Adjusting Dispersion at injection in the LHC using orbit correctors (Beam 1–IR2)

Idea:

- Seeking for more flexibility concerning optics parameters during injection process.
- Keep emittance blow-up due to dispersion mismatch low at injection.
- Match optics (dispersion) at injection point in the LHC to transfer line (TI2) optics (or vice versa).

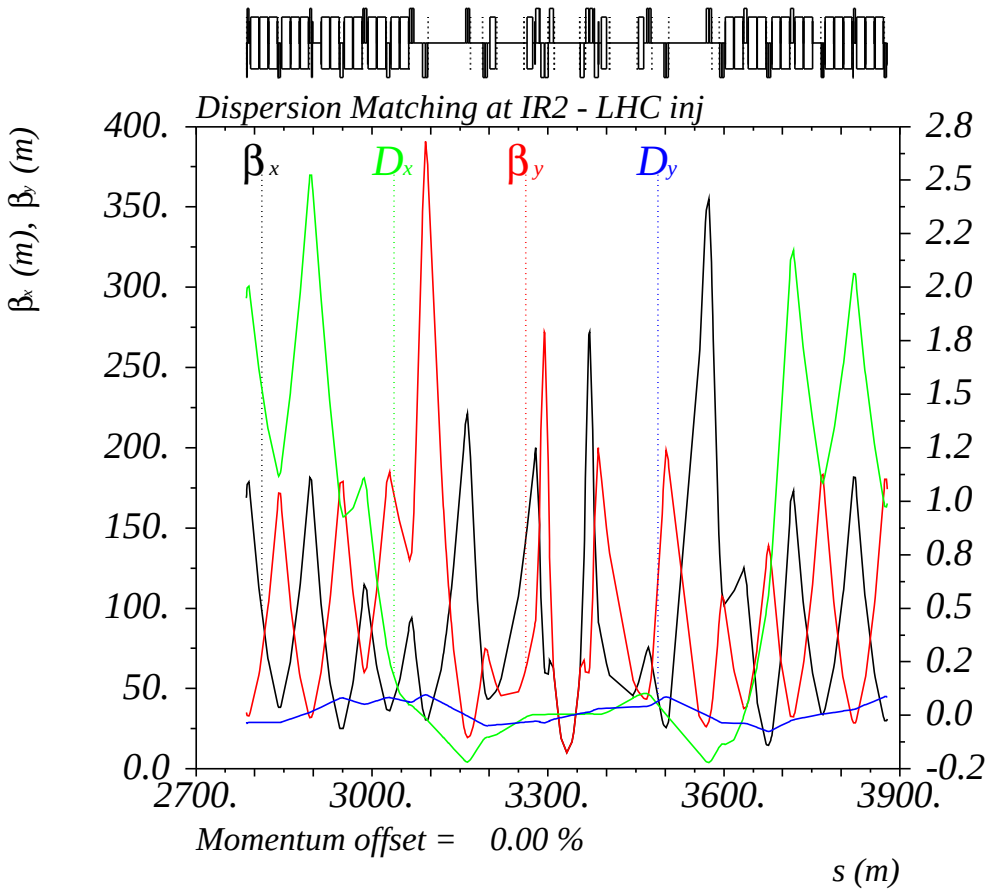
Procedure to change dispersion at injection point:

