Overview of Lattice

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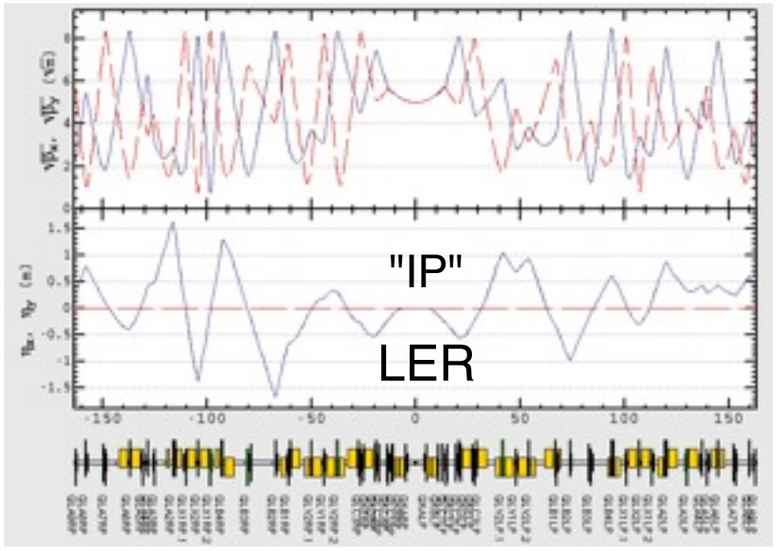
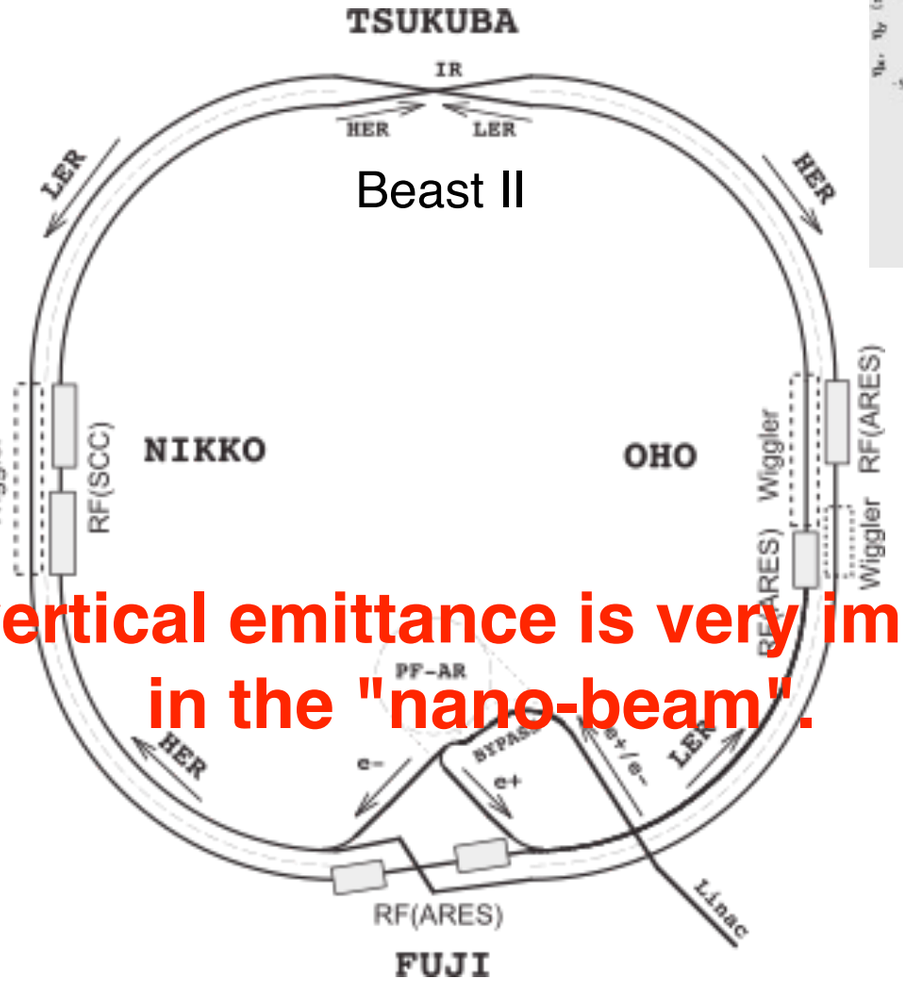
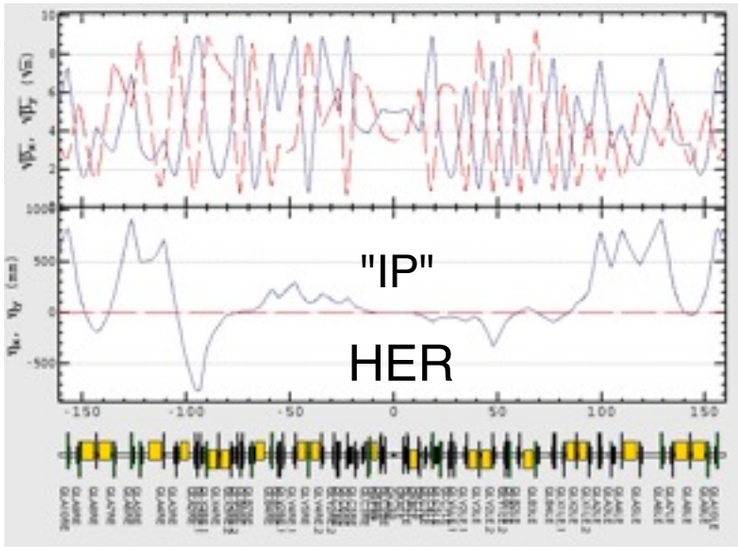
The 21th KEKB Accelerator Review Committee

