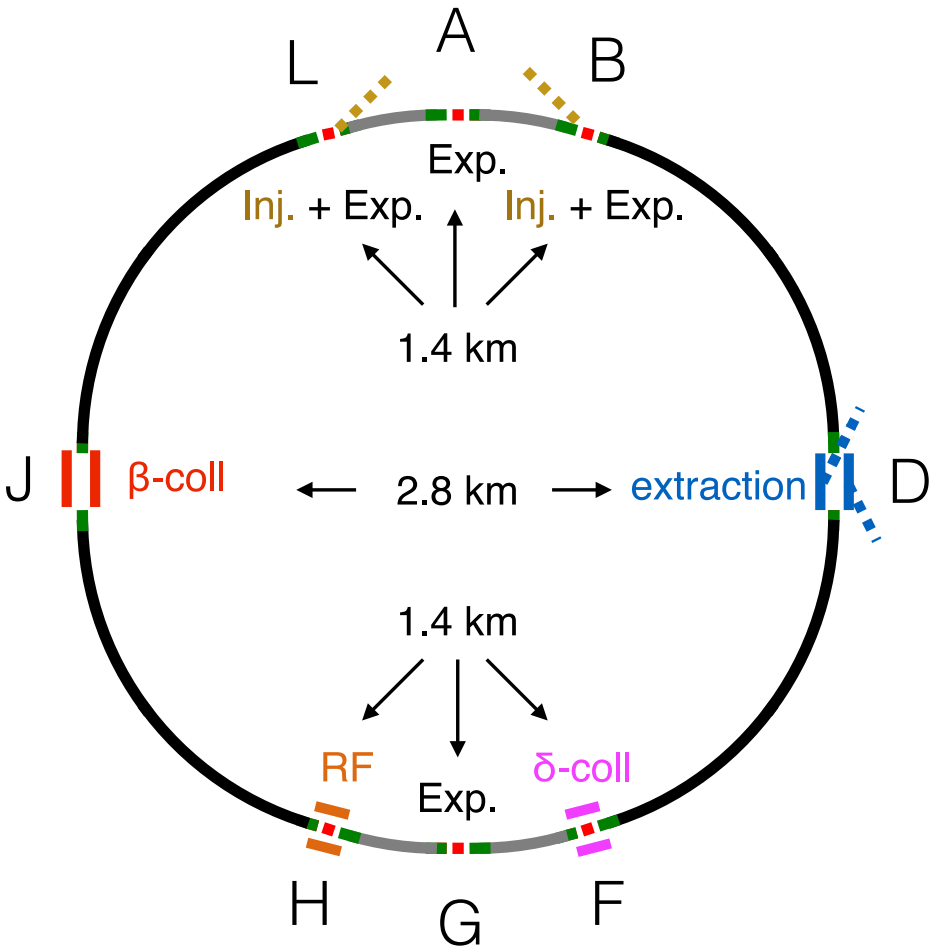
FCC-hh layout



- Main experiments in Point A and G
- “Low luminosity” experiments in Points L and B
- Geology makes **Point L** best option for FCC-eh
- 1400 m straight section to be shared with injection section
  $\Rightarrow$ **limited space**

FCC-eh Parameters

Tech report CERN-ACC-2017-0019:

Parameter	LHeC CDR	FCC-he
E_P [TeV]	7	50
γ_P	7460	53300
E_e [GeV]	60	60
$\sqrt{(s)}$ [TeV]	1.3	3.5
bunch spacing [ns]	25	25
protons per bunch [10^{11}]	1.7	1
$\gamma_p \epsilon_p$ [µm]	3.7	2.2
electrons per bunch [10^9]	1	3.0
electron current [µA]	6.4	20
IP beta function β^* [m]	0.1	0.15
hourglass factor H_{geom}	0.9	0.9
pinch factor $H_{\text{b-b}}$	1.3	1.3
proton filling H_{coll}	0.8	0.8
luminosity [$10^{33}\text{cm}^{-2}\text{s}^{-1}$]	1	15

Goal: $\gamma\epsilon_e = 10\,\mu\text{m}$

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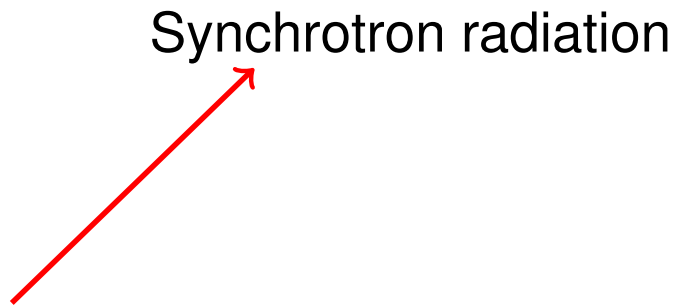

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Low $\gamma\epsilon_e$ important because high γ_P requires strongly focused e^- beam

