Synchrotron Knobs Updates

- Incorporated positron knobs into mpmdb.grp

OSC Updates

- Normalized cooling rate
- Dynamic aperture optimization (1 GeV and bypass lattices) (former includes multipoles)

Normalized Cooling Rate

- Define as half of $\langle \Delta x^2 \rangle / \langle x^2 \rangle$

  (For easy comparison with typical definition of λ)

- Takes into account the variation of cooling rate with amplitude

- Assume x and δ normally distributed with standard deviations of sqrt($\beta\varepsilon$) and σ_δ

Help from Lebedev (ICFA Paper)

$$\begin{bmatrix} \lambda_1(a_x, a_p)/\lambda_1 \\ \lambda_2(a_x, a_p)/\lambda_2 \end{bmatrix} \equiv \begin{bmatrix} F_1(a_x, a_p) \\ F_2(a_x, a_p) \end{bmatrix}$$

$$\begin{bmatrix} F_1(a_x, a_p) \\ F_2(a_x, a_p) \end{bmatrix} = 2\begin{bmatrix} J_0(a_p)J_1(a_x)/a_x \\ J_0(a_x)J_1(a_p)/a_p \end{bmatrix}$$

$$a_x = k\sqrt{\tilde{\varepsilon}\left(\beta_1 M_{1_{51}}{}^2 - 2\alpha_1 M_{1_{51}} M_{1_{52}} + \left(1+\alpha_1{}^2\right) M_{1_{52}}{}^2/\beta_1\right)}$$

$$\frac{\delta p}{p} = \kappa \sin\left(a_x \sin(\psi_x) + a_p \sin(\psi_p)\right)$$

Quick Derivation

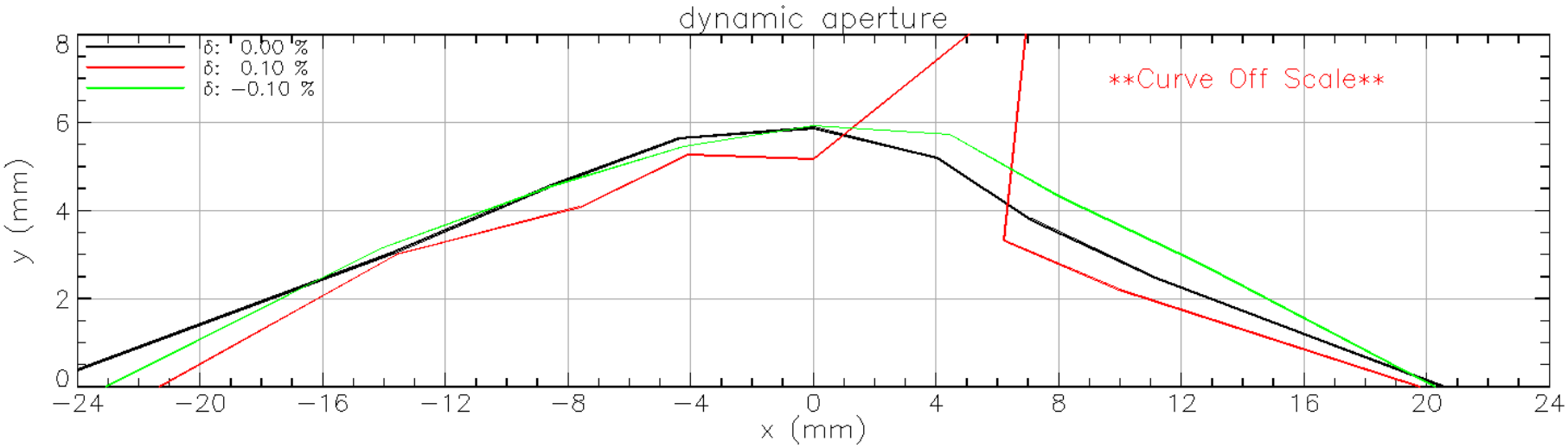
$\langle \Delta x^2 \rangle = \langle (x+\Delta x)^2 \rangle - \langle x^2 \rangle \approx 2\langle x\ \Delta x \rangle$

$\Delta x = -\lambda x$ (λ is function of x, δ)

$\langle \Delta x^2 \rangle \approx -2\langle \lambda x^2 \rangle$

$\lambda_{norm} = -\langle \lambda x^2 \rangle / \langle x^2 \rangle$ (remove factor of 2 to compare with cooling rate in absence of OSC ≈ -5.37E-06)