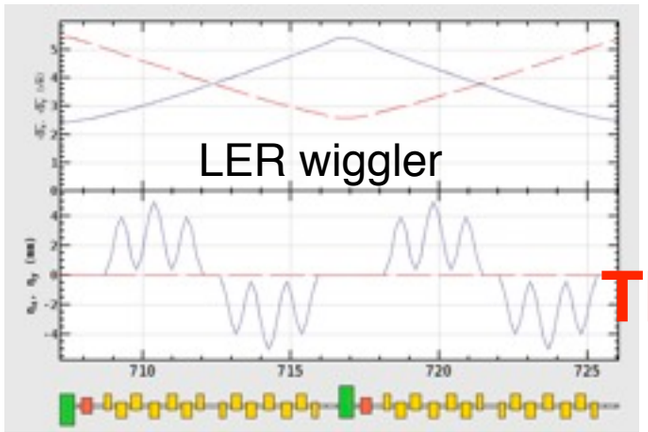
Outlook of Lattice

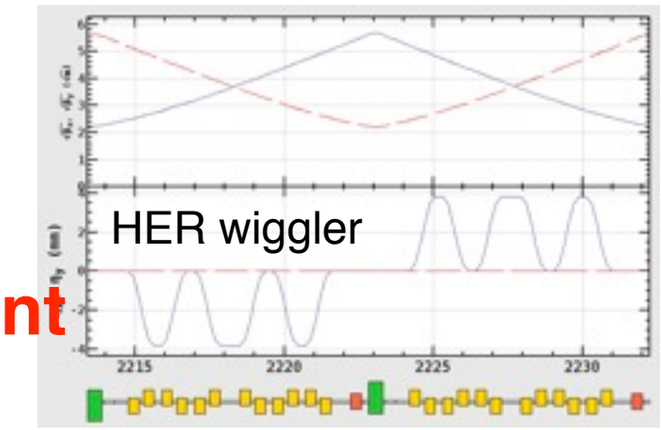


No QCS, No Solenoid
No Local Chromaticity Correction

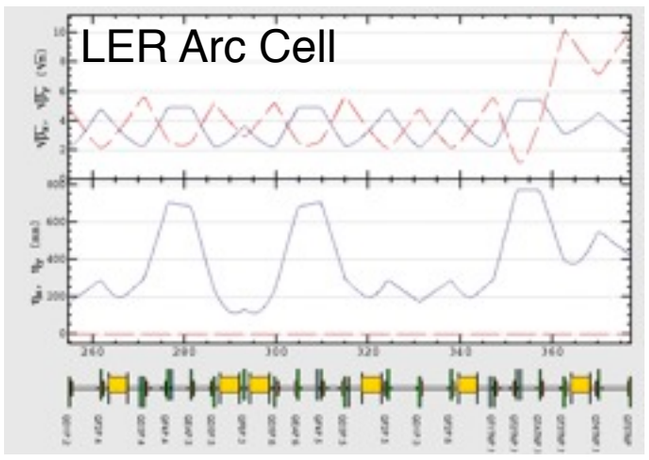


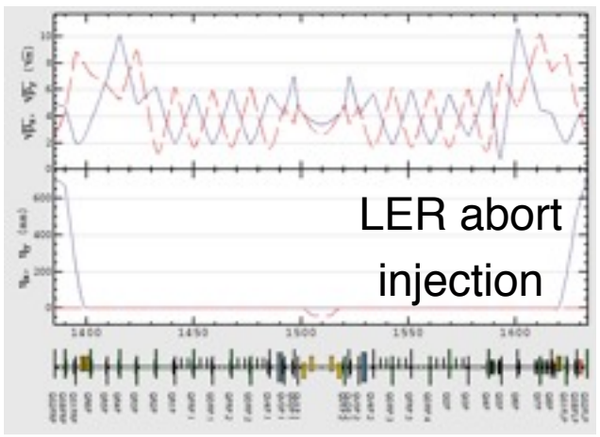


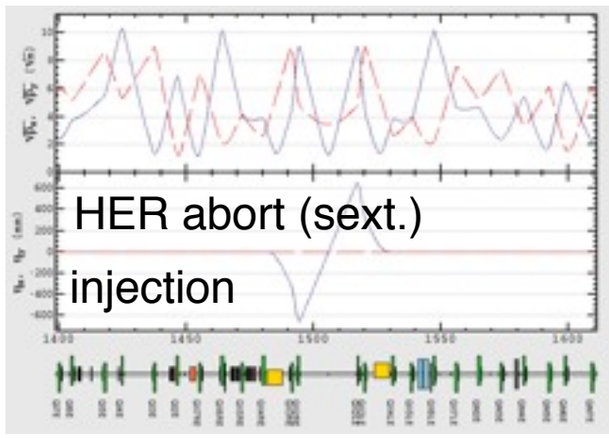


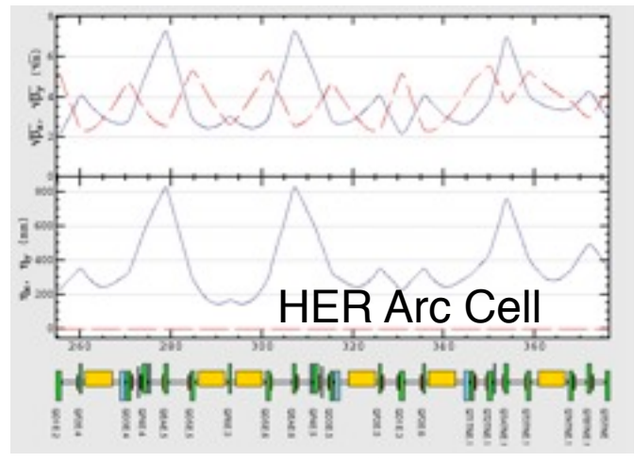


The vertical emittance is very important in the "nano-beam".

