

# Prospects for a 'Phase Trombone'

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- Ⓢ Further suppression of betatron motion driven asymmetries
- Ⓢ 'Phase Trombone'
  - ⌘ betatron phase 'sweep' in search of a 'node' (at the target)
  - ⌘ 'closed beta bump' insert in a non dispersive region
  - ⌘ independent control in the horizontal and vertical planes
- Ⓢ Hall A Optics implementation with five  $(2 \times 2 + 1)$  quads
- Ⓢ 'Multi knob' control software

❖ Betatron motion, beam envelope, beta-function and phase advance

- ◆ betatron function (or  $\beta$ -function)

$$a(s) = \sqrt{\varepsilon\beta(s)},$$

$a(s)$  is the beam envelope and  $\varepsilon$  is the beam emittance (geometric).

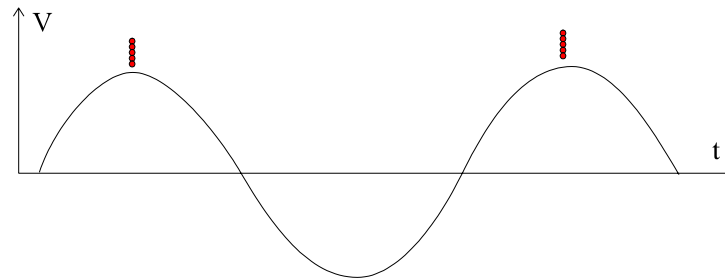
- ◆ Introducing special variables  $X$  and  $\mu$ :