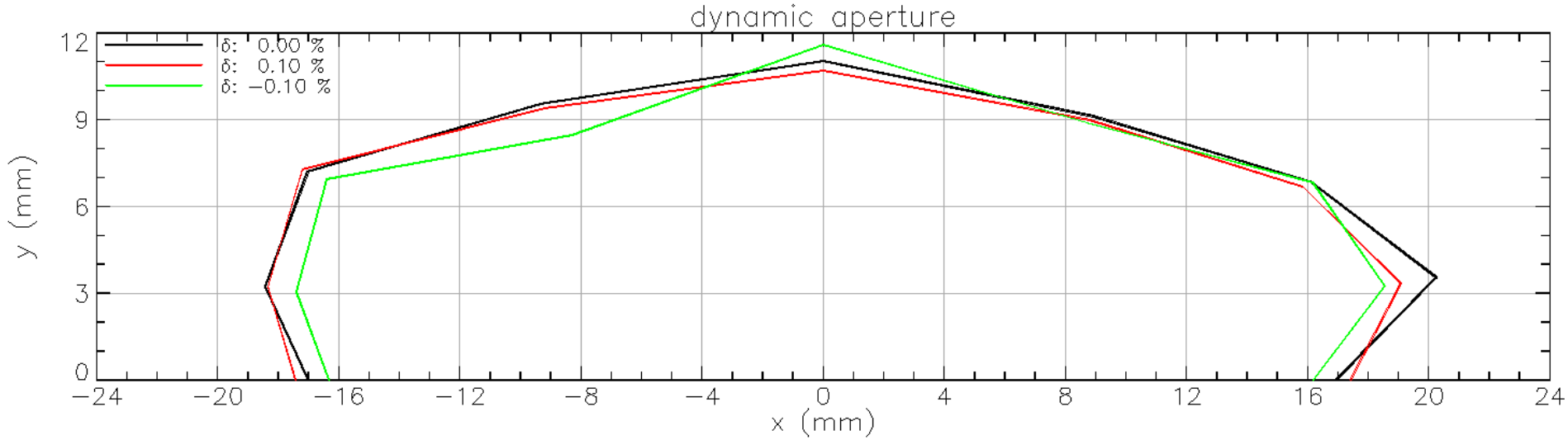
Bypass DA Optimization



- Emittance: 3.78 nm
- Emittance Acceptance: 24.93 nm
- Emittance Acceptance Ratio: 6.60
- Momentum Acceptance: 1.00%
- Cooling Rate: -1.20E-06
- Normalized Cooling Rate: -8.68E-07

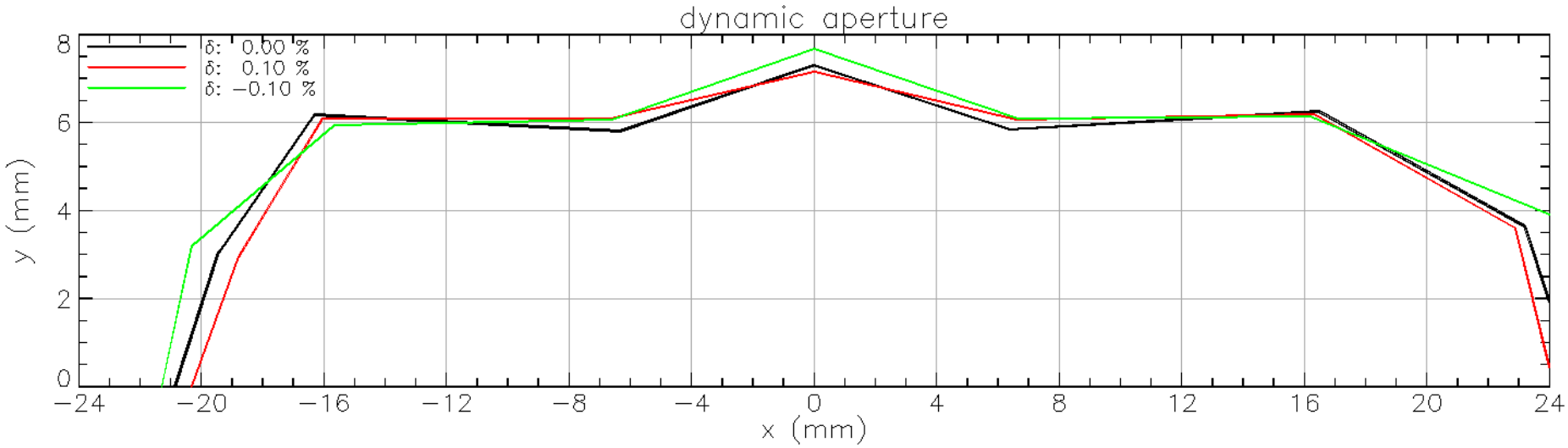
- ξ_x: 0.99
- ξ_y: 0.95
- ADTS_x: 68.8987
- ADTS_y: 1530.96