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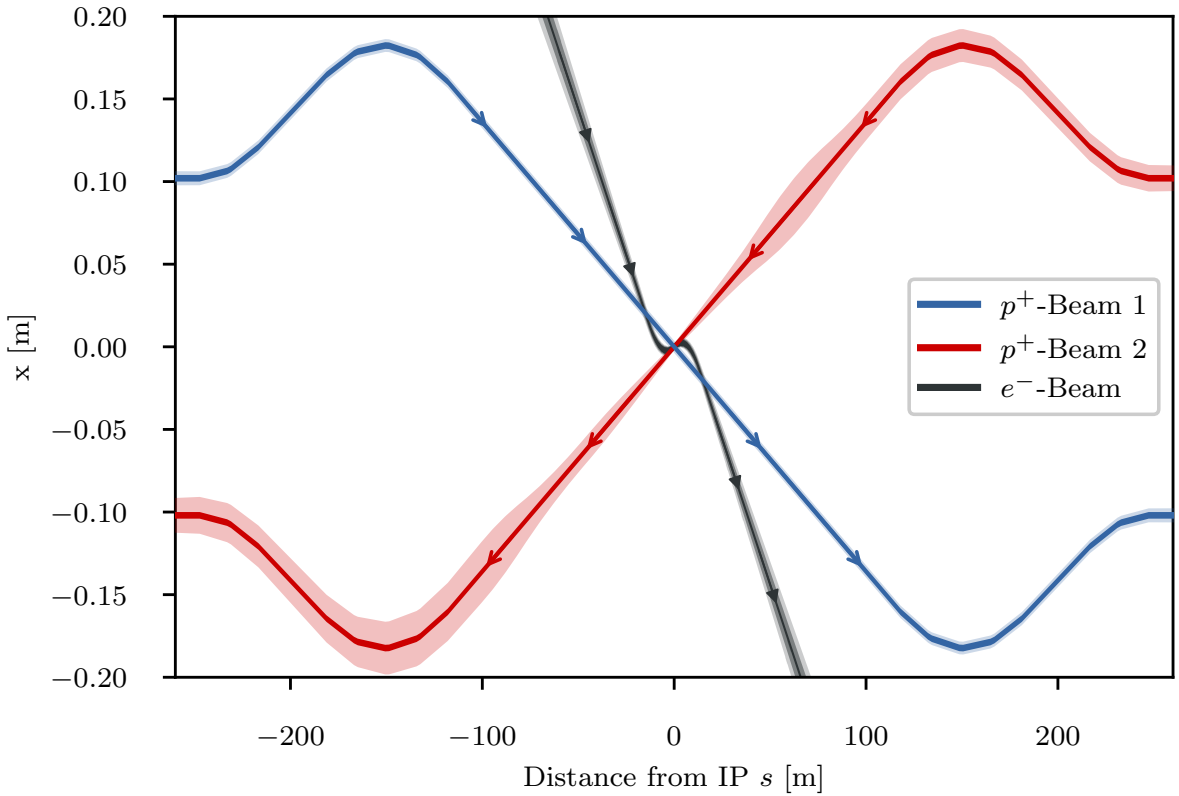
Ambitious, try $\beta^* = 0.3\,\text{m}$ first

