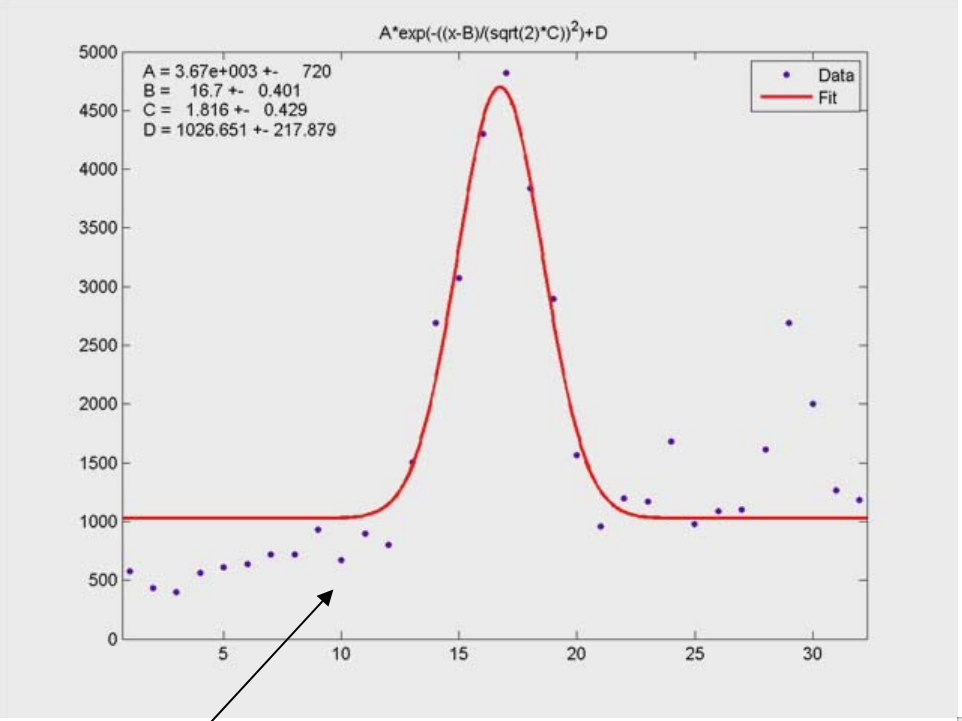
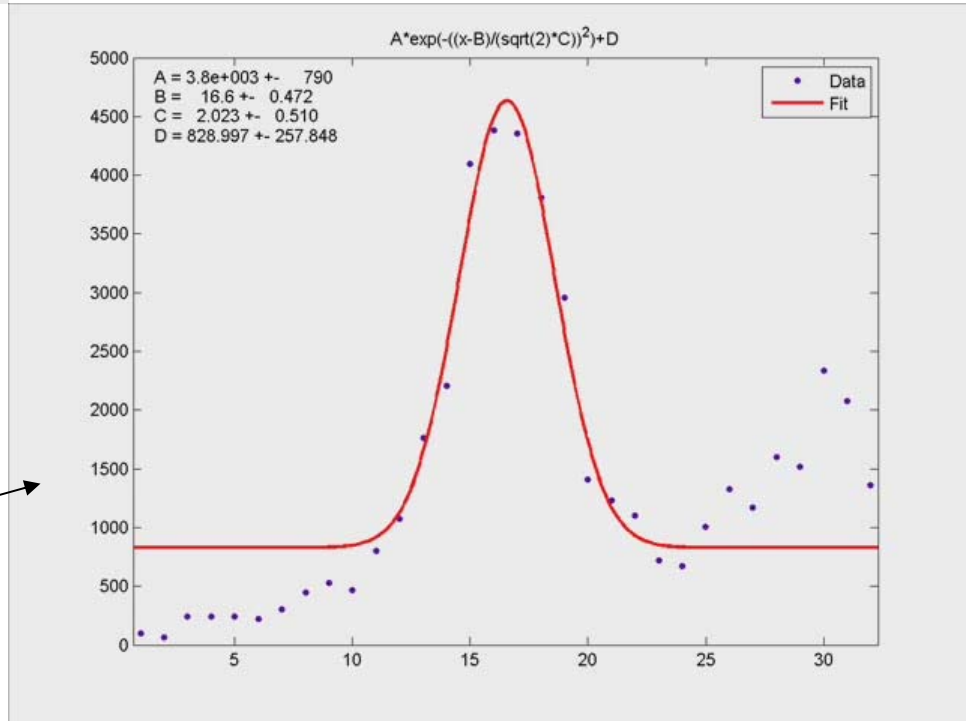
III. e- turn-by-turn measurements

e- single bunch vertical bunch distributions from the PMT array.

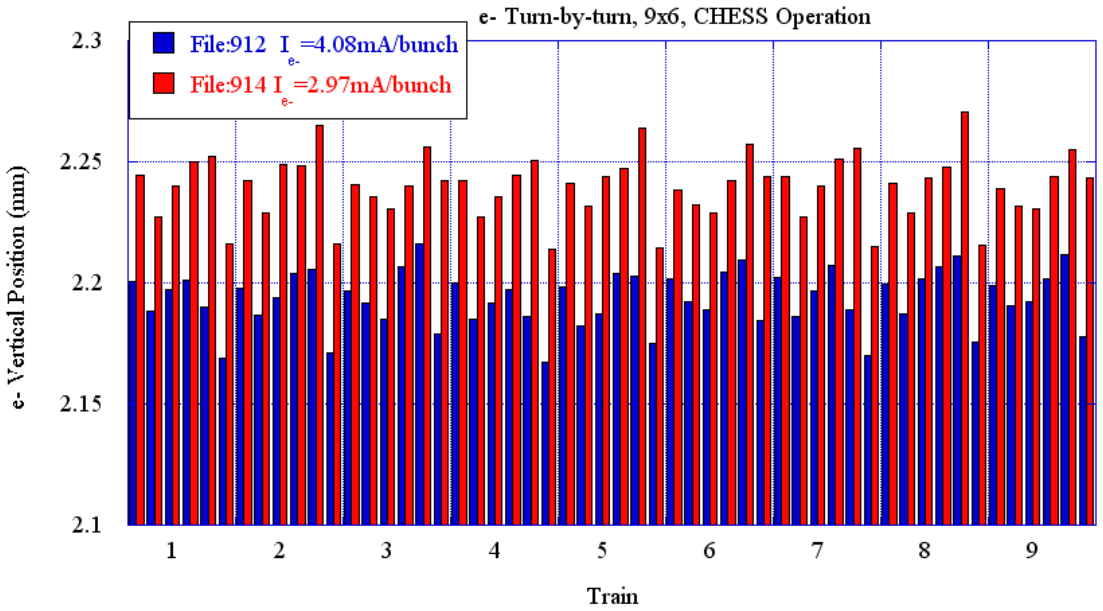
- 9,000 turns of all 54 e+/e- bunches.
- High I File:912 I_{e-}=4.08mA/bunch



e- Bunch 1 Train 1
1st ten turns (movie)



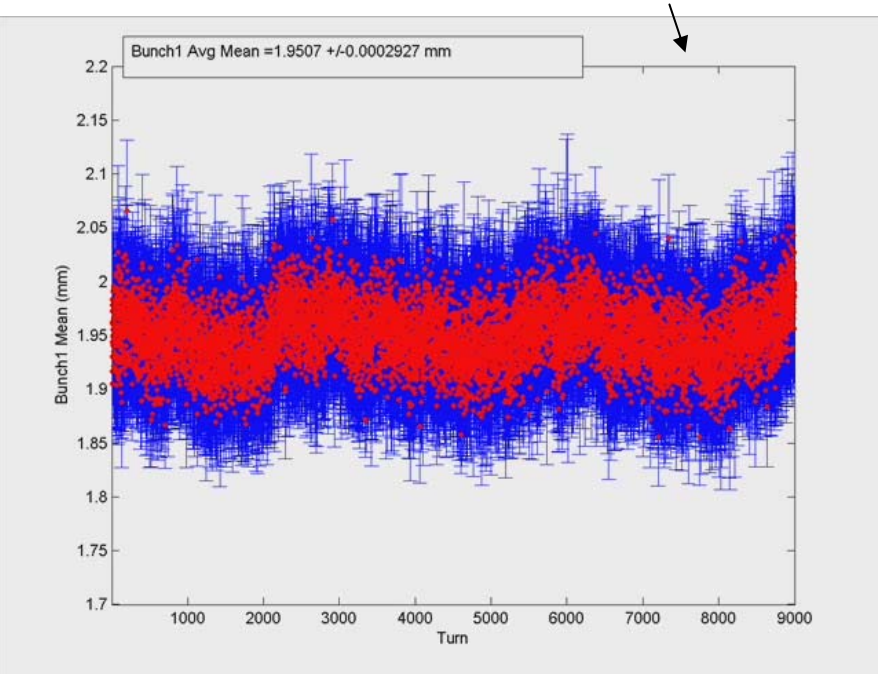
e- Bunch 6 Train 2
1st ten turns (movie)



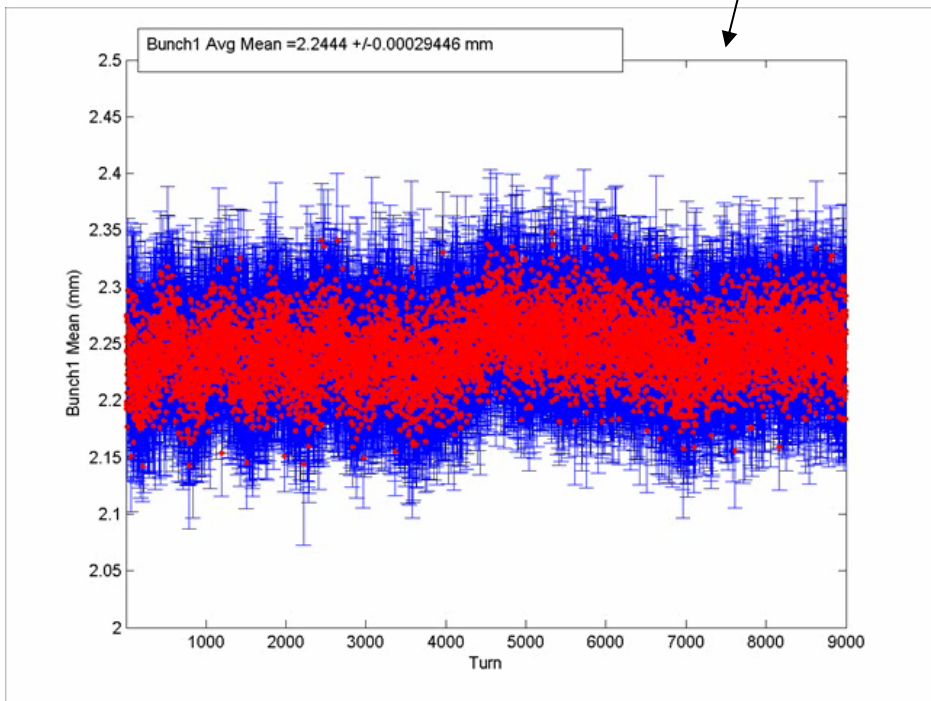
e- Vertical Position

- e- mean vertical position along the train-offset was included to have the plots coincide.
- Mean vertical position for 9,000 turns for 54 bunches.
- An increased beam position oscillation amplitude is noted for certain bunches.

