CHESS 6x5 e+/e- Vertical Beam Size

At the CHESS energy and train pattern (6x5) the relative vertical beam size change as a function of current was measured with the PMT array on 4/24/2006.

Measurements

I. CHESS e+ 6x5 vertical beam size and tune

II. CHESS e- 6x5 vertical beam size and tune

III. Summary

R. Holtzapple, M. Billing, G. Codner, J. Kern, M. Palmer, E. Tanke
I. CHESS 6x5 e+ Vertical Beam Size and Tune

e+ 6x5 PMT set for 100 turn average/10K turns.

Vertical beam size and tune was measured at I=1, 2, 4, and 8mA/bunch.

I=1mA/bunch

Positive tune shift and $\sigma_v$ reduction from front to back of each train.

$\bar{y} = 17.4 \pm 0.6$ pixels

$\bar{\sigma}_v = 3.0 \pm 0.2$ pixels

Centroid and $\sigma_v$ for 6x5 pattern (100 measurements for each bunch)
$\sigma_v$ decreases from front to back of the train.

Tune shift along the train does not correlate with bunches in each train.

$\bar{y} = 18.3 \pm 0.6$ pixels

$\sigma_v = 3.0 \pm 0.1$ pixels

$\Delta v_v \sim 0.3$ kHz
All zero's occurred on the same turn.

$e^+ I=4mA/bunch$  

Bunch 1 train 1 $\sigma_v$ is 2-3 times larger than other bunches.

Front to back tune shift along each train (bunch 4 & 5 have the same tune)

Train 1 Bunch 1

Train 1 Bunch 2

$\Delta v_v \sim 0.6kHz$

All zero's occurred on the same turn.
Bunches with $\nu_v \sim 241.5 \text{kHz}$ have 50% larger $\sigma_v$ (resonance).

Bunches with $\nu_v \sim 241.7 \text{kHz}$ have slightly larger $\sigma_v$ (close to resonance).

Strong vertical tune shift $\sim 1.5 \text{kHz}$ along each train.

$y = 22.8 \pm 0.7$ pixels

$\Delta \nu_v \sim 1.5 \text{kHz}$
Bunch 2 train 1, bunch 1 train 2-6 with $v \approx 241.5$ kHz

Bunch 2 train 2-5 with $v \approx 241.7$ kHz

All other bunches

$\sigma_v$ changed during the measurement
II CHESS e- Vertical Beam Size

e- 6x5  100 turn average/10K turns.

Vertical beam size measured at I=1, 2, 4, and 7.5 mA/bunch.

e- I=1mA/bunch

Slight $\sigma_v$ growth along each train

Vertical tune reduction along each train.

$\bar{y}=13.19\pm0.05$ pixels

$\bar{\sigma}_v=1.1\pm0.1$ pixels

$\Delta \nu_v \sim -0.1$kHz
\( e^- I=2\text{mA/bunch} \)

\( \sigma_v \) growth along each train

\( \Delta \nu_v \sim -0.2 \text{kHz} \) shift along each trains.

\( \bar{y} = 13.01 \pm 0.03 \text{ pixels} \)

\( \bar{\sigma}_v = 1.0 \pm 0.1 \text{ pixels} \)
e- I=4mA/bunch

Significant $\sigma_v$ growth along each train. $\sigma_v$ increased by $\sim80\%$ from the I=2mA/bunch measurement.

Negative tune shift along each train. Large tune shift between bunch 3 and 4.

$\bar{y}=13.60\pm0.09\text{ pixels}$

$\bar{\sigma}_v=1.8\pm0.2\text{ pixels}$

$\Delta\nu_v\sim-0.5\text{kHz}$
\textbf{e-} \textit{I}=7.5\text{mA/bunch}

Factor of 2.5 $\sigma_v$ increase between bunch 1 and bunches 2-5.

Strong negative tune shift along each train.

$\Delta \nu_v \sim -0.8\text{kHz}$
$\bar{\sigma}_v = 3.3 \pm 0.1$ pixels, $\bar{y} = 13.91 \pm 0.03$ pixels

Bunch 2 train 1 movie $I = 7.5\text{mA/bunch}$

$\bar{\sigma}_v = 1.3 \pm 0.1$ pixels, $\bar{y} = 14.33 \pm 0.03$ pixels

Bunch 1 train 1 movie $I = 7.5\text{mA/bunch}$
Summary

CHESS 6x5 e+ trains:

• The vertical tune shift along each train increased with bunch current. With I=8mA/bunch, the vertical tune shift is ~1.5 kHz which can be large enough to cross a tune resonance.

• The vertical beam size decreases along each train.

CHESS 6x5 e- trains:

• A negative vertical tune shift along each train was measured that increases with current.

• As the bunch current is increased the vertical beam size along the train increases.