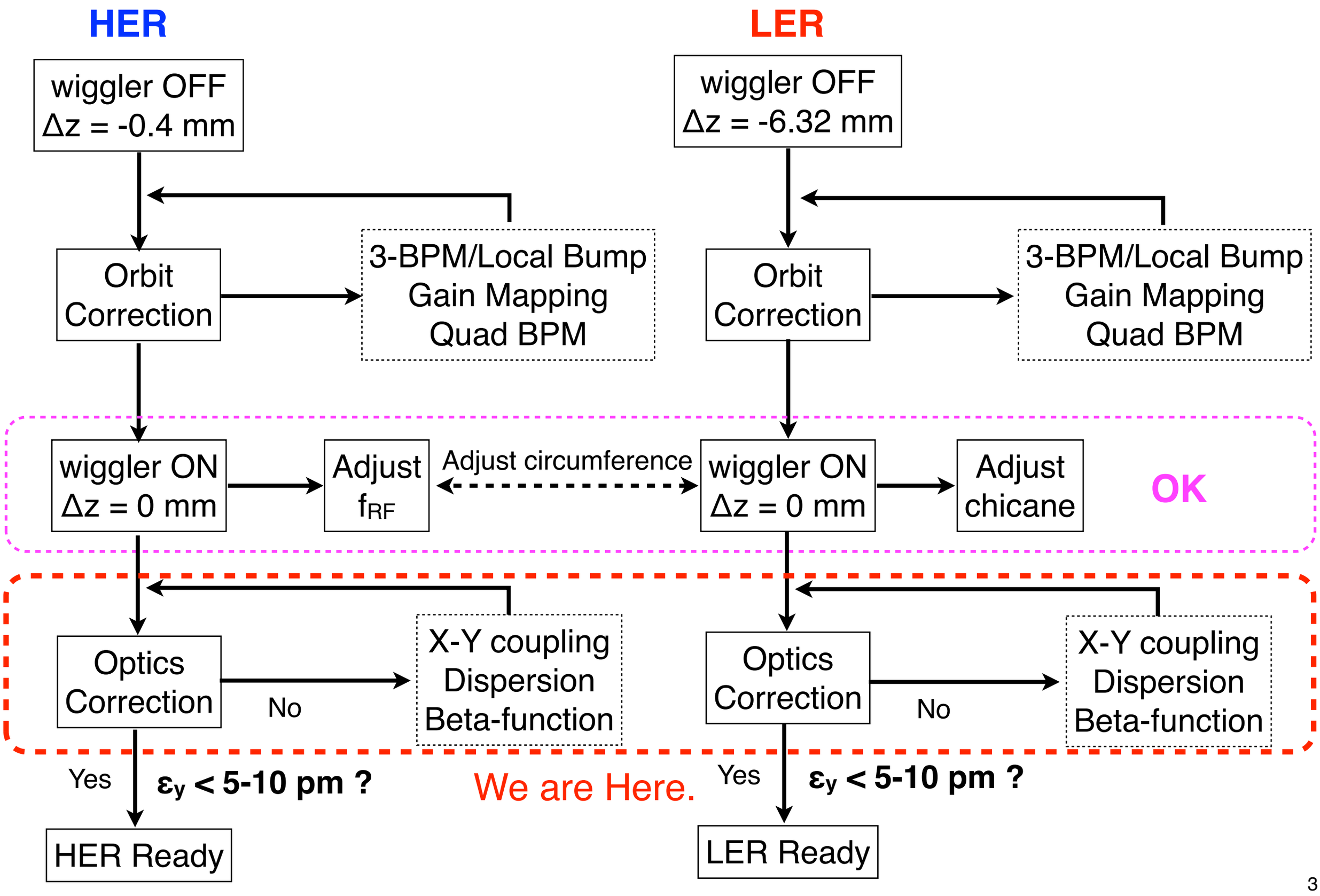








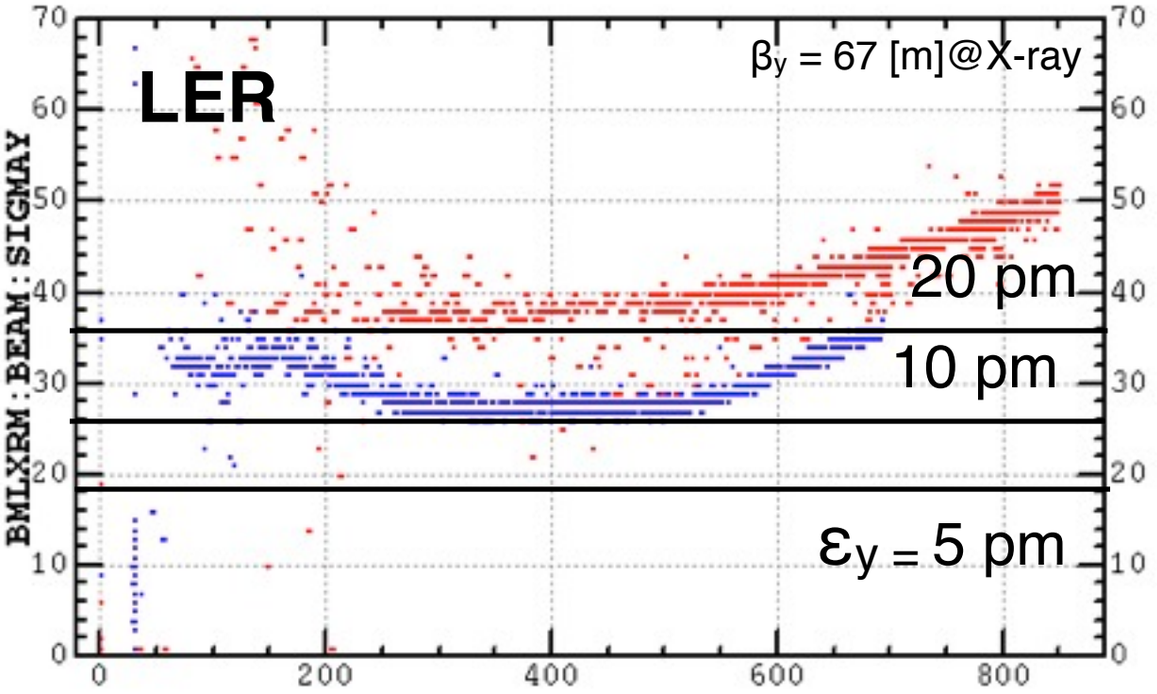
Strategy of Optics Tuning at Phase-1



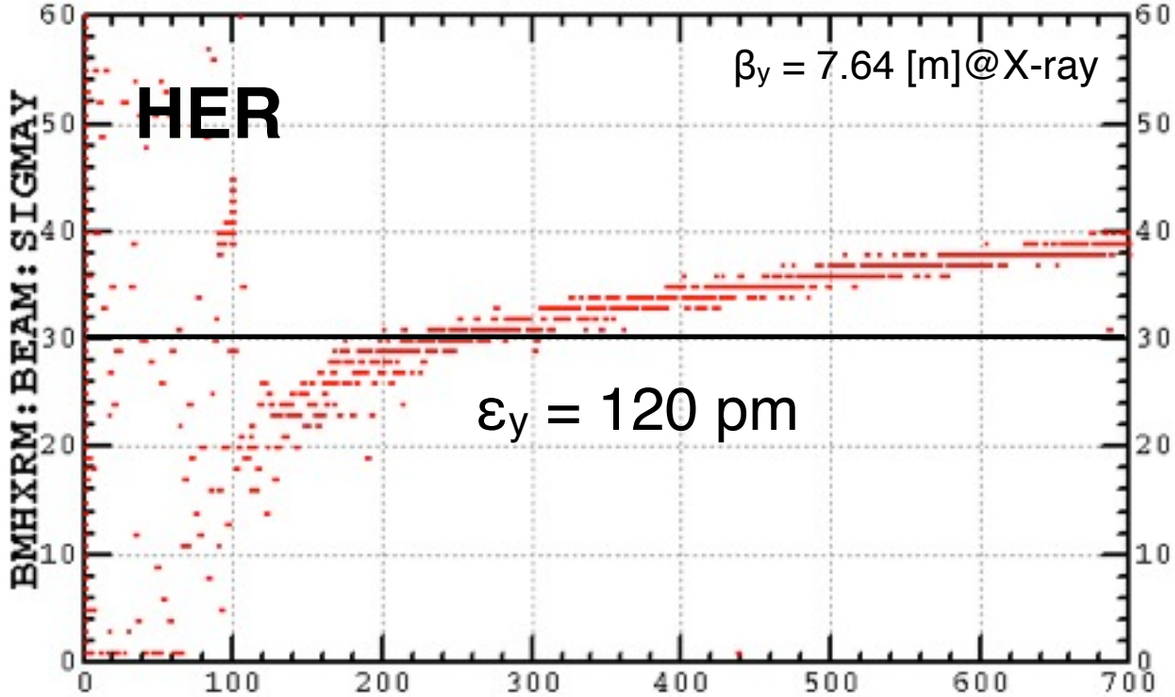
Vertical Beam Size

Target ε_y is less than 10 pm, hopefully 5 pm.

X-ray Beam Size Monitor



Beam Current [mA]



Beam Current [mA]

Red: before installing permanent skew quad to correct leakage skew quad. field from Lambertson.

Blue: after installing permanent skew quad

ε_x = 4.6 nm

↓

$\varepsilon_y/\varepsilon_x$ = 2.6 % ?

Is ε_y relally big in HER ?

Estimation of Vertical Emittance

Target value is less than 10 pm, hopefully 5 pm.

6 kinds of steerings are used to induce orbits for each x and y.

β measurement based on orbit distortion (x, y)

Twiss parameters (β_x, β_y, ϕ_x, ϕ_y) $\xrightarrow{M_{11}}$ α_x

X-Y coupling (u-mode) (r_1,r_2) $\xrightarrow{M}$ X-Y coupling (r_3,r_4)

$$\frac{y_j}{x_j} = \frac{r_2}{\beta_x}(\tan(|\phi_x - \phi_x^j| - \pi\nu_x) + \alpha_x) - r_1$$

$j = 1 \sim 6$ for 440 - 460 BPMs

physical dispersion measurement (η_x, η_y)

$\downarrow M_{6x6}$

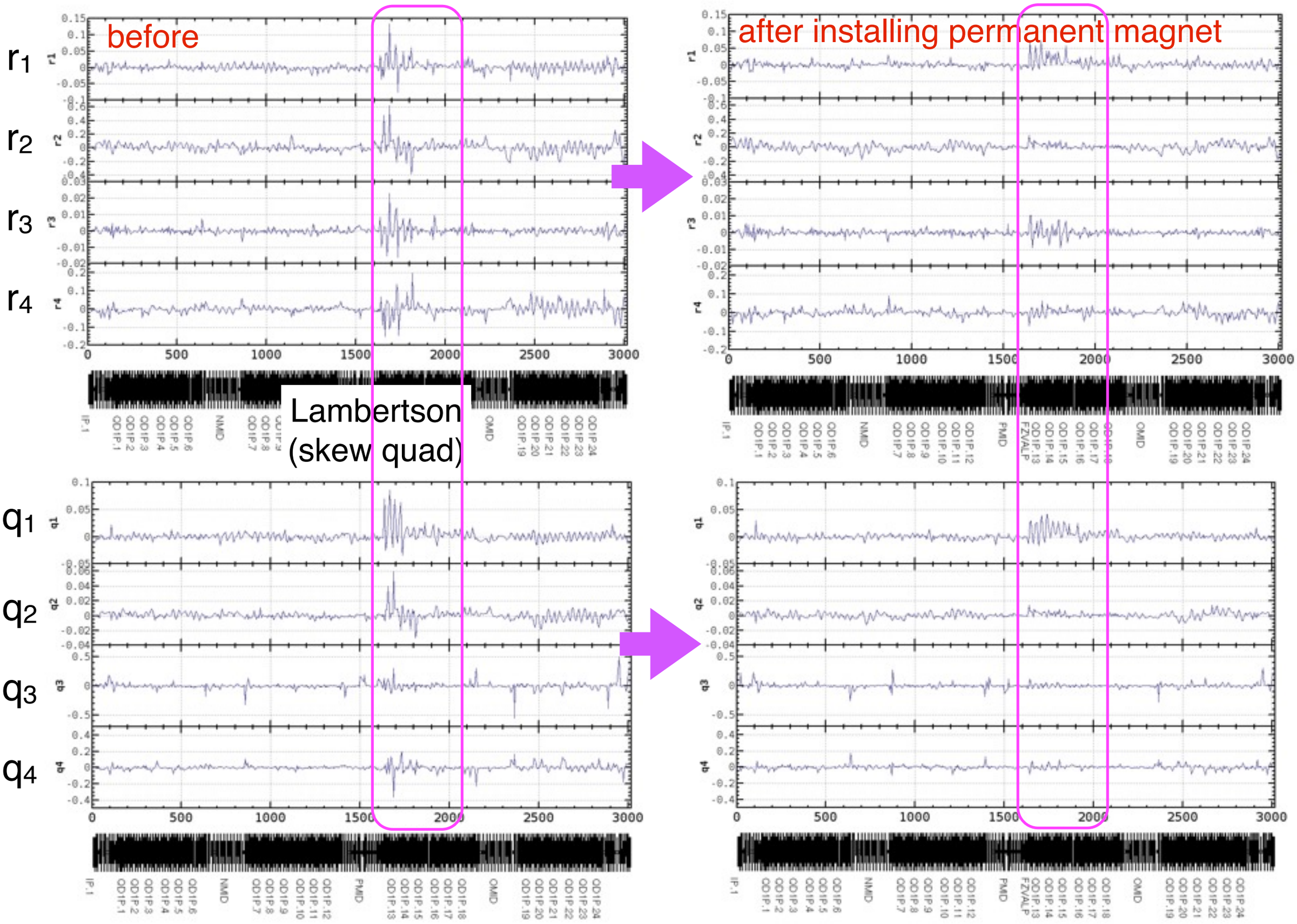
(η_x, η_{px}, η_y, η_{py})