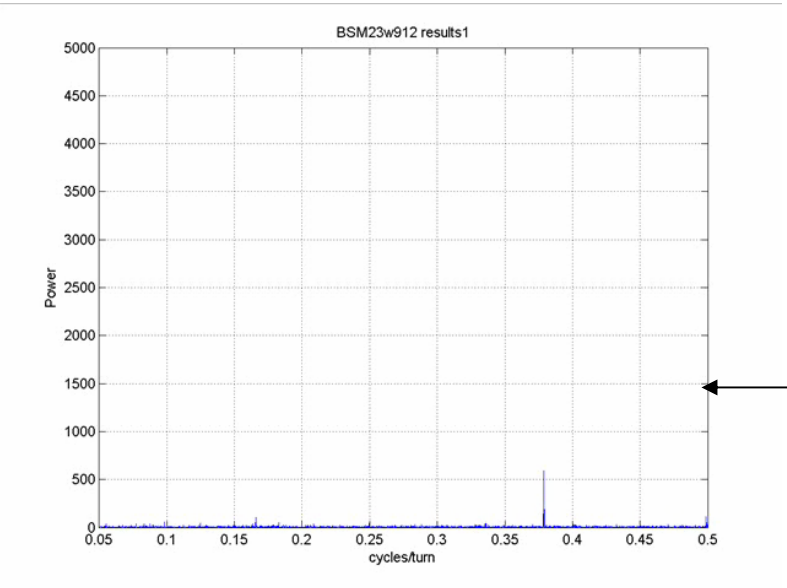
High I File:912 I_{e-}=4.08mA/bunch (movie)



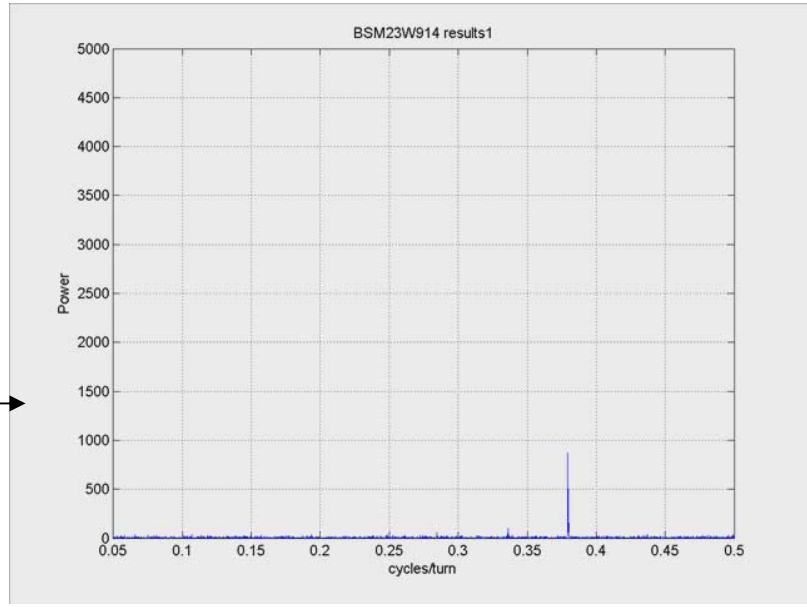
Low I File:914 I_{e-}=2.97mA/bunch (movie)



e- high frequency vertical position oscillation-FFT of vertical position for 9,000 turns



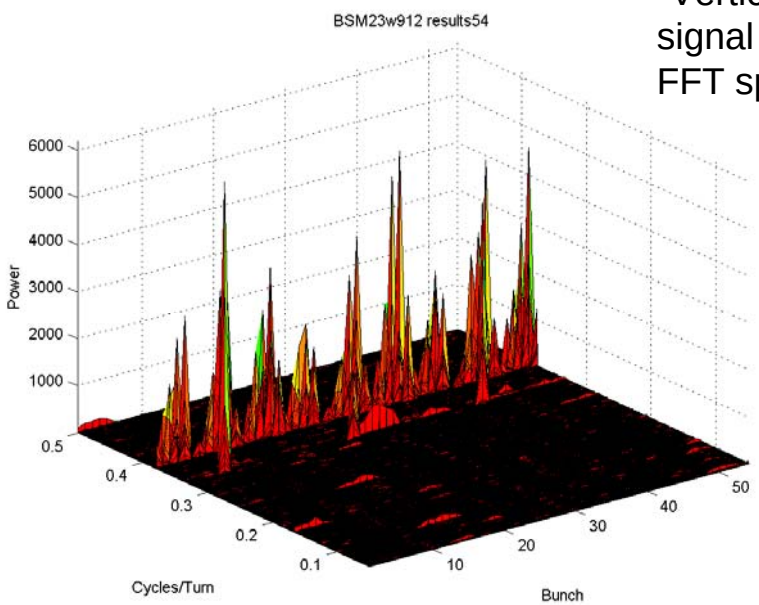
movies

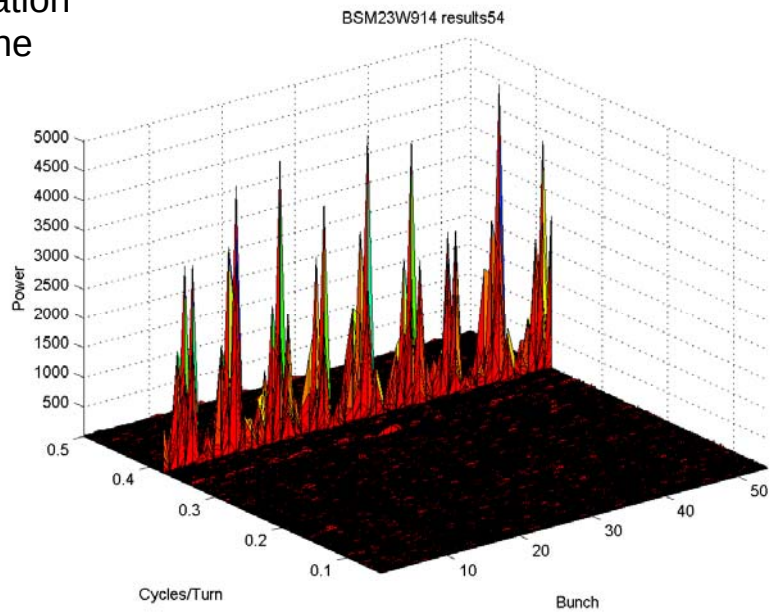


High I File:912 I_{e-}=4.08mA/bunch

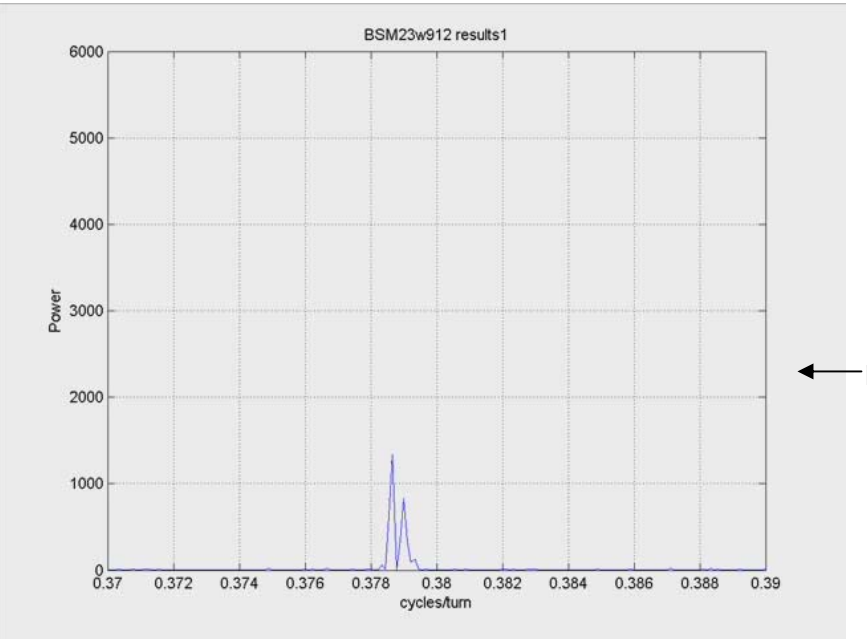
- FFT of the vertical position.
- Vertical position oscillation signal is prominent in the FFT spectrum.

Low I File:914 I_{e-}=2.97mA/bunch

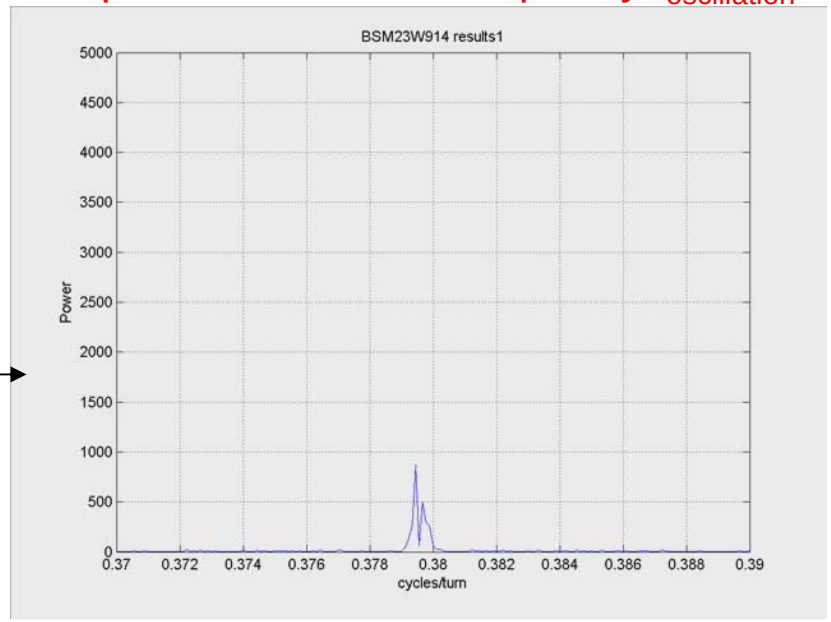




e- high frequency vertical position oscillation-close up of the oscillation frequency $f_{oscillation}$



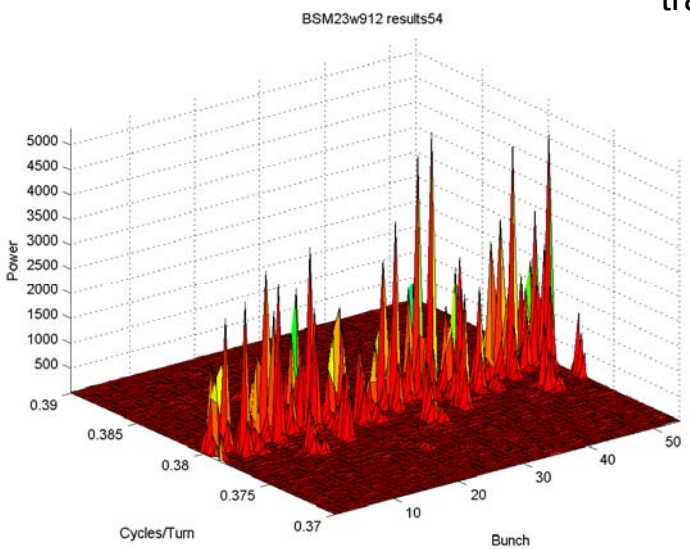
movies

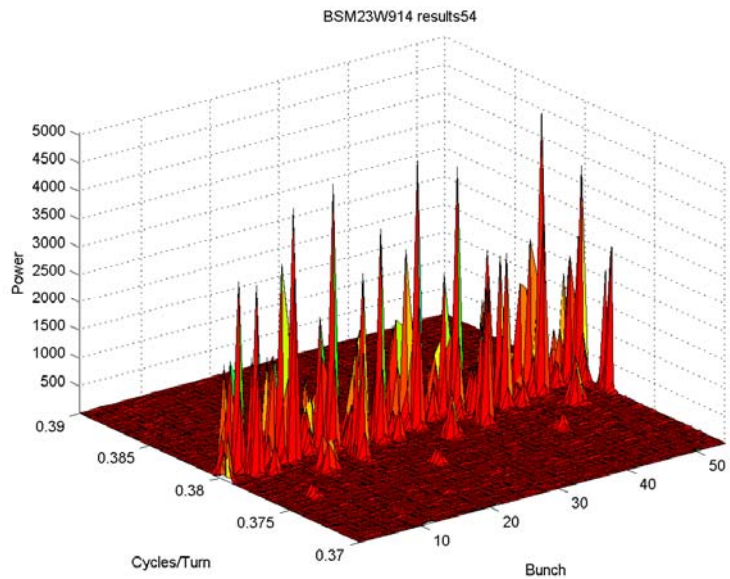


High I File:912 I_{e-}=4.08mA/bunch

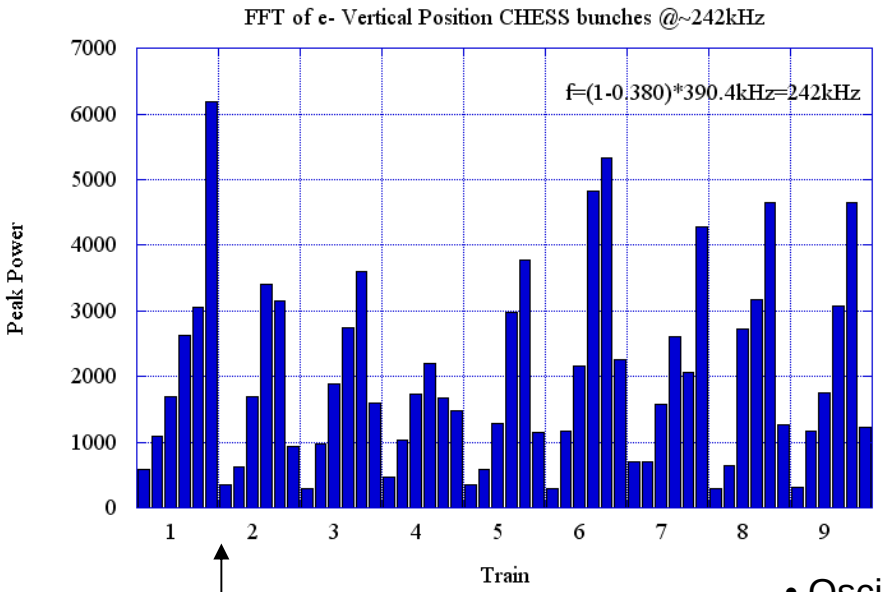
•Vertical position oscillation frequency shifts along the train.

