Squeeze of the crossing scheme in IR1 & IR5

- X-angle, parallel separation and IP shift versus β^*
- Set-points for the orbit correctors
- Beam excursion during the squeeze

X-angle, parallel sep. and IP shift versus β^* (1/3)

- **Starting point:**
  - End of ramp (7TeV)
  - Injection optics → Injection tune, $\beta^* = 17$ m
  - Crossing angle reduced by a factor of 4 w.r.t. to injection (same b-b separation in the triplets in terms of σ compared to injection, triplet aperture still protected with the injection setting of the collimators)

    → $\alpha_{x,y} / 2 = 40$ μrad (half-crossing angle)
  - Parallel separation set to the pre-collision setting

    → $\delta_{y,x} /2 = 0.5$ mm (half-parallel separation)
  - IP shift in the crossing plane to symmetrize the left/right peak orbit excursion

    → $s_{x,y} = 0.15$ mm

→ n1 ~ 28 in the triplet

→ B-b separation > 11 σ (big contribution from the parallel sep.)

→ X-angle could be reduced by 60% to get 9.5 σ b-b separation

X-angle, parallel sep. and IP shift versus β^* (2/3)

- **Strategy of the squeeze**
  - Parallel separation kept constant: $\delta_{x,y}(\beta^*) = cst = 1\ \mathrm{mm}$
  - Scaling of the X-angles
    - With $1/\sqrt{\beta^*}$
    - While reducing the initial margin of 60%
      - Very smoothly at the beginning of squeeze to keep safety margin in terms of beam-beam separation.
      - More rapidely at the end of the squeeze to avoid saturating the triplet aperture.

$$\alpha_{x,y}(\beta^*) = \alpha_{col} \times \sqrt{\beta^*_{col}/\beta^*} \times \left[1 + m\left(\frac{\beta^* - \beta^*_{col}}{\beta^*_{inj} - \beta^*_{col}}\right)^r\right]$$

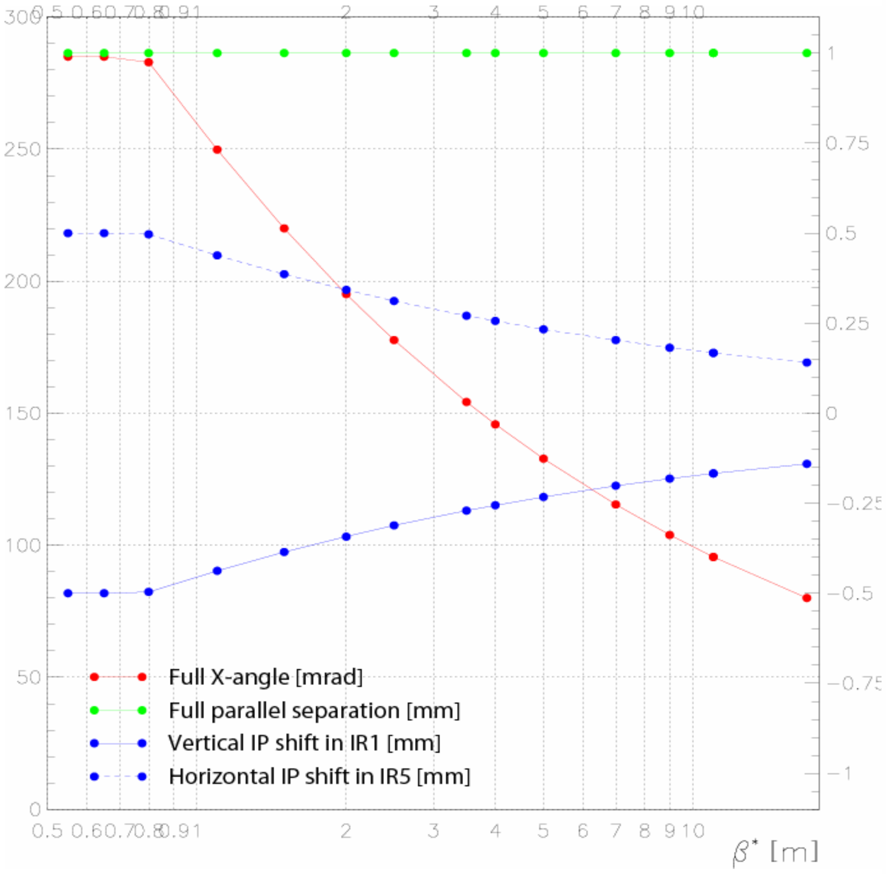
→ With α_{col}= 285 μrad, the full X-angle in collision

