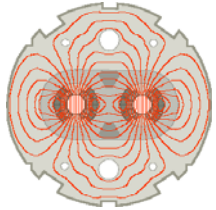
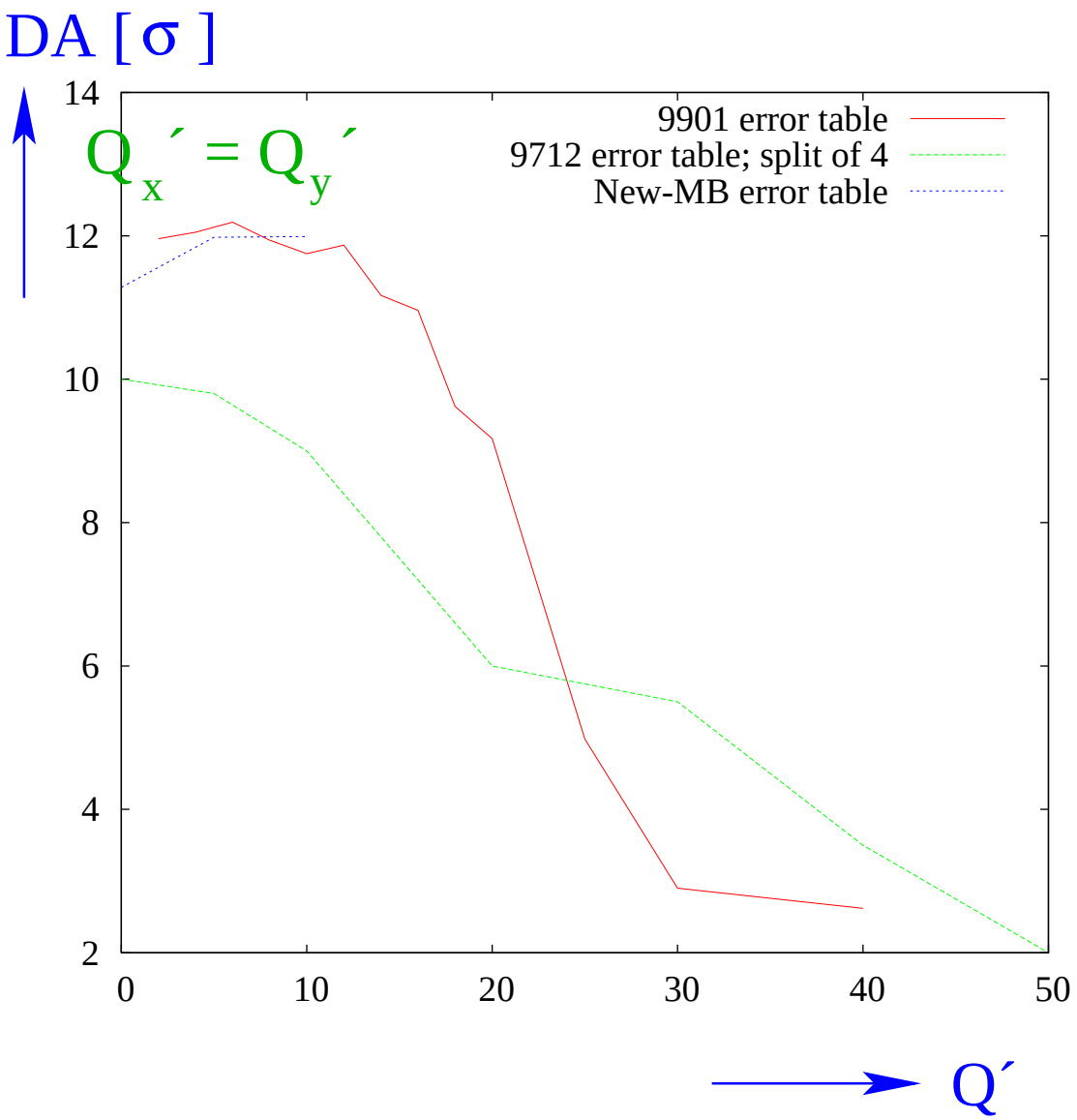
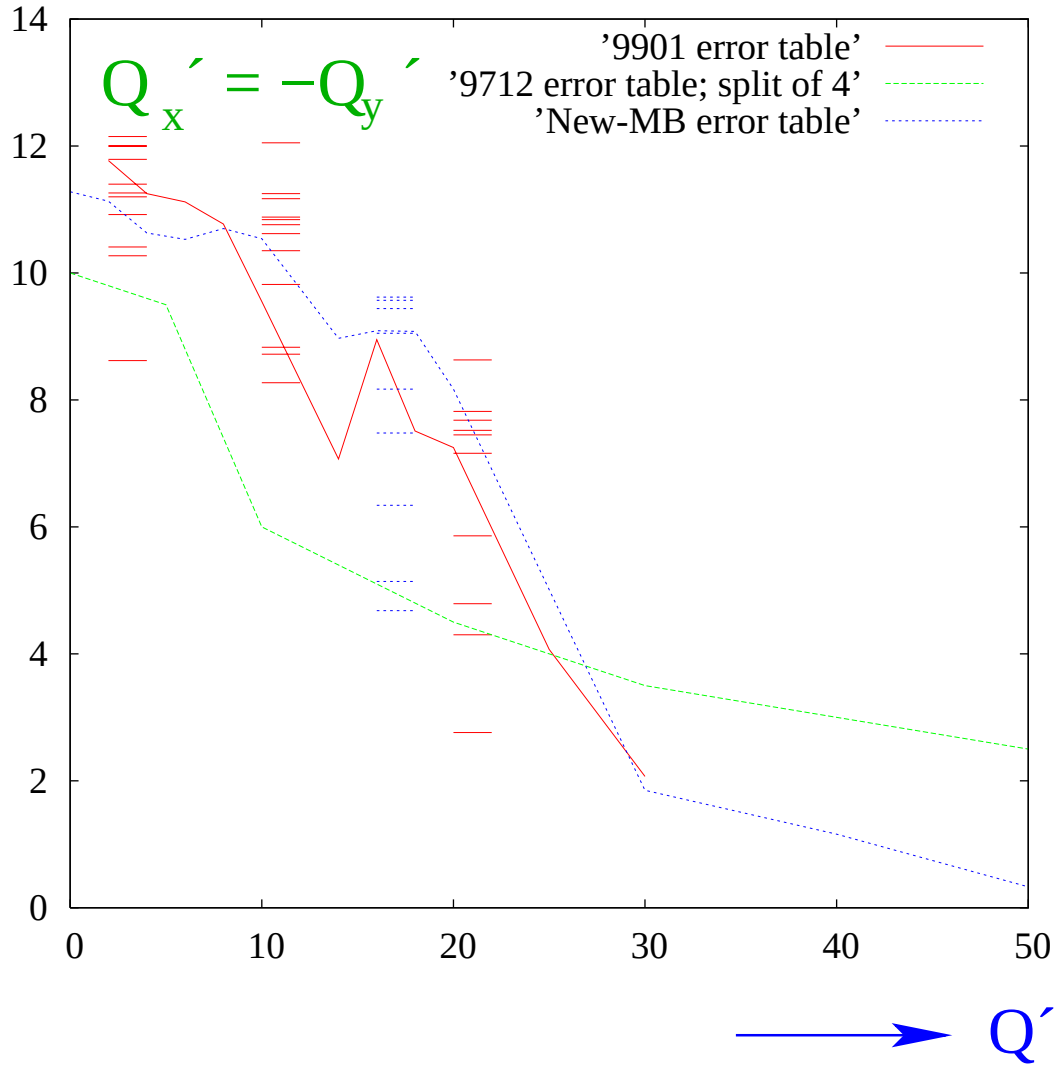