Low I File:914 I_{e-}=2.97mA/bunch

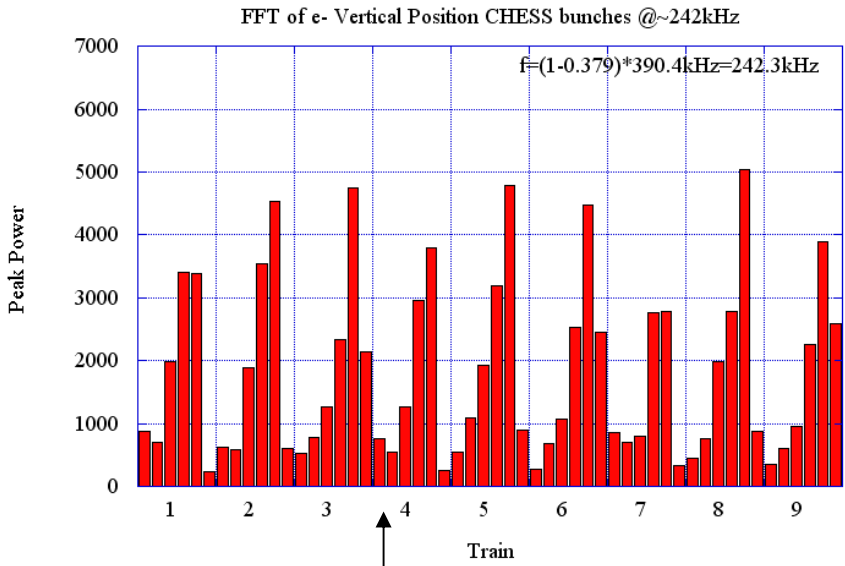




e- high frequency vertical position oscillation-Power and Frequency of Oscillation

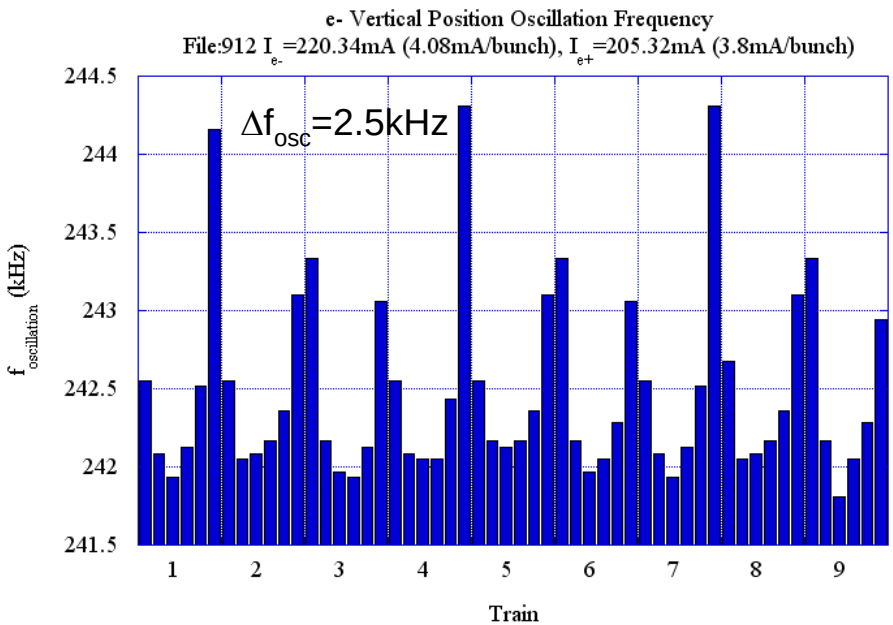


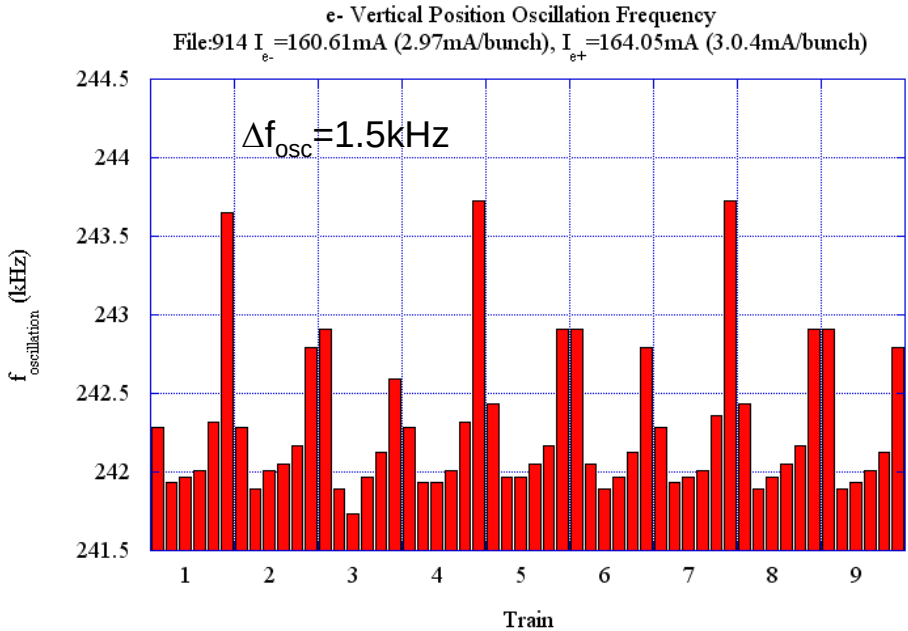
High I File:912 I_{e-}=4.08mA/bunch



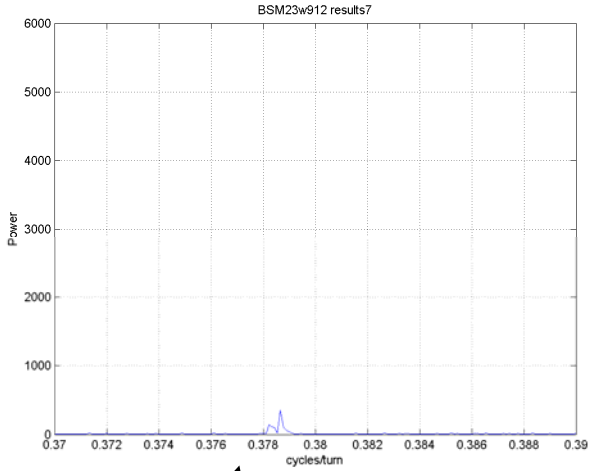
Low I File:914 I_{e-}=2.97mA/bunch

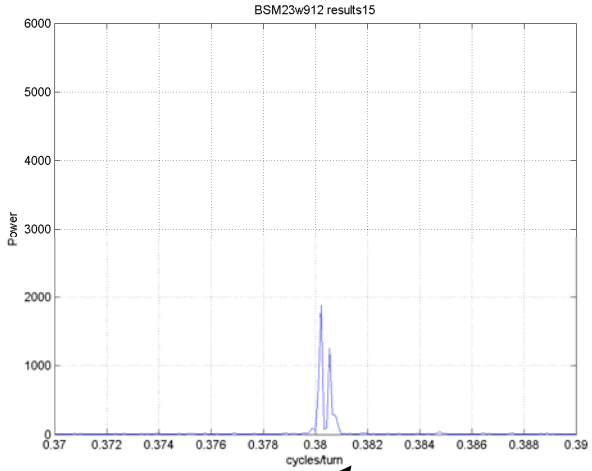
- Oscillation frequency shift, Δf_{osc}, along the trains is current dependent.

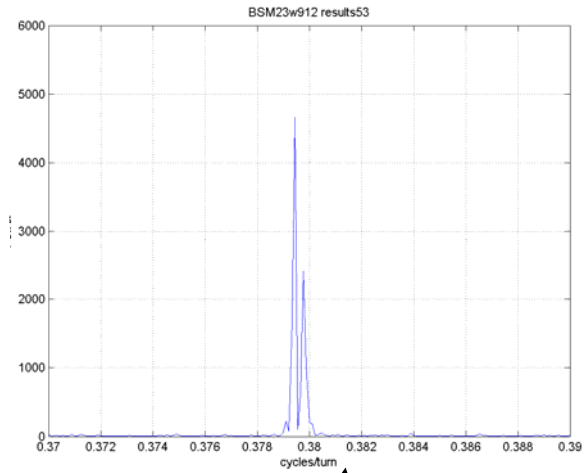




e- high frequency vertical position oscillation - FFT of vertical position – High I





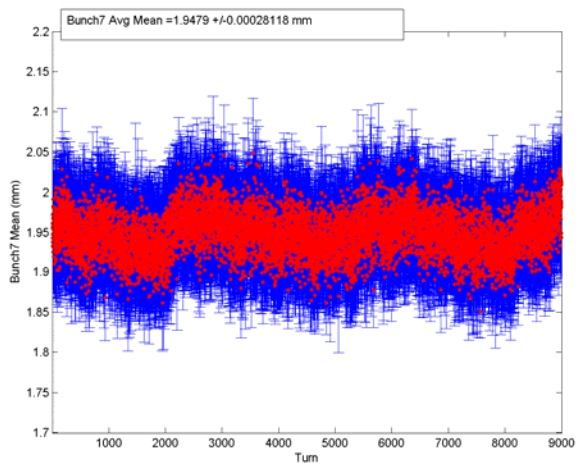


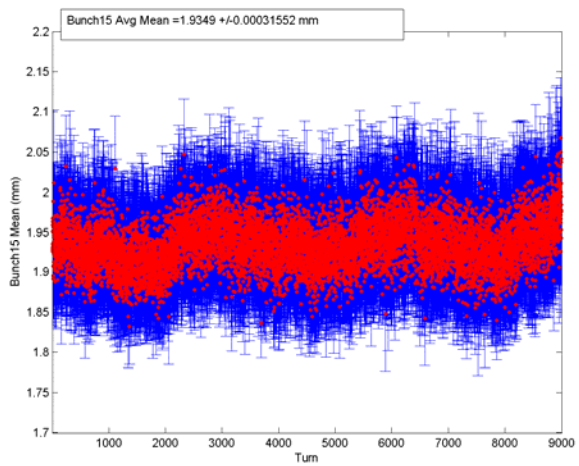
Bunch 7
Peak Power=353@242.6kHz
y_{avg}=1.94mm
Std=0.027mm

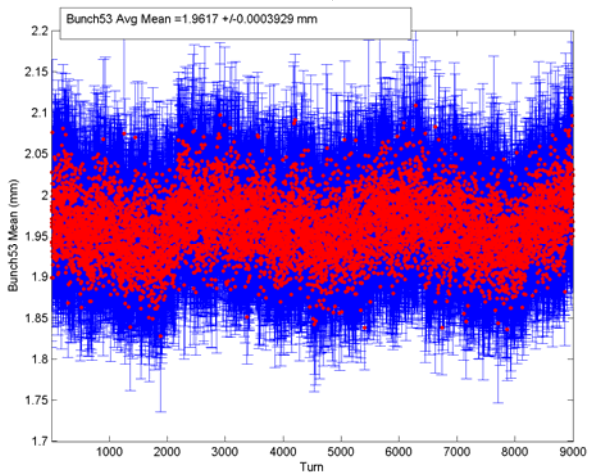
Bunch 15
Peak Power=1889@242kHz
y_{avg}=1.93mm
Std=0.030mm

Bunch 53
Peak Power=4659@242.3kHz
y_{avg}=1.96mm
Std=0.037mm

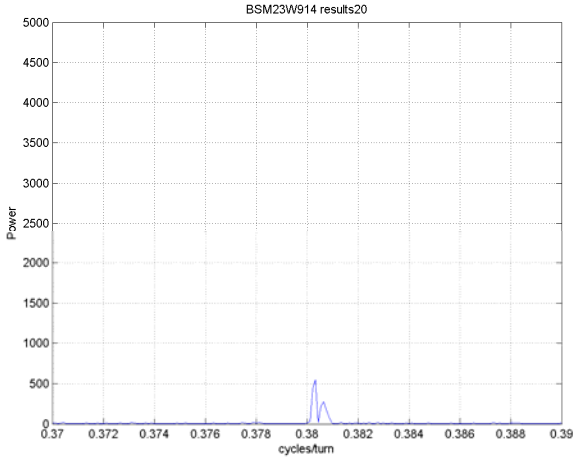
File:912 I_{e-}=4.08mA/bunch
•Vertical position oscillation amplitude correlates with FFT power.