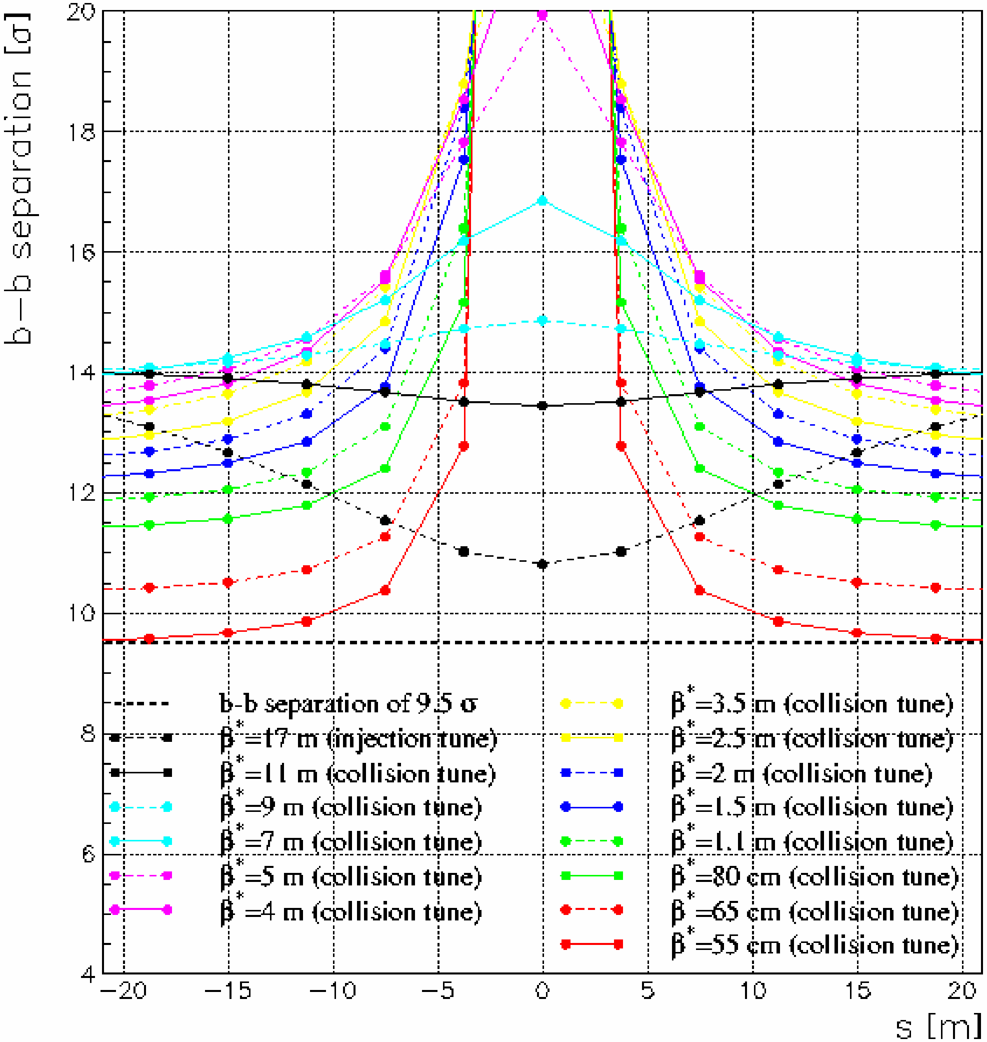
→ With m the initial margin of about 60 % in the X-angle (m = 0.5606)

→ r = 0.37 for a "good compromise" between b-b separation and aperture during the squeeze … but other options possible!!

  - Scaling law for the IP shift: $s_{x,y}(\beta^*) = 0.5\ \mathrm{mm} \times \alpha_{x,y}(\beta^*)/\alpha_{col}$

X-angle, parallel sep. and IP shift versus β* (3/3)