(η_u, η_{pu}, η_v, η_{pv})

$\downarrow$ integration in dipoles

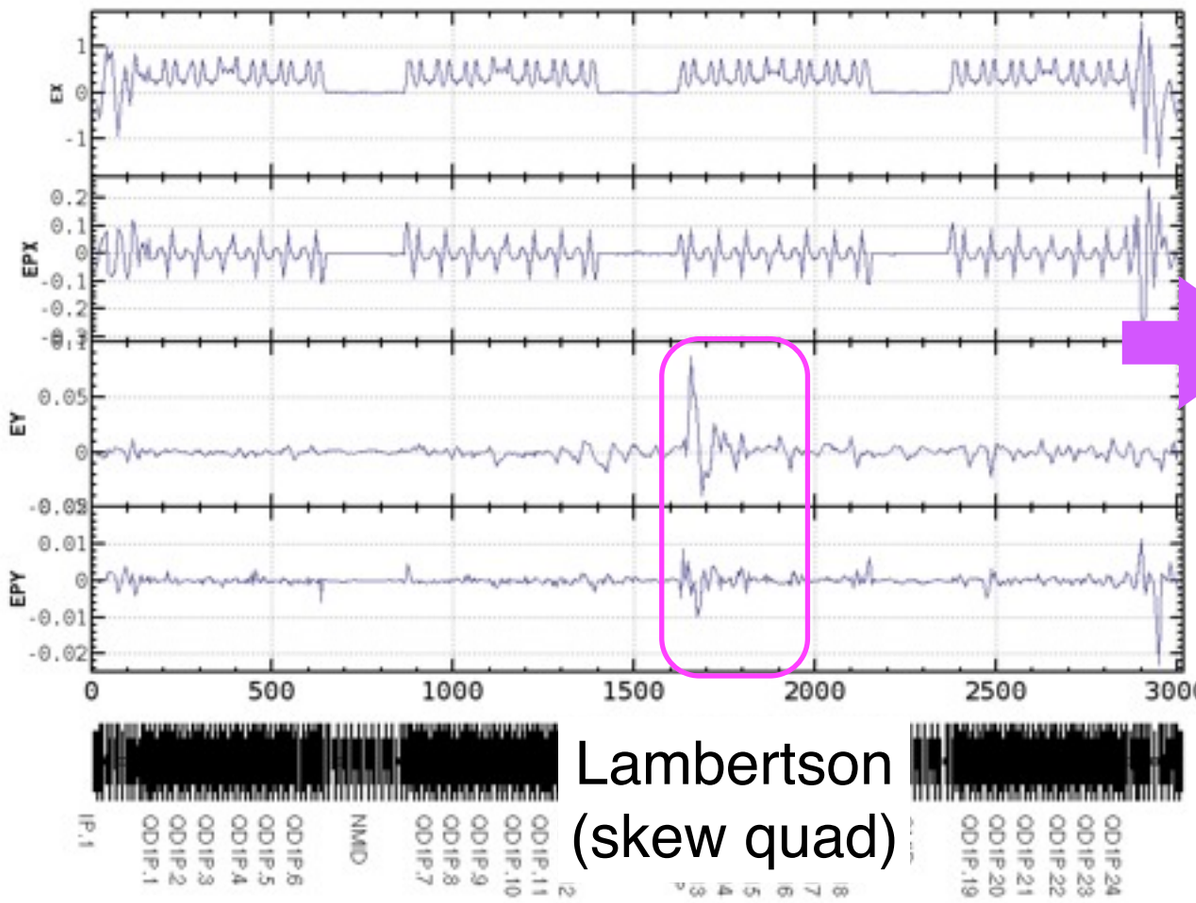
$$\varepsilon_y = C_q \gamma^2 \frac{I_5}{J_x I_2}$$

X-Y Coupling in LER



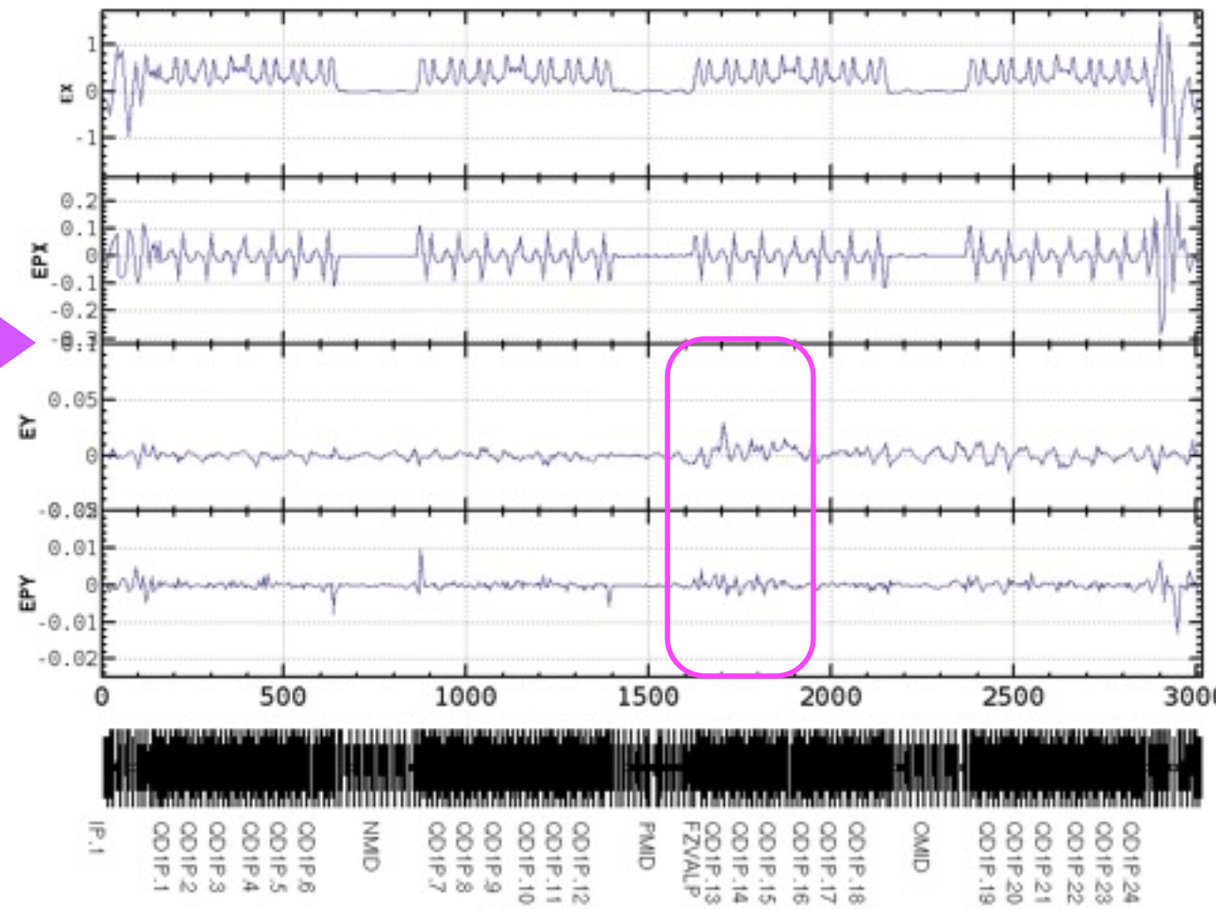
Normal Dispersions in LER

before installing permanent magnet



Lambertson
(skew quad)