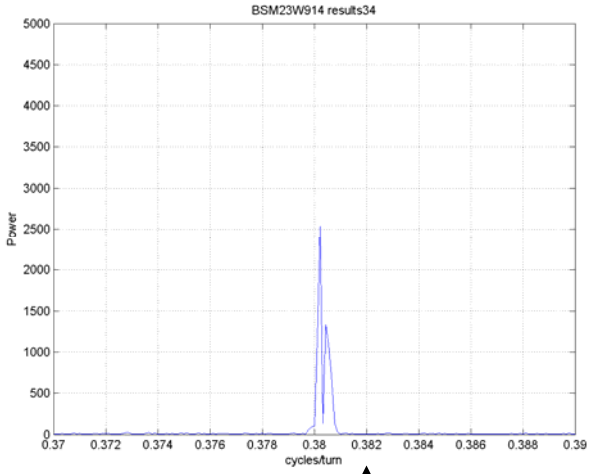


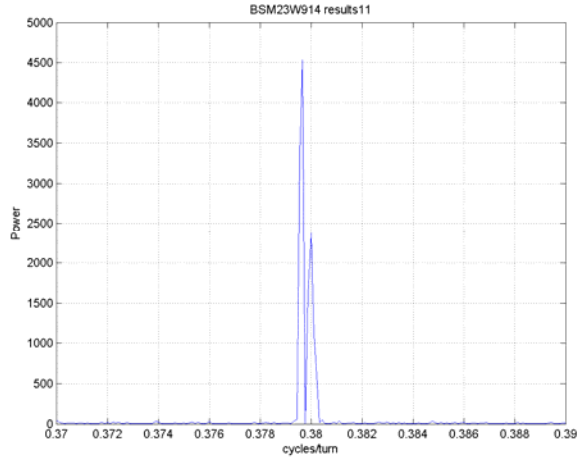




e- high frequency vertical position oscillation - FFT of vertical position – Low I





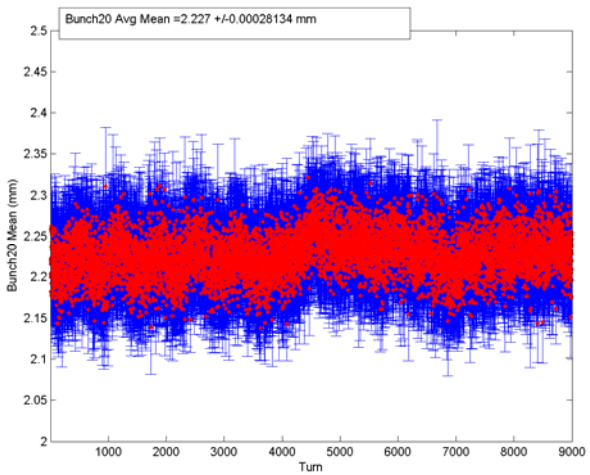


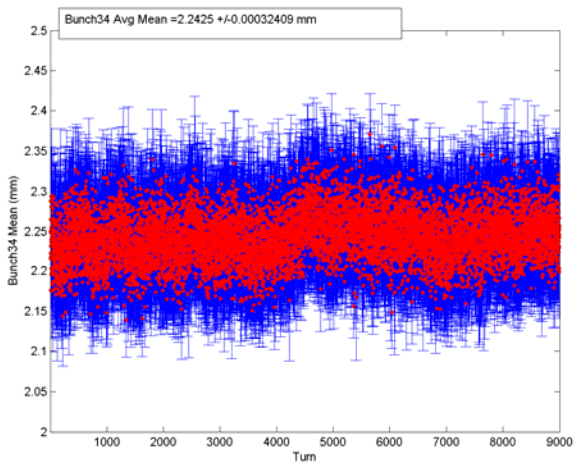
Bunch 20
Peak Power=547@241.4kHz
y_{avg}=2.227mm
Std=0.0267mm

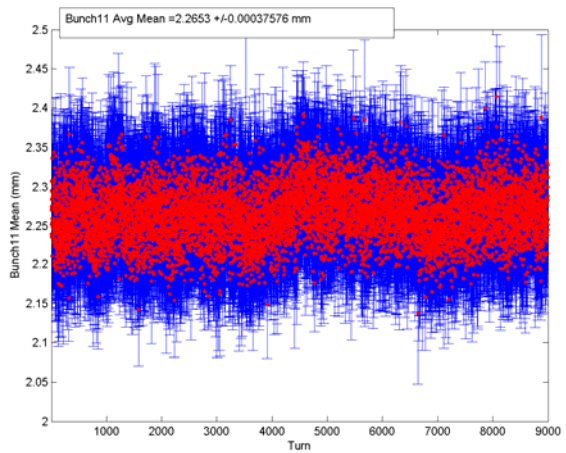
Bunch 34
Peak Power=2531@242kHz
y_{avg}=2.242mm
Std=0.0308mm

Bunch 11
Peak Power=4533@242.2kHz
y_{avg}=2.265mm
Std=0.036mm

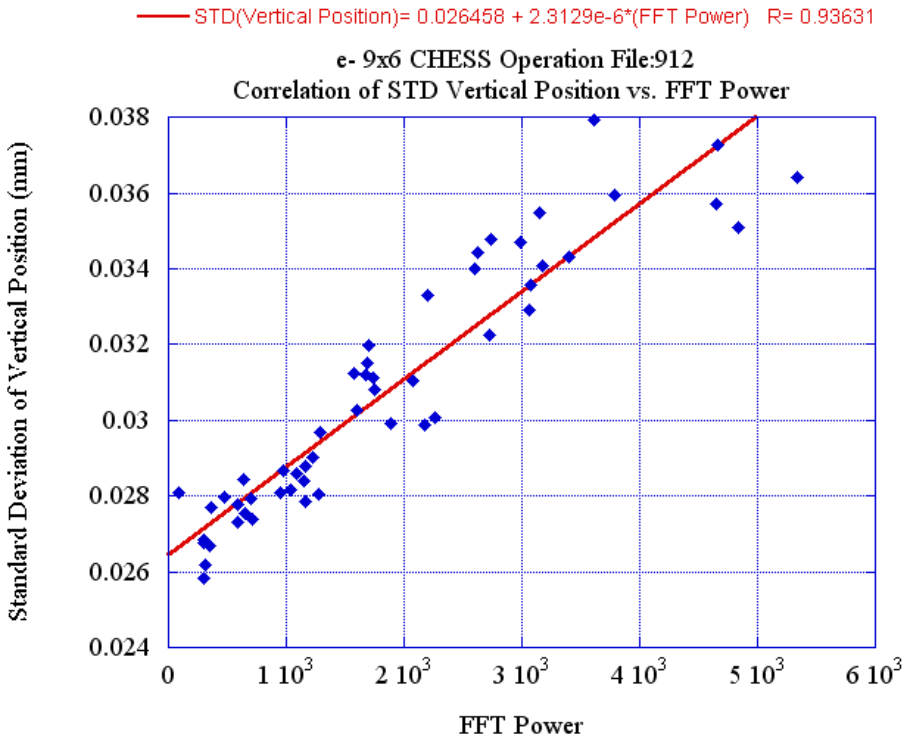
File:914 I_{e-}=2.97mA/bunch
•Vertical position oscillation amplitude correlates with FFT power.



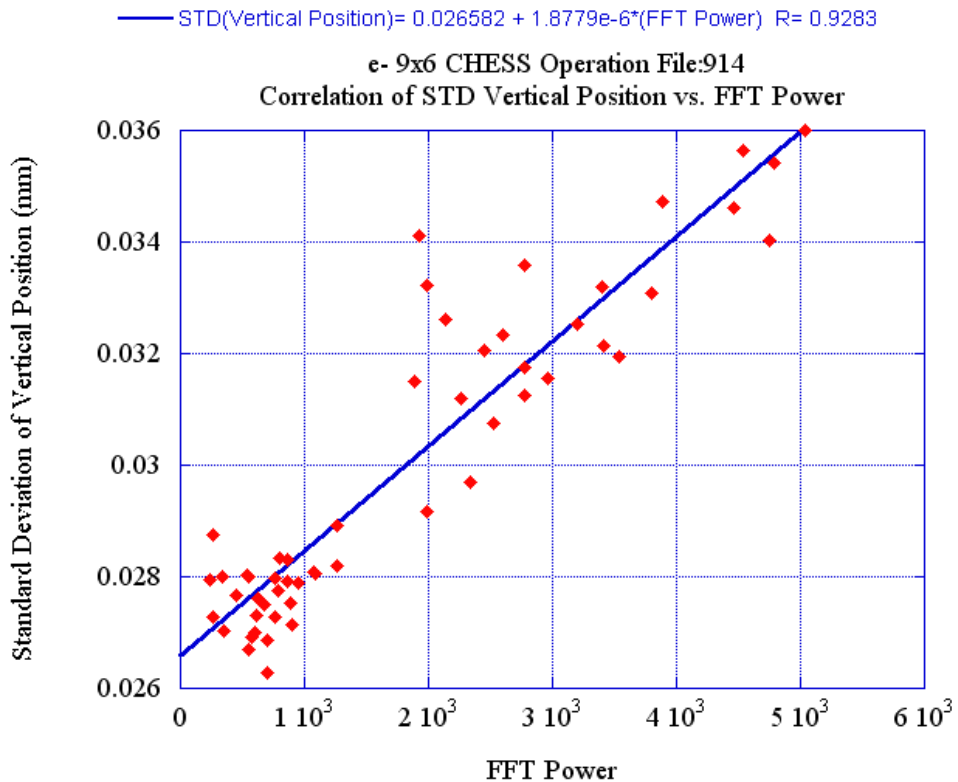


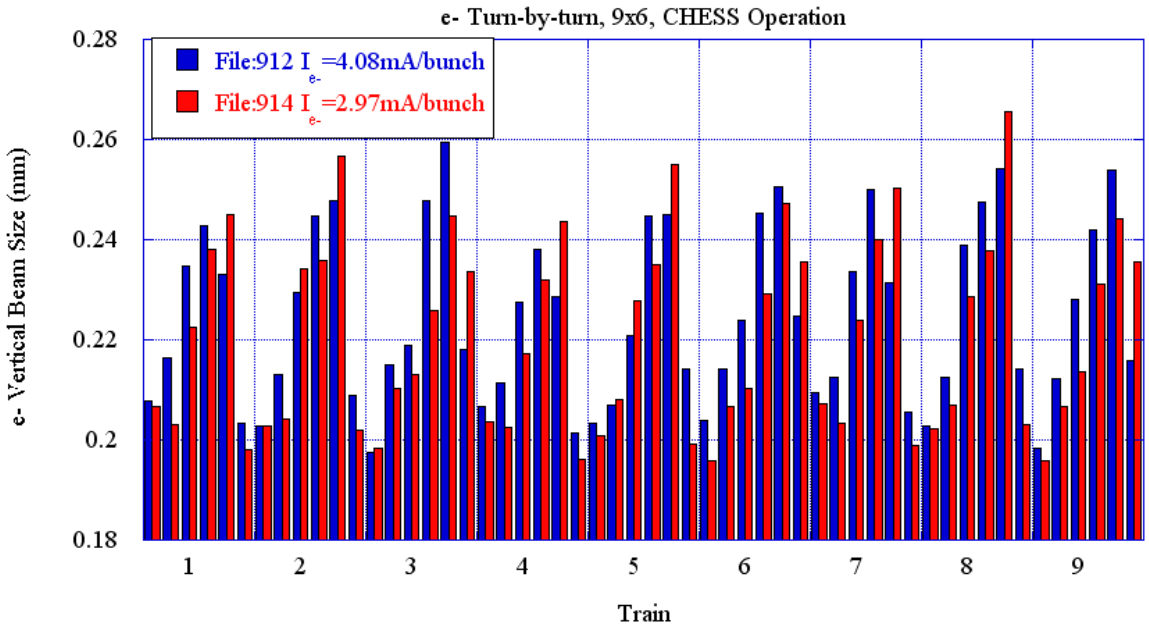


e- vertical position oscillations amplitude correlation FFT Power



•Correlation between e- vertical position oscillation amplitude and FFT power. Signature of coherent oscillation.

