



# CesrTA Update

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CLASSE



# CesrTA Schedule and Status

- Completed experimental run 2/2/2009
  - **Major focus on:**
    - Low emittance correction in 2.085 GeV baseline optics
    - X-ray Beam Size Monitor (xBSM) commissioning
    - EC Measurements
      - RFA & TE wave measurements
      - Dynamics
    - General instrumentation/feedback tests/commissioning
  - **13 visitors (even with sub-zero °F temperatures and lots of snow)**
    - LET - J. Jones, A. Wolski
    - xBSM – J. Flanagan, H. Sakai
    - EC – S. De Santis, R. Holtzapple, K. Shibata, L. Wang
    - Feedback – D. Teytelman, M. Tobiya
    - CLIC – H. Schmickler
    - Instrumentation – A. DellaPenna, I. Pinayev
  - **A few highlights on following pages...**
- 2<sup>nd</sup> upgrade down is underway...
  - **Installation of PEP-II experimental hardware**
  - **Installation of photon stop chamber for 5GeV operation of the CesrTA L0 wiggler straight**
  - **Replacement of SRF cavity that failed during summer 2008**
  - **Installation of xBSM beam line front end for electron beam**
  - **Continue with instrumentation upgrade for 4ns bunch train operation**
- Ongoing emphasis on EC dynamics simulations and studies

