Measuring Beam Size with Sextupoles

Average Kick on Beam from Sextupole Field

$$\Delta p_x = -\tfrac{1}{2}\,\Delta K_2\, L\sigma^2$$

$$\sigma^2 = -(2\Delta p_x) / (\Delta K_2 L)$$

Ariel Shaked (ags232)

Cornell ERL/EIC Group

9/26/2022

Δp_x: The change in the centroid value between the exit of the sextupole, from the centroid value at the end of the element upstream

$$(p_{x,\text{ sextupole exit}} - p_{x,\text{ element upstream}})$$

ΔK: The change in the sextupole strength when it is turned off

$$(0 - K_{original})$$

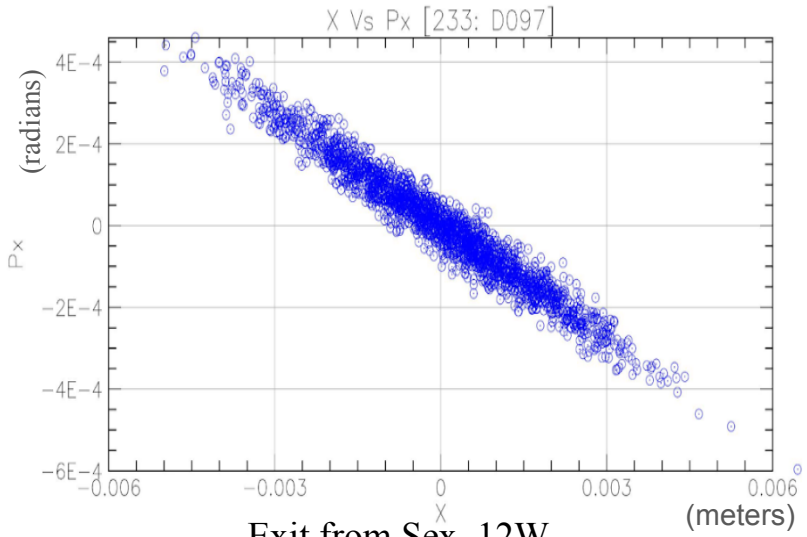
- No average kick when sextupole is turned off because avg position of bunch is in the center of the sextupole

