Interaction region developments

R. Martin

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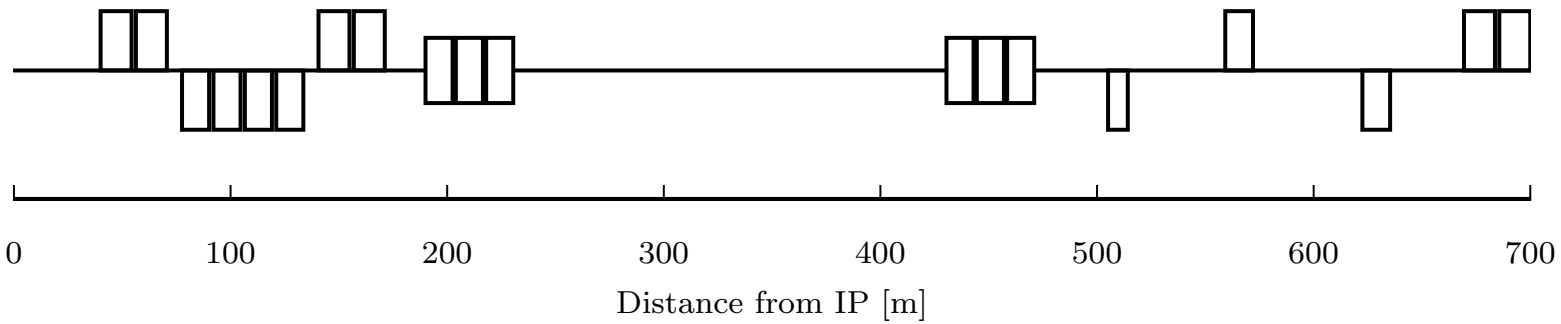
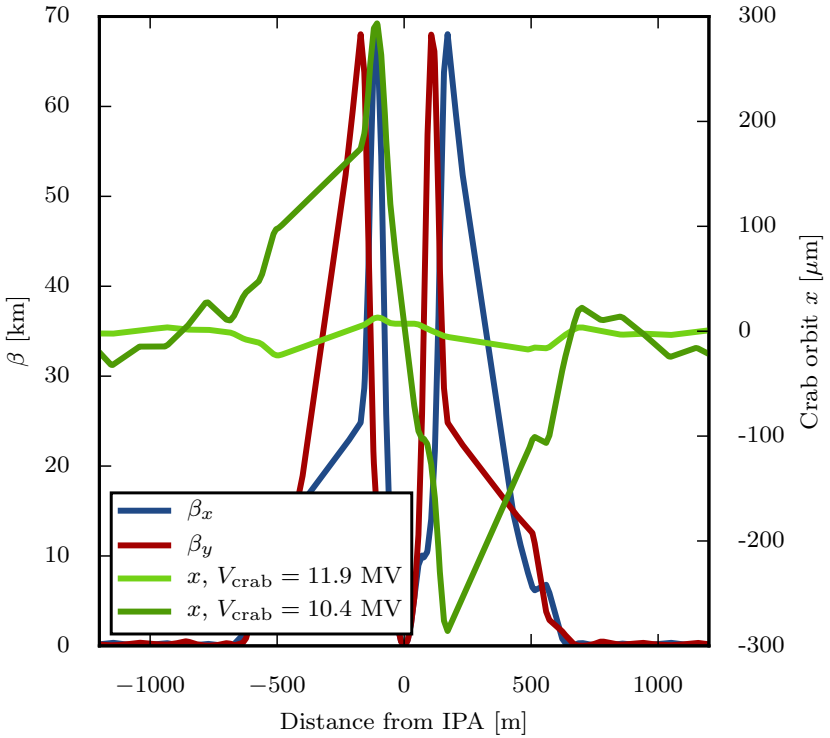
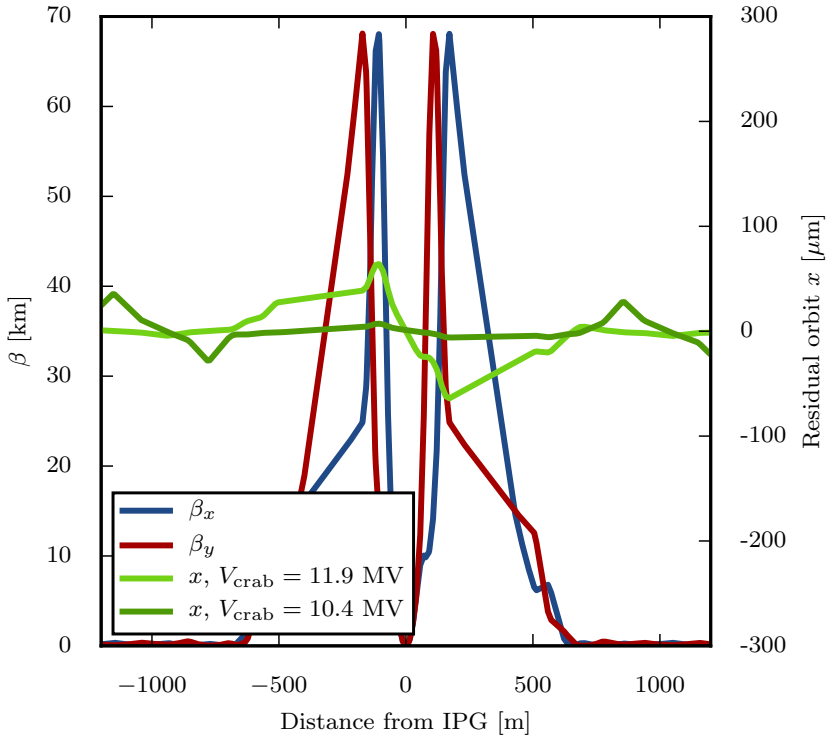
New IR Lattice: $L^* = 40\,\text{m}$