Specification Criteria: Dynamic Aperture

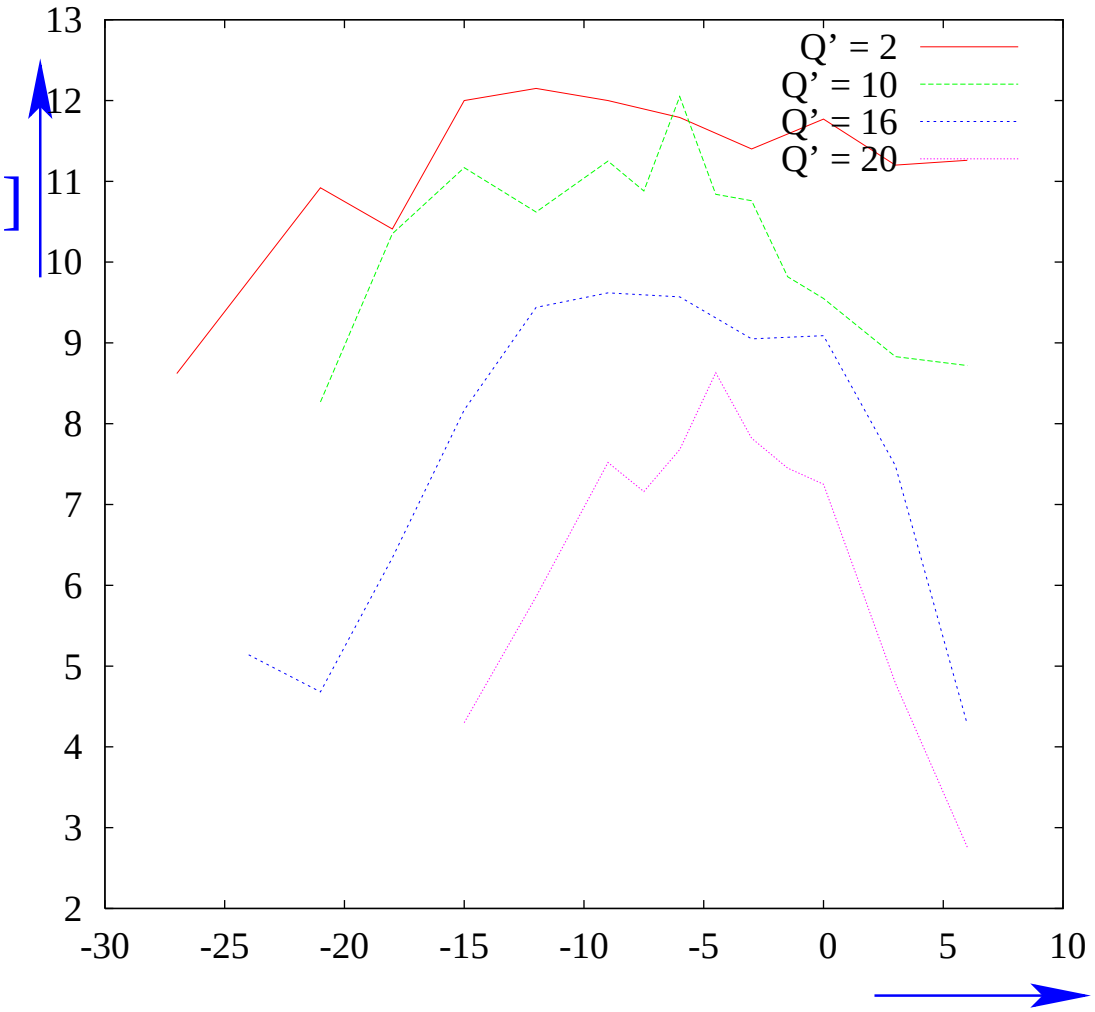
- perform dedicated simulation studies for Q and Q´ tolerance:





Specification Criteria: Dynamic Aperture

- Q´ values up to 10 units seems to be acceptable in simulations
- but the tune window shrinks with increasing Q´: $(Q_x' = -Q_y')$



(Q´ = 2: 9901)

(Q´ = 10: 9901)

(Q´ = 16: new)

(Q´ = 20: 9901)

