

2021 CHESS-U REU Project

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

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Lorentz force equation

 $ec{F} = q ~ec{\mathrm{v}} imes ec{B}$

Sextupole magnetic field

$$B_{\mathrm{y}}(\mathrm{x}) = B_{\mathrm{y}}^{''}\,\mathrm{x}^2$$

Beam bunch Gaussian charge distribution

$$q = q_0 \int \limits_{-\infty}^{+\infty} \exp\left(rac{-\left(\mathrm{x}-\mathrm{x}_0
ight)^2}{\sigma^2}
ight) \mathrm{dx}$$

Average force on the charge distribution

$$egin{aligned} &\langle F_{\mathrm{x}}
angle_{\mathrm{x}_{0},\sigma} \,=\, q_{0} \; B_{\mathrm{y}}^{\prime\prime} \int\limits_{-\infty}^{+\infty} \mathrm{x}^{2} \exp\left(rac{-\left(\mathrm{x}-\mathrm{x}_{0}
ight)^{2}}{\sigma^{2}}
ight) \mathrm{dx} \ &=\, q_{0} \; B_{\mathrm{y}}^{\prime\prime} \left(\mathrm{x}_{0}^{2}+\sigma^{2}
ight) \end{aligned}$$

1) Original idea, potentially seminal work

2) Basic accelerator physics formalism

3) Measurements February-May now available for all 76 CESR sextupole magnets

4) Data analysis software infrastructure exists

This REU Project

* Perform data analysis
* Evaluate/quantify measurement accuracy
* Prepare for publication

Jim Crittenden and Suntao Wang CLASSE 2021 REU Mentor Introductions 7 June 2021 *12th International Particle Accelerator Conference May 24-28, 2021, Campinas, Brazil (remote) J.A. Crittenden et al, Abstract MOPAB254