after installing permanent magnet

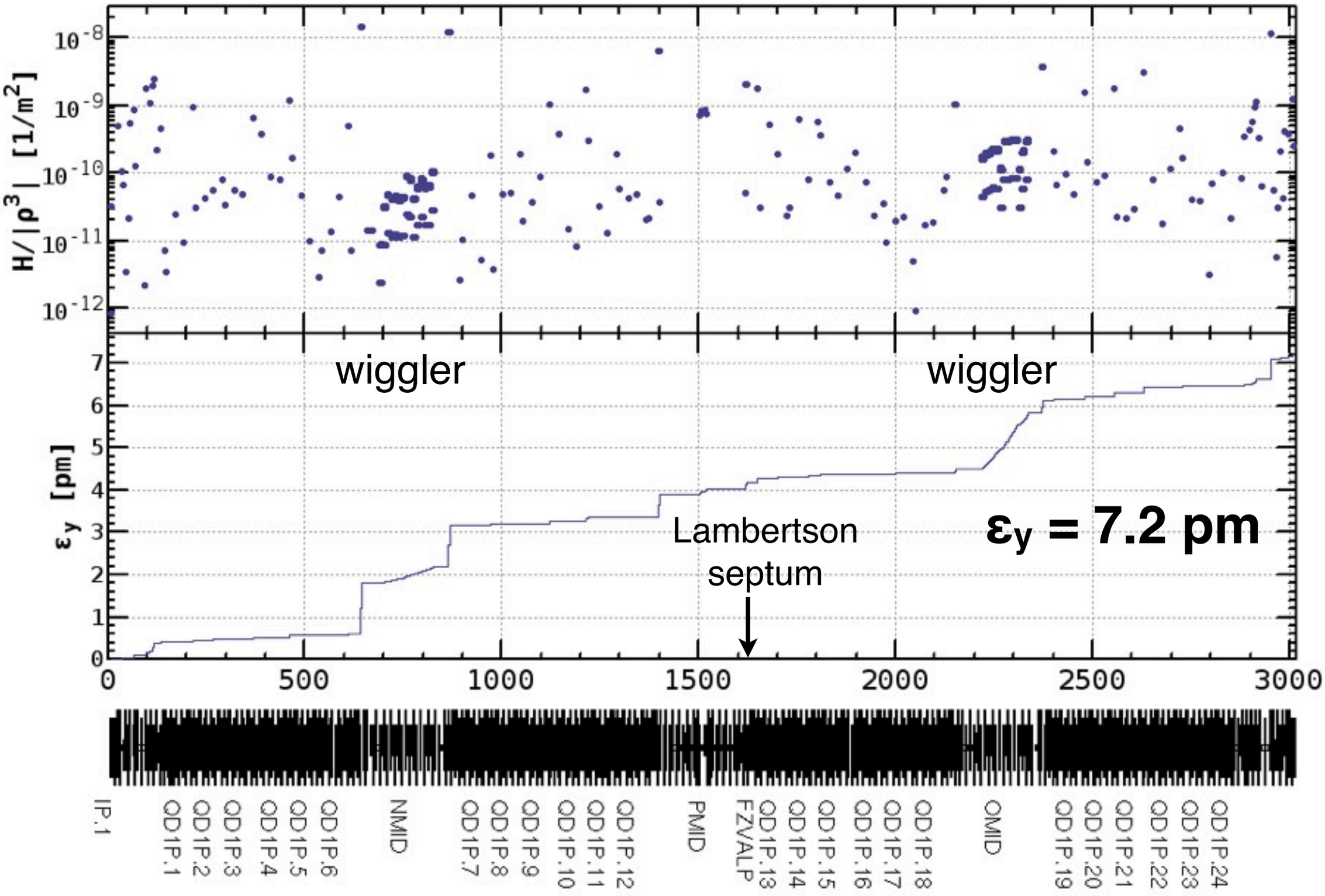


physical dispersion
(measurement)

normal dispersion

$$\begin{pmatrix} \eta_u \\ \eta_{pu} \\ \eta_v \\ \eta_{pv} \end{pmatrix} = \begin{pmatrix} \mu & 0 & -r_4 & r_2 \\ 0 & \mu & r_3 & -r_1 \\ r_1 & r_2 & \mu & 0 \\ r_3 & r_4 & 0 & \mu \end{pmatrix} \begin{pmatrix} \eta_x \\ \eta_{px} \\ \eta_y \\ \eta_{py} \end{pmatrix}$$

Estimation of Vertical Emittance in LER



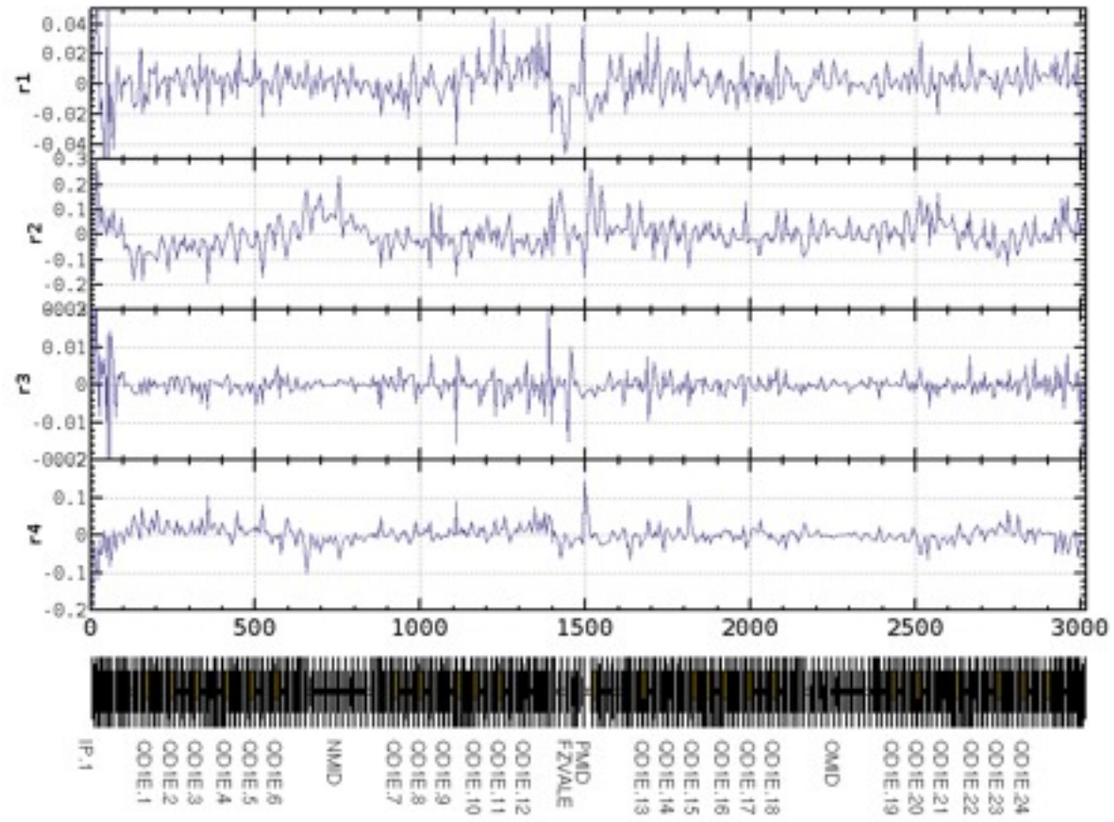
X-Y Coupling and Normal Dispersions in HER