→ $\Delta Q < +/- 3\ 10^{-3}$

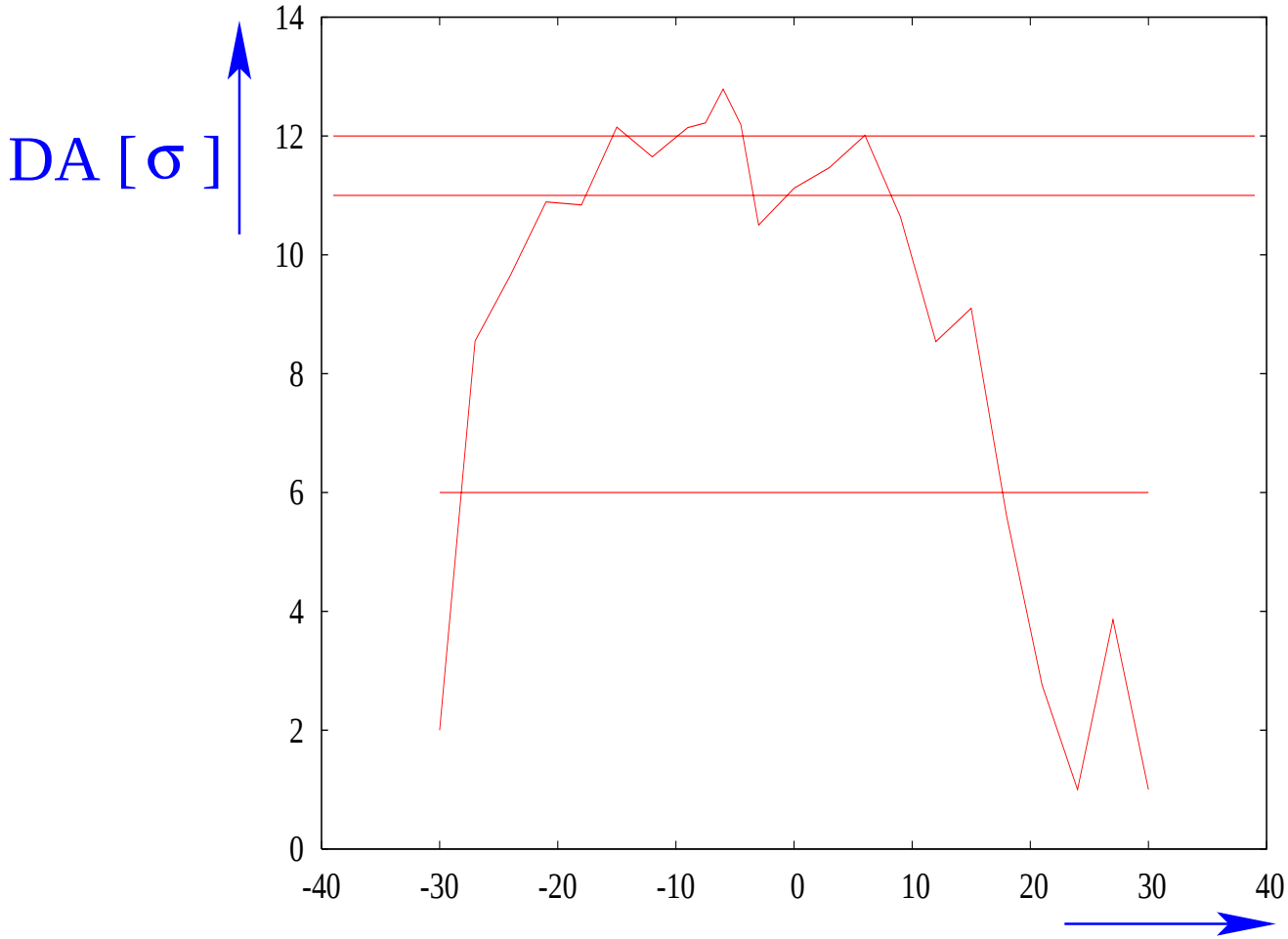
Q´ = 10 seems to be at the limit of what can be accepted.

Specification Criteria: Dynamic Aperture

- nominal parameter: $Q_x = 64.28;\ Q_y = 59.31;\ Q_x' = +2;\ Q_y' = +2$

  (Q' tolerance = +/− 1)

- simulation results for 10^5 turn tracking studies: (new dipole error table)



→ $\Delta Q = +/- 10^{-2}$ if DA < 11.5σ is accepted for 3 seeds!

→ $\Delta Q = +/- 0.7 \cdot 10^{-2}$ otherwise!

→ nominal tune should be lower!

Specification Criteria: Dynamic Aperture

- positive Q´ in both planes seems to be better → $Q' > 2$!
- however: both cases studied so far are not realistic ($Q_x' = Q_y'$; $Q_x' = -Q_y'$)
- perform study with:

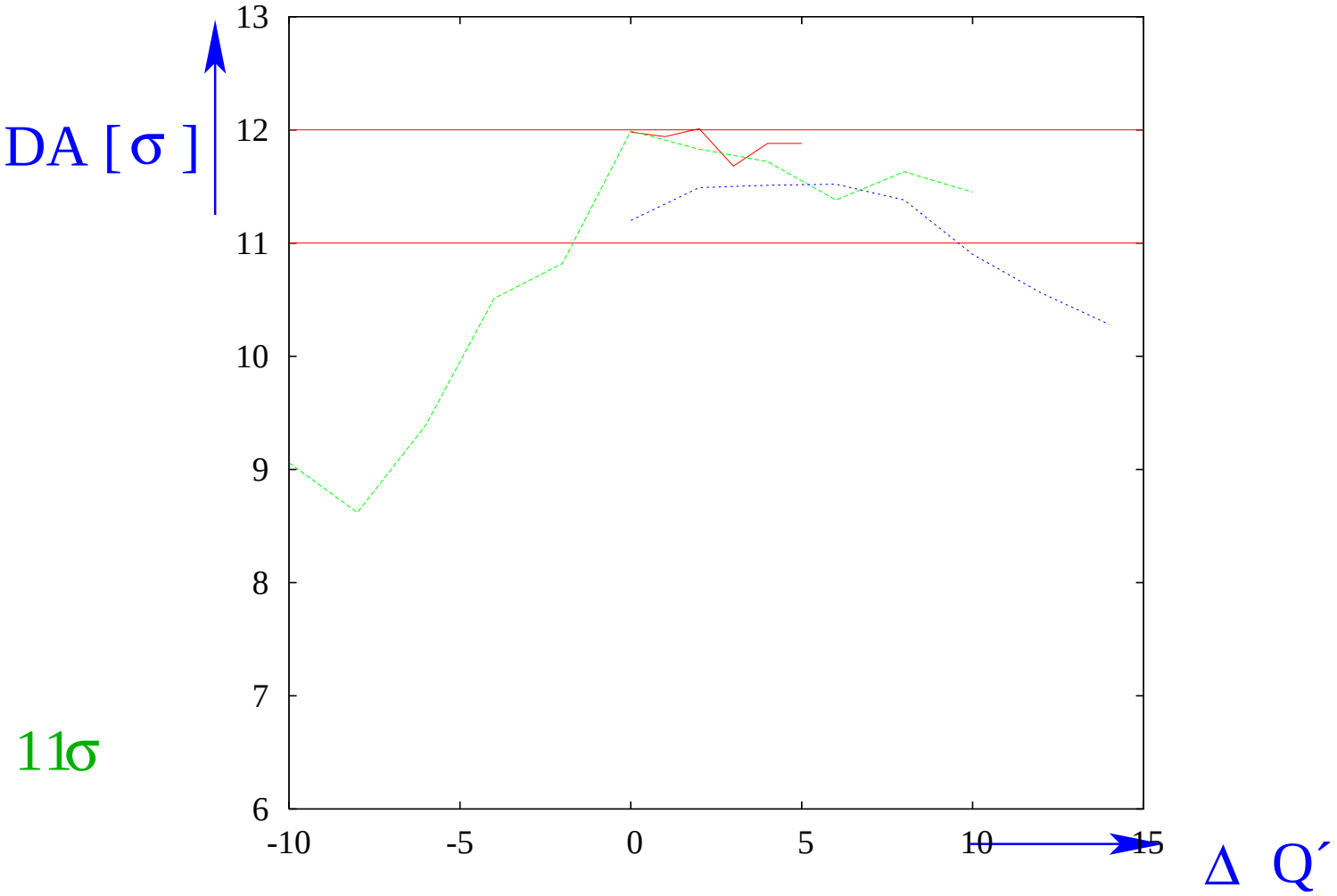
$Q_x' = Q_0' + \Delta Q'$

$Q_y' = Q_0' + \Delta Q'$

$Q_0' = 10 <-> 15$ and

$\Delta Q' = 0 <-> 10$

is the limit for DA > 11σ



Summary Tune and Chromaticity Tolerances

- specification foresees an operational margin in Q of $\delta Q = +/- 3 \cdot 10^{-3}$