- After FCC week in Berlin L^* of the main IR was reduced from 45 m to 40 m in accordance with the detector group
- Most significant changes:
  - $L^* = 40\,\text{m}$
  - Total IR length is now 1400 m
  - Maximum length of individual triplet quadrupoles was reduced to 14.3 m
  - Separation and recombination dipoles are normal conducti



Crab cavities: Voltage

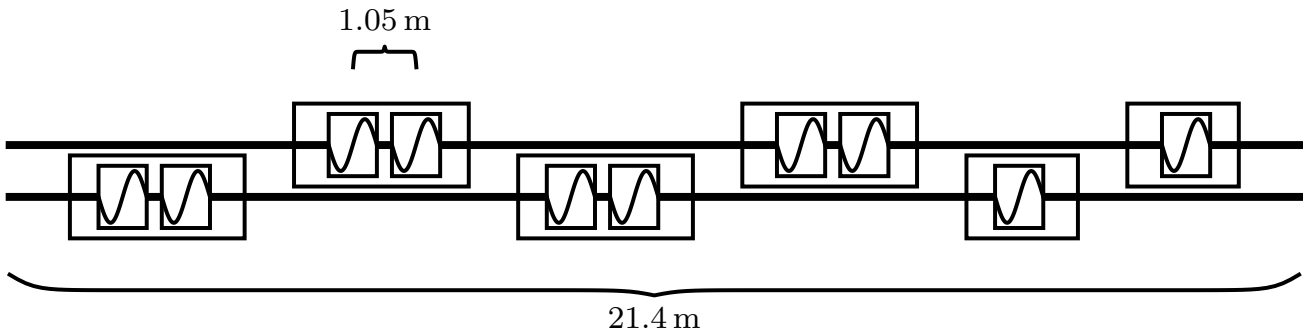




- Voltages for $\beta^* = 0.3\,\mathrm{m}$: crab orbits found for $V_{\mathrm{crab}} = 10.4\,\mathrm{MV}$ to $11.9\,\mathrm{MV}$
- Varying degrees of orbit leakage:
  - $\approx$ 1% h-crabbing in IPG for 11.9 MV
  - $\approx$ 14% h-crabbing in IPG for 10.4 MV
- Optimum to be found

Crab cavities: Beyond “Ultimate”

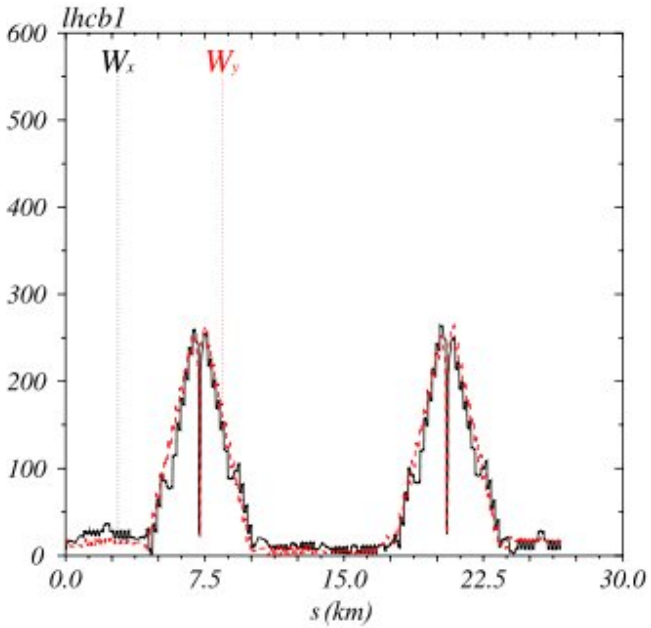
- Similarly, Crab voltages found for $\beta^* = 0.15\,\text{m}$: $V_{\text{crab}} = 15.9\,\text{MV}$ to $18.5\,\text{MV}$
- Extrapolation to $\beta^* = 0.1\,\text{m}$: $V_{\text{crab}} = 19.5\,\text{MV}$ to $22.7\,\text{MV}$
- Question: full crabbing at $\beta^* = 0.1\,\text{m}$ really important? $\Rightarrow$ probably not