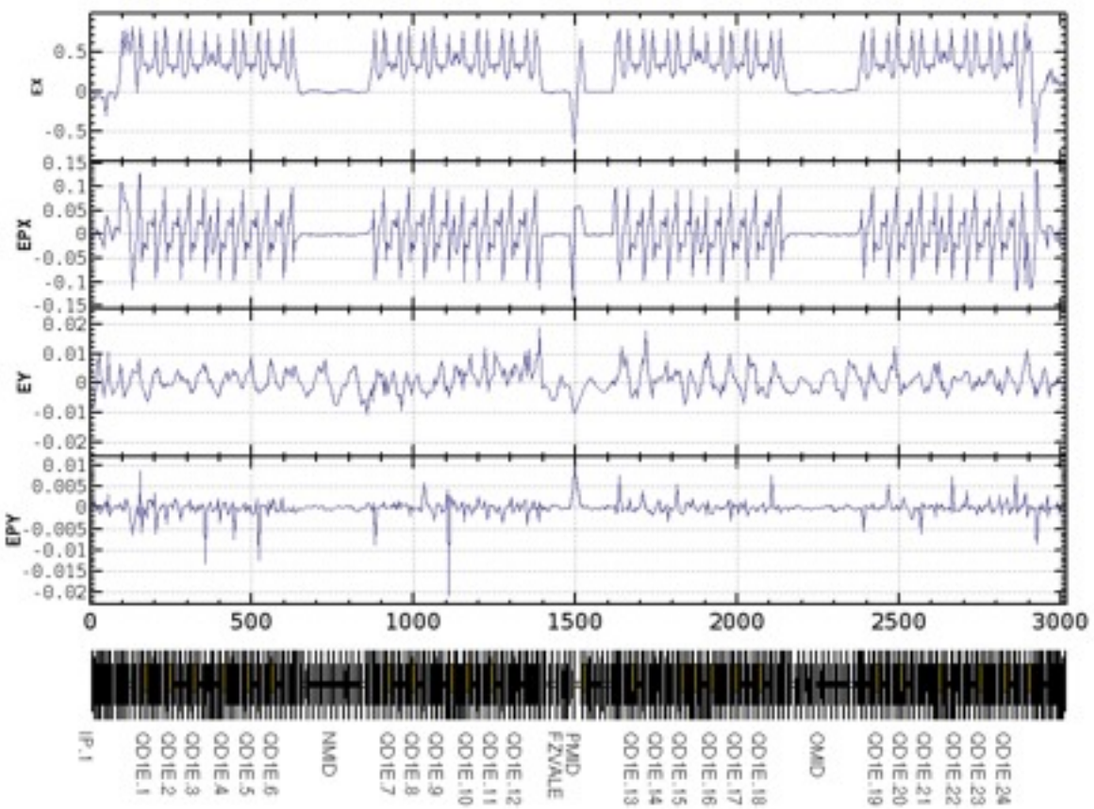
r_1

r_2

r_3

r_4





wiggler

Lambertson
(skew dipole)

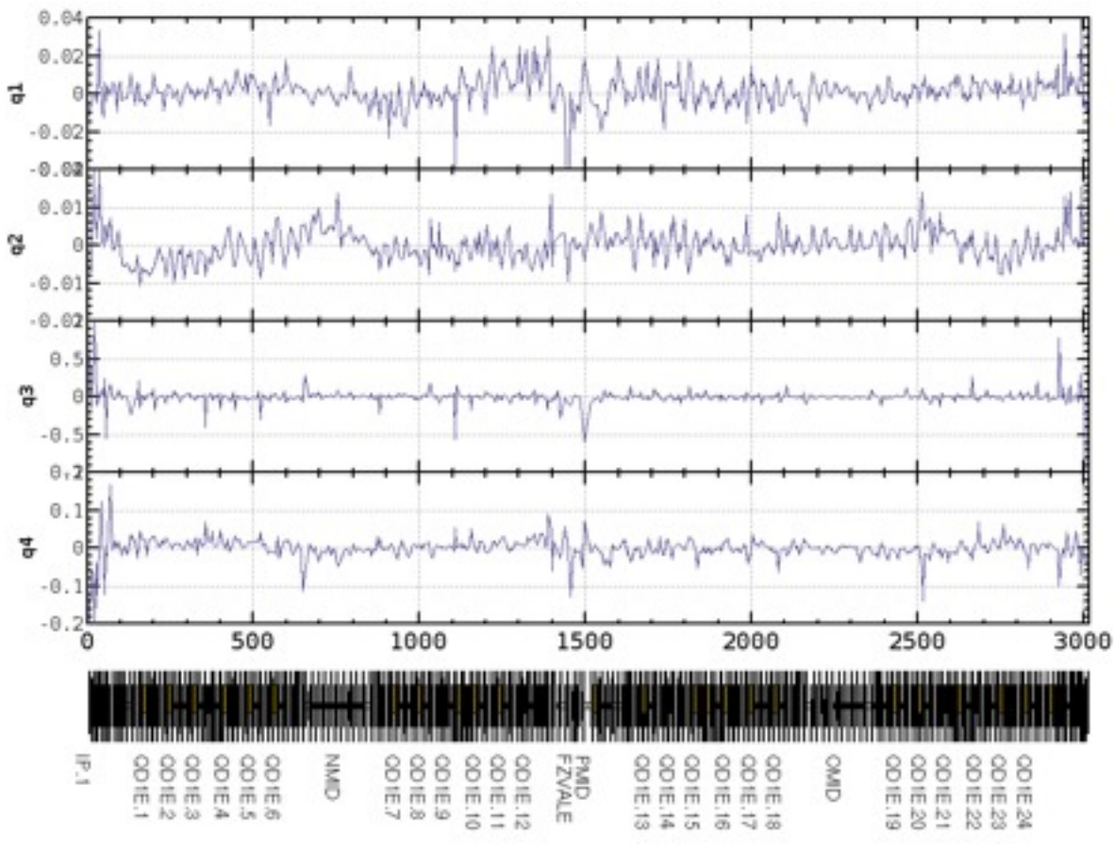
η_y should be corrected.

q_1

q_2

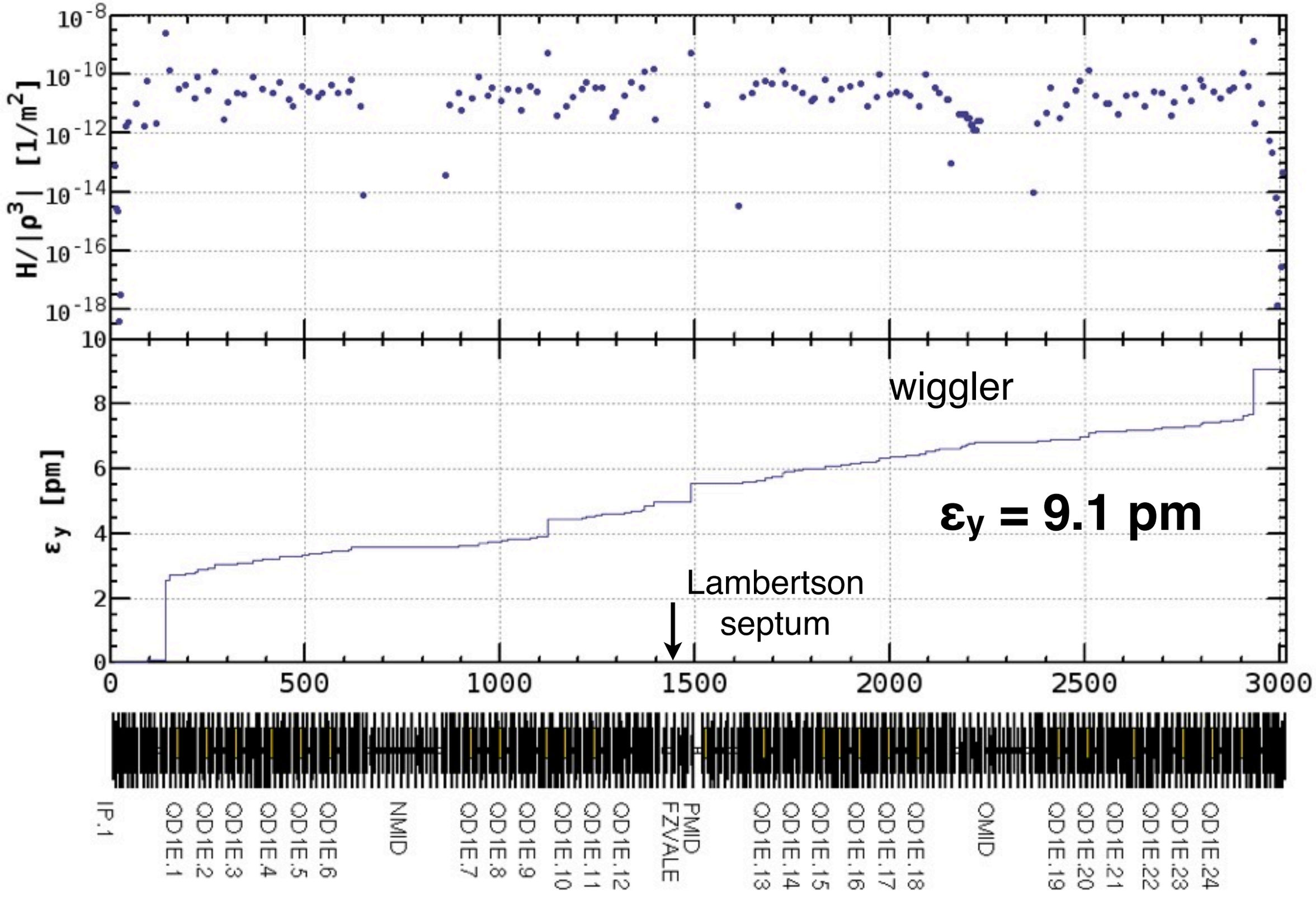
q_3

q_4



X-Y coupling is well corrected.