- chromaticity tolerance is potentially larger than initial specification
  (studies are still ongoing)

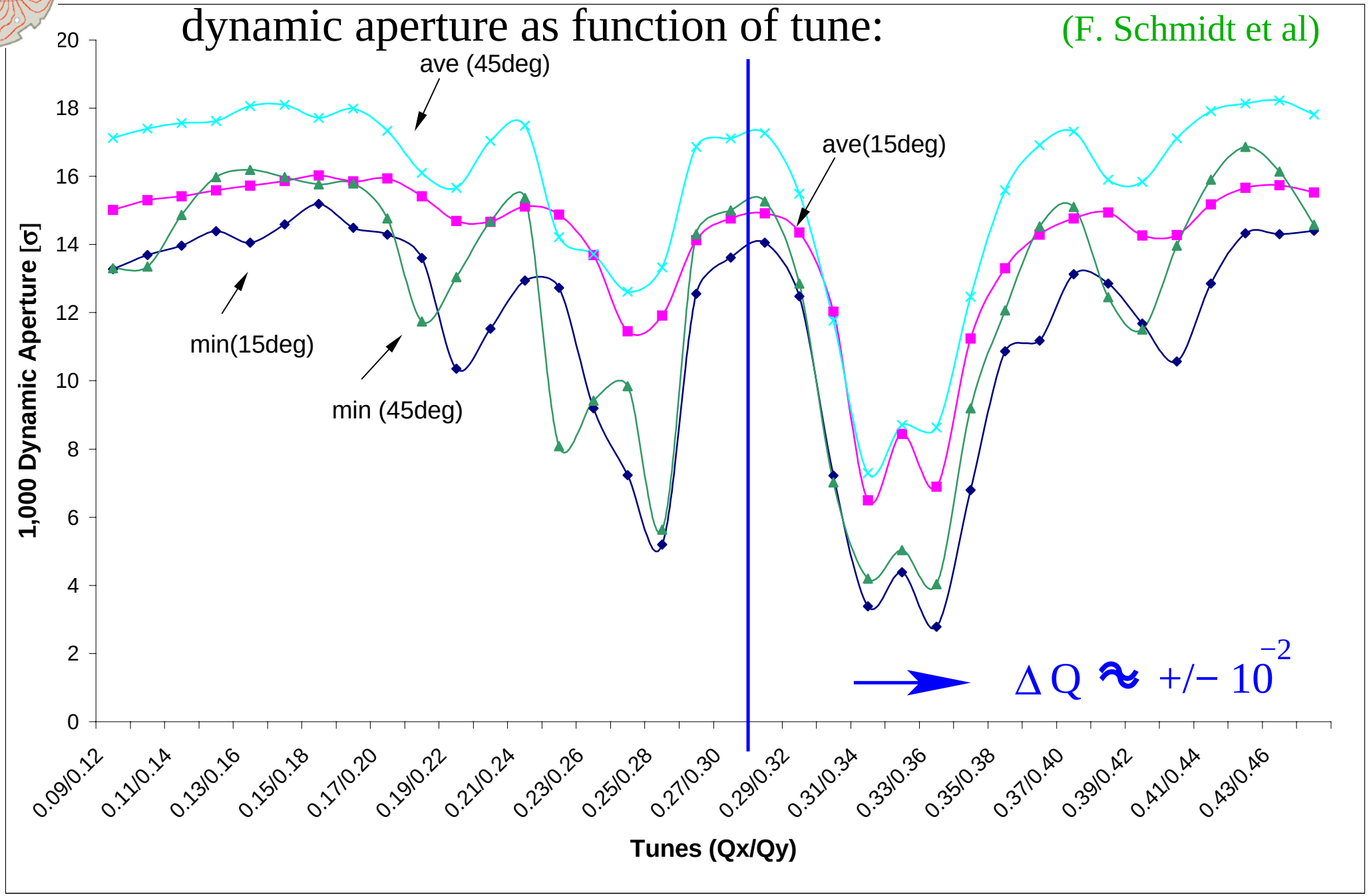
  original specification: $Q' = 2.0; \Delta Q' = +/- 1.0$ with: $Q_y' = Q_y'$