Goal: $\gamma\epsilon_e = 10\,\mu\text{m}$

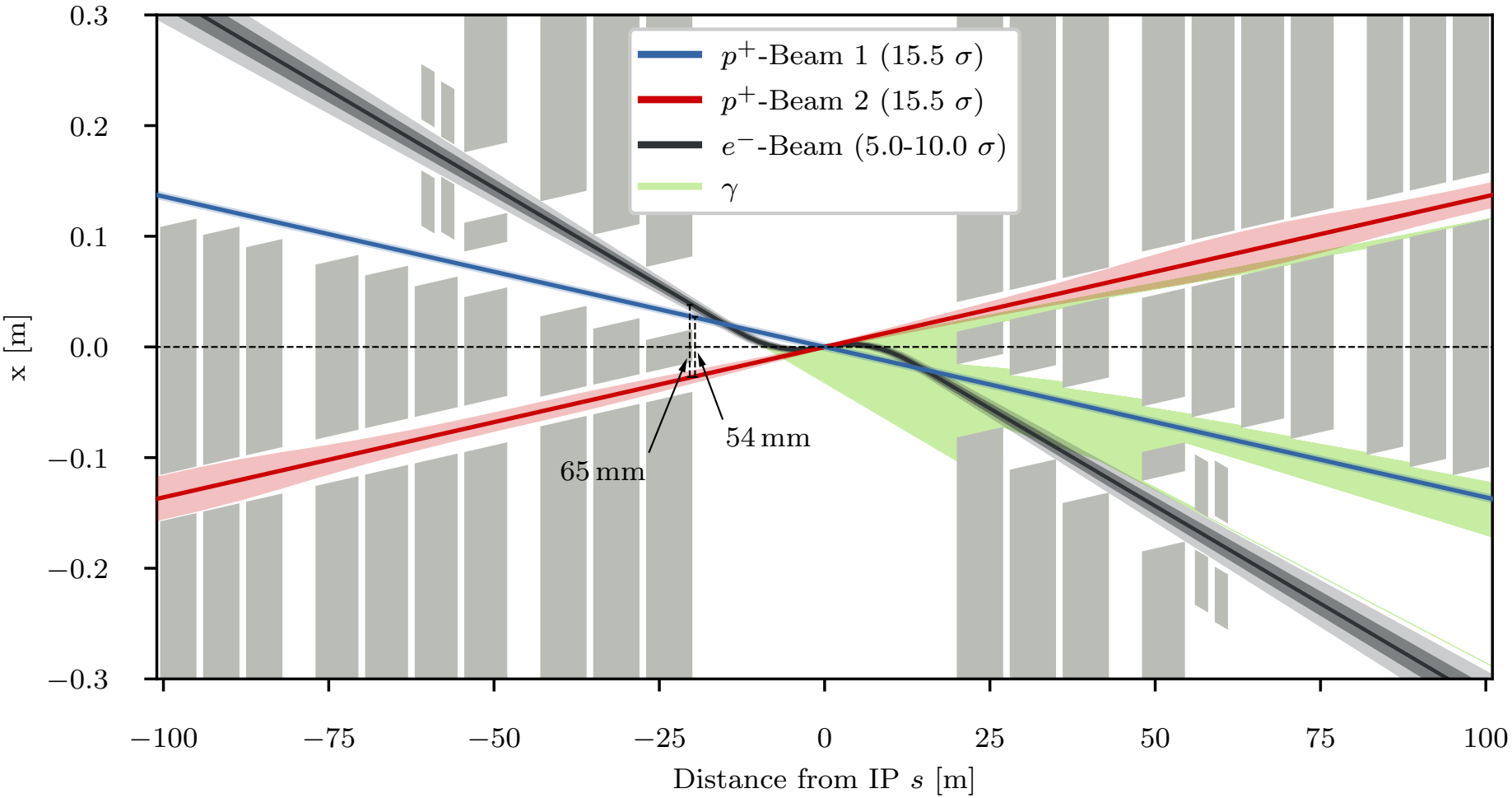
FCC-eh IR principles

- Like LHeC



- Detector integrated dipoles region provide head-on collisions with proton Beam 2

