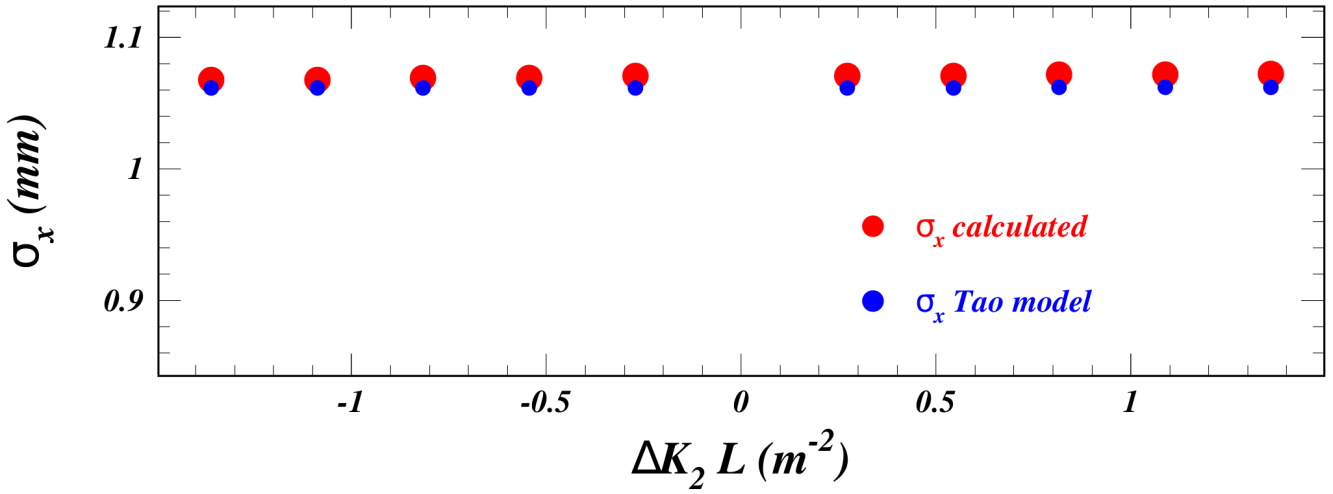
First Results from the Tao Model for Measuring Beam Size with Sextupole Magnets



The sextupole strength scan method works very well for the CESR design lattice.
Sextupoles are at design settings for chromaticities = 1.
The beam is close to on axis and there are no misalignments except for the scanned sextupole.

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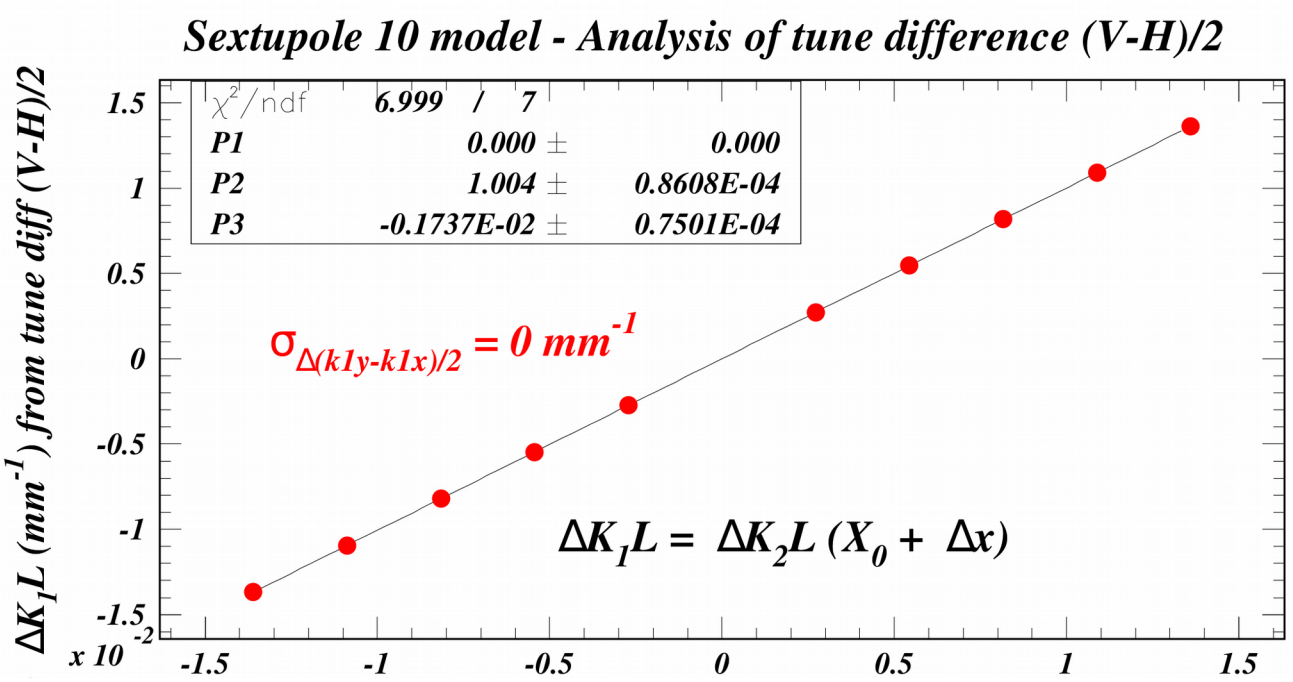
X_0 from the tunes