CHESS-U DA (Note Scale)



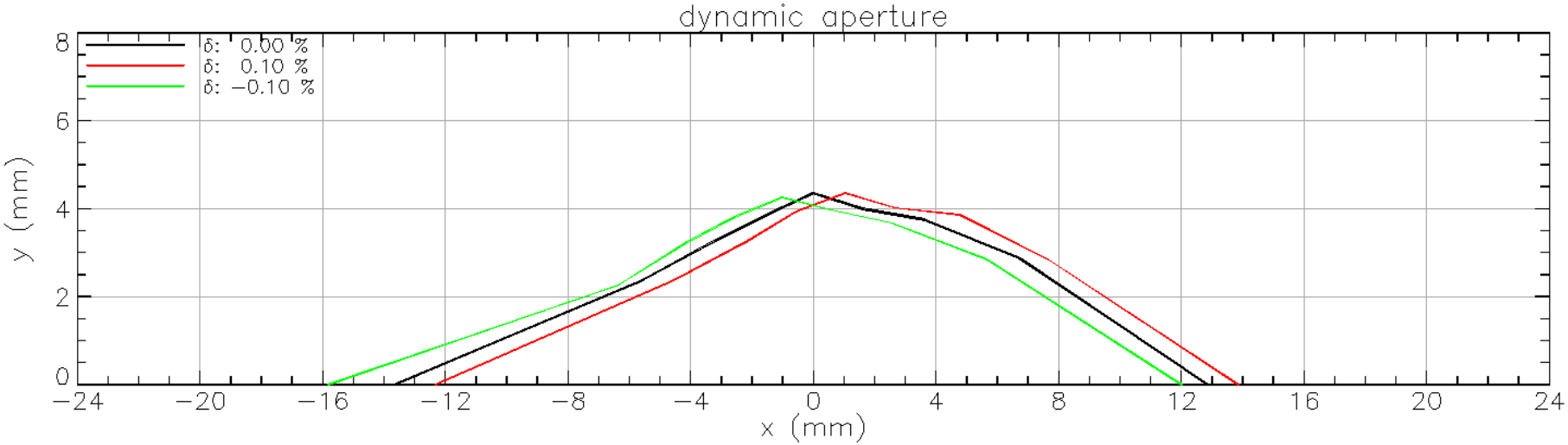
- ξ_x: 0.97
- ξ_y: 1.03
- ADTS_x: -6.13846
- ADTS_y: -201.522