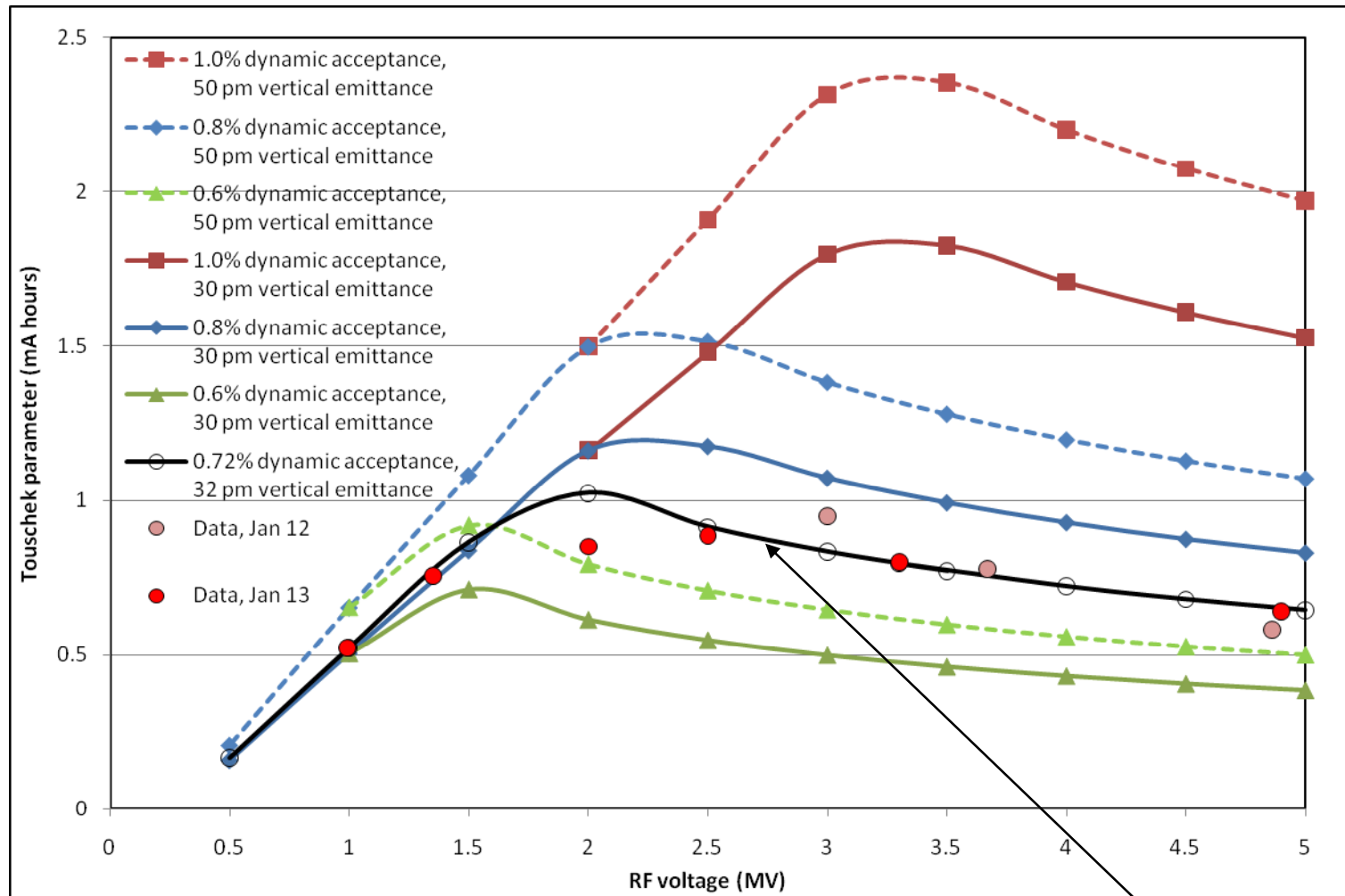


# Optics and LET

- Low emittance 2.085 GeV optics loaded and corrected
  - **Correction methods tested**
  - **Beam-based alignment measurements**
  - **Coupling and dispersion bumps created for tuning**
- Emittance measurements begun...
  - **Touschek lifetime measurements initially used to characterize beam size**
  - **xBSM measurements as detector and optics were characterized**
- Ongoing program of magnet alignment to improve emittance
  - **Alignment work continued throughout the run**
  - **2 anomalous locations in the ring have been identified which are being scrutinized.**



# First Detailed Optics Correction $\Rightarrow$ Touschek Study $\Rightarrow$ xBSM Measurement (Preliminary)



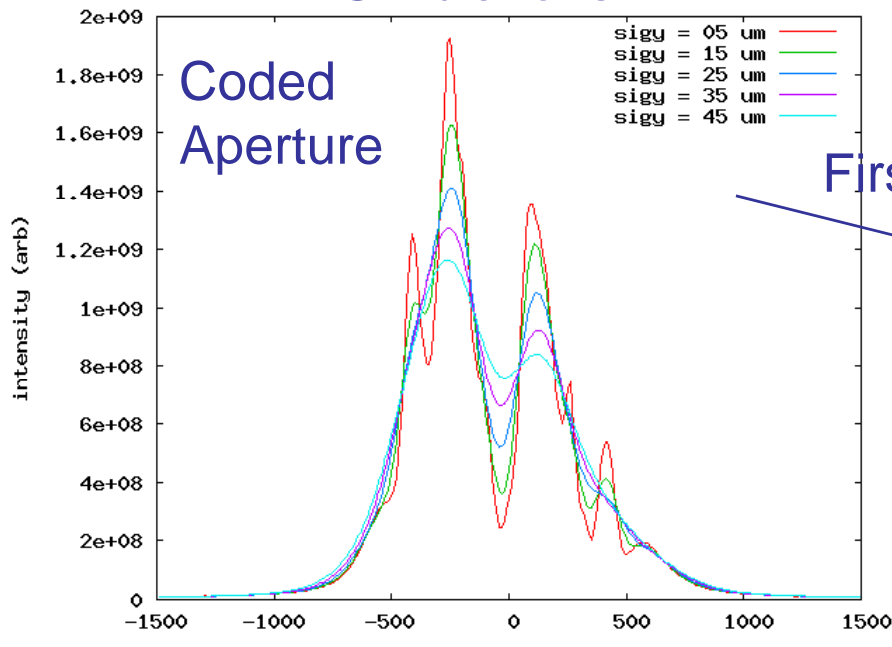
Measured energy acceptance = 0.7%  $\rightarrow \epsilon_v \sim 32\text{pm}$   
From xBSM  $\sigma_v \sim 15 \pm 5 \mu\text{m} \rightarrow \epsilon_v \sim 38\text{pm}$



# xBSM Snapshots (Preliminary)

- Scan of coupling knob
- Coded aperture measurements
- Smallest recorded size:  
~15  $\mu\text{m}$  (but further calibration work needed)

