Two-dimensional Beam Size Analysis with Sextupoles

(Include $Y_0 \neq 0$, $\sigma_Y \neq 0$)

Bmad manual section 16

Assuming initial $K_2L = 0$ and including second and third order terms:

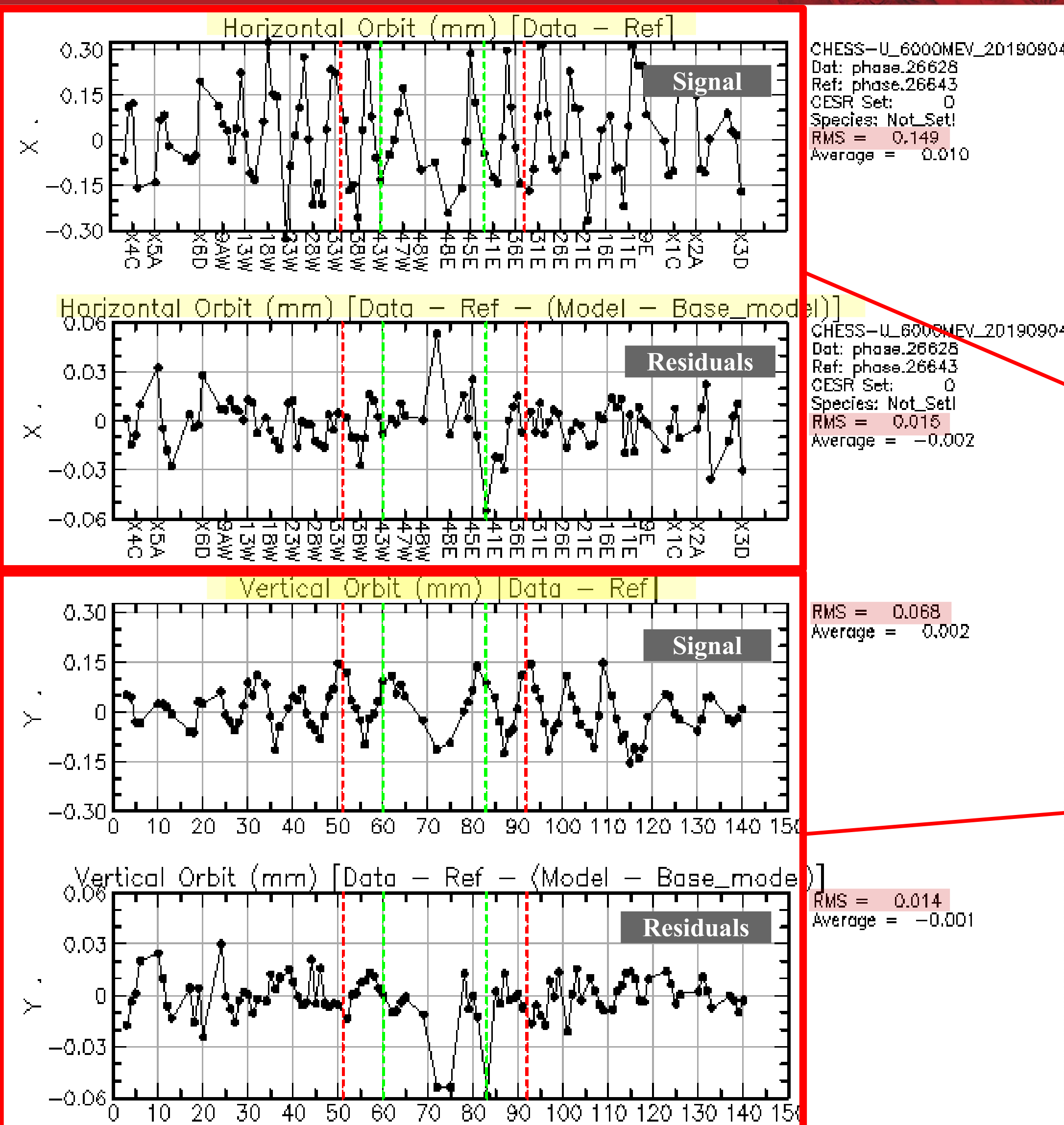
$$\sigma_X^2 - \sigma_Y^2 = -2\,\frac{\Delta p_X}{\Delta K_2 L} + \left(\frac{\Delta p_Y}{\Delta K_2 L}\right)^2 \left(\frac{\Delta K_1 L}{\Delta K_2 L}\right)^{-2} - \left(\frac{\Delta K_1 L}{\Delta K_2 L}\right)^2$$