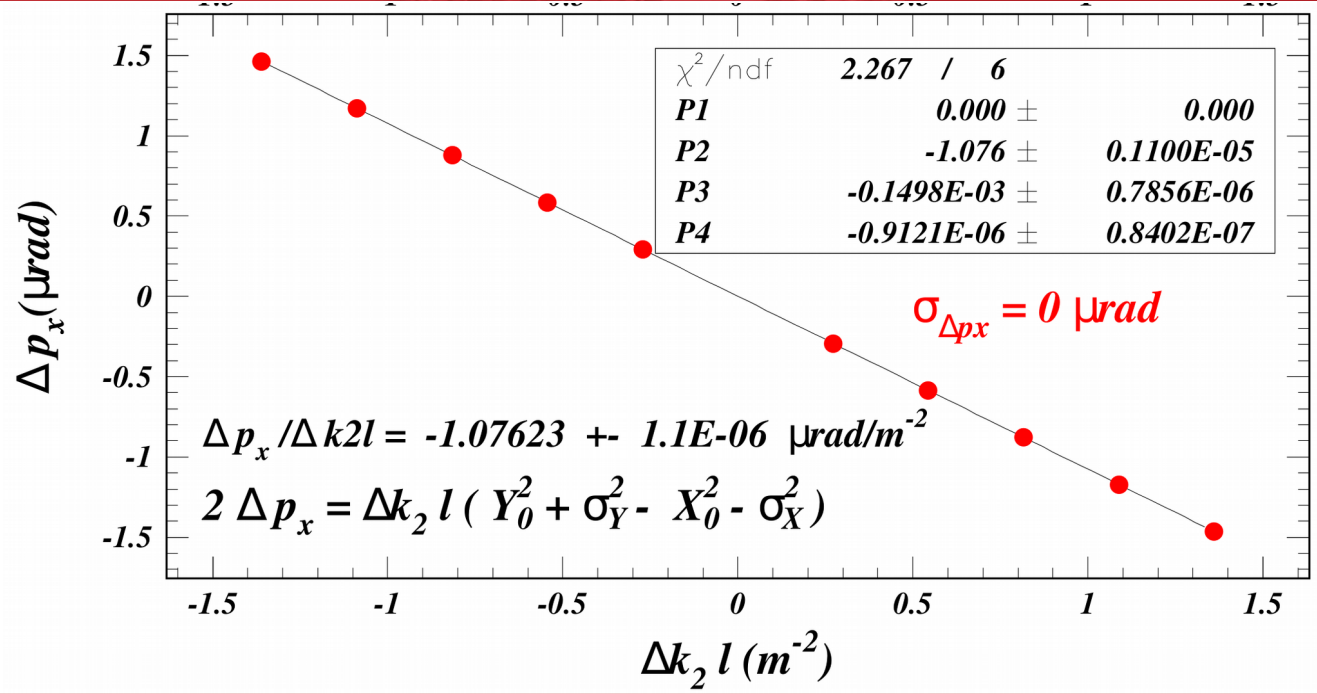


Tao model: track 2k positrons through the CESR design lattice.

Put 1 mm horizontal misalignment in CESR sextupole 10AW.
Choose 11 K2 settings and for each write out tunes and sextupole attributes including beam coordinate centroid and RMS values at the sextupole.

We use our IPAC22 trick of subtracting beta-weighted H and V tunes to remove coupling contributions (Eq. 14). This model also proves that the trick works.
Since the beam is on-axis, we recover the 1-mm offset with an error of 4 microns.