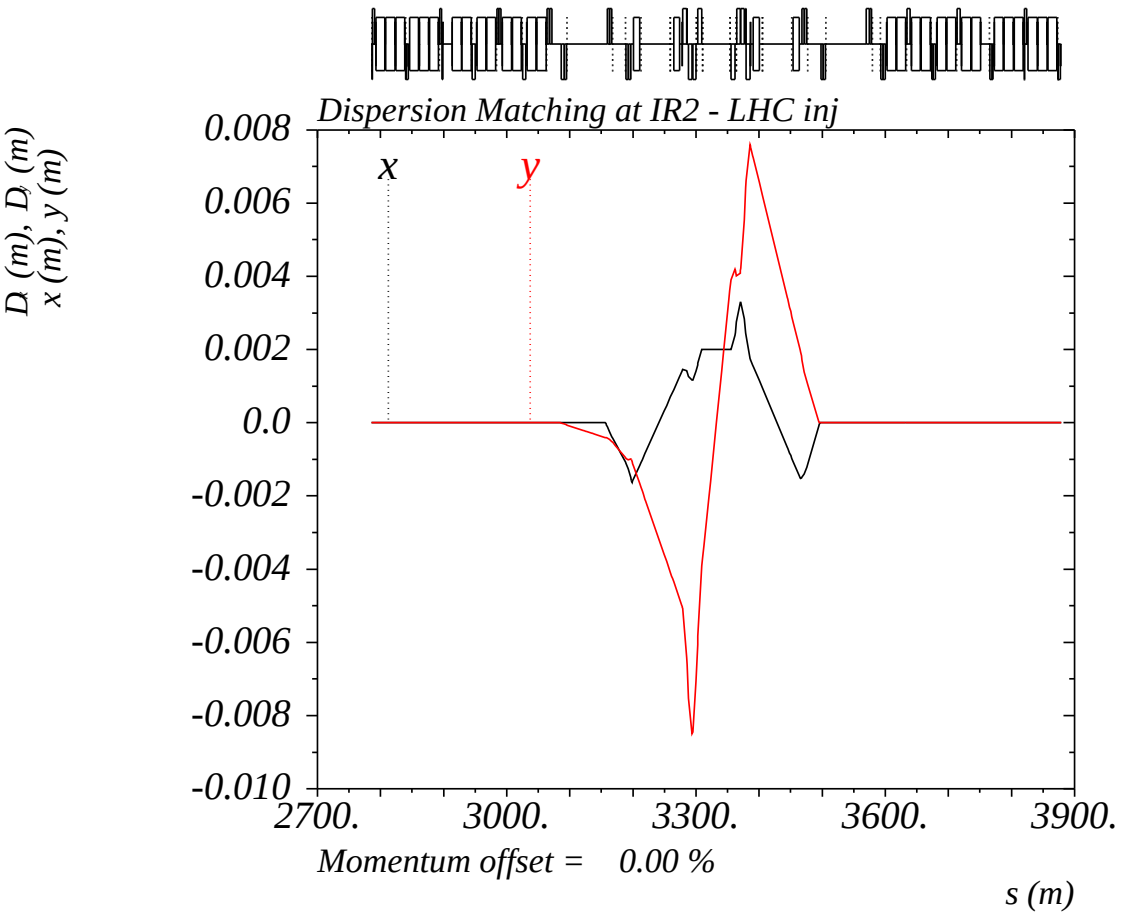
- Use "free" available orbit correctors in IR2:
  MCBH.13L2.B1, MCBH.11L2.B1, MCBCH.9L2.B1, (MCBCH.7L2.B1)
  MCBH.12R2.B1, MCBCH.10R2.B1, MCBCH.8R2.B1, (MCBCH.6R2.B1)
  All other orbit correctors in IR2 are used for separation and crossing.
- Create closed orbit bumps to generate horizontal dispersion wave.
- Use 2 closed orbit bumps (horizontal) to create local dispersion wave.

IR2 optics V6.5

Several constraints:

- Separation + crossing
  (this scheme is foreseen to be used for injection also)
- Aperture, phase advance (injection point – collimators), . . .