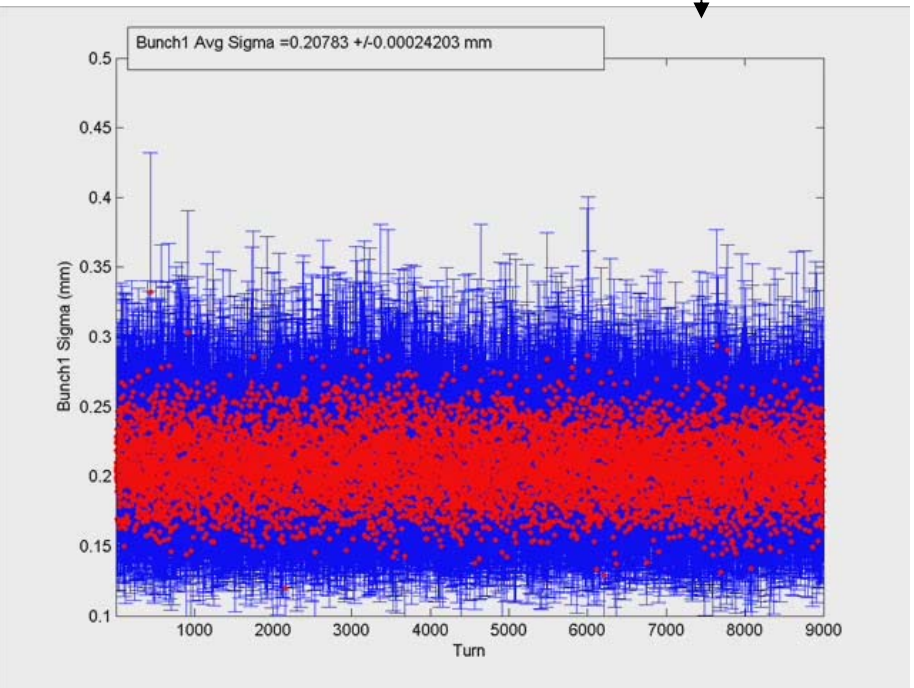




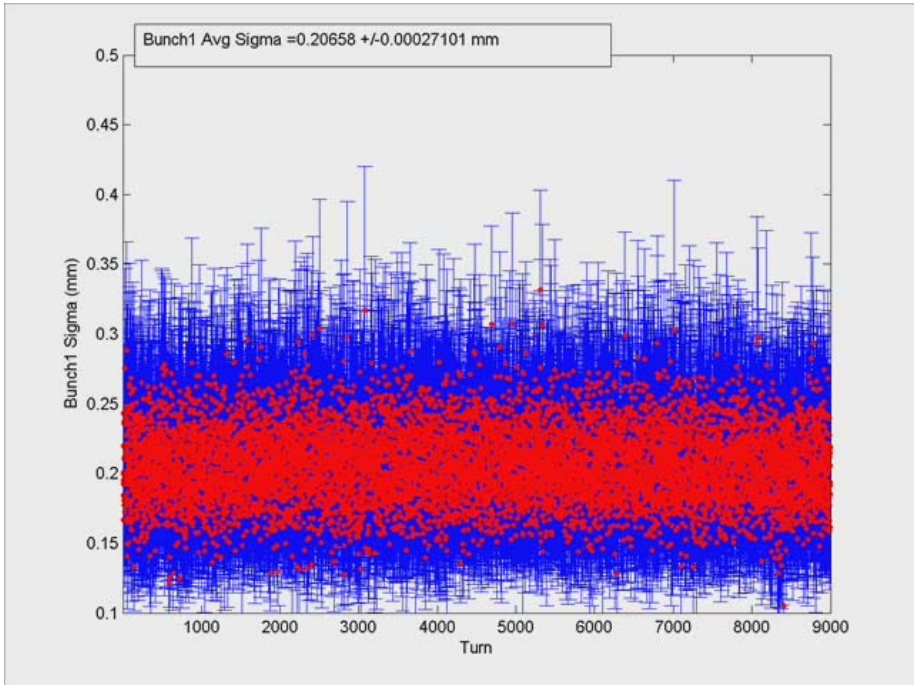
e- σ_v along the train

- σ_v 9,000 turns for 54 bunches.
- Vertical beam size growth along each train.

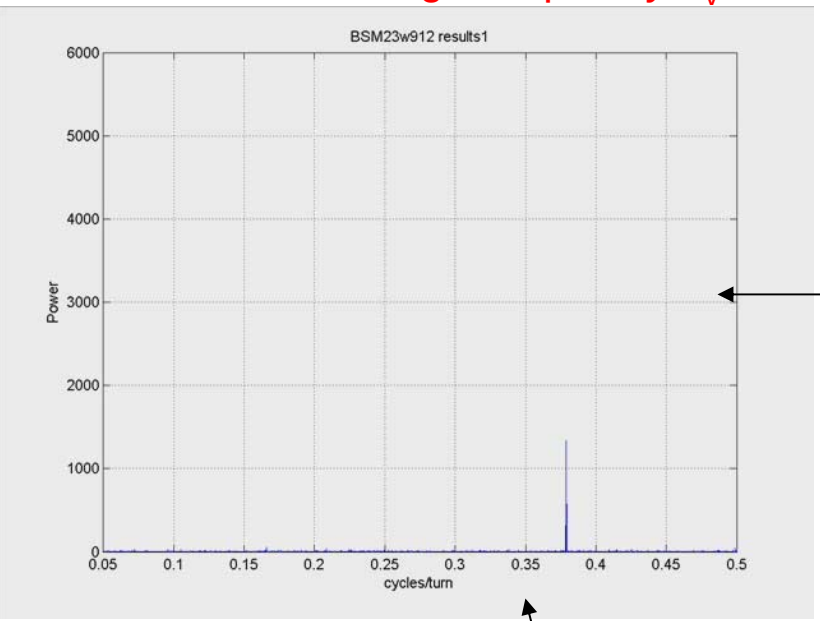
High I File:912 I_{e-}=4.08mA/bunch (movie)



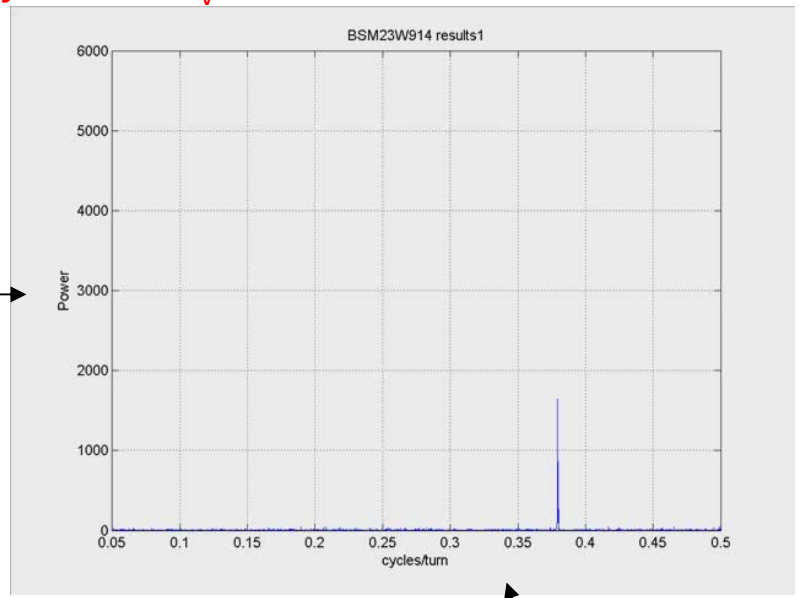
Low I File:914 I_{e-}=2.97mA/bunch (movie)



e- high frequency σ_v oscillation frequency-FFT of σ_v for 9,000 turns



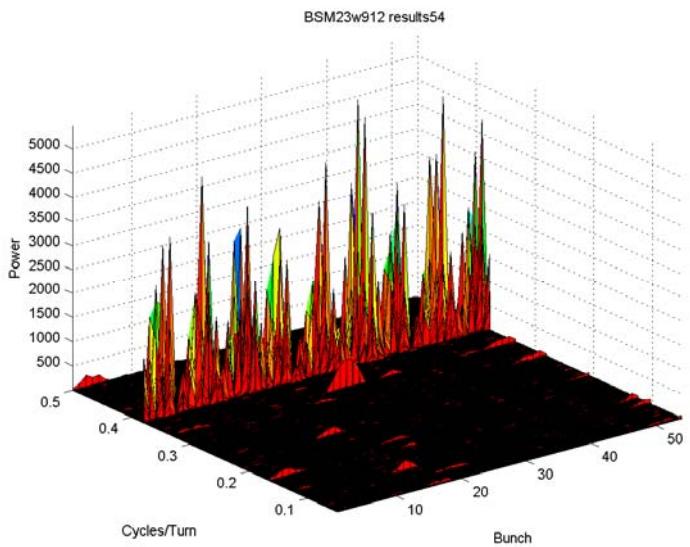
movies

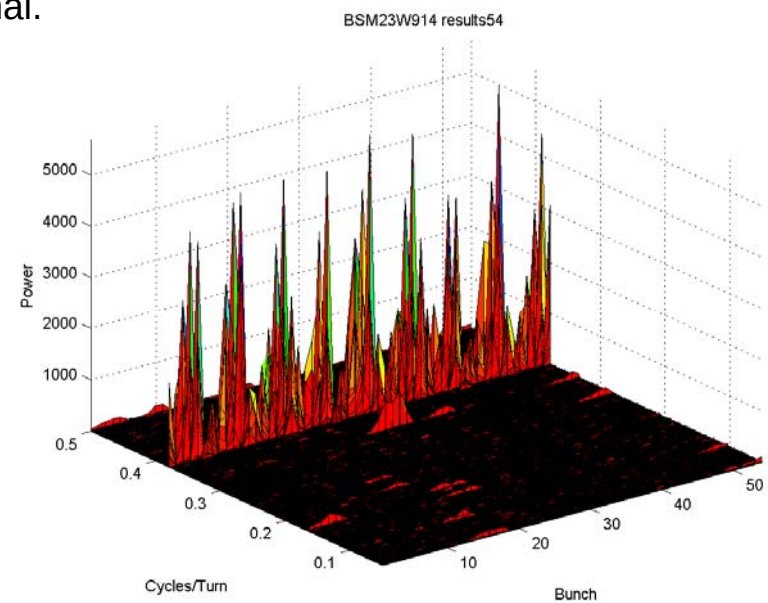


High I File:912 I_{e-}=4.08mA/bunch

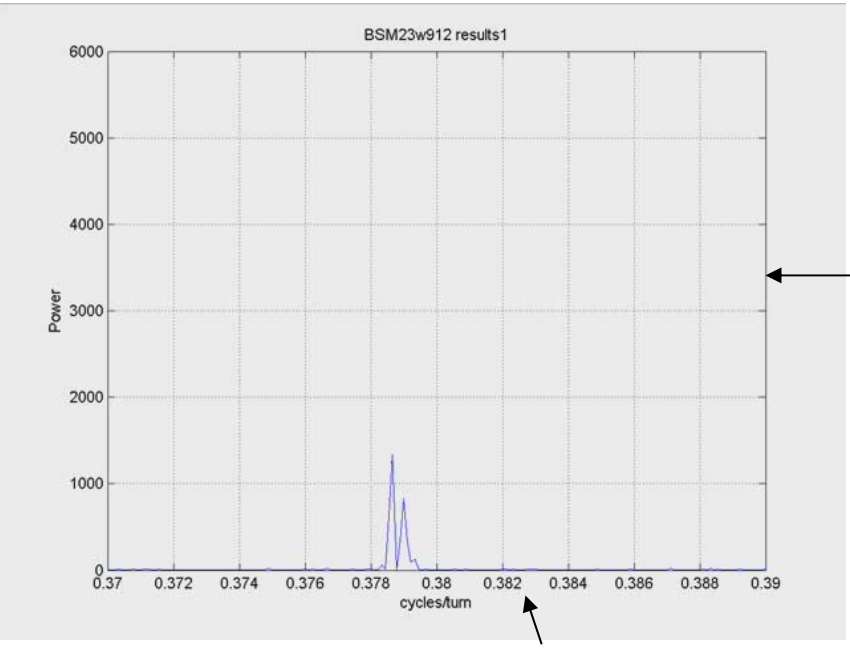
- FFT of σ_v for all 54 bunches
- Strong σ_v oscillation signal.