L: Length of Element

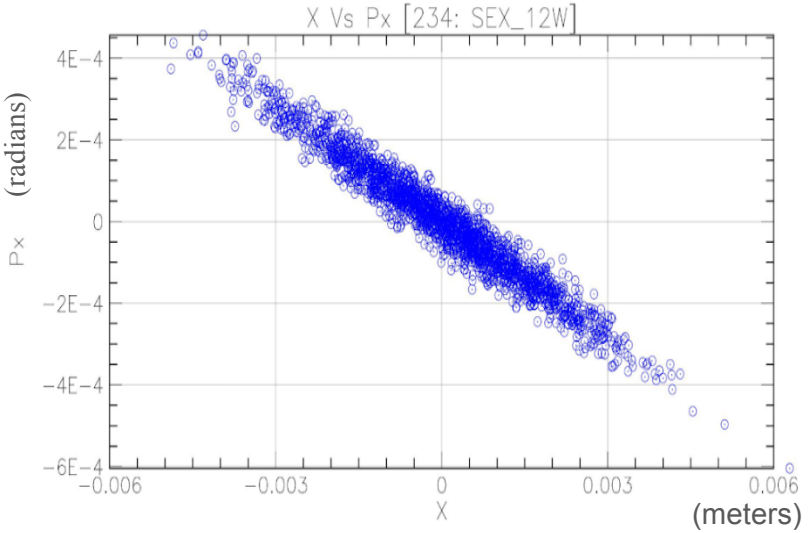
σ: Beam Size

Visualizing the beam with Tao: x – p_x Phase Space

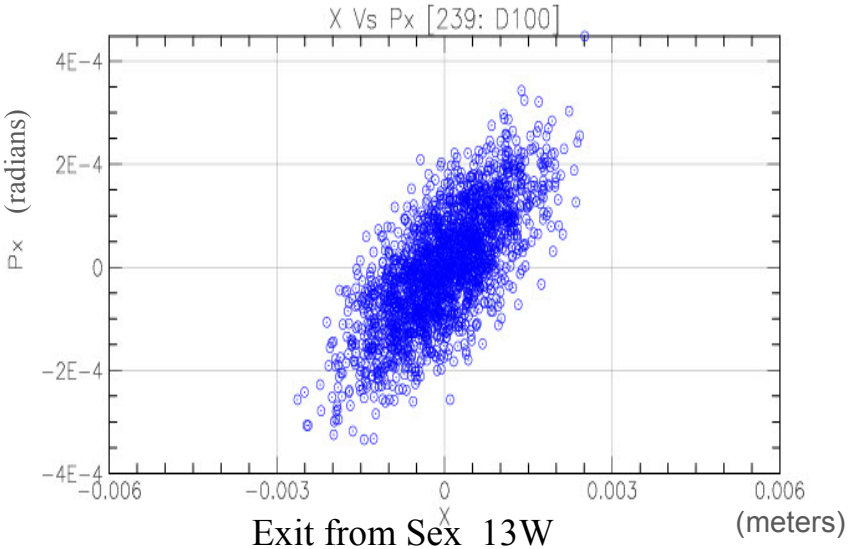
Entrance to Sex_12W



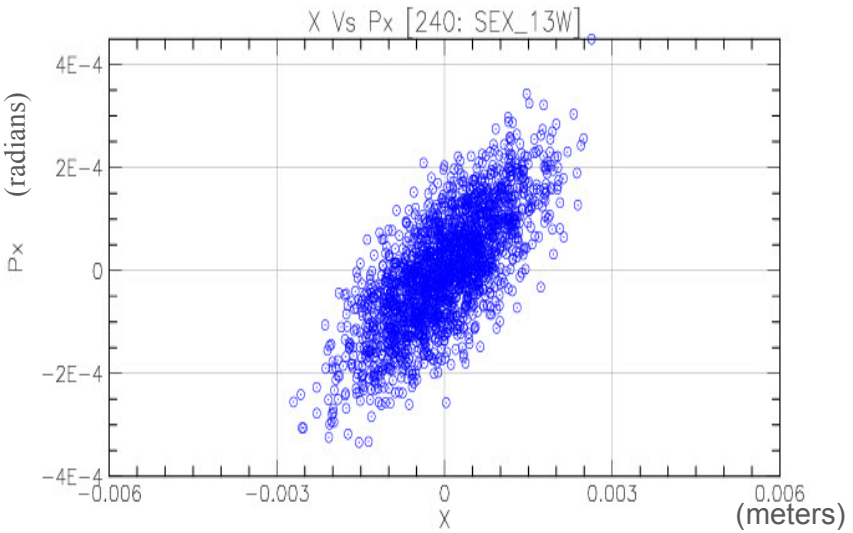
Exit from Sex_12W



Entrance to Sex_13W



Exit from Sex_13W



sex 12W

K_2L decreases from positive value to zero

$\rightarrow \Delta K_2 L < 0$

Angle Change in Sextupole decreases from positive value to zero

$\rightarrow \Delta p_x < 0$

$\Delta K_2 L$ and Δp_x have the same sign

$\rightarrow \sigma^2 > 0$

$\Delta p_x = (4.23 - 8.92)e\text{-}7$

$= -4.69\ e\text{-}7$

$\Delta K_2 L = -0.369\ m^{-2}$

$\sigma = 1.59$ mm

sex 13W

K_2L increases from negative value to zero

$\rightarrow \Delta K_2 L > 0$

Angle Change in Sextupole increases from negative value to zero

$\rightarrow \Delta p_x > 0$

$\Delta K_2 L$ and Δp_x have the same sign

$\rightarrow \sigma^2 > 0$

$\Delta p_x = (1.36 - (-9.77))e\text{-}8$

$= +11.13\ e\text{-}8$

$\Delta K_2 L = +.318\ m^{-2}$

$\sigma = .837$ mm

$\sigma^2 > 0$ in both cases