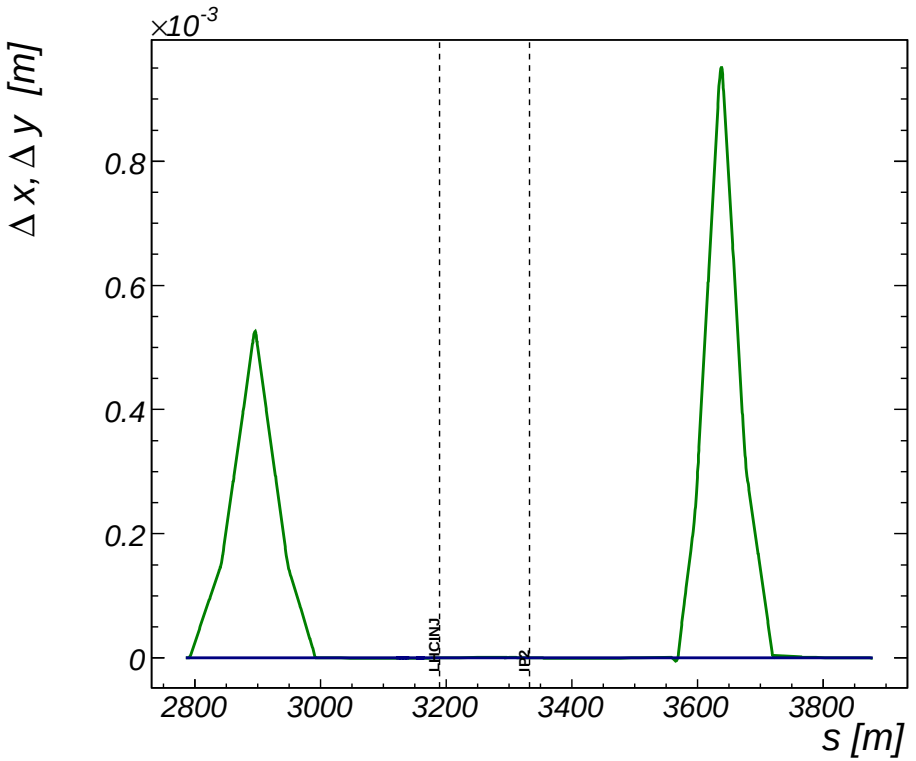




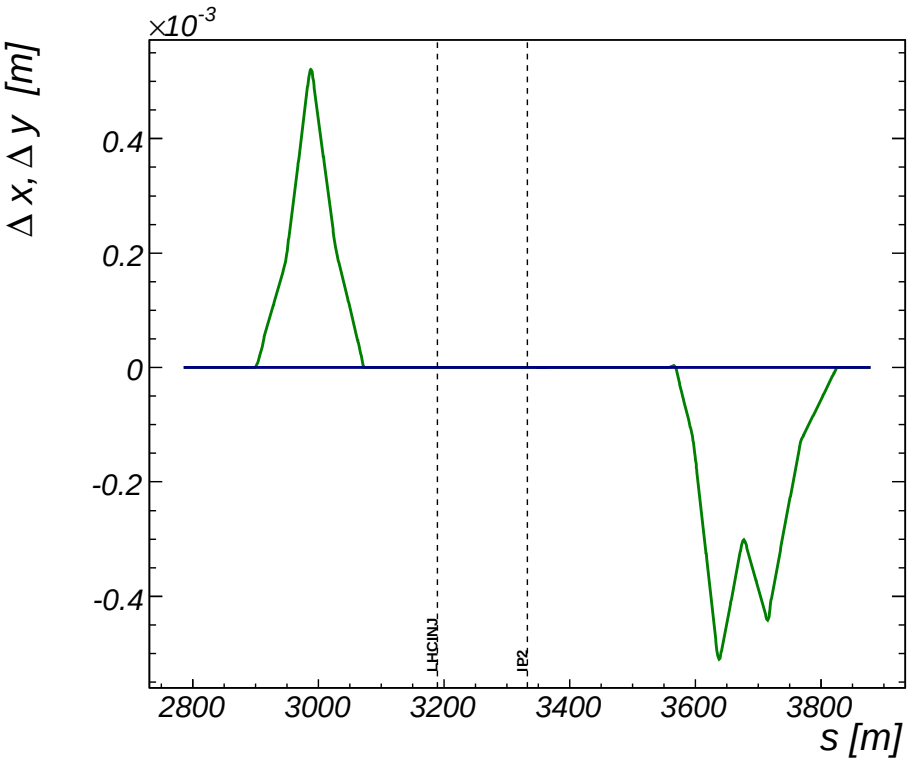
Orbit bumps - antisymmetric and symmetric!