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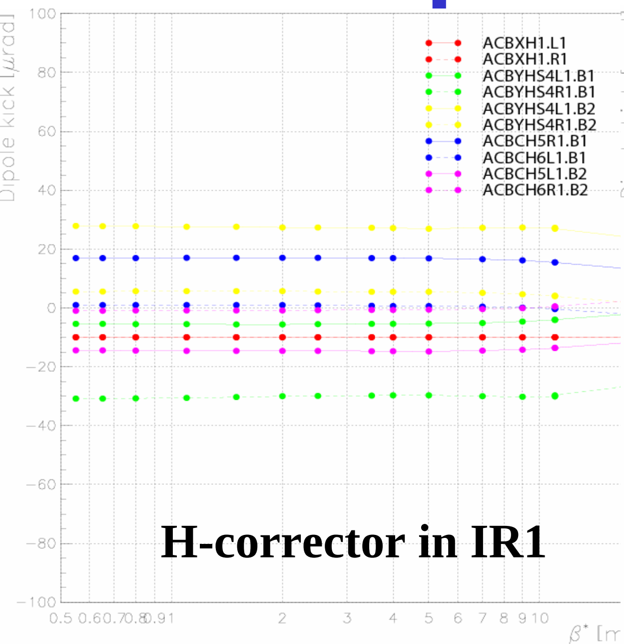
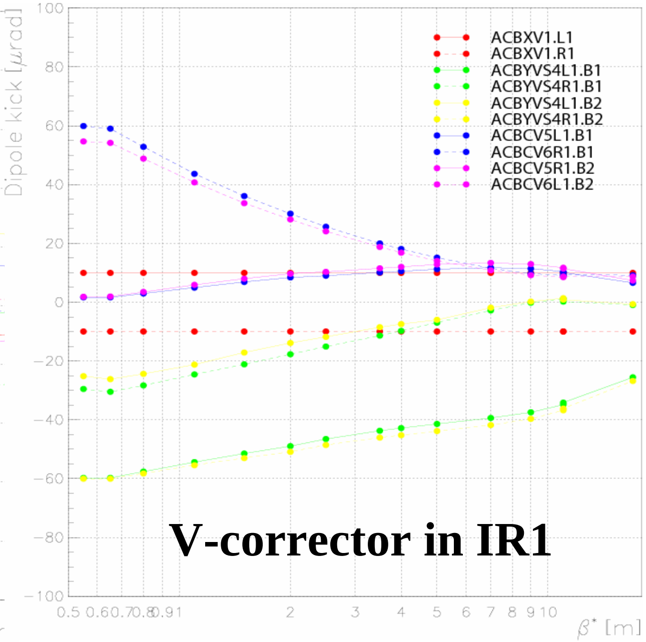
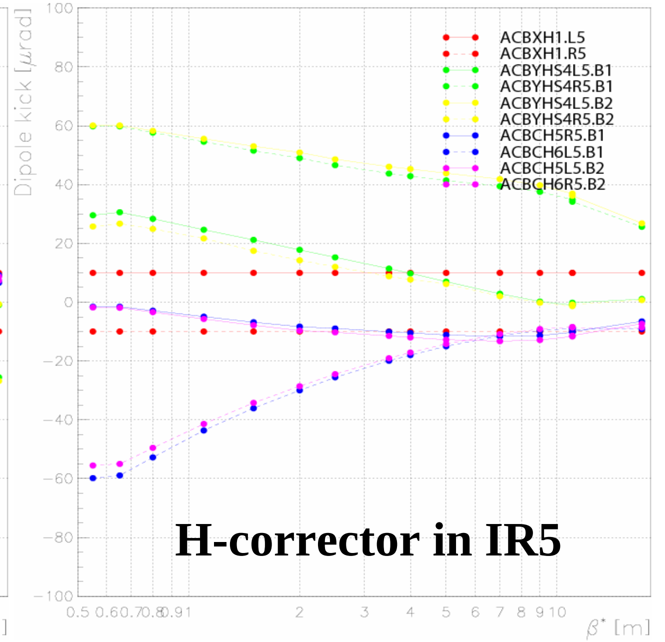
Set-points for the orbit correctors



H-corrector in IR1



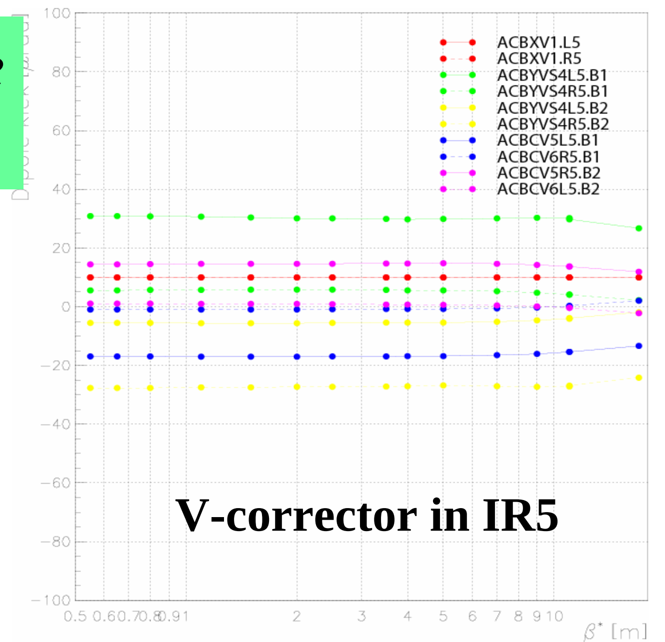
V-corrector in IR1



H-corrector in IR5

Strategy: *keeping constant the excitation of the H and V corrector at Q1*

- → Squeeze almost flat in the plane of the parallel separation (V in IR1, H in IR5)
- → Very Smooth in the crossing plane with
  - → ~ 80% margin in the MCBX strength (at Q1)
  - → ~ 40% (or more) margin in the MCBC (at Q5/Q6)
  - → ~ 40% (or more) margin in the special MCBY (at Q4)