$$X = \frac{x}{\sqrt{\beta}}, \quad d\mu = \frac{ds}{\beta}$$

- ◆ Then, in the new variables betatron motion will be harmonic

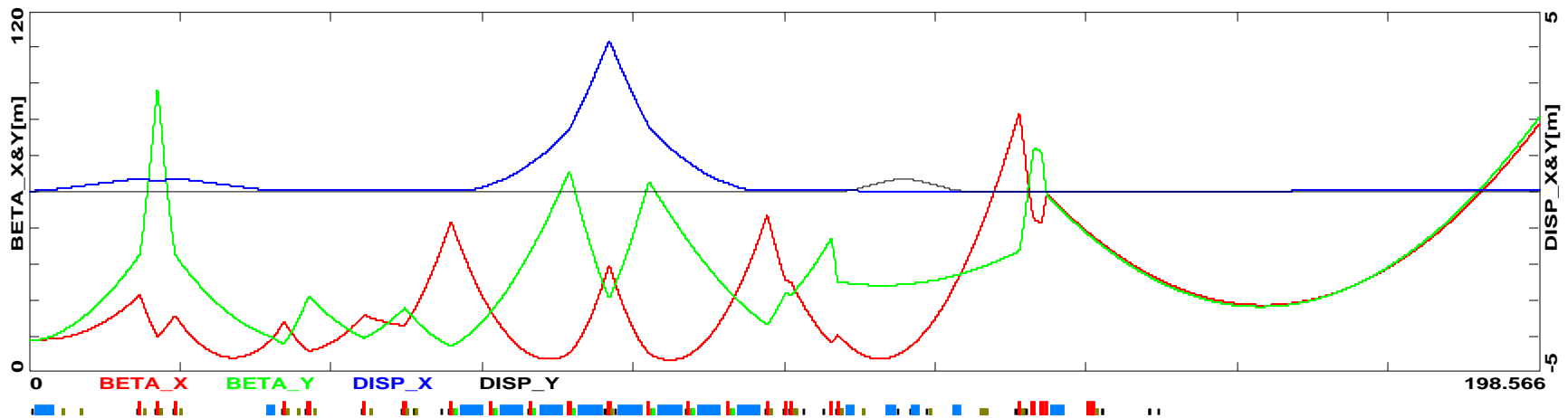
$$X(\mu) = A \cos(\mu - \mu_0),$$

$\mu$  is the betatron phase

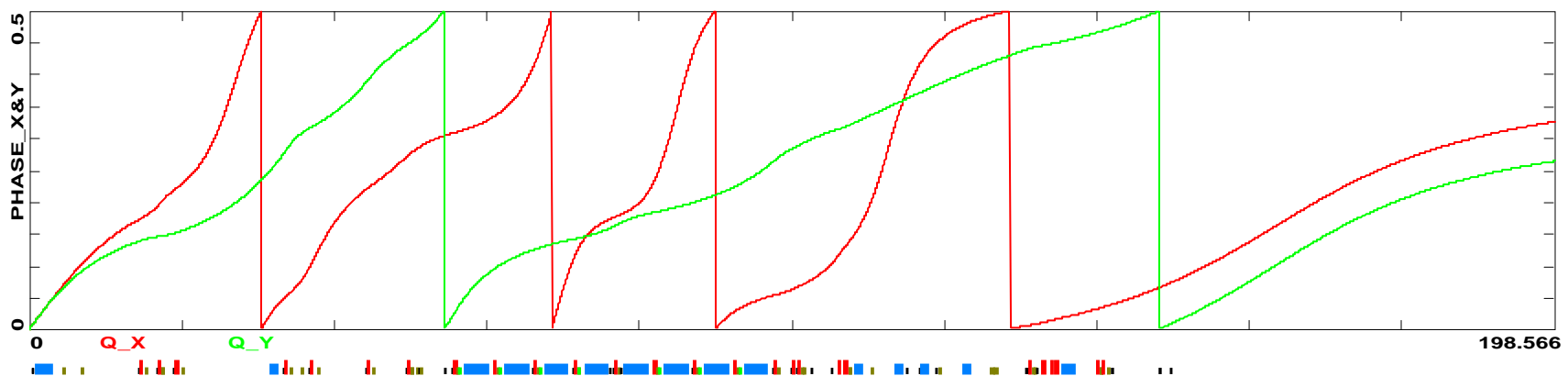


❖ Hall A Optics (betas, dispersion) – localized betatron phase control insert

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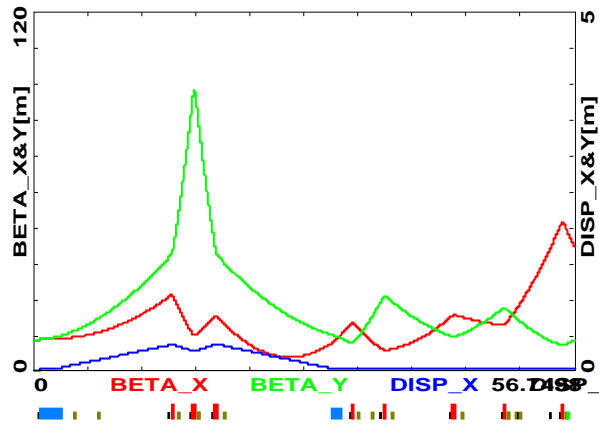


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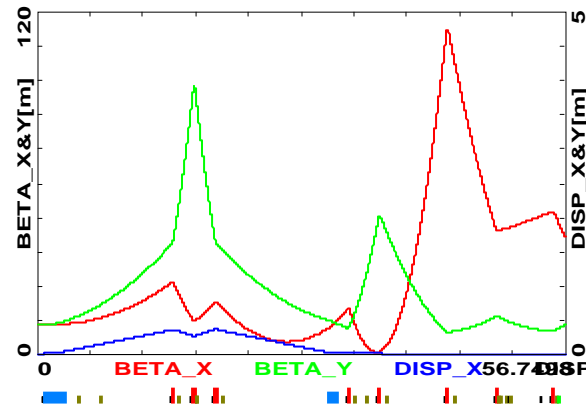