Difference plot: new orbit - standard orbit

Symmetric



Anti-Symmetric

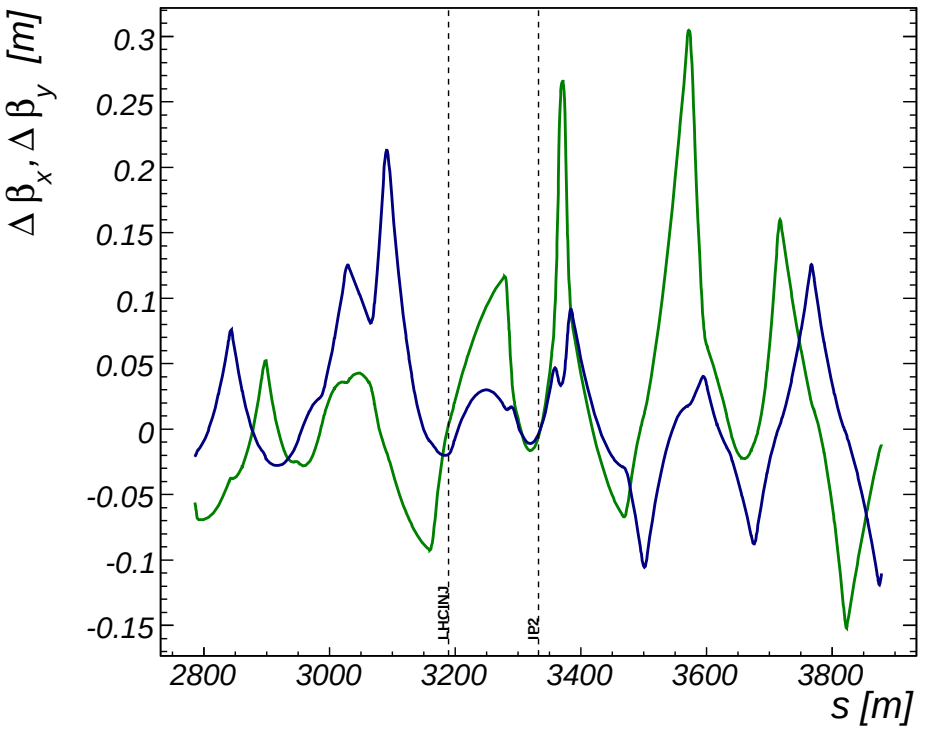


Antisymmetric bump is preferred because of less magnitude.
The dashed line near $s = 3200$ marks the Injection Point, the other line IP2.