  new tracking studies: $Q' = 2 <-> 15; \Delta \quad Q' = 0 <-> 10$ with: $Q_y' = Q_y'$

- dependence on central machine tune −> next three transparencies

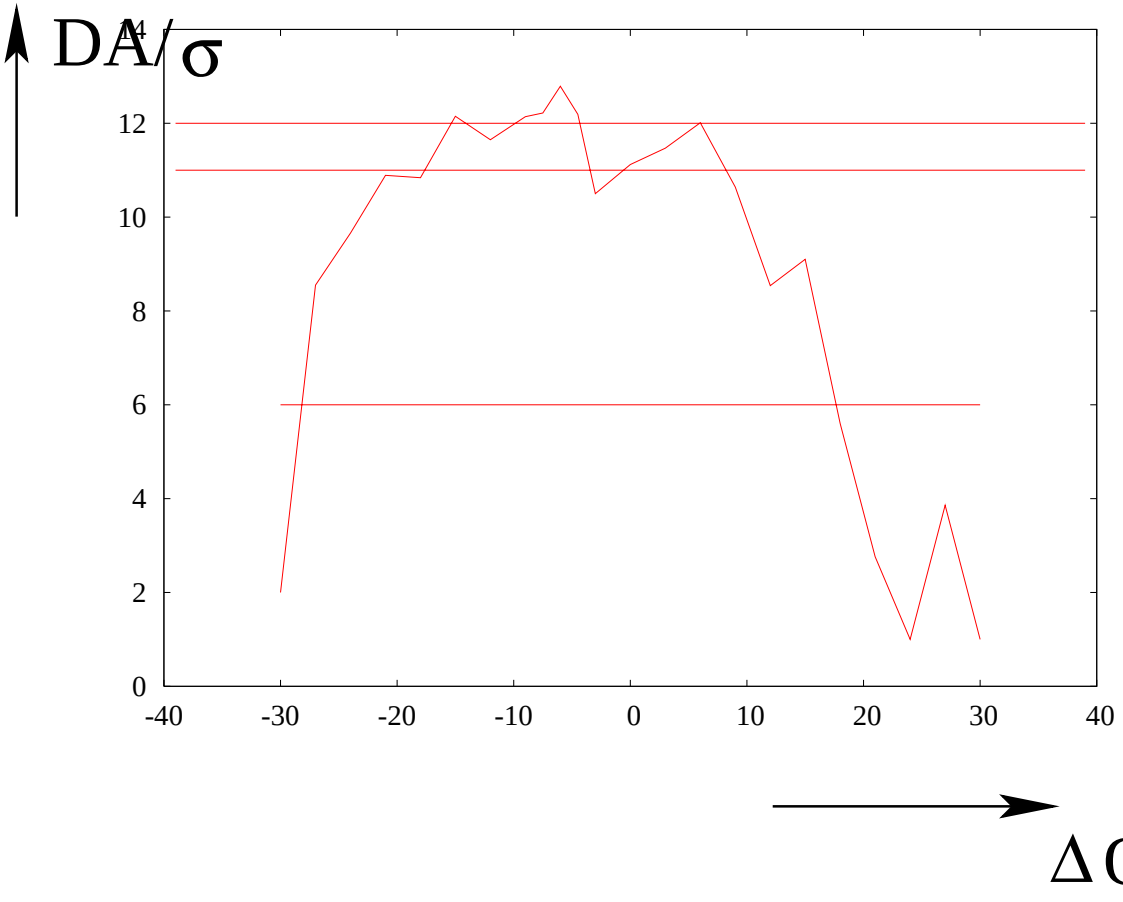
- perform dedicated tune scan for $Q' = 10$ & 15 (still to be done)

