CESR-c e- Cloud Machine Studies
e+ with witness bunch
3/13/2007

## Introduction

e- cloud witness bunch measurements were made at the CESR-C operating energy with only e+ present in CESR.

Turn-by-turn vertical beam distribution measurements were made using the photomultiplier tube array. The vertical distribution was measured for 8192 turns with an e+ train of 10 bunches and e+ witness bunches located behind the main train.

The e+ bunch current was $0.75 \mathrm{~mA} / b u n c h$ (on average). The e-feedback was off and the horizontal/vertical separators were off.

Displayed on the following slides is a movie of the turn-by-turn mean vertical position and beam size as well as the FFT of these quantities. The main 10 bunch train is displayed first in the movie and FFT. The witness bunches are displayed in order from closest to furthest from the main train.


FFT of mean vertical position from $242.0-249.8 \mathrm{kHz}$
e+ vertical dynamics
Witness bunch 42
File: 1045


File: 1046


FFT of mean vertical
position from 242.0-249.8 kHz

e+ vertical dynamics Witness bunch 42 File: 1046

FFT of mean vertical position from $35-39 \mathrm{kHz}$
bsm23e01046 results
Strong signal at $v_{s}$


FFT of mean vertical bsm23e01047r results position from $242.0-249.8 \mathrm{kHz}$

bsm23e01047 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01047 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics Witness bunches 38,42 File: 1047


File: 1048



FFT of mean vertical bsm23eel1048 results position from $242.0-249.8 \mathrm{kHz}$


FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01048 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

Witness bunches 34,38,42

File: 1048


FFT of mean vertical bmpzeocousemenses position from $242.0-249.8 \mathrm{kHz}$

bsm23e01049 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsmzeoloas resuls position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches $30,34,38,42$
File: 1049


Witness bunches $28,30,34,38,42$
File: 1050
bsm23e01050 results


FFT of mean vertical bsm23ee01050 results position from $242.0-249.8 \mathrm{kHz}$

bsm23e01050 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01050 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 28,30,34,38,42
File: 1050

Bunch
10 bunches + witness bunches $\quad \mathrm{I}=0.75 \mathrm{~mA} /$ bunch


e+ Single Bunch Current
10 bunches + witness bunches




FFT of mean vertical bmpzenomsinemes. position from $242.0-249.8 \mathrm{kHz}$

bsm23e01051 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm2zeolostresulus position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$


Bunch
e+ vertical dynamics
Witness bunches 26,28,30,34,38,42
File: 1051


e+ vertical dynamics
Witness bunches $26,28,30,34,38,42$
File: 1052
bsm23e01052 results


FFT of mean verticalbsm23e01052results position from $242.0-249.8 \mathrm{kHz}$

bsm23e01052 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical position from $35-39 \mathrm{kHz}$

e+ vertical dynamics
Witness bunches 26,28,30,34,38,42 File: 1052


e+ vertical dynamics
Witness bunches $22,25-26,28,30,34,38,42$
File: 1053
bsm23e01053 results

| $\sigma_{\mathrm{v}}$ |  |
| :--- | :--- | :--- |
| $(\mathrm{mOVie})$ | 1400 |
| FFT $\sigma_{\mathrm{V}}$ | 1200 |

 position from $242.0-249.8 \mathrm{kHz}$

bsm23e01053 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical $\quad$ bsm23eocos5s esesuls Strong signal at $v_{\mathrm{S}}$ position from $35-39 \mathrm{kHz}$

e+ vertical dynamics
Witness bunches $22,25-26,28,30,34,38,42$ File: 1053


FFT of mean vertical bmmenonssasemus. position from $242.0-249.8 \mathrm{kHz}$

bsm23e01054 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01054 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches $20,22,25-26,28,30,34,38,42$
File: 1054


FFT of mean vertical smmenomss.s.ans position from $242.0-249.8 \mathrm{kHz}$ $\times 10^{4}$

bsm23e01055 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01055 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 20,22,25-26,28,30,34,38,42
File: 1055


FFT of mean verticalssmzze0105f resulus position from $242.0-249.8 \mathrm{kHz}$

bsm23e01056 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsmzeeo1056fessults

e+ vertical dynamics
Witness bunches $19-20,22,25-26,28,30,34,38,42$
File: 1056

Bunch
e+ Mean Vertical Beam Size
10 bunches + witness bunches $\mathrm{I}=0.75 \mathrm{~mA} /$ bunch
File:1051 (bunch $1 \sigma_{\mathrm{V}}=0.315 \mathrm{~mm}$ ) Witness Bunches 26,28,30,34,38,42File:1052 (bunch $1 \sigma_{v}=0.309 \mathrm{~mm}$ ) Witness Bunches 26,28,30,34,38,42File:1053 (bunch $1 \sigma=0.315 \mathrm{~mm}$ ) Witness Bunches 22,25-26,28,30,34,38,42
$\square$ File:1054 (bunch $1 \sigma_{\mathrm{v}}=0.319 \mathrm{~mm}$ ) Witness Bunches 20,22,25-26,28,30,34,38,42
$\square$ File:1055 (bunch $1 \sigma=0.320 \mathrm{~mm}$ ) Witness Bunches $20,22,25-26,28,30,34,38,42$
$\square$ File:1056 (bunch $1 \sigma_{\mathrm{v}}=0.308 \mathrm{~mm}$ ) Witness Bunches $19-20,22,25-26,28,30,34,38,42$