1 GeV DA



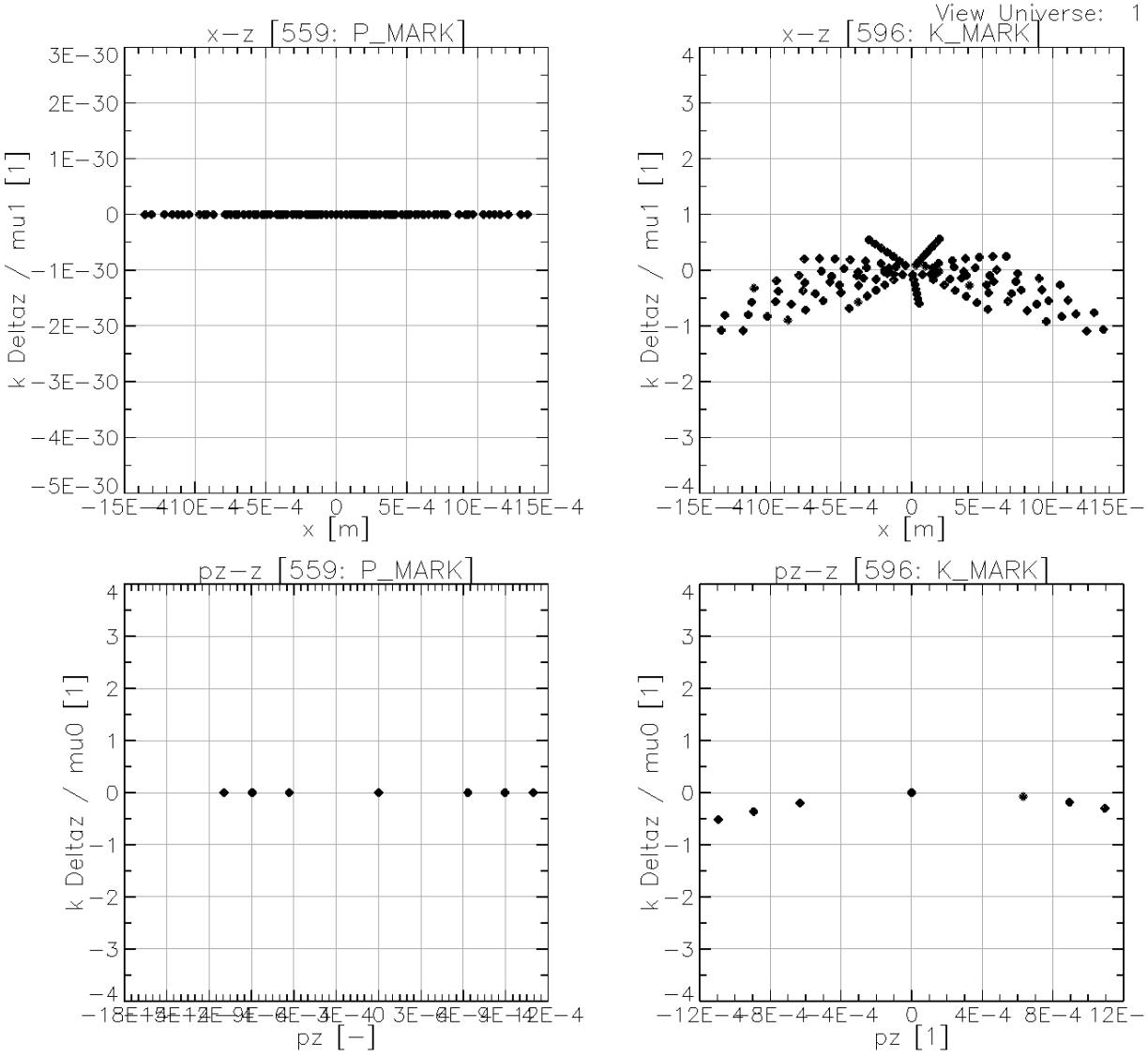
- ξ_x: 0.97
- ξ_y: 0.95
- ADTS_x: 18.9807
- ADTS_y: -147.646

Spring 1 GeV DA



- ξ_x: 0.43
- ξ_y: 1.15
- ADTS_x: -161.411
- ADTS_y: 1650.79

First Look at Nonlinearities of Cooling Window (Out to 3x Emittance)