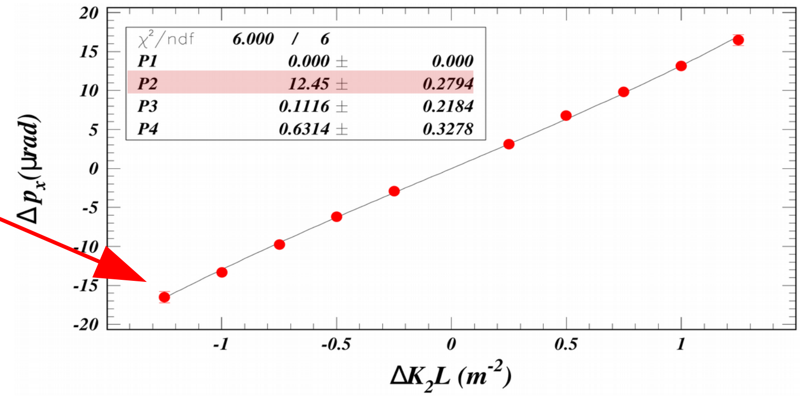
Linear terms only:

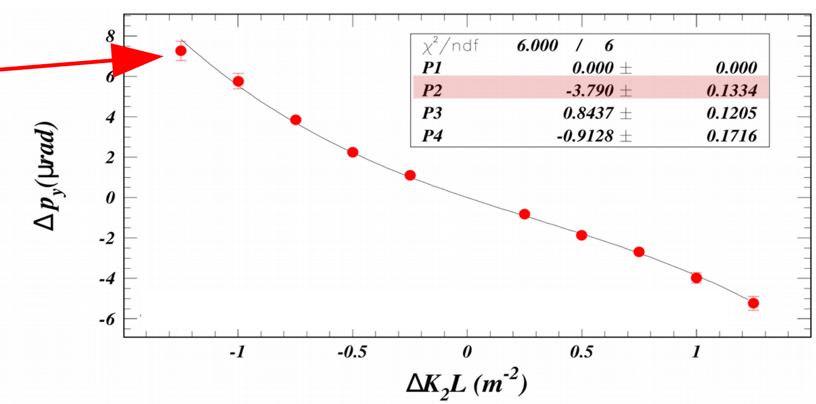
$$\sigma_X^2 - \sigma_Y^2 = -2\,\frac{\Delta p_X}{\Delta K_2 L} + Y_0^2 - X_0^2$$

Jim Crittenden
Bazarov/Rubin group meeting
8 December 2021

H and V Orbit Kicks







Beam size
Example of 10aw February data

Three equations, four unknowns:

$$\Delta K_1 L = \Delta K_2 L \, (X_0 + \Delta \mathrm{x})$$

$$\Delta p_{\mathrm{Y}} = \Delta K_2 L \, (X_0 + \Delta \mathrm{x}) \, (Y_0 + \Delta \mathrm{Y})$$

$$2 \, \Delta p_{\mathrm{X}} = \Delta K_2 L \left[\left(\frac{\Delta p_{\mathrm{Y}}}{\Delta K_2 L} \right)^2 \left(\frac{\Delta K_1 L}{\Delta K_2 L} \right)^{-2} + \sigma_{\mathrm{Y}}^2 - \left(\frac{\Delta K_1 L}{\Delta K_2 L} \right)^2 - \sigma_{\mathrm{X}}^2 \right]$$

X_0 = -4.945 +- 0.023 mm (from $\Delta K_1 L$ fit to H and V phase difference)

$X_0 Y_0$ = -3.79 +- 0.13 mm^2

Y_0 = 0.766 +- 0.26 mm

$\sigma_X^2 - \sigma_Y^2 = 2*12.45 + Y_0^2 - X_0^2 = 1.03$ +- 0.53 mm^2