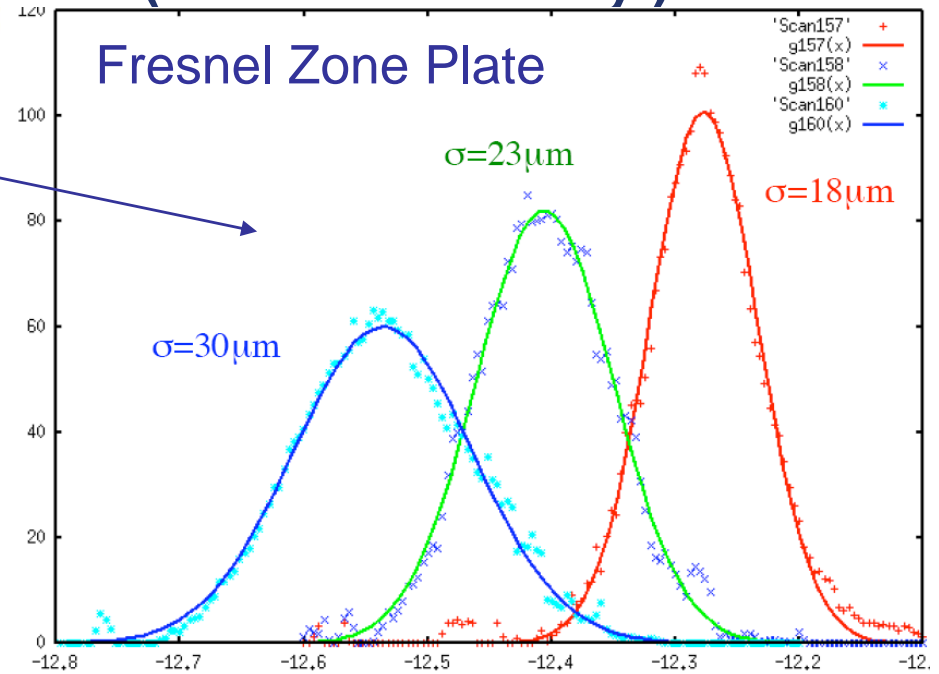
Simulations



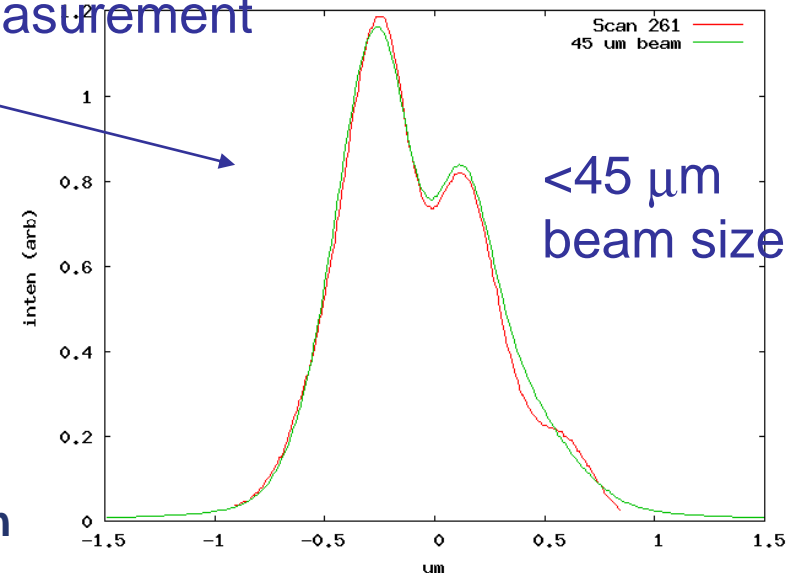
02/04/2009

AS-TAGL Mtg

Global Design



First measurement





# EC Data-Simulation Updates

- Simulations of tune shifts in POSINST at Cornell and LBNL, using a new option in POSINST for offsetting the bunches, have shown that the tune shifts of a single bunch are different if the whole train is oscillating coherently, than if just the single bunch is oscillating.
  - **Horizontal tune shifts in a dipole are much smaller when the whole train is oscillating coherently. This is particularly relevant for the tune shift measurements at CsrTA, since we kick the whole train coherently to do the measurement.**
  - **Tune shifts calculated for a coherently oscillating beam give better agreement with measurements: see following three slides.**
- January run
  - **Studies of systematic effects in the tune shift measurements were carried out.**
  - **Measurements of tune shift vs. current for long trains (10, 20, 45 and 116 and 145 bunches) were carried out (evidence of instability developing at the end of the 116 and 145 bunch trains)**
  - **RFA and TE wave measurements to characterize EC density in drifts, dipoles and wigglers**
  - **Work on comparisons between RFA and TE wave measurements as well as systematics checks for both**