Interaction region layout for $\beta^* = 0.3\,\mathrm{m}$



Note: β^*_e naively scaled to have $\beta^*_e \cdot \epsilon_e = \beta^*_p \cdot \epsilon_p$

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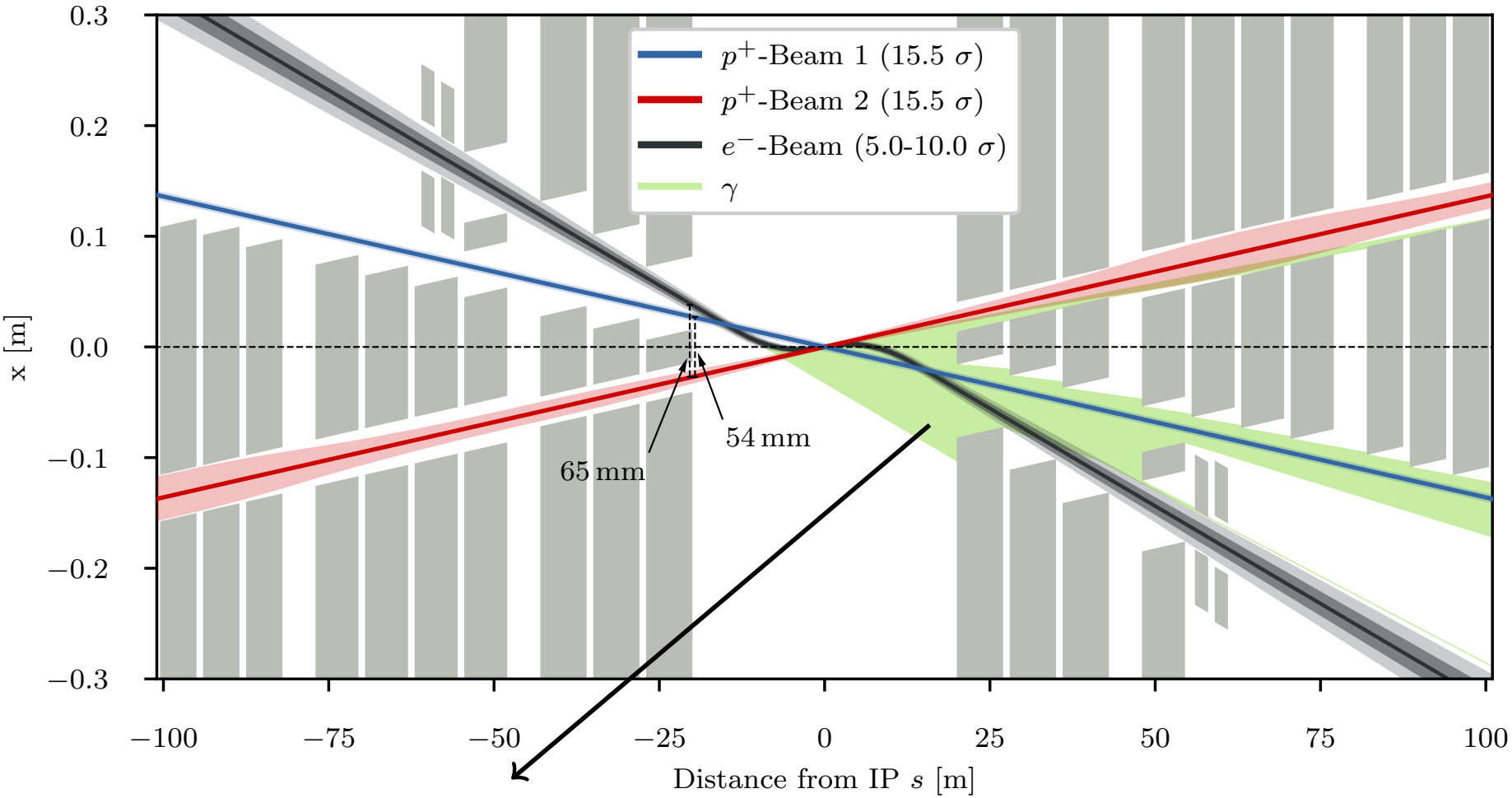