Vertical mean

e+ vertical dynamics
Witness bunches 18-20,22,25-26,28,30,34,38,42
File: 1057

bsm23e01057 results


FFT of mean vertical bsm23e01057 resulus position from $242.0-249.8 \mathrm{kHz}$

bsm23e01057 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01057 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 18-20,22,25-26,28,30,34,38,42
File: 1057

 File: 1058


FFT of mean verticalssmzze01058 resulus position from $242.0-249.8 \mathrm{kHz}$

bsm23e01058 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm2eecoss results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches $17-20,22,25-26,28,30,34,38,42$
File: 1058


e+ vertical dynamics
Witness bunches 16-20,22,25-26,28,30,34,38,42
File: 1059

 position from $242.0-249.8 \mathrm{kHz}$


FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01059 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 16-20,22,25-26,28,30,34,38,42
File: 1059


FFT of mean verticalssmzeelvosoresulus position from $242.0-249.8 \mathrm{kHz}$

bsm23e01060 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm2eeco180 results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 15-20,22,25-26,28,30,34,38,42 File: 1060


e+ vertical dynamics
Witness bunches 14-20,22,25-26,28,30,34,38,42
File: 1061
bsm23e01061 results


FFT of mean vertical bsmzeeolo6i results position from $242.0-249.8 \mathrm{kHz}$

bsm23e01061 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsmzeeno6t resulus position from $35-39 \mathrm{kHz}$

e+ vertical dynamics
Witness bunches $14-20,22,25-26,28,30,34,38,42$
File: 1061


Bunch
e+ Mean Vertical Beam Size
$\square$ File:1057 (bunch $1 \sigma=0.314 \mathrm{~mm}$ ) Witness Bunches 19-20,22,25-26,28,30,34,38,42File:1058 (bunch $1 \sigma=0.318 \mathrm{~mm}$ ) Witness Bunches 17-20,22,25-26,28,30,34,38,42
$\square$ File:1059 (bunch $1 \sigma=0.310 \mathrm{~mm}$ ) Witness Bunches $16-20,22,25-26,28,30,34,38,42$
File:1060 (bunch $1 \sigma=0.316 \mathrm{~mm}$ ) Witness Bunches $15-20,22,25-26,28,30,34,38,42$ $\square$ File:1061 (bunch $1 \sigma=0.313 \mathrm{~mm}$ ) Witness Bunches $14-20,22,25-26,28,30,34,38,42$File:1062 (bunch $1 \sigma_{\mathrm{v}}=0.311 \mathrm{~mm}$ ) Witness Bunches $13-20,22,25-26,28,30,34,38,42$


10 bunches + witness bunches $\mathrm{I}=0.75 \mathrm{~mA} /$ bunch

e+ Vertical Tune 10 bunches + witness bunches $\mathrm{I}=0.75 \mathrm{~mA} /$ bunch


File 1995 Witness B19-20,22,25-26,28,30,34,38,42 $\nu_{\mathrm{y}}($ bunch1 $)=245.57 \mathrm{kHz}$
$\square$ File 1996 Witness B18-20,22,25-26,28,30,34,38,42 $\nu y_{\mathrm{y}}($ bunch $)=245.48 \mathrm{kHz}$
$\square$ File 1997 Witness B17-20,22,25-26,28,30,34,38,42 $\nu$ (bunch1) $=245.56 \mathrm{kHz}$
File 1998 Witness B16-20,22,25-26,28,30,34,38,42 $\nu($ bunch1 $)=245.64 \mathrm{kHz}$
$\square$ File 1999 Witness B15-20,22,25-26,28,30,34,38,42 $\nu$ (bunch1) $=245.51 \mathrm{kHz}$
$\square$ File 2000 Witness B14-20,22,25-26,28,30,34,38,42 (bunch1) $=245.32 \mathrm{kHz}$
e+ Single Bunch Current
10 bunches + witness bunches


Bunch
e+ Horizontal Tune



e+ vertical dynamics
Witness bunches 13-20,22,25-26,28,30,34,38,42
File: 1062
bsm23e01062 results


FFT of mean vertical bemzanouneremese position from $242.0-249.8 \mathrm{kHz}$

bsm23e01062 results
FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01062 results
position from $35-39 \mathrm{kHz}$
Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 13-20,22,25-26,28,30,34,38,42 File: 1062


e+ vertical dynamics
Witness bunches 12-20,22,25-26,28,30,34,38,42
File: 1063


FFT of mean vertical bsm23e01063 results position from $242.0-249.8 \mathrm{kHz}$


FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$

e+ vertical dynamics
Witness bunches 12-20,22,25-26,28,30,34,38,42
File: 1063


e+ vertical dynamics
Witness bunches $22,25-26,28,30,34,38,42$
File: 1064

bsm23e01064 results

FFT of mean vertical bmanzonoses mesus position from $242.0-249.8 \mathrm{kHz}$


FFT of mean vertical bsm23e01064results position from $35-39 \mathrm{kHz}$

Strong signal at $v_{\mathrm{s}}$


FFT of $\sigma_{v}$ from $242.0-249.8 \mathrm{kHz}$
Cut bunches 18-20
e+ vertical dynamics
Witness bunches 22,25-26,28,30,34,38,42
File: 1064
e+ Mean Vertical Beam Size


$\square$ File 2001 Witness B13-20,22,25-26,28,30,34,38,42 $\nu_{\mathrm{x}}$ (bunch1) $=203.39 \mathrm{kHz}$File 2000 Witness B12-20,22,25-26,28,30,34,38,42 $\nu_{x}($ bunch1 $)=203.40 \mathrm{kHz}$
0.8
0.6
0.4
0.2

0
-0.2


Bunch