V-corrector in IR5

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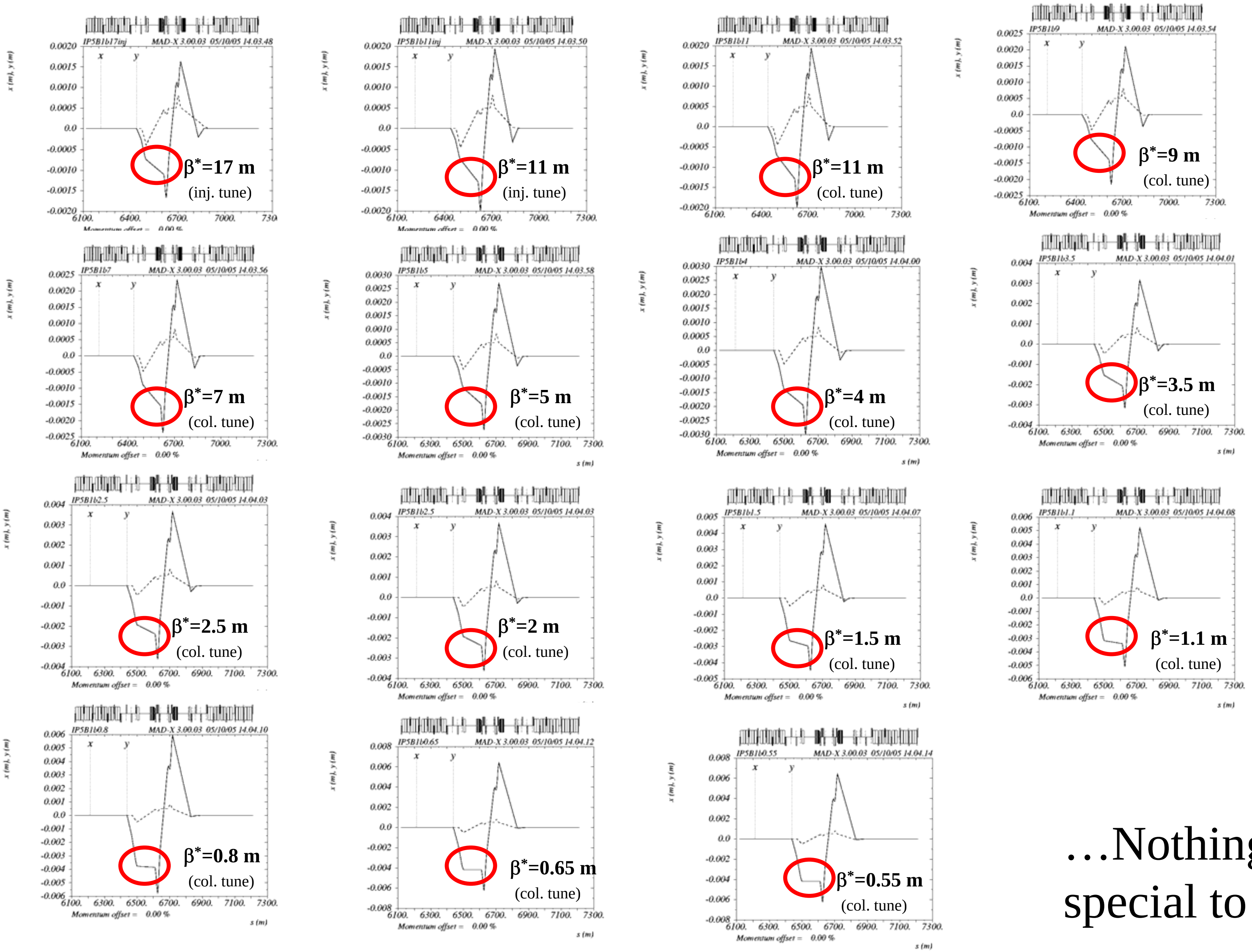
Beam excursion during the squeeze



…Nothing really special to signal

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