Low I File:914 I_{e-}=2.97mA/bunch

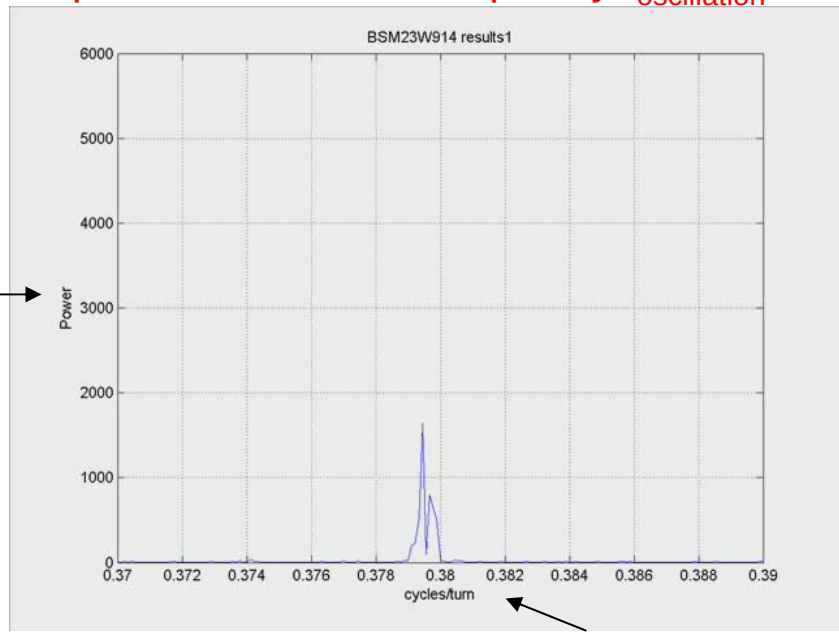




e- high frequency σ_v oscillation frequency-FFT of σ_v-Close up of the oscillation frequency $f_{oscillation}$



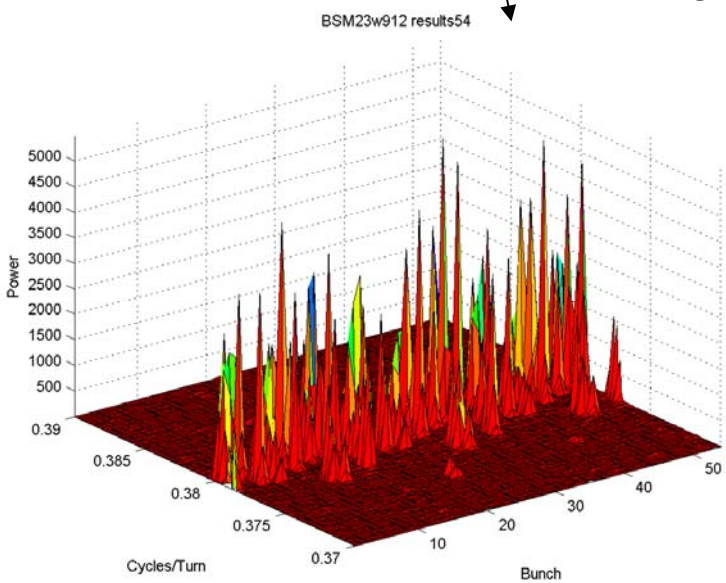
movies

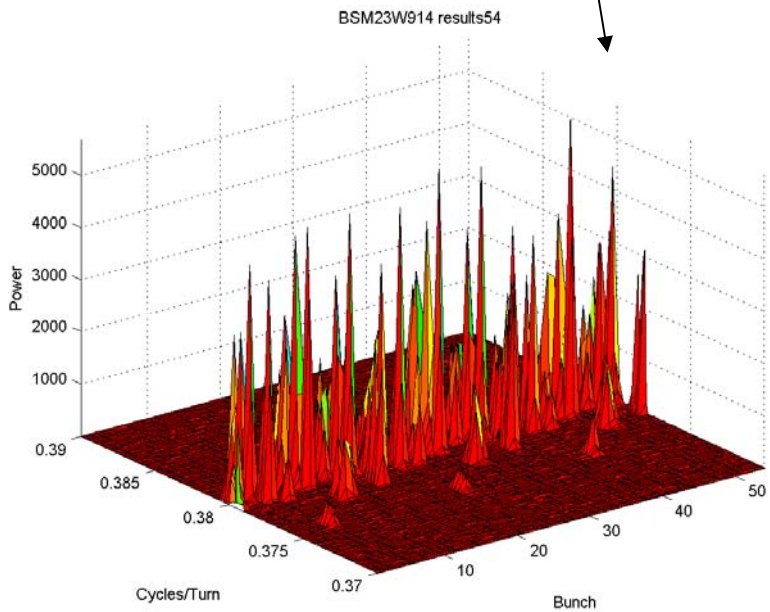


High I File:912 I_{e-}=4.08mA/bunch

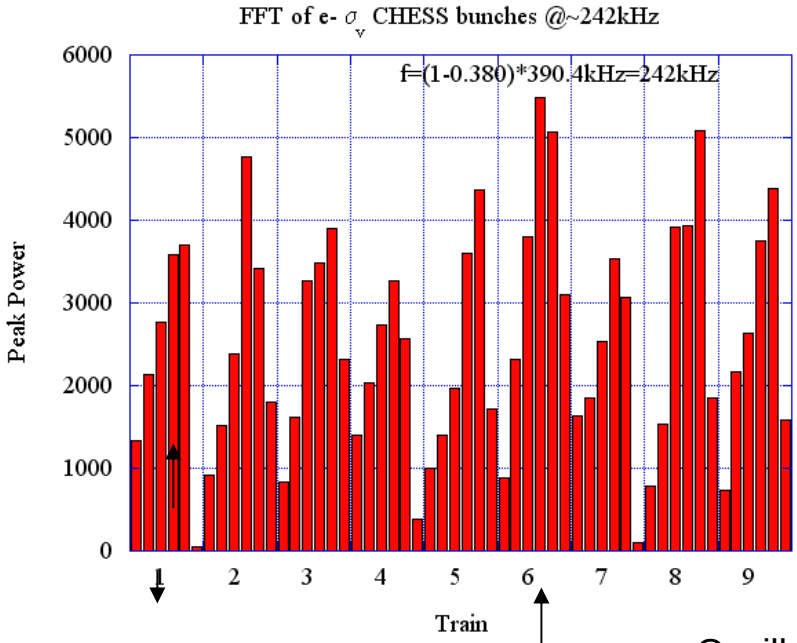
Low I File:914 I_{e-}=2.97mA/bunch

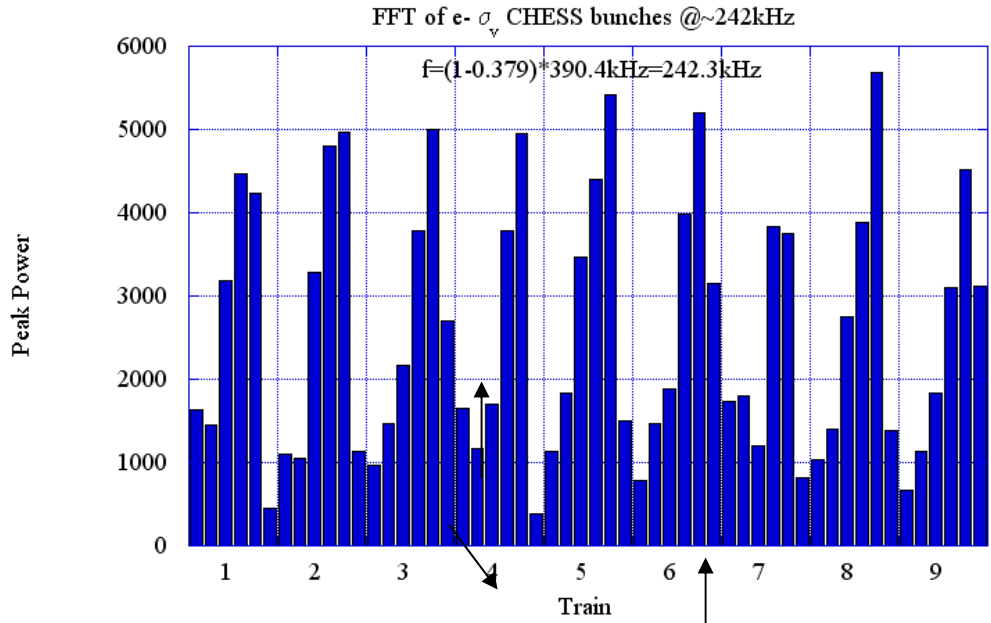
- σ_v oscillation frequency shifts along the train.