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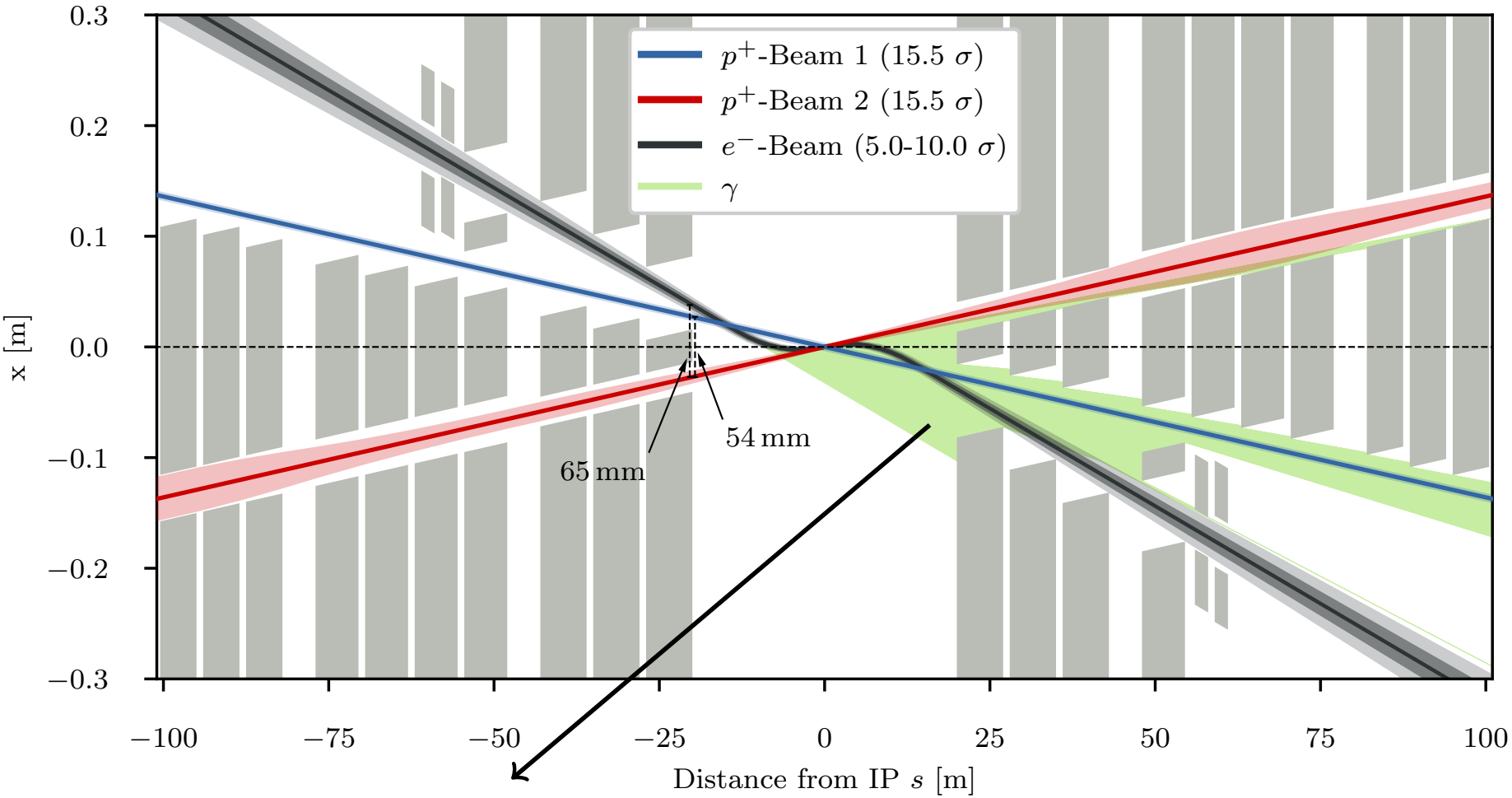