# 10 Bunch Train with Trailing Witness Bunch(es) Data-POSINST Comparison (Preliminary)

Coherent tune shift vs. bunch number

Tune shift data 1.885 GeV 10 bunch train 0.75 mA/bunch positrons 4/2/07

Purple Squares: Simulation, vertical tune shift

Blue Circles: data, vertical tune shift

Pink Squares: Simulation, horizontal tune shift

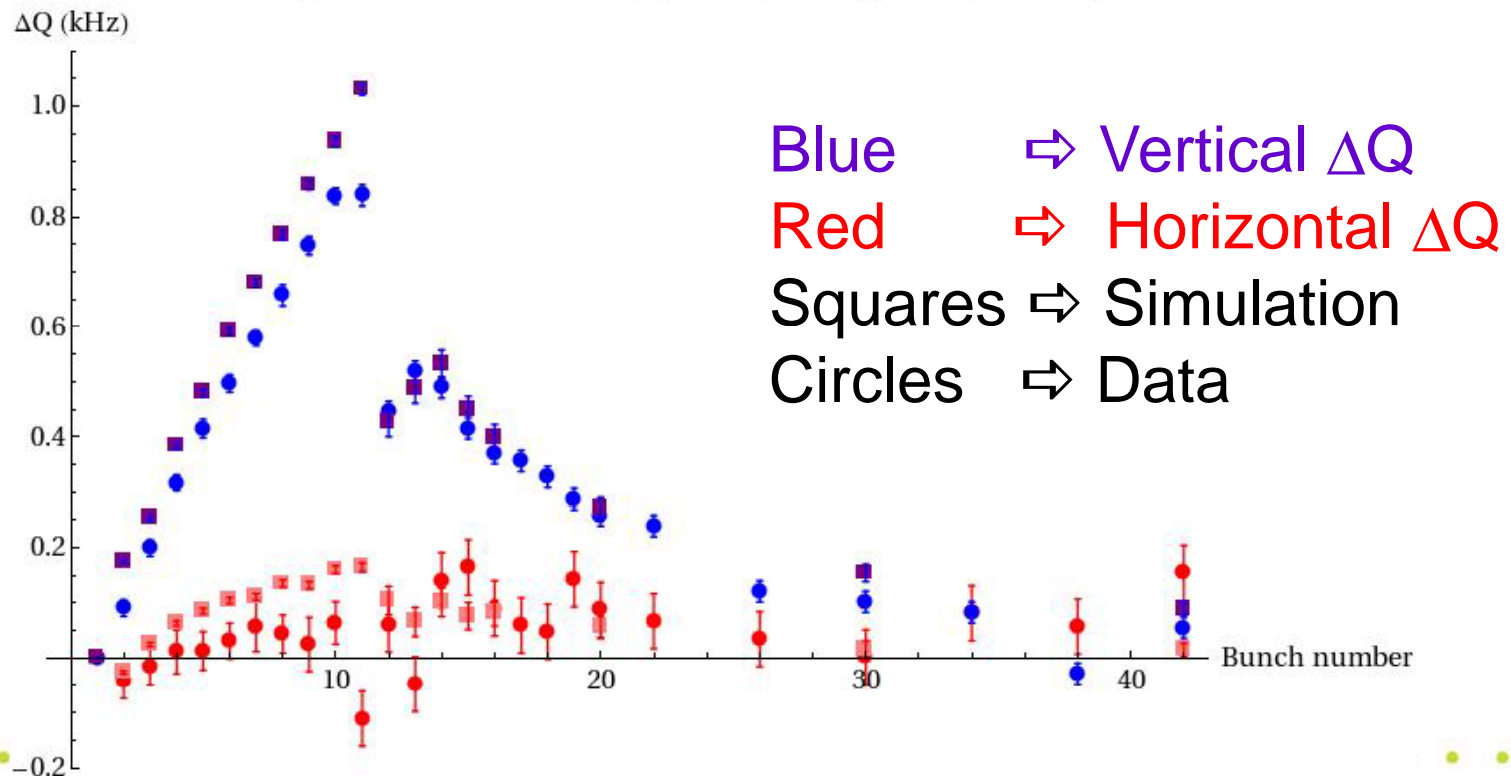
Red circles: data, horizontal tune shift