e- high frequency σ_v oscillation-Power and Frequency of Oscillation

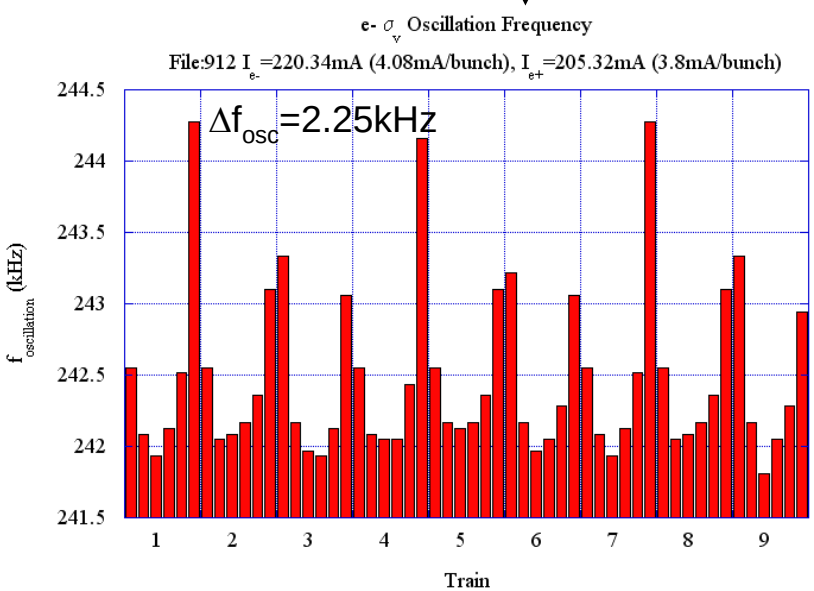


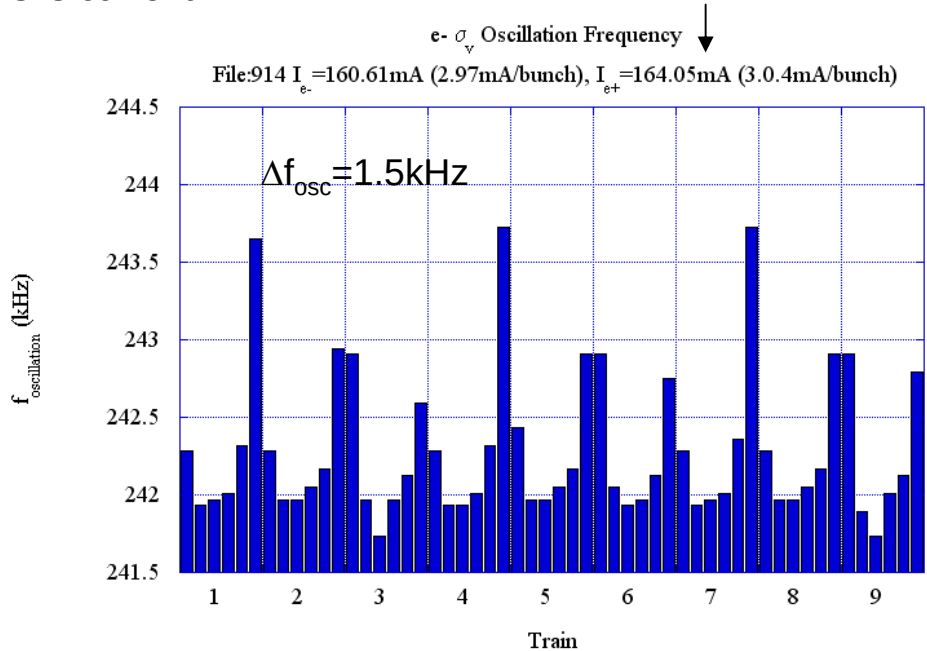


High I File:912 I_{e-}=4.08mA/bunch

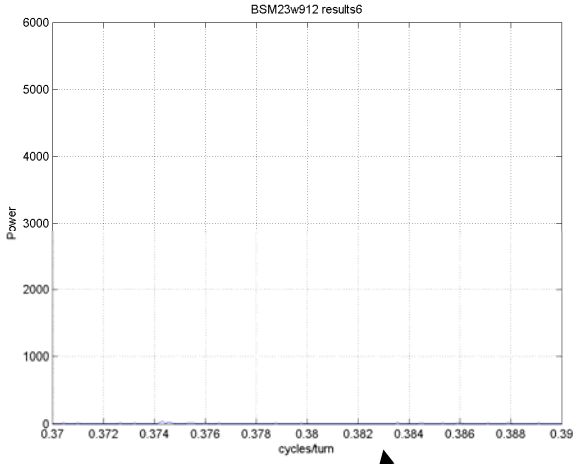
- Oscillation frequency shift, Δf_{osc}, along the trains is current dependent.

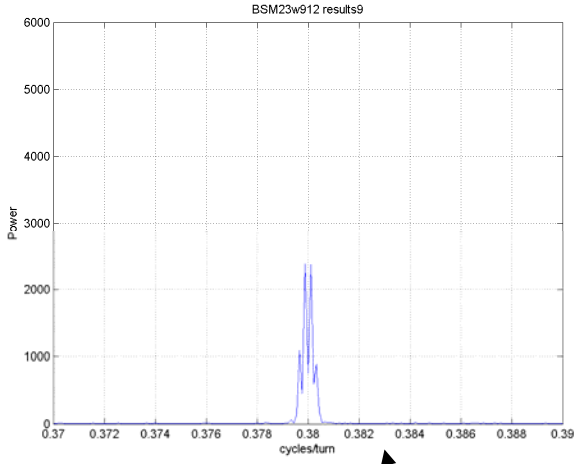
Low I File:914 I_{e-}=2.97mA/bunch

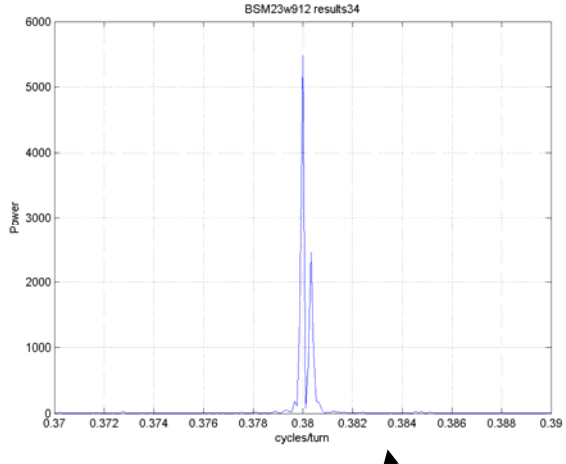




e- high frequency σ_v oscillation - FFT of σ_v – High I







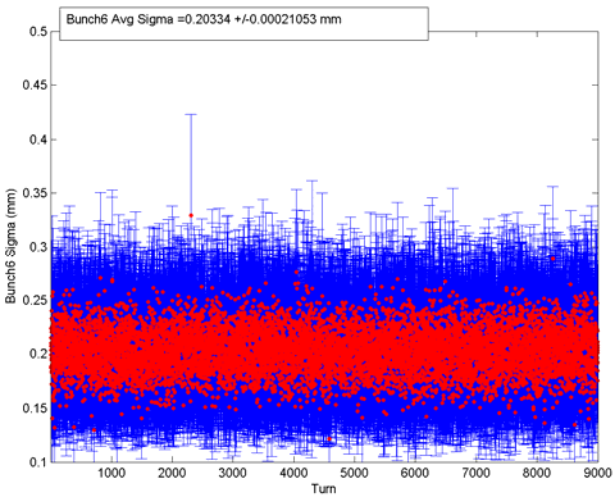
Bunch 6
Peak Power=45@244.3kHz
σ_v=0.203mm
Std=0.020mm

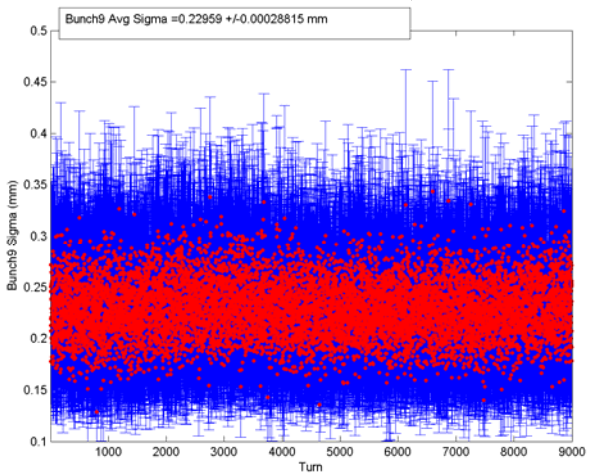
Bunch 9
Peak Power=2387@242.1kHz
σ_v=0.230mm
Std=0.027mm

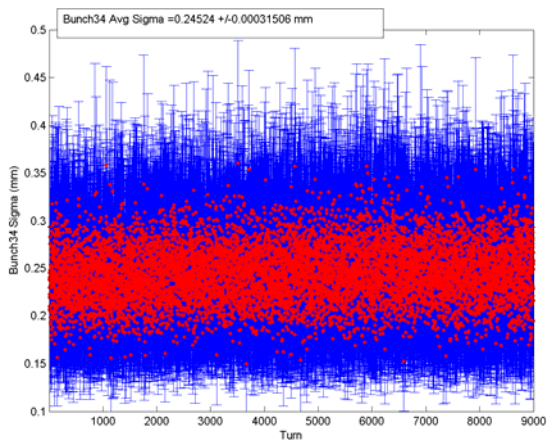
Bunch 34
Peak Power=5485@242.1kHz
σ_v=0.224mm
Std=0.030mm

File:912 I_{e-}=4.08mA/bunch

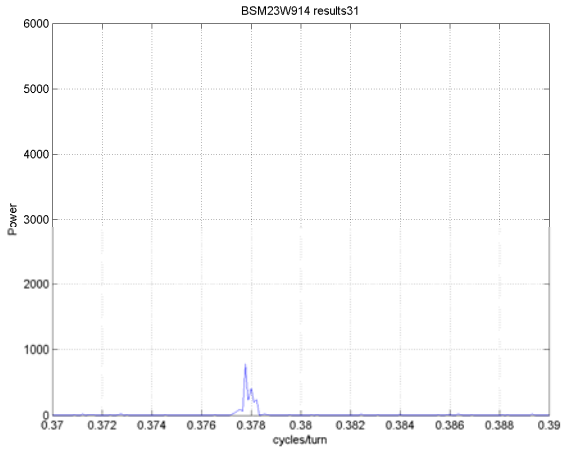
- σ_v oscillation amplitude correlates with FFT power



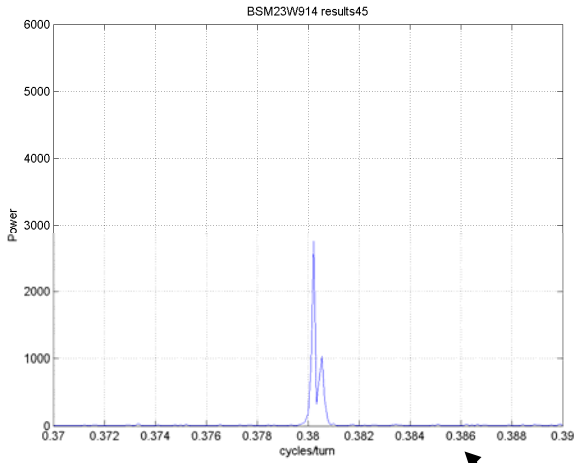




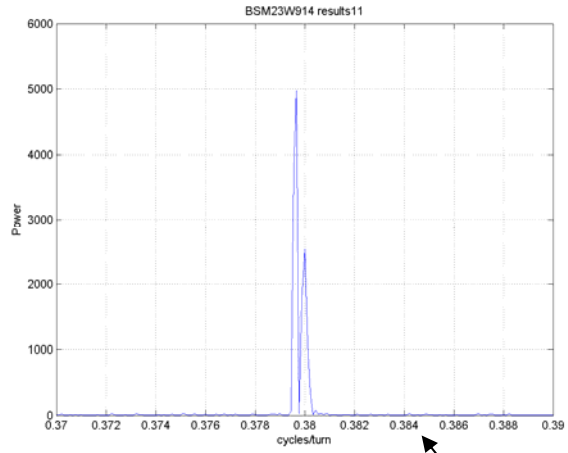
e- high frequency σ_v oscillation - FFT of σ_v – Low I



Bunch 31
Peak Power=794@242.9kHz
σ_v=0.196mm
Std=0.023mm



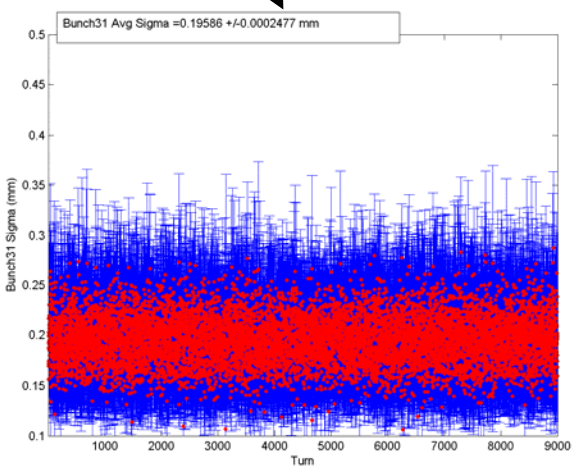
Bunch 45
Peak Power=2754@242kHz
σ_v=0.229mm
Std=0.0299mm