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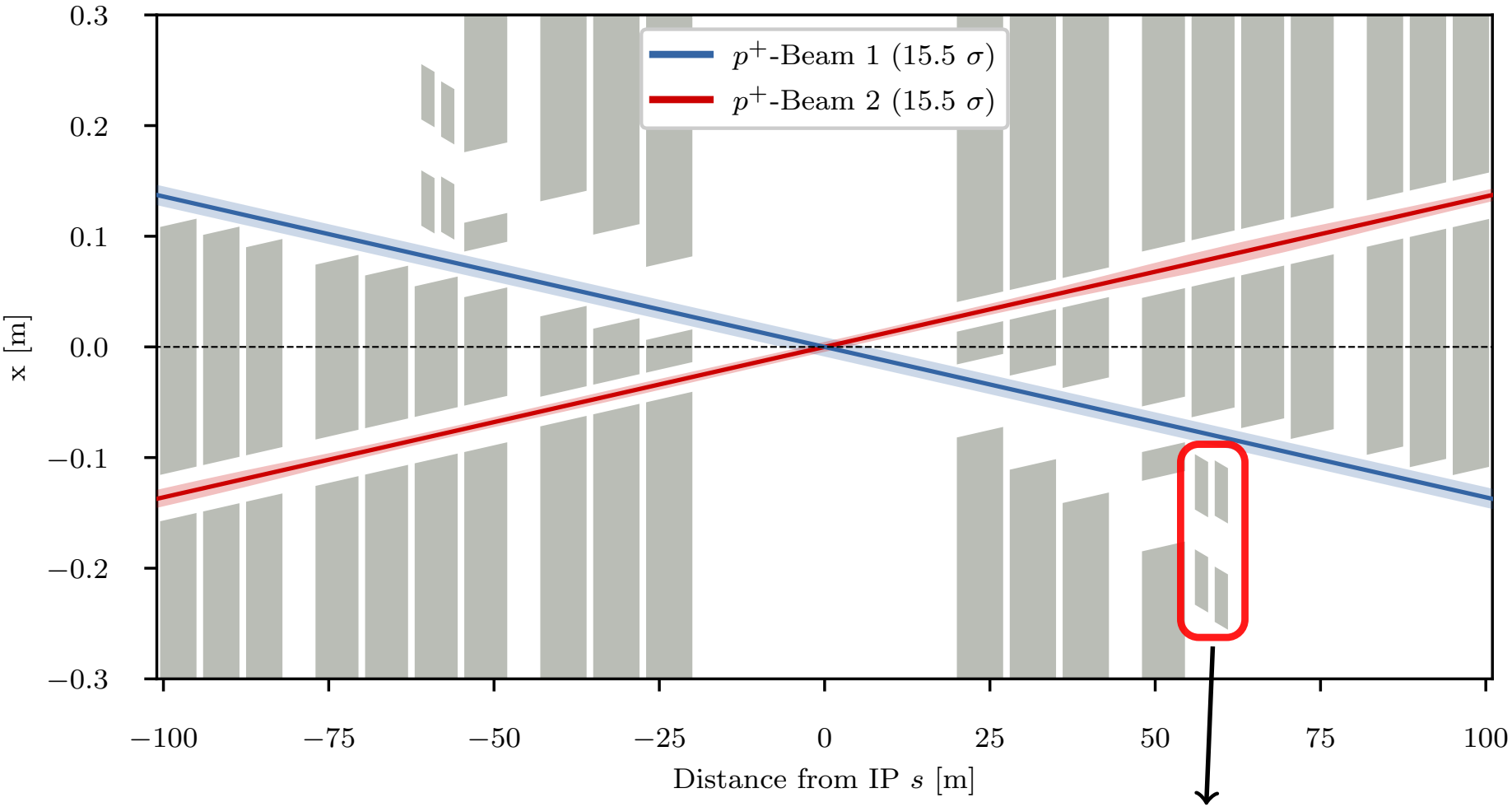
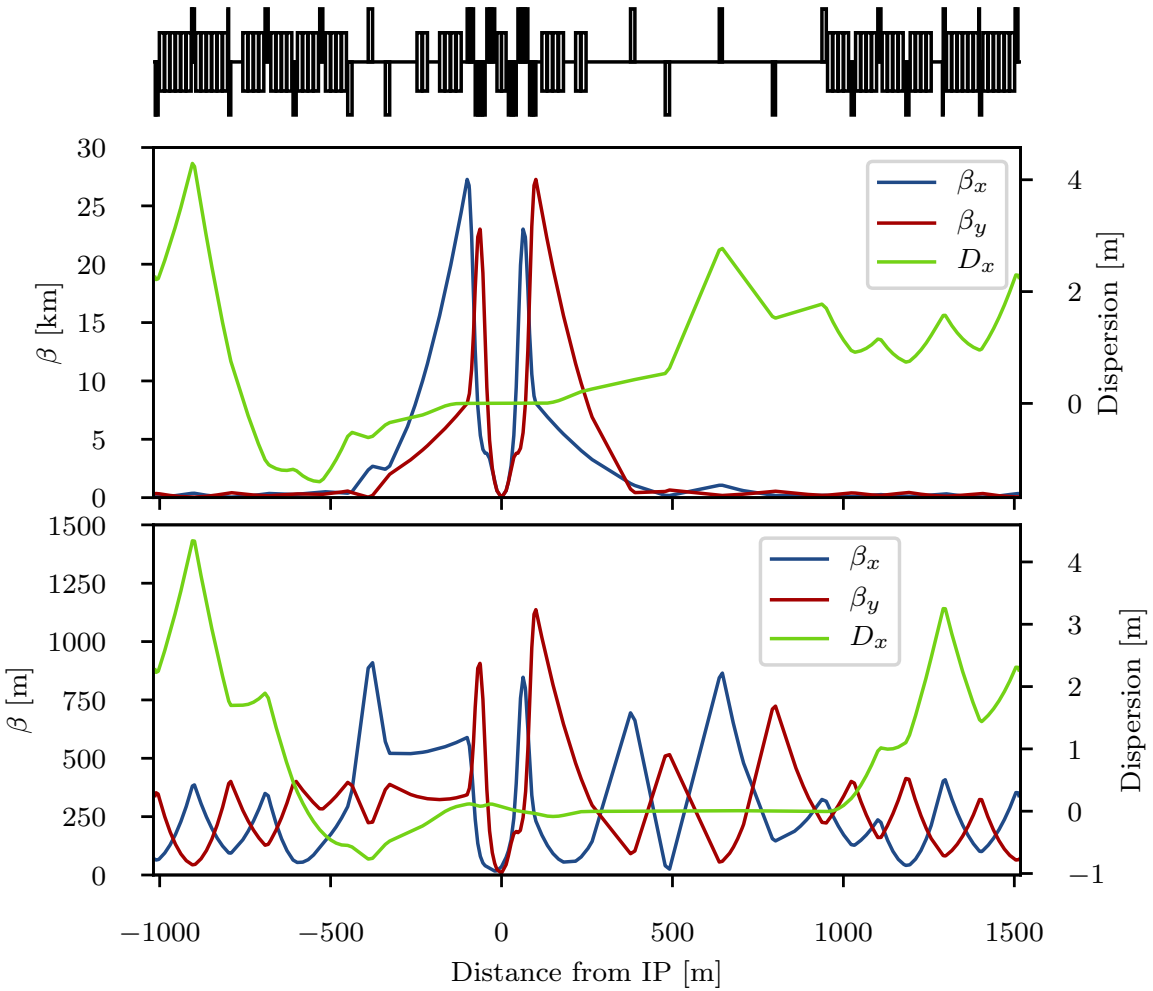
Compare with LHeC:

$P_{\mathrm{synch}} = 49\,\mathrm{kW}$,
$E_{\mathrm{crit}} = 718\,\mathrm{keV}$

Interaction region at injection energy

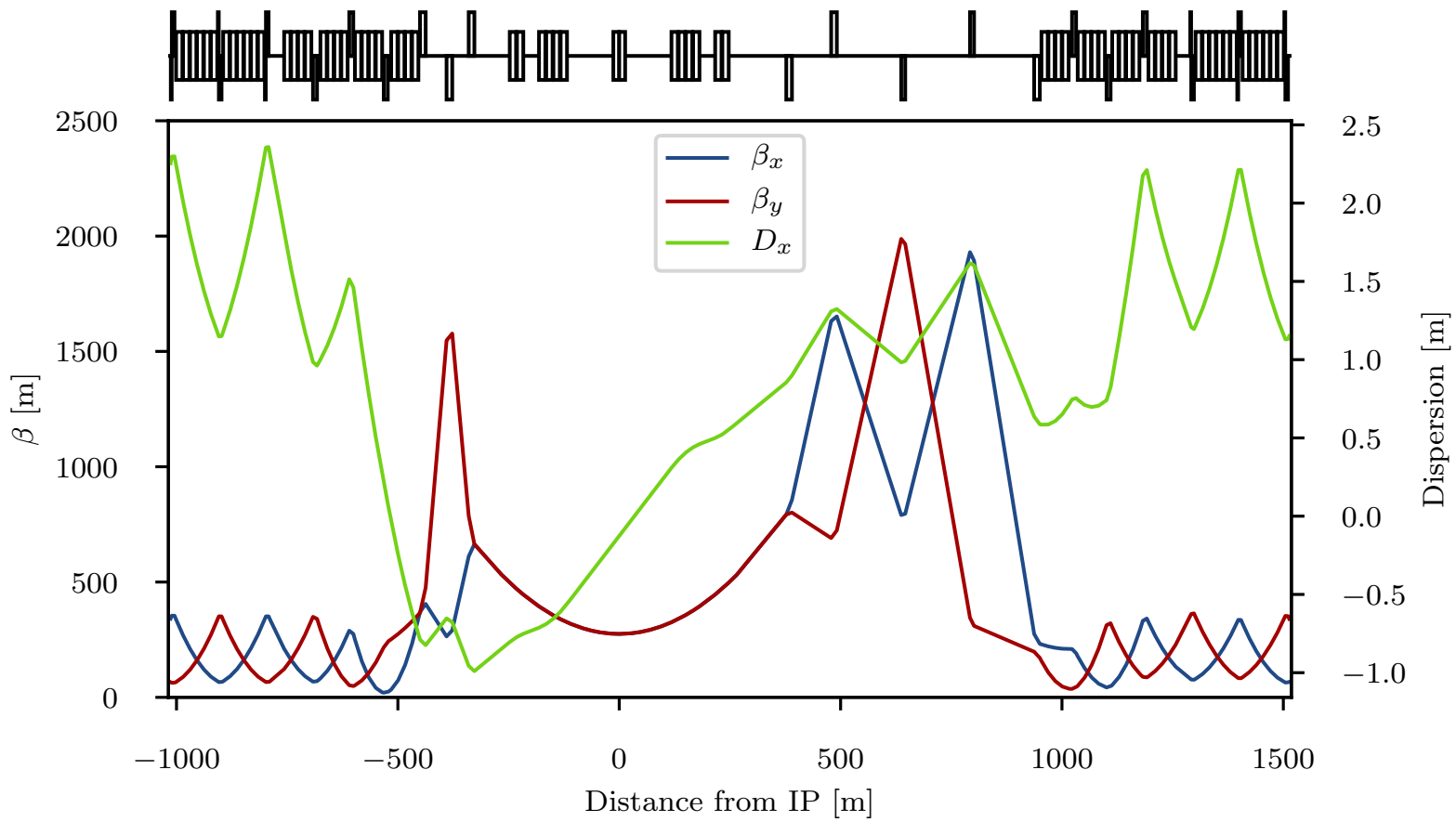


Beam optics: colliding beam



- Collision optics: few constraints coming from injection section $\Rightarrow$ used as additional matching quadrupoles on one side of IP
- Injection optics: provide correct optics at injection section and somehow "fiddle" beam through IR optics
- Phase advance in current optics not matched / not constant from injection to collision optics

Beam optics: non-colliding beam



- Drift space of 700 m results in large β functions in adjacent quadrupoles $\Rightarrow$ limited optical flexibility
- Injection of non-colliding beam looks actually harder to implement

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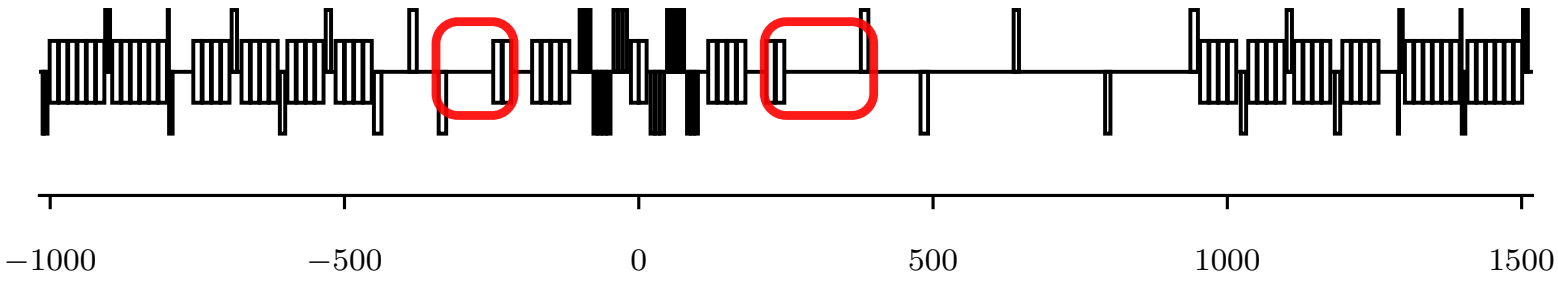

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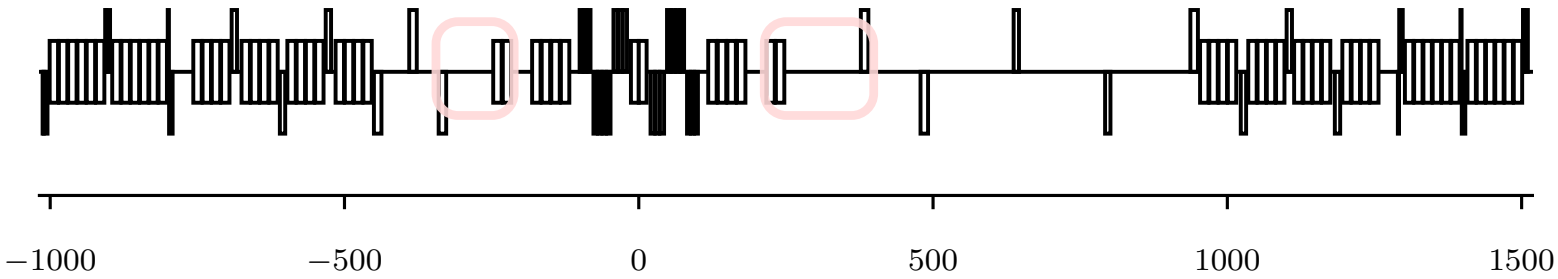

