Beam-Beam and chromaticity: first considerations

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• Train Code used
• LHC case
• Long Ranges effects:
  – 1IP only
  – 2 Ips with alternating crossing
• Head-on case:
  – 1IP only
  – 2 Ips synchronized
Squeeze IP1&5
LHC IP5:Qpx

Nominal LHC 1.15e11 ppb and 3.75mmum
Separa-on of 9.5 \( \sigma \)
IP5 only

Figure 36: Horizontal chromaticity variation along the batch. Horizontal-horizontal crossing in red, vertical-horizontal crossing in green.

Only 1 IP, no alternating crossing compensation \( \rightarrow \) similar behaviour could come from IP2/8 long ranges.
NO COMPENSATION!

Shift of Chroma 1-2 units and spread of maximum 1 unit
Can be different for the two beams

To be understood and measured
LHC IP5: Qpy

Nominal LHC 1.15e11 ppb and 3.75mum
Separation of 9.5 $\sigma$
IP5 only

Figure 37: Vertical chromaticity variation along the batch. Horizontal-horizontal crossing in red, vertical-horizontal crossing in green.

Only 1 IP, no alternating crossing compensation $\rightarrow$ similar behaviour could come from IP2/8 long ranges.
NO COMPENSATION!

Shift of Chroma 1-2 units and spread of maximum 1 unit
Can be different for the two beams and have different directions H and V.

To be understood and measured
Alternating crossing

Figure 30: Horizontal tune variation along the batch. Horizontal-horizontal crossing in red, vertical-horizontal crossing in green.

No differences but COMPENSATION should be expected:
This can be deteriorated by:
Emittance fluctuations
Intensity fluctuations
Different betas*
Adjust beam process

- Collapse separation bumps
- Reduce octupole currents
- Reduce Chromaticity (second half year)

Collapsing IP1 separation bump without beam-beam

Chromaticity without beam-beam

$Q' = 2$ units horizontal and vertical

![Graph showing Q' units vs. half separation](image)
IP1 only collapse

H separation collapsed in steps and Chroma recomputed with Head-on BB only in IP1

Other IPs crossing angle off, all separated!
IP1 and IP5 synchronously

IP2 and IP8 crossing angle off

IP2 and IP8 crossing angle on

Chroma trims are settled with single beams: this effect is not compensated!
Can one think of feed-forward correction based on models?
On-going:

Adjust Beam Process:
• Add octupoles trims during adjust
• Check differences between adjust beam process of 2012 run (i.e. IP8 tilting, asynchronous closure of bumps crossing and sep plane... etc)
• Check impact of octupole polarity change

Stable Beams:
• Check impact on chromaticity during stable beams (special attention IP8 bunches)

Squeeze:
• Add to modeling long-range encounters and reproduce squeeze changes (emittance/intensity fluctuations betabeating any other possible asymmetry → IP2&IP8 (no compensation))