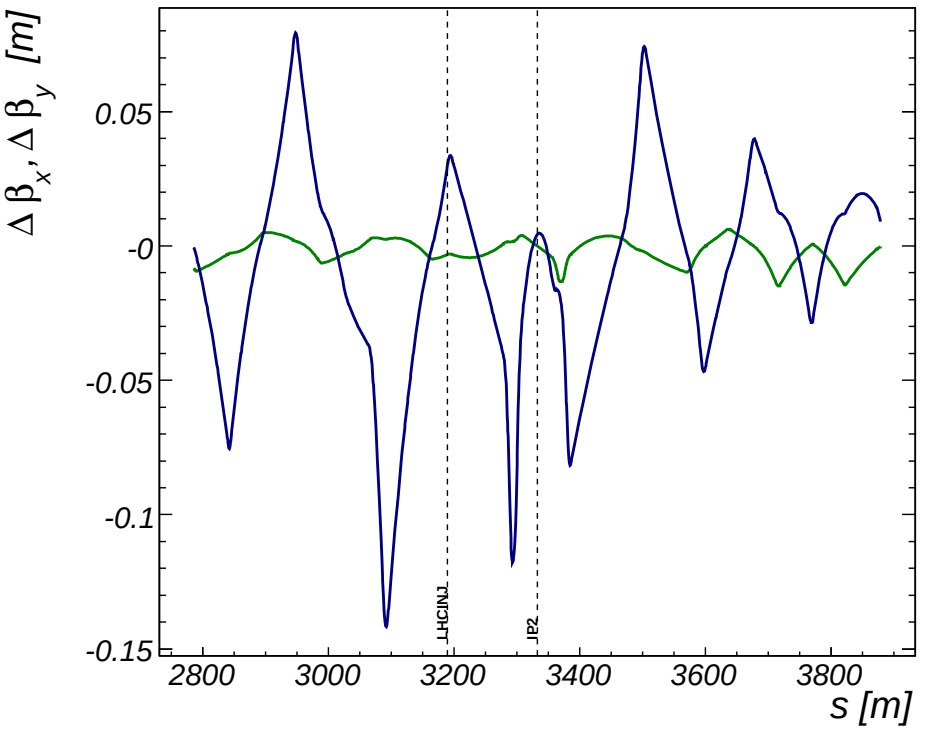
Beta function

Difference plot: new betas - standard betas

Symmetric



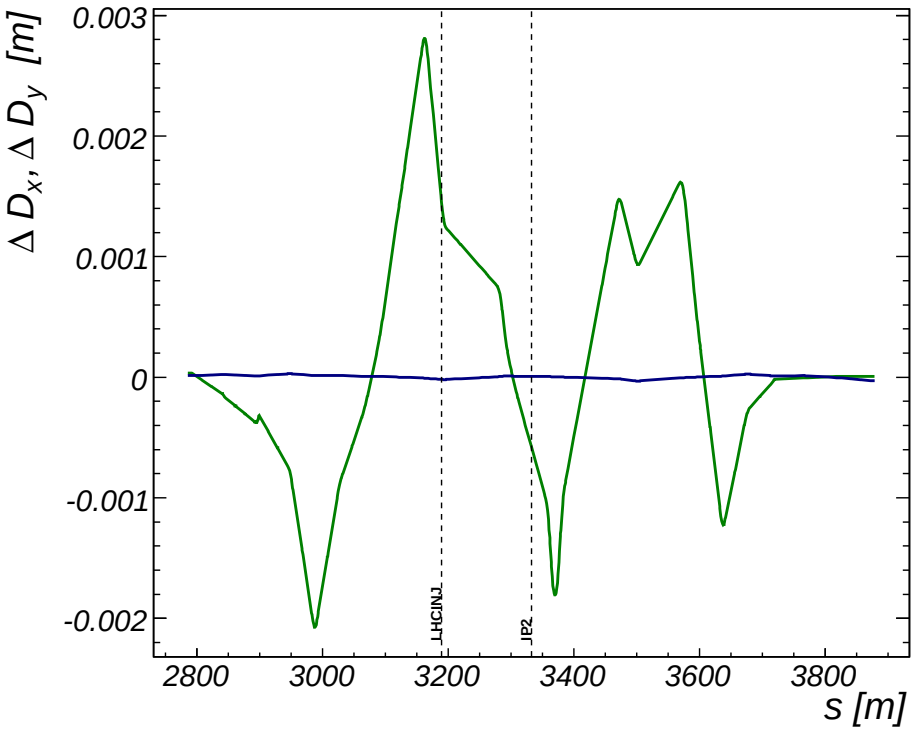
Anti-Symmetric



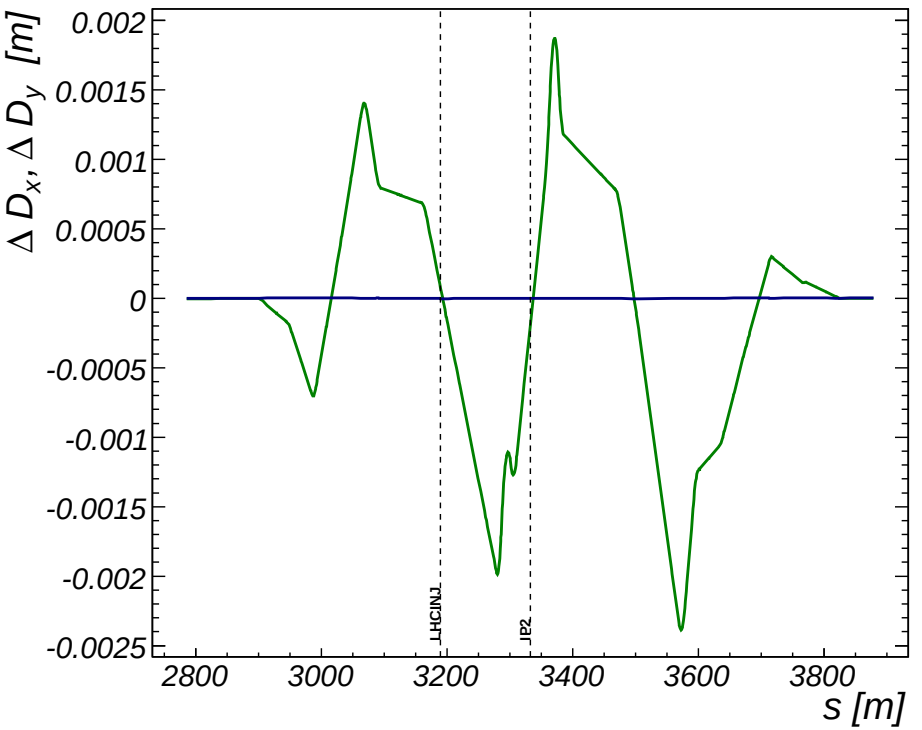
Dispersion bumps

Difference plot: new dispersion - standard dispersion

Symmetric



Anti-Symmetric



Adjusting Dispersion at injection
Conclusions so far

- Closed dispersion bumps/waves can be created using 2 closed orbit bumps. Those can be either symmetric or anti-symmetric.
- *Anti-symmetric solution:*
  The two closed orbit bumps have equal magnitude. The generated dispersion wave has zero-crossings at the injection point and the IP, hence no dispersion produced at the desired place.
- *Symmetric solution:*
  The second orbit bump to close the dispersion wave needs roughly twice the magnitude of the first one. The generated dispersion wave has some non-zero value at the injection point and the IP, however magnitudes are very small.
- 1 mm orbit bump gives roughly 1 mm dispersion at injection point.
- Creating dispersion values in the order of 10 cm is *NOT feasible* using this scheme.