



Beam Size Measurements Using Sextupole Magnets in the Cornell Electron/Positron Storage Ring*

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Lorentz force equation

$$\vec{F} = q \vec{v} \times \vec{B}$$

Sextupole magnetic field

$$B_y(\mathbf{x}) = B_0 x^2$$

Beam bunch Gaussian charge distribution

$$q = q_0 \int_{-\infty}^{+\infty} \exp\left(-\frac{(x - x_0)^2}{\sigma^2}\right) dx$$

Average force on the charge distribution

$$\begin{aligned} \langle F_x \rangle_{x_0, \sigma} &= q_0 c B_0 \int_{-\infty}^{+\infty} x^2 \exp\left(-\frac{(x - x_0)^2}{\sigma^2}\right) dx \\ &= q_0 c B_0 (x_0^2 + \sigma^2) \end{aligned}$$

1) Original idea, seminal work

2) Basic storage ring physics formalism

3) Measurements February/2021-May/2022 now available for the 76 CESR sextupole magnets

4) Data analysis software infrastructure exists

This REU Project

* Perform data analysis

* Evaluate measurement accuracy and theoretical limits

* Prepare for publication

Jim Crittenden and Suntao Wang
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