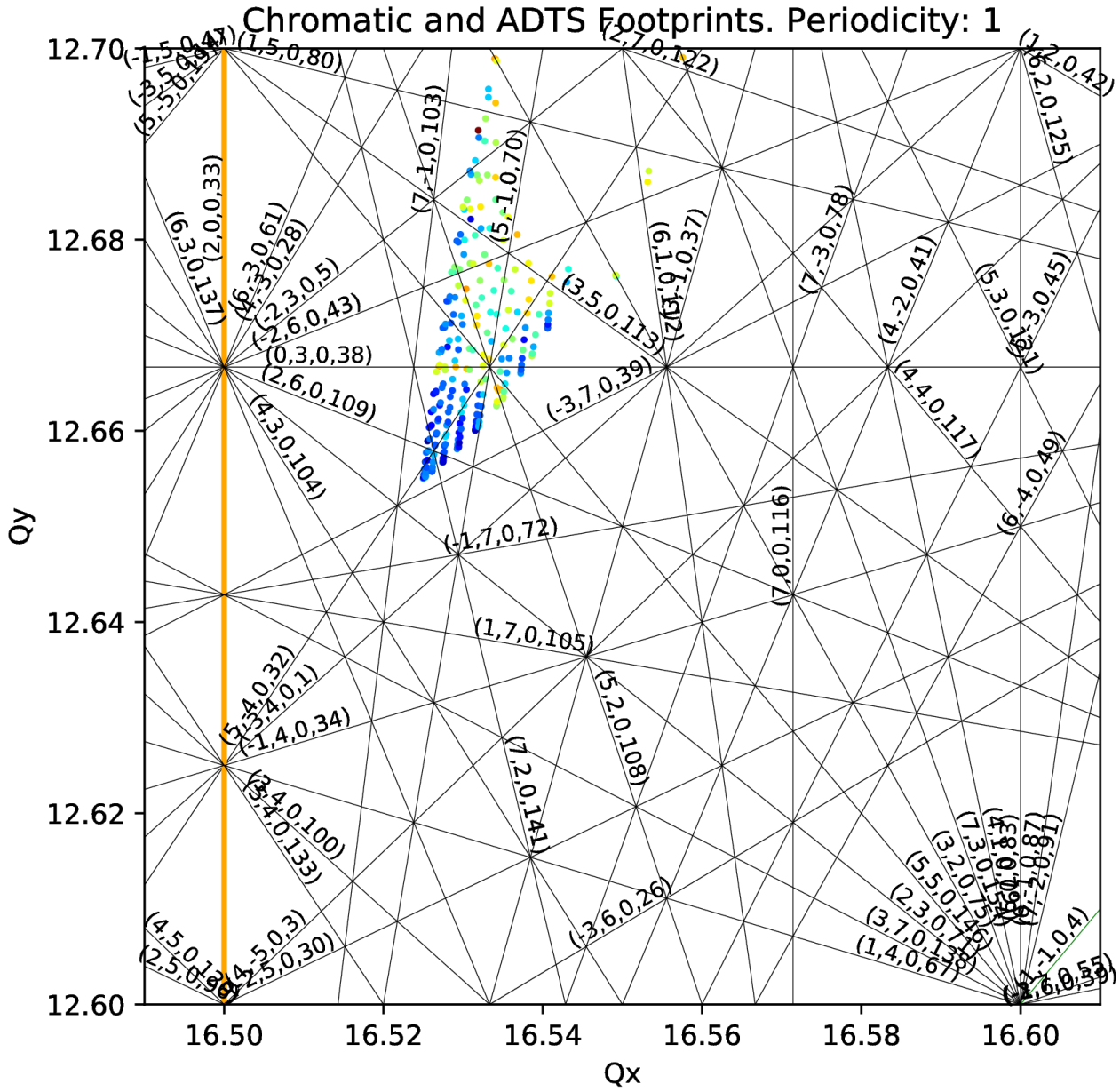
Conclusions

- ADTS is large for bypass, but does it matter if DA is good?
- Start beating down nonlinearities