$\Delta p_x / \Delta K_2 L$ from the beam centroid value



Calculated horizontal beam size:

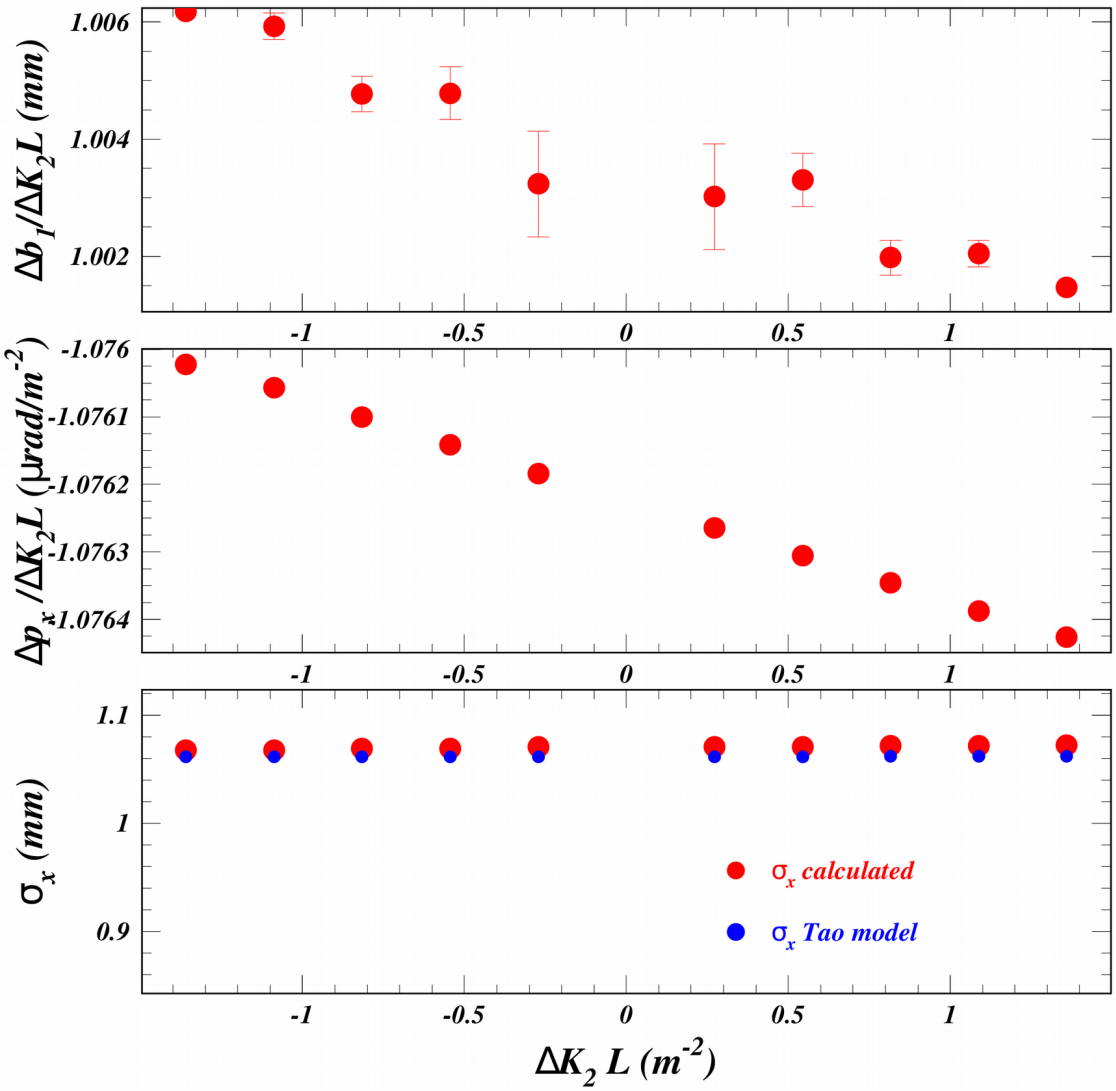
$$\sigma_x^2 = -2\,\Delta p_x / \Delta k_2 l - X_0^2 = -2*-1.076 - 1.004^2 = 1.145\ \text{mm}^2$$

$$\Longrightarrow \sigma_x = 1.070\ \text{mm}.$$

The Tao modeled value (beam X coordinate RMS at the sextupole) is 1.062 mm.

Nonlinear effects are present but small

Sextupole 10 model - Δb_1 and Δp_X from tune and beam centroid analyses



The calculated horizontal beam size exhibits very little dependence on the magnitude of the K_2 change.