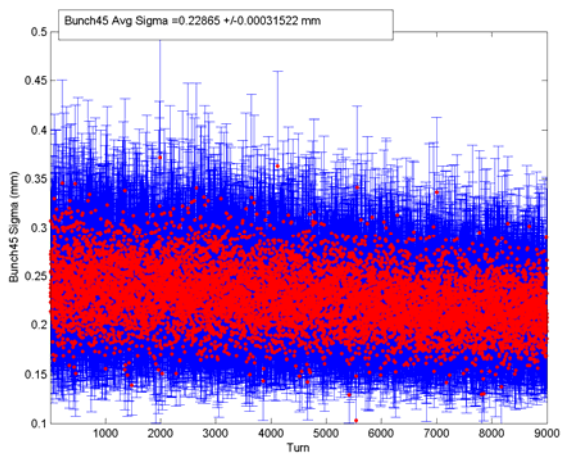


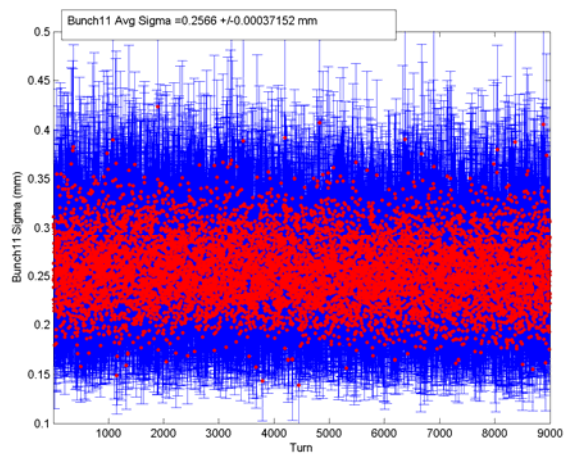
Bunch 11
Peak Power=4971@242.2kHz
σ_v=0.257mm
Std=0.0353mm

File:914 I_{e-}=2.97mA/bunch

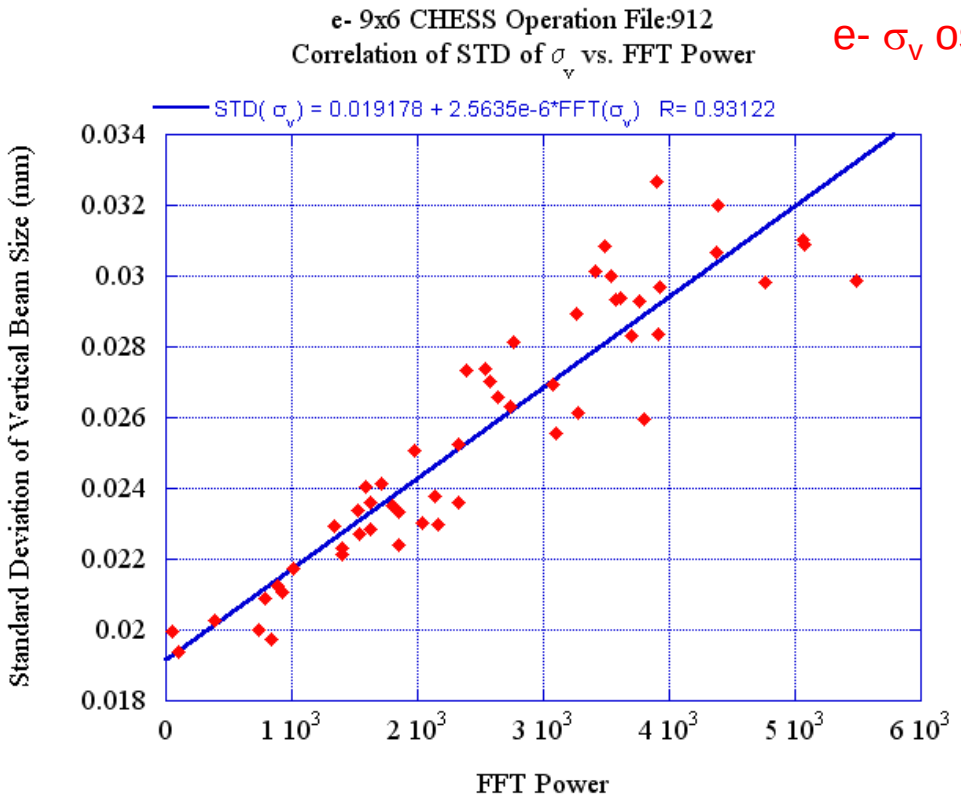
- σ_v oscillation amplitude correlates with FFT power.



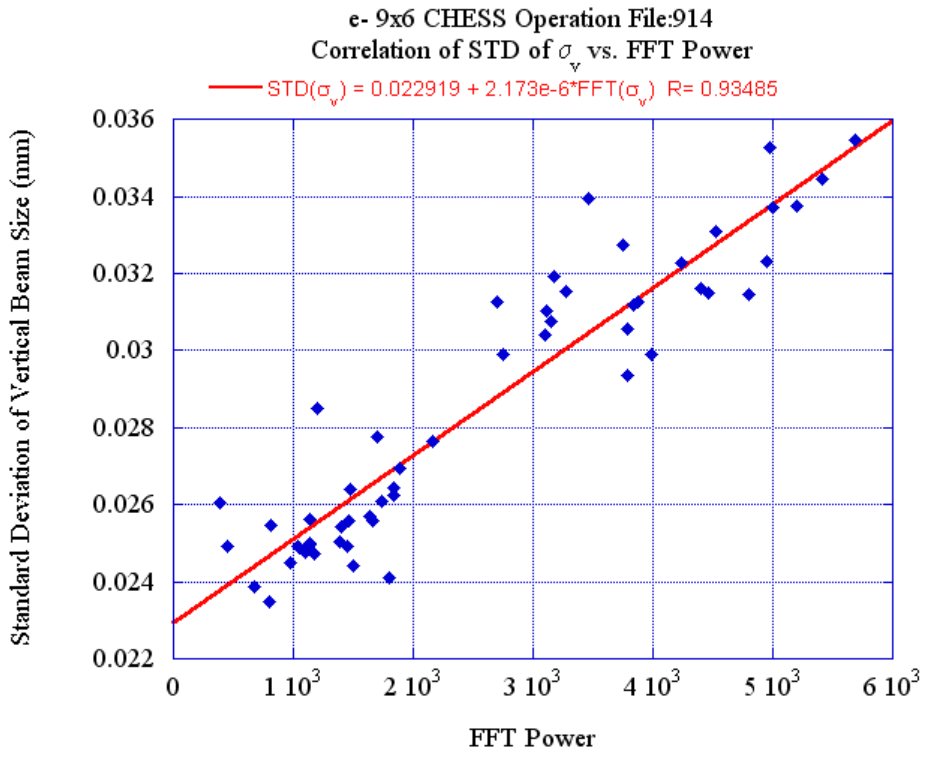




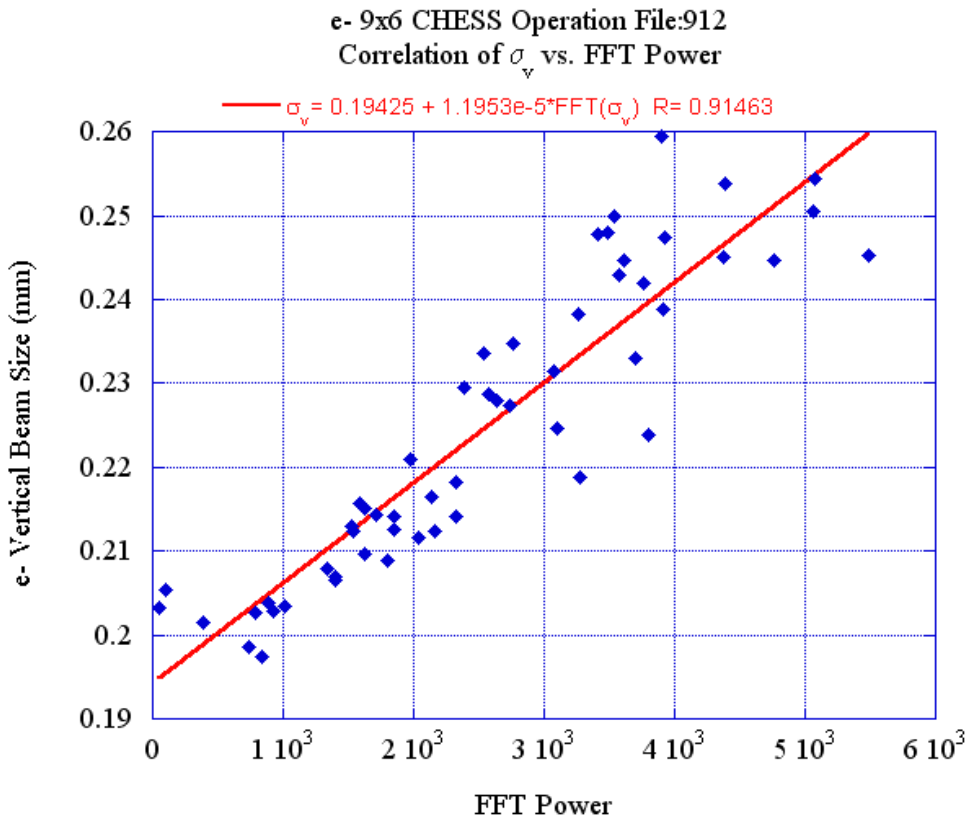
e- σ_v oscillation amplitude correlation with FFT Power



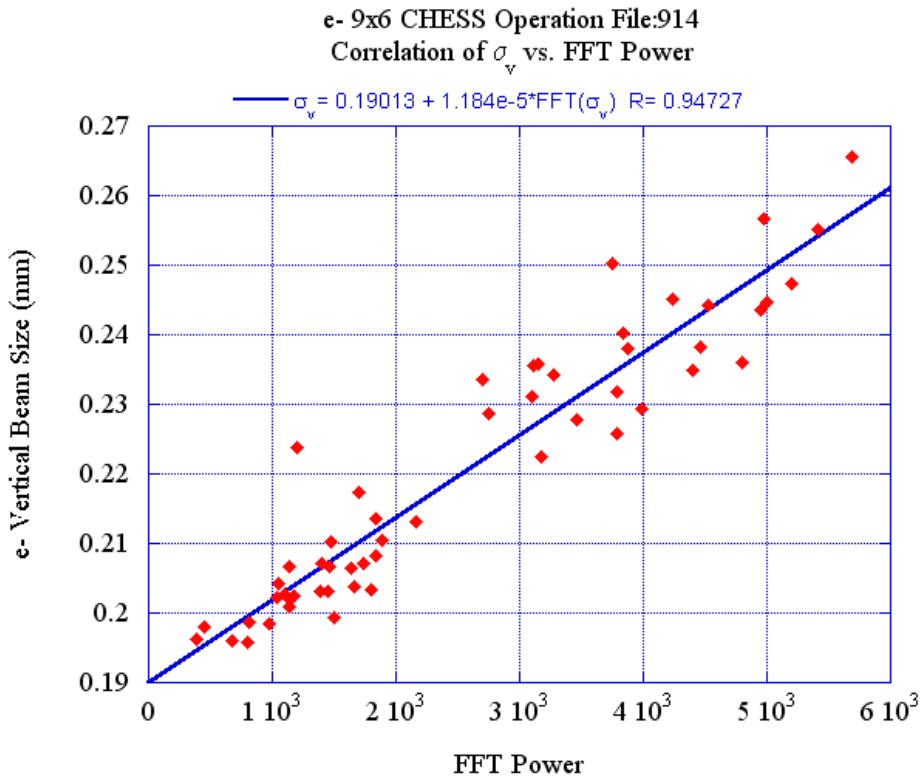
- Direct correlation between σ_v oscillation amplitude (standard deviation of σ_v) and FFT power- coherent oscillation of σ_v oscillation amplitude.



e- σ_v correlated with FFT Power



- Direct correlation between σ_v oscillation and FFT power- σ_v growth due to coherent instability



IV Summary

e+ turn-by-turn vertical dynamics:

•The e+ vertical position oscillation is denoted in the FFT spectrum of the vertical position. The vertical position oscillation frequency shifts along the train. As the bunch current is increased the oscillation frequency shift increases along the train. The vertical position oscillation amplitude is not dependent on the FFT power but correlates with noise in the FFT spectrum.

•Significant e+ σ_v growth along each train was measured and is dependent on the bunch current. No clear oscillation frequency of σ_v was measured and σ_v's growth correlates with a noise in the FFT spectrum This is a signature that an incoherent instability causes the σ_v growth along the train

e- turn-by-turn vertical dynamics:

• The e- vertical position oscillation is prominent in the FFT spectrum and the oscillation frequency shifts along the train increases with current. The vertical oscillation amplitude correlates with the FFT power which is a signature of a coherent oscillation.

•A σ_v growth and oscillation along the e- trains was measured. The σ_v oscillation frequency shifts along the train. The σ_v oscillation amplitude (standard deviation of σ_v) correlates with the FFT power. A direct correlation between σ_v and FFT power suggests a coherent instability is the cause of the σ_v growth along the trains.