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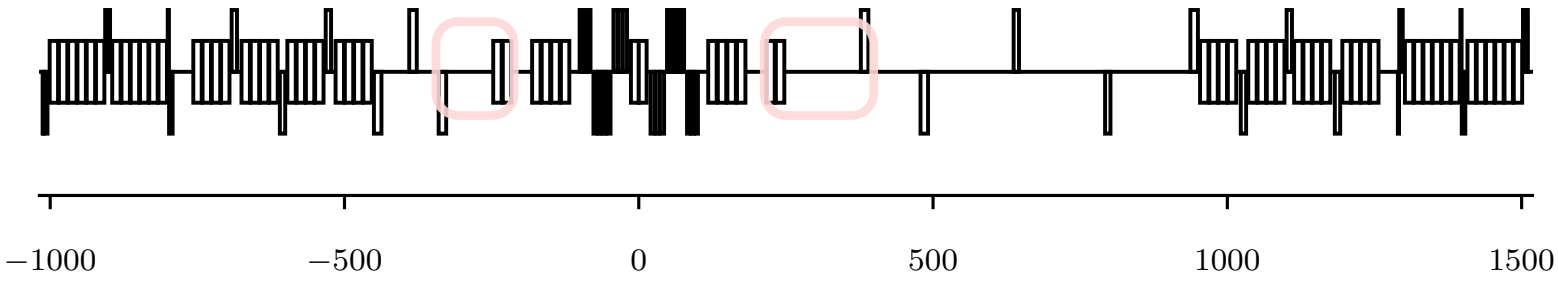

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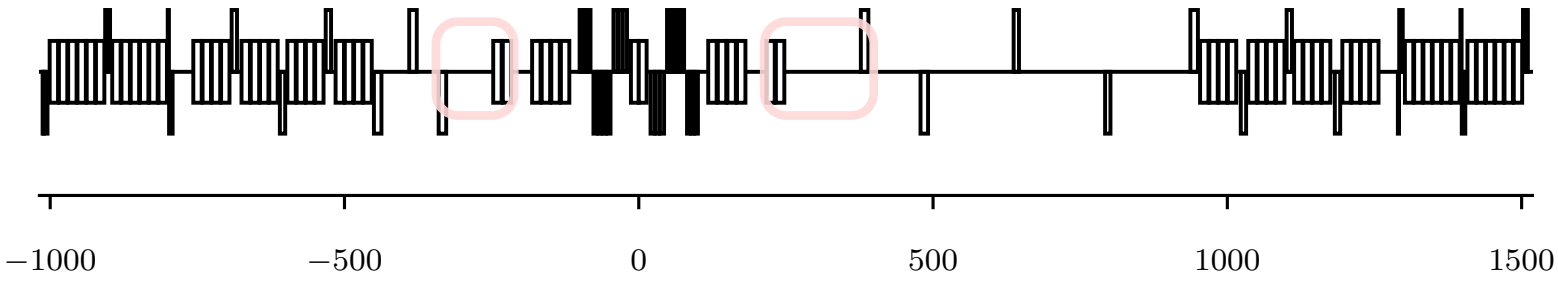

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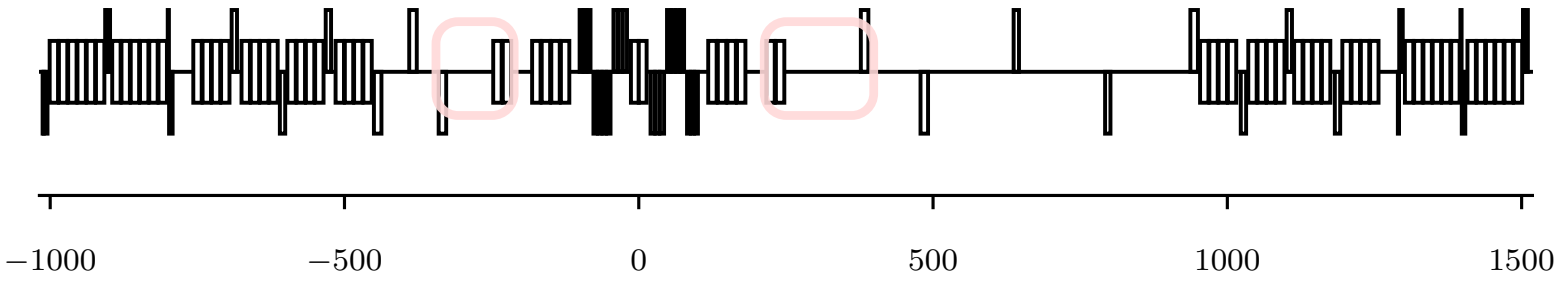

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- Chromaticity correction?