Simulation,

CESR-TA drift at 1.885 GeV: SEY=2.0, epk=310, r=15%, QE=12%, 51 nicks, pa=1

CESR-TA dipole at 1.885 GeV: SEY=2.0, Epk=310, r=15%, QE=12%, 51 nicks, p

## Positron Beam







# 10 Bunch Train with Trailing Witness Bunch(es) Data-POSINST Comparison (Preliminary)

Coherent tune shift vs. bunch number

Tune shift data 1.885 GeV 10 bunch train 0.75 mA/bunch electrons 4/2/07

Purple Squares: Simulation, vertical tune shift

Blue Circles: data, vertical tune shift

Pink Squares: Simulation, horizontal tune shift

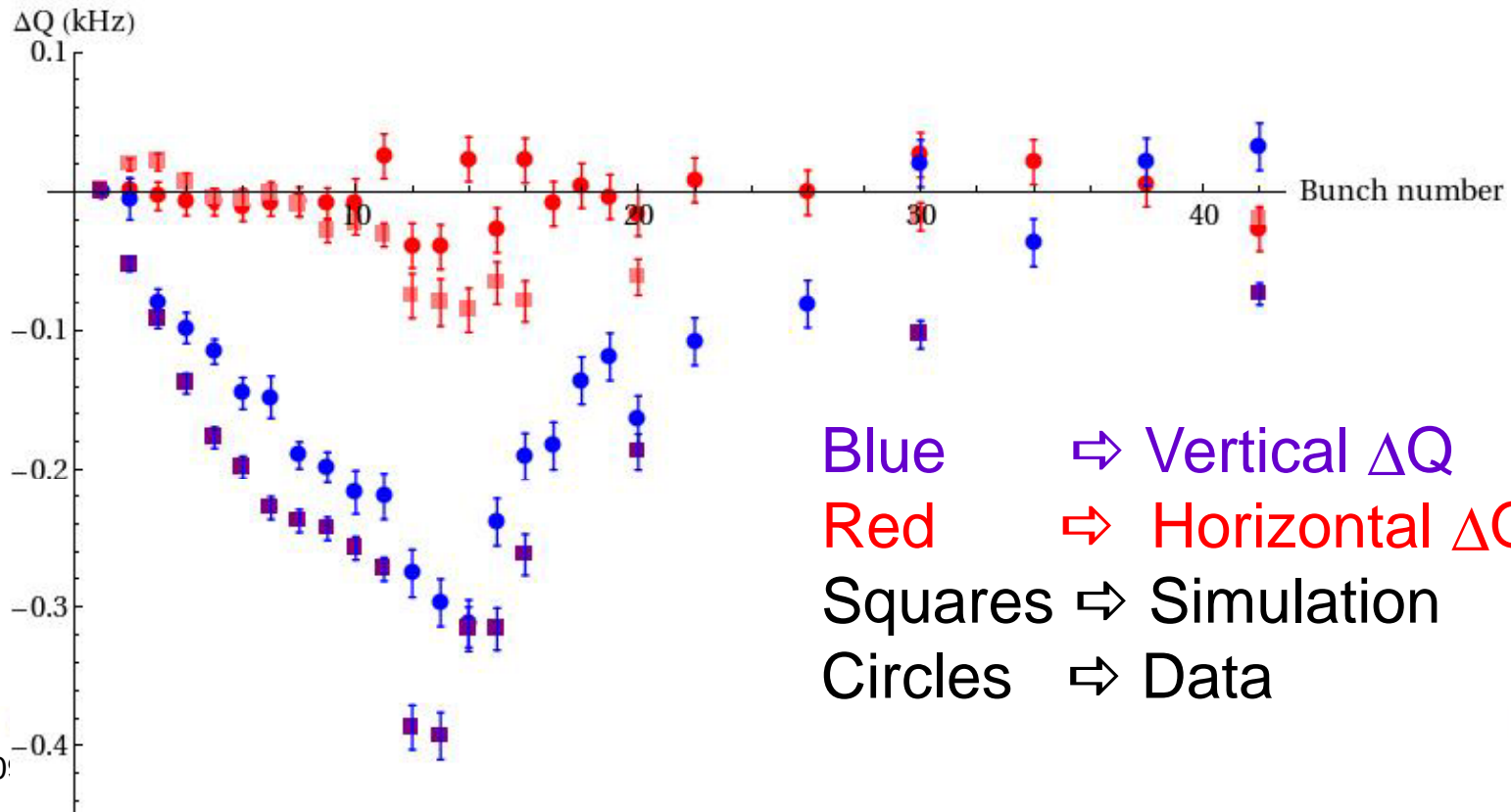
Red circles: data, horizontal tune shift

Simulation,

CESR-TA drift at 1.885 GeV: elec, SEY=2.0, epk=310, r=15%, QE=12%, 51 nick

CESR-TA dipole at 1.885 GeV: elec, SEY=2.0, Epk=310, r=15%, QE=12%, 51 ni

## Electron Beam



Blue  $\Rightarrow$  Vertical  $\Delta Q$   
Red  $\Rightarrow$  Horizontal  $\Delta Q$   
Squares  $\Rightarrow$  Simulation  
Circles  $\Rightarrow$  Data





# 45 Bunch Train: Data-POSINST Comparison (Preliminary)

Coherent tune shift vs. bunch number

Tune shift data 2.085 GeV 45 bunch train 0.75 mA/bunch positrons 1/26/09

Purple Squares: Simulation, vertical tune shift

Blue Circles: data, vertical tune shift

Pink Squares: Simulation, horizontal tune shift