Estimation of Vertical Emittance in HER



Summary

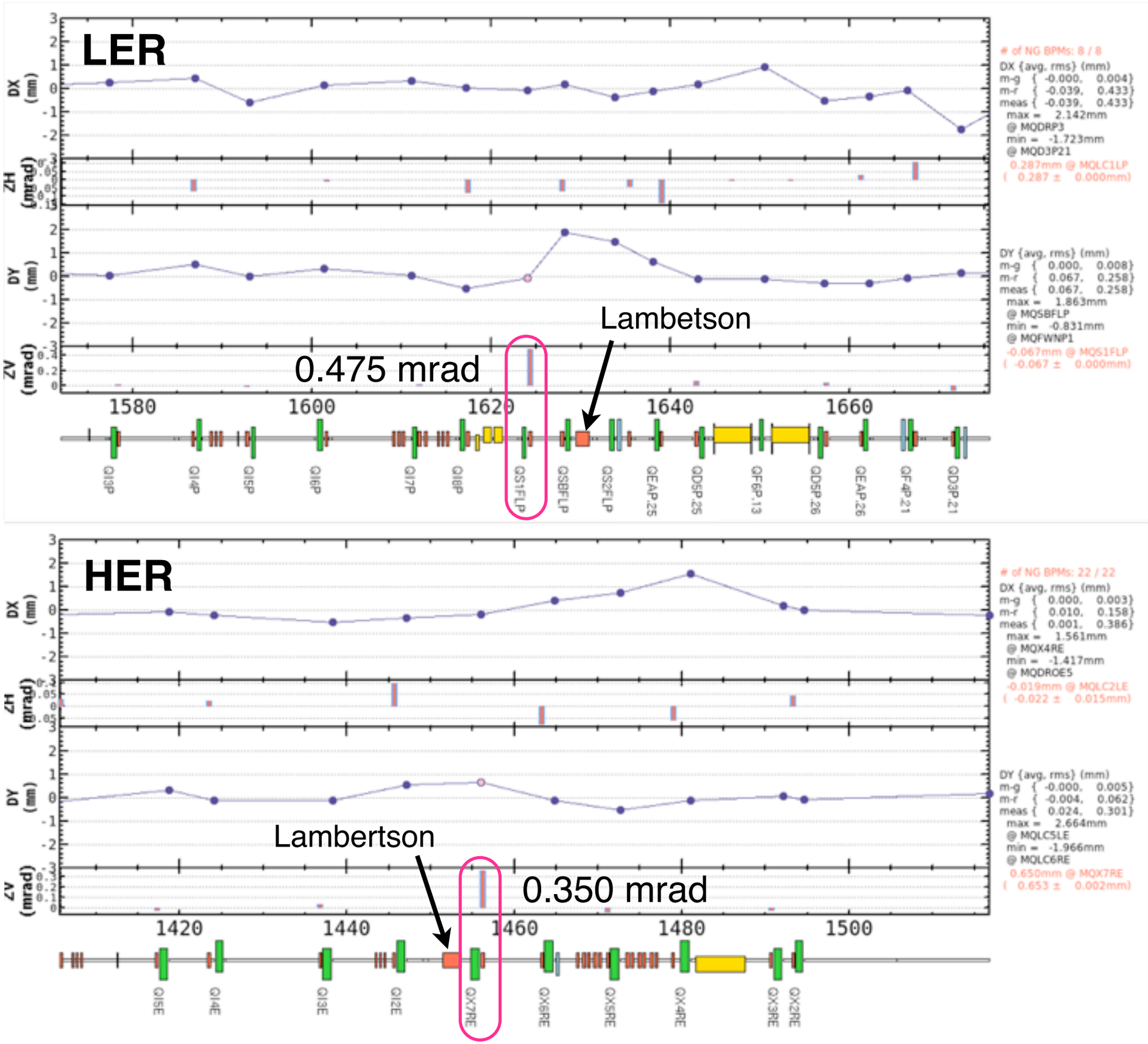
- The vertical emittance is the most important parameter in the nano-beam scheme. The target is less than 10 pm (desired value is 5 pm).
- Lambertson leakage skew quad. field is successfully corrected by installing the permanent skew quad. in LER.
- The vertical emittance is estimated by the optics measurement data;
  - ε_y = 7.2 pm in LER, ε_y = 9.1 pm in HER
- The vertical emittance is also obtained from X-ray beam size monitor;
  - ε_y = ~10 pm in LER, ε_y = ~120 pm in HER
- The vertical emittance in LER is almost consistent with X-ray monitor, however the big discrepancy in HER is found. How to confirm ?