❖ Phase Trombone –  $\pm\pi/2$  sweep in the horizontal plane

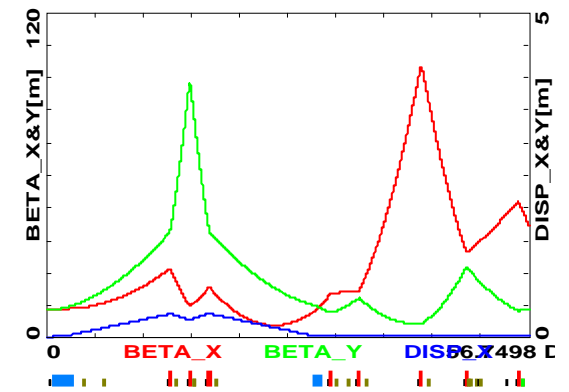
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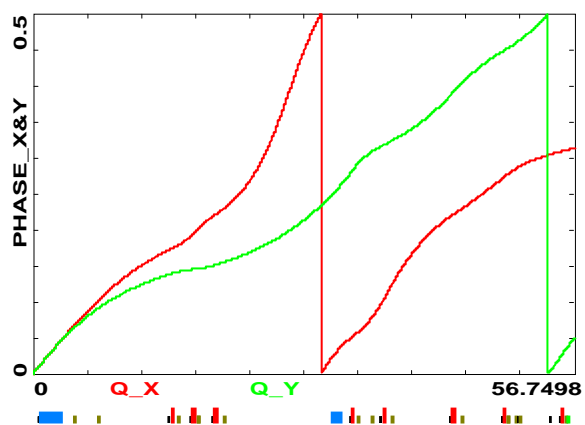
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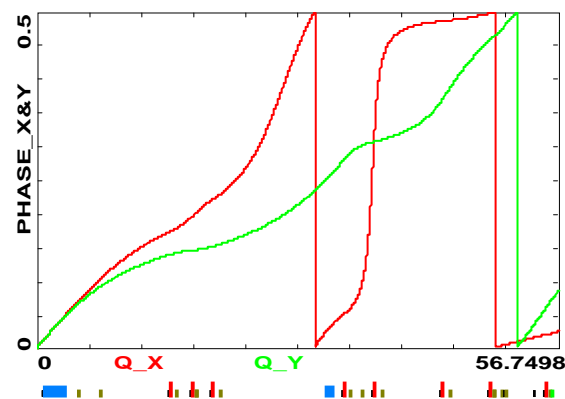
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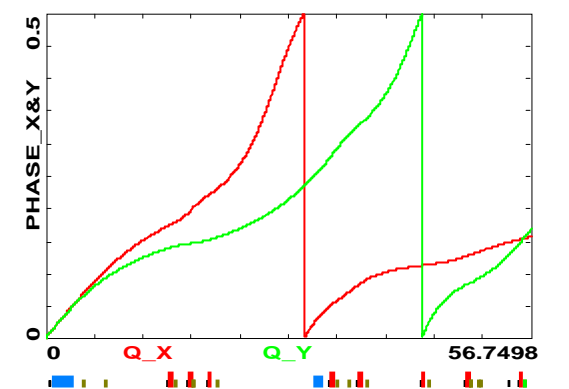
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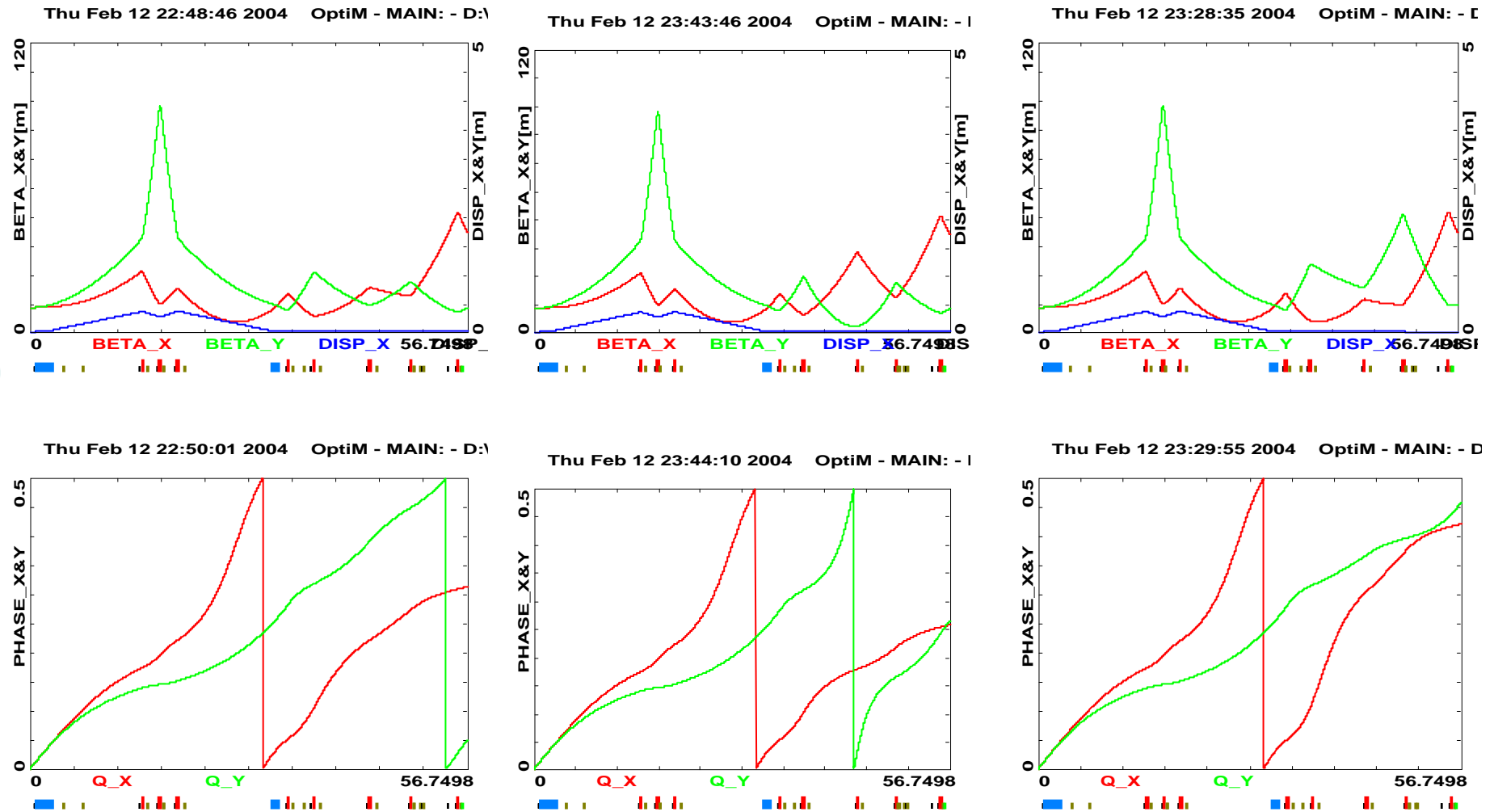
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❖ Phase Trombone –  $\pm\pi/2$  sweep in the vertical plane



## Conclusions

- Prospects for additional suppression of betatron motion driven asymmetries
- Hall A Optics has enough flexibility to 'install' a phase control 5-quad 'knob'
- Full betatron phase sweep  $\pm\pi/2$  (one plane at the time)
- Model based assessment of the 'Phase Trombone' - feasible