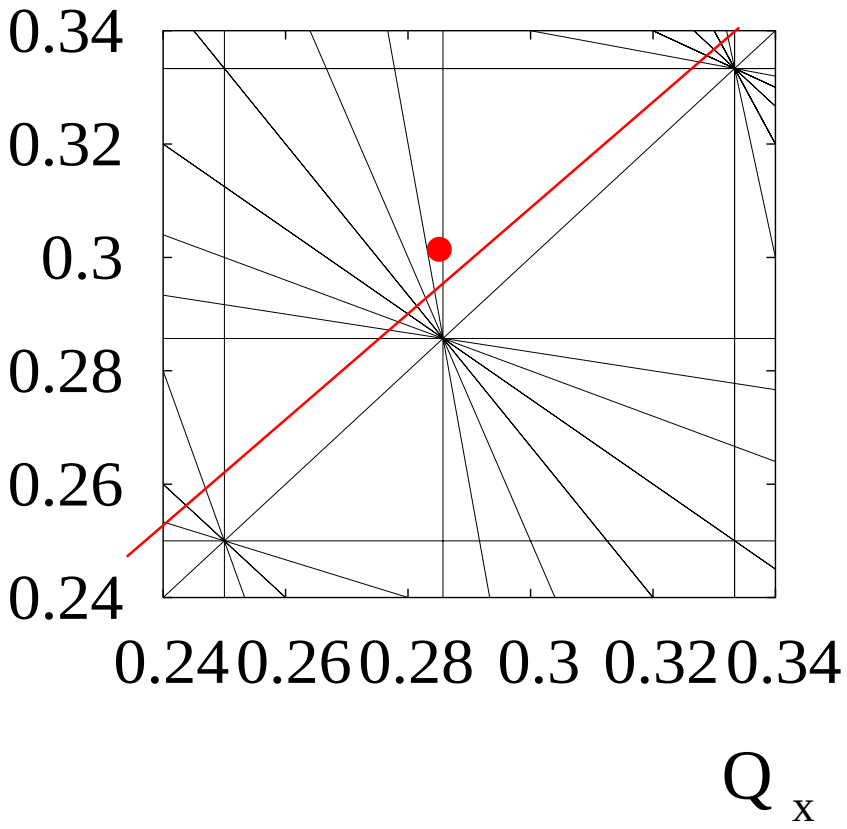
LHC Working Point



LHC Working Point

WP below the half integer tune



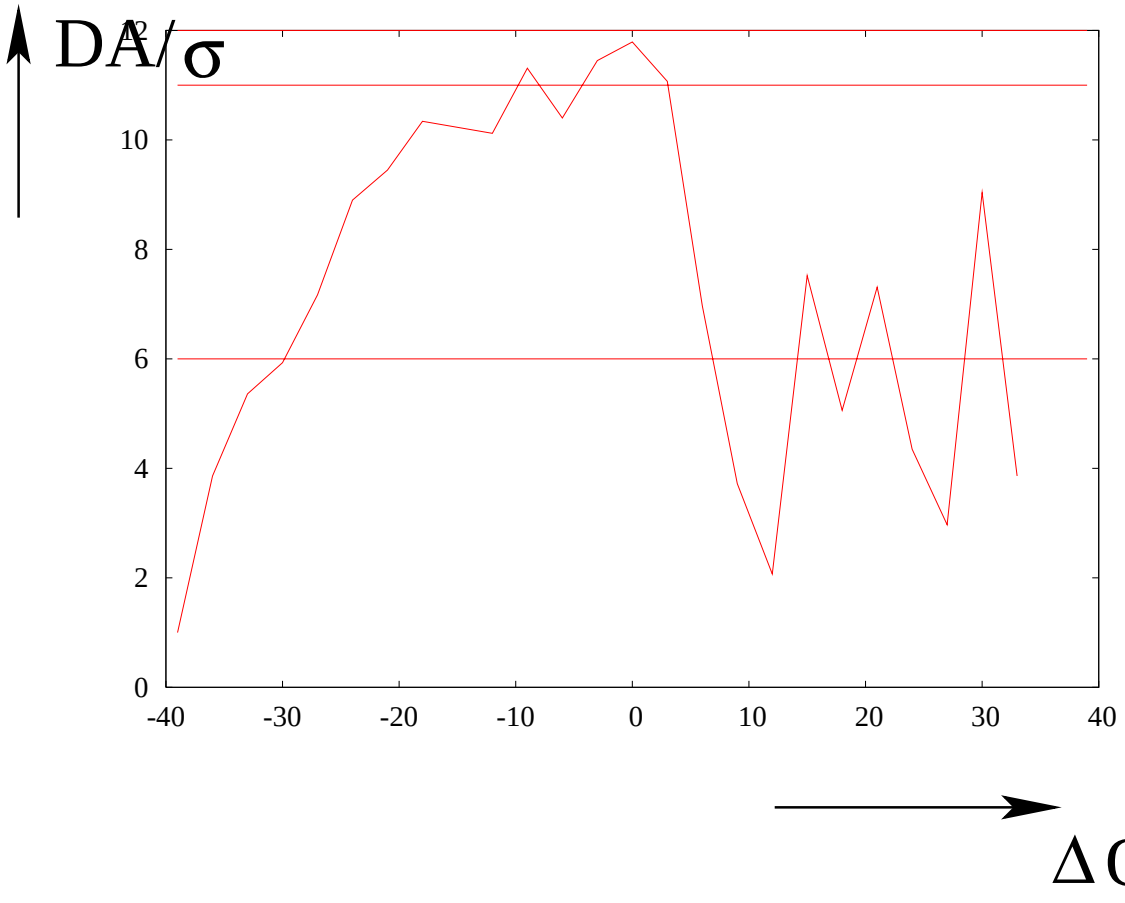


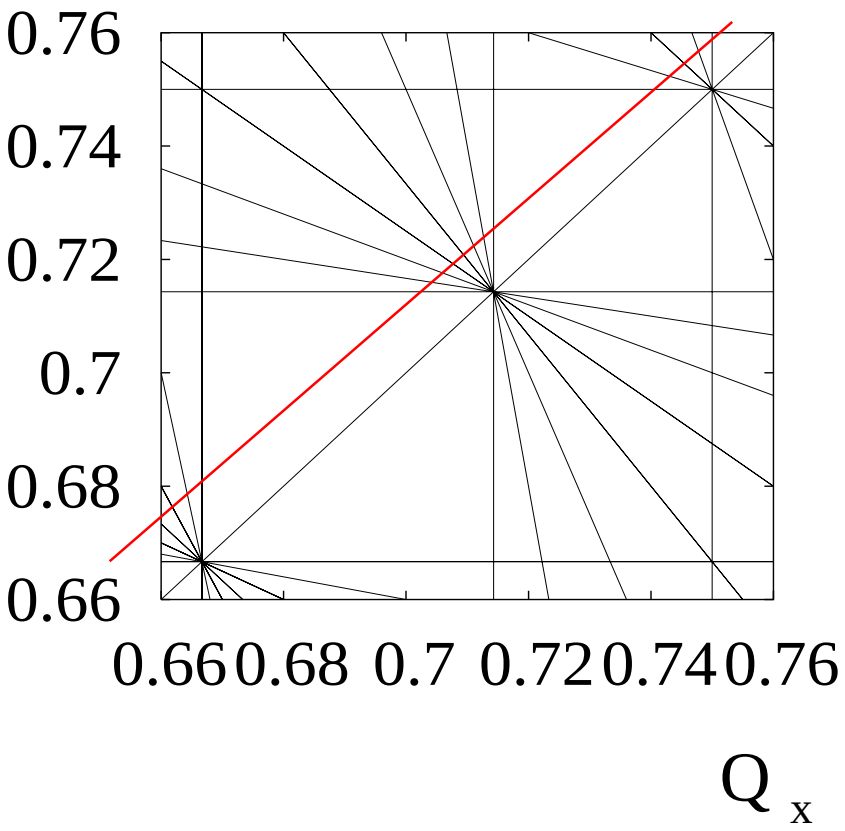
$\Delta Q = 0.015$ for $DA > 11\,\sigma$

$\Delta Q = 0.035$ for $DA > 10.7\,\sigma$

LHC Working Point

WP above the half integer tune





$\Delta Q = 0.008$ for $DA > 11\sigma$

clearly worse than nominal WP!

$\Delta Q = 0.001$ for $DA > 10.7\sigma$