Appendix

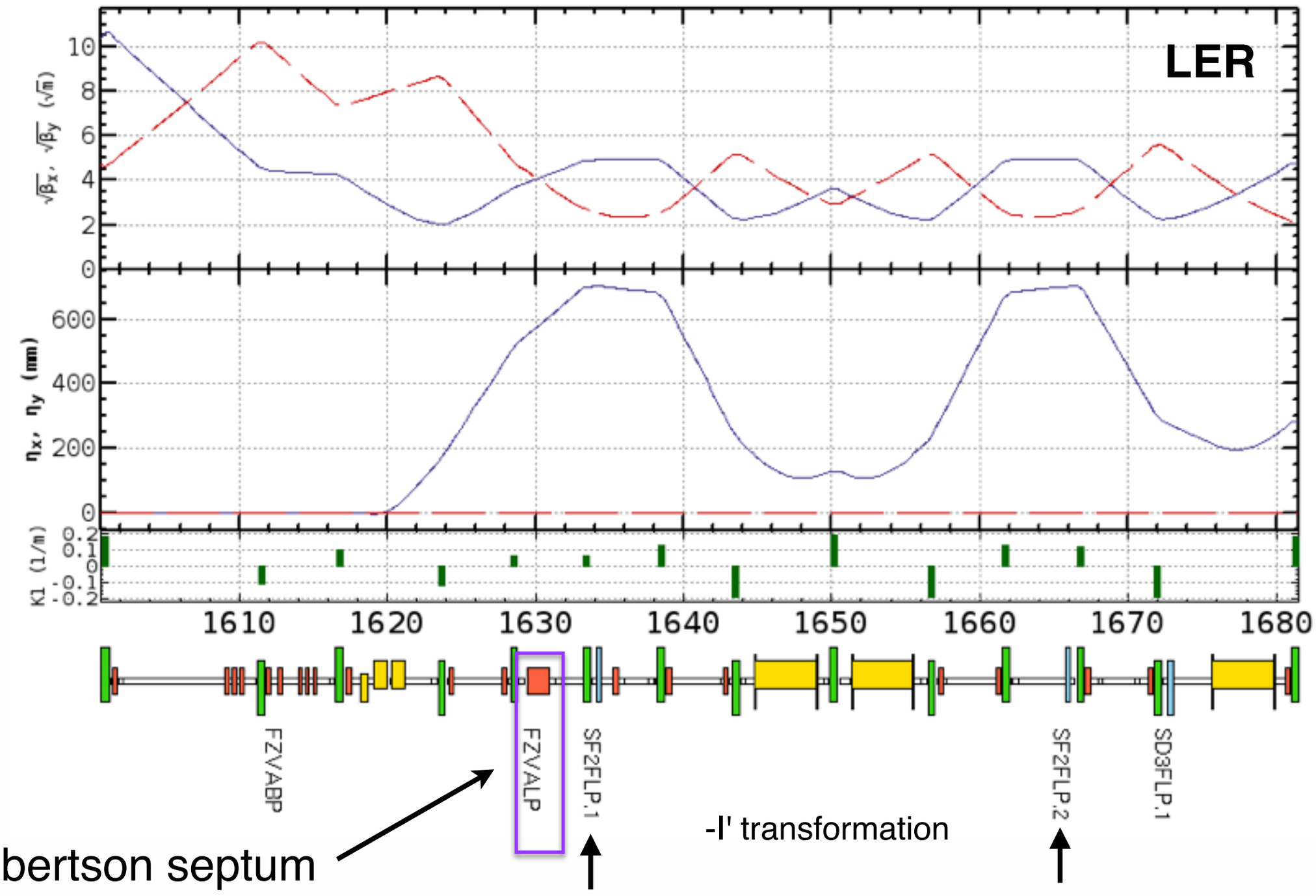
Machine Parameters at Phase-I

Parameter	LER	HER
E [GeV]	4	7
I [mA]	890	810
n_b	1576	1576
ε_x [nm]	1.8	4.6
α_p	2.45x10^{-4}	4.44x10^{-4}
σ_δ	7.72x10^{-4}	6.30x10^{-4}
V_c [MV]	7.56	12.61
U_0 [MeV]	1.76	2.43
τ_s [msec]	23	29
σ_z [mm]	4.6	5.3
ν_s	-0.0192	-0.0251
ν_x	44.555	45.572
ν_y	46.595	43.589

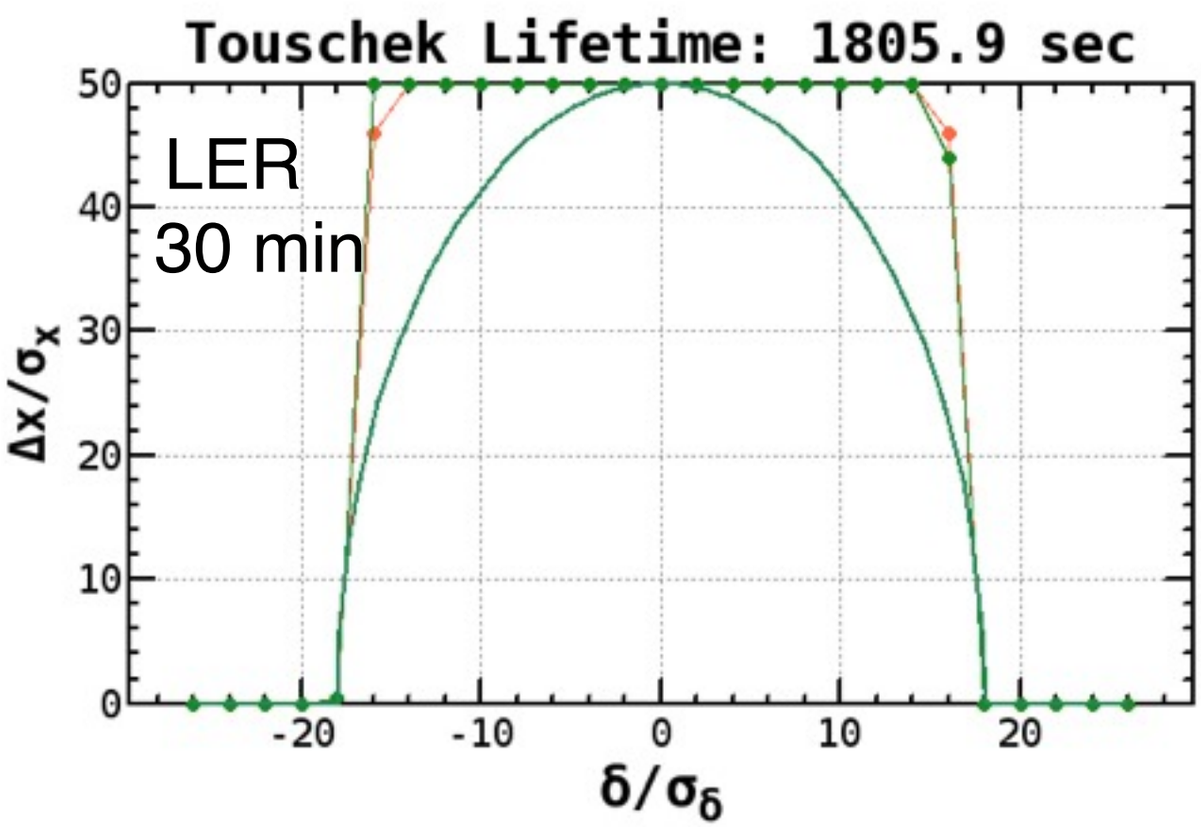
Orbit at Lambertson Septum



Lambertson in LER



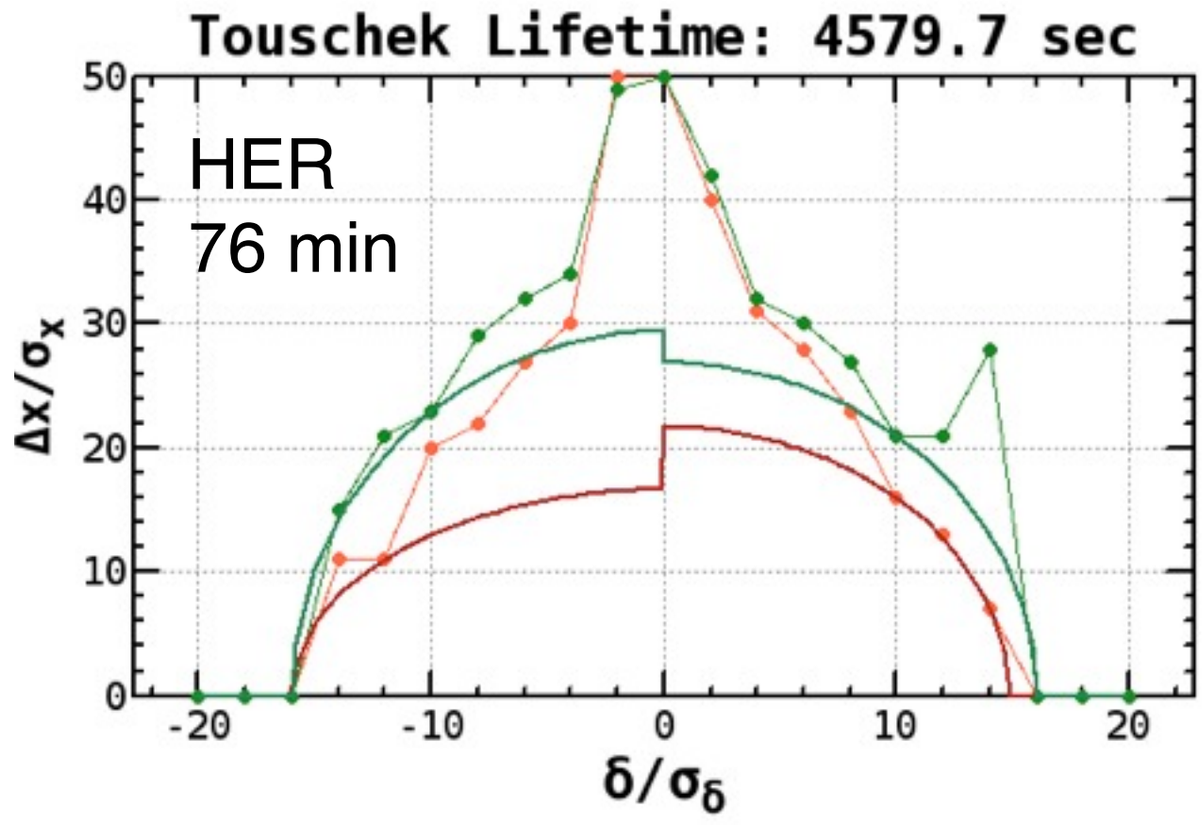
Dynamic Apertrue



$\varepsilon_y/\varepsilon_x$ = 0.4 %

(ε_x = 1.8 nm, ε_y =7.2 pm)

I_b = 0.34 mA



$\varepsilon_y/\varepsilon_x$ = 0.2 %

(ε_x = 4.6 nm, ε_y =9.1 pm)

I_b = 0.34 mA