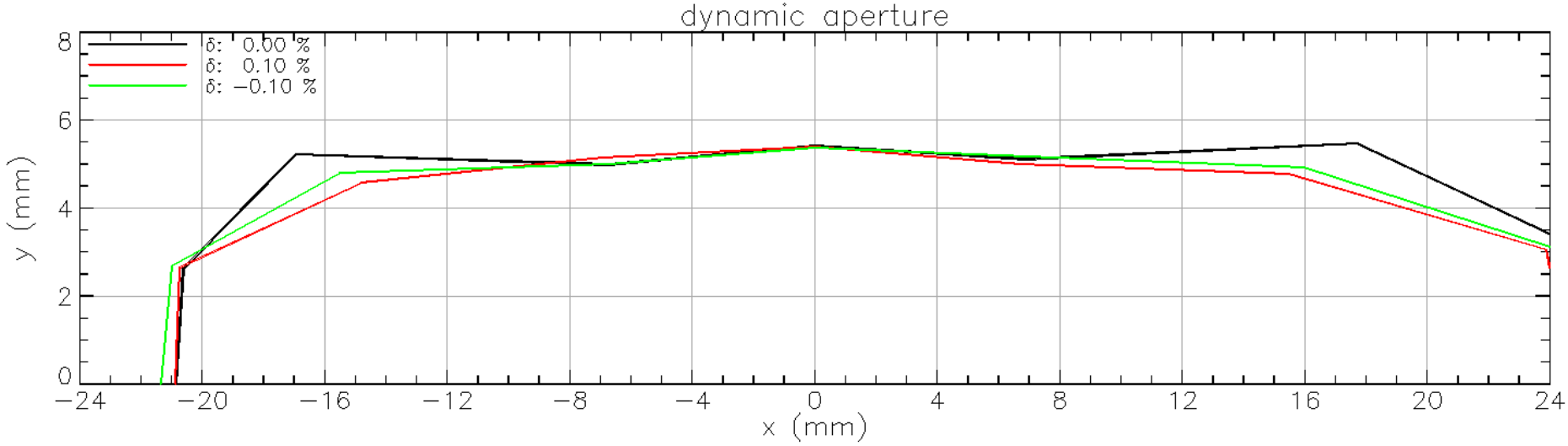
Backup Slides

- Tune plane for optimized bypass
- More Das
- Bypass Optics

Optimized Bypass Tune Plane

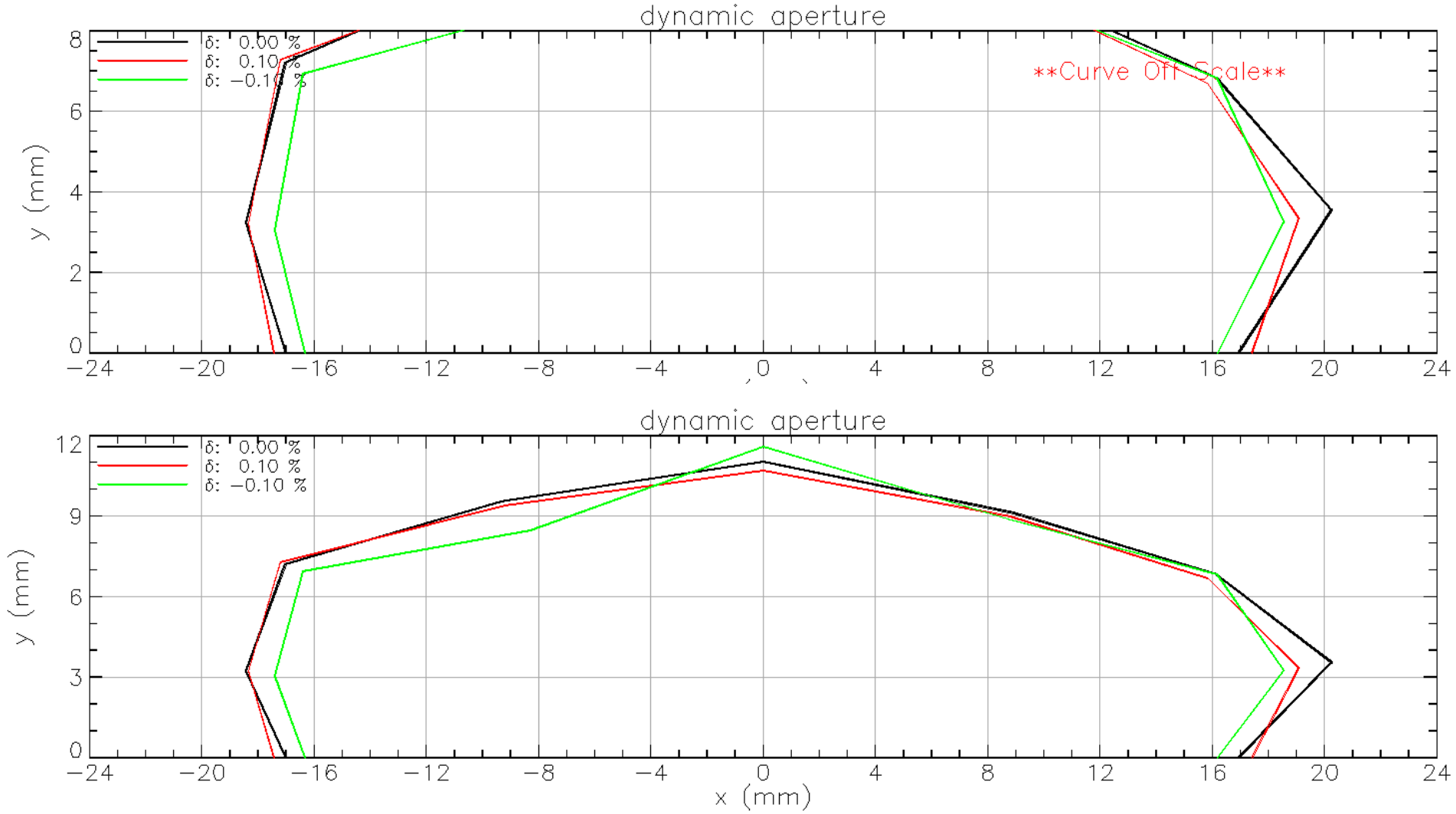


1 GeV DA - all wigglers NOT optimized



- ξ_x: 0.97
- ξ_y: 0.95
- ADTS_x: 18.9593
- ADTS_y: 2433.64

CHESS-U DA


dynamic aperture
δ: 0.00 %
δ: 0.10 %
δ: −0.10 %
Curve Off Scale
y (mm)
dynamic aperture
δ: 0.00 %
δ: 0.10 %
δ: −0.10 %
y (mm)
x (mm)

Optimized Bypass Optics