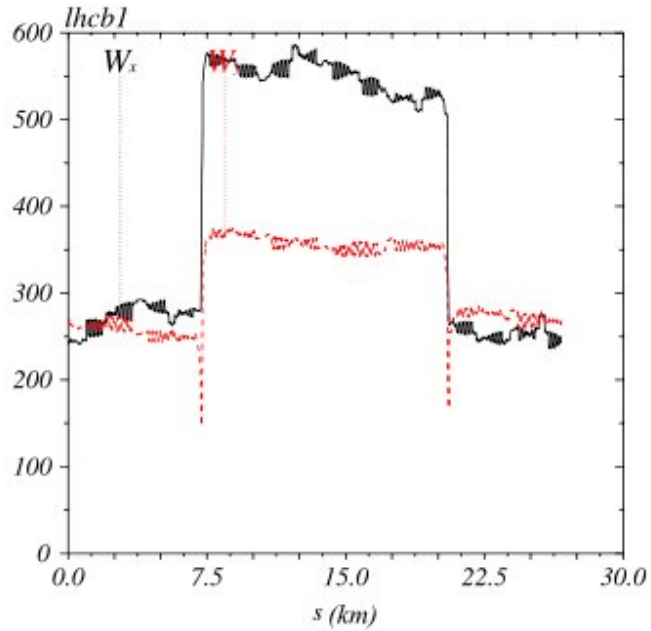
- Initial guess of $\approx 22\,\text{m}$ space for crab cavities
- With lengths from HL-LHC lattice, we can fit in 5 cavities per beam per side
- Probably more with 3 or more CCs per cryostat
- Enough for $\approx 18.5\,\text{MV}$?

Chromatic β beating

- Collimation studies by J. Molson show significant losses around IPG
- First analysis suggest chromatic β beating to be the reason
- $\Rightarrow$ try to reduce chromatic β beating, i.e. Montague functions
- 1. Option: HL-LHC-like sextupole scheme with 2 strong and 2 weak families per plane



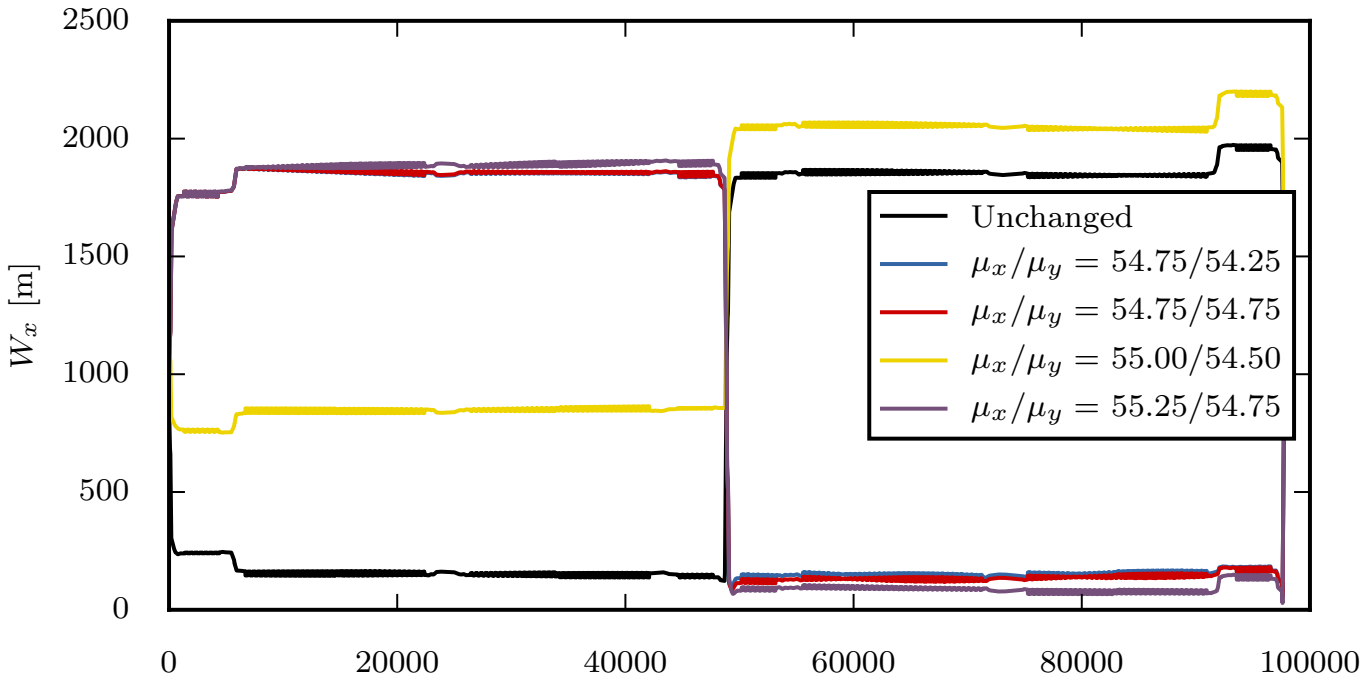
(c): $W_{x,y}(s)$ (pre-squeezed ATS optics)



(d): $W_{x,y}(s)$ (nominal-like LHC optics)

Chromatic β beating: Correction

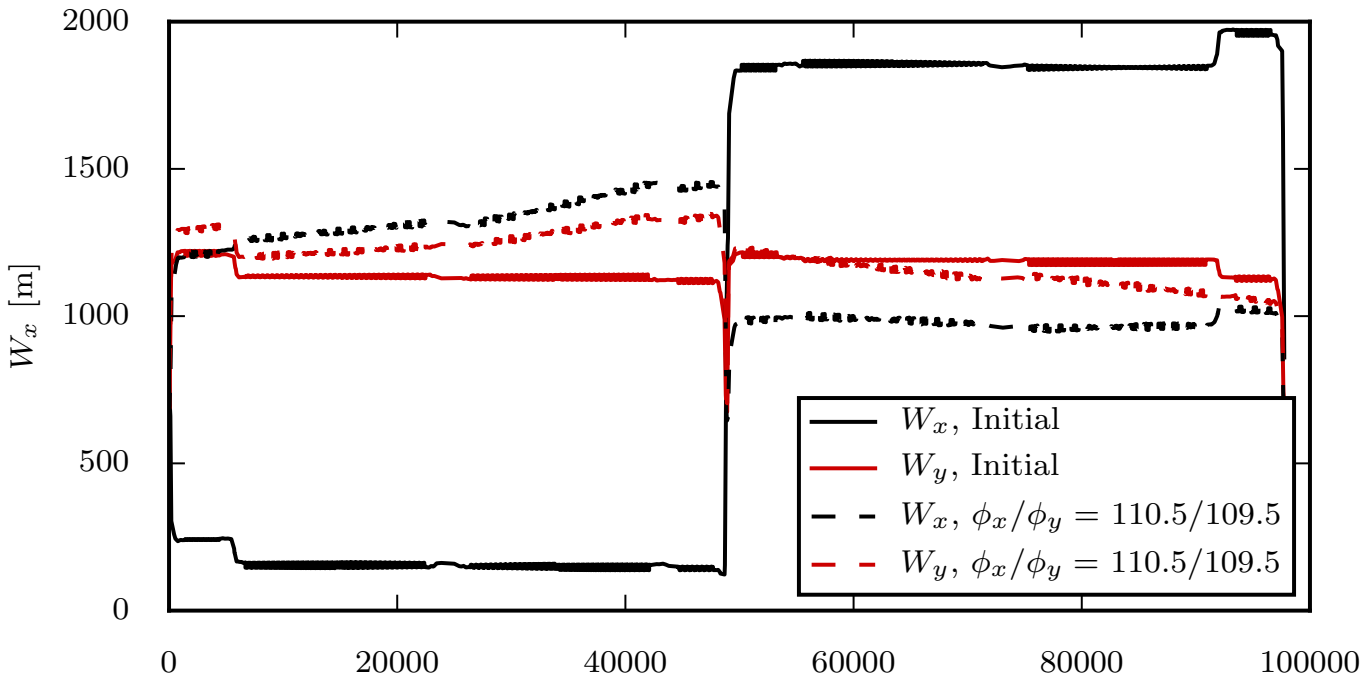
- First trials showed: Sextupole strengths increased by **factor up to 10** $\Rightarrow$ **impossible** with current cells
- Alternative suggestion: Match phase advance between IPs to $\pi/2$ to get cancelation



- **Didn't improve**

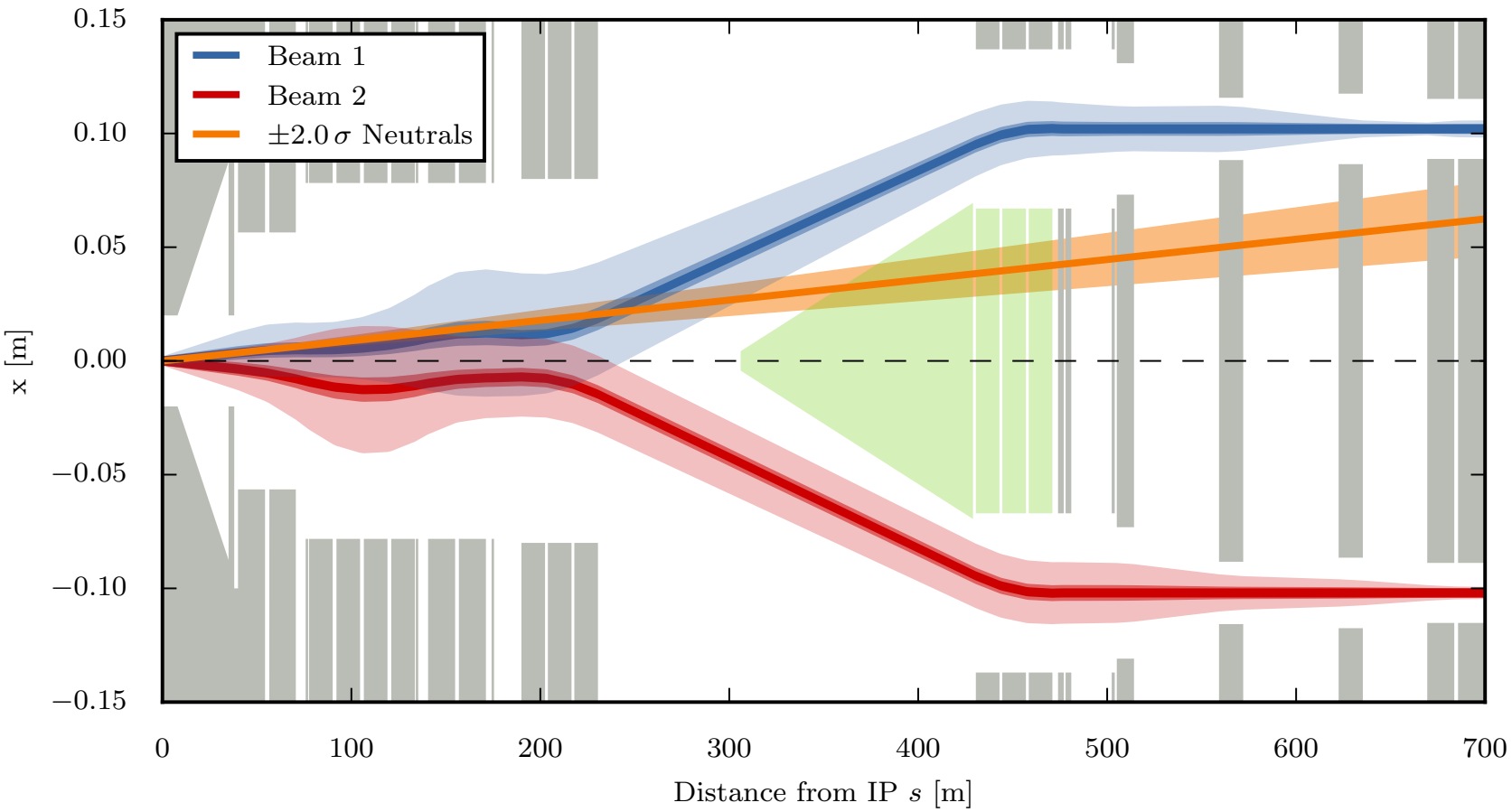
Alternative approach

- Instead of betatron phase advances μ_x/μ_y, match Montague phases ϕ_x/ϕ_y between IPs to π
- Upside: can match both from IPA to IPG and IPG to IPA



- Space for improvement, but $W_{x,\text{max}}$ decreased by 25 %
- Downside: matching chromatic variables with quadrupoles, can't match tunes $\Rightarrow$ try using sextupoles instead $\Rightarrow$ no success yet

TAN



- Looked into space for TAN for the FLUKA studies extending up to D2
- β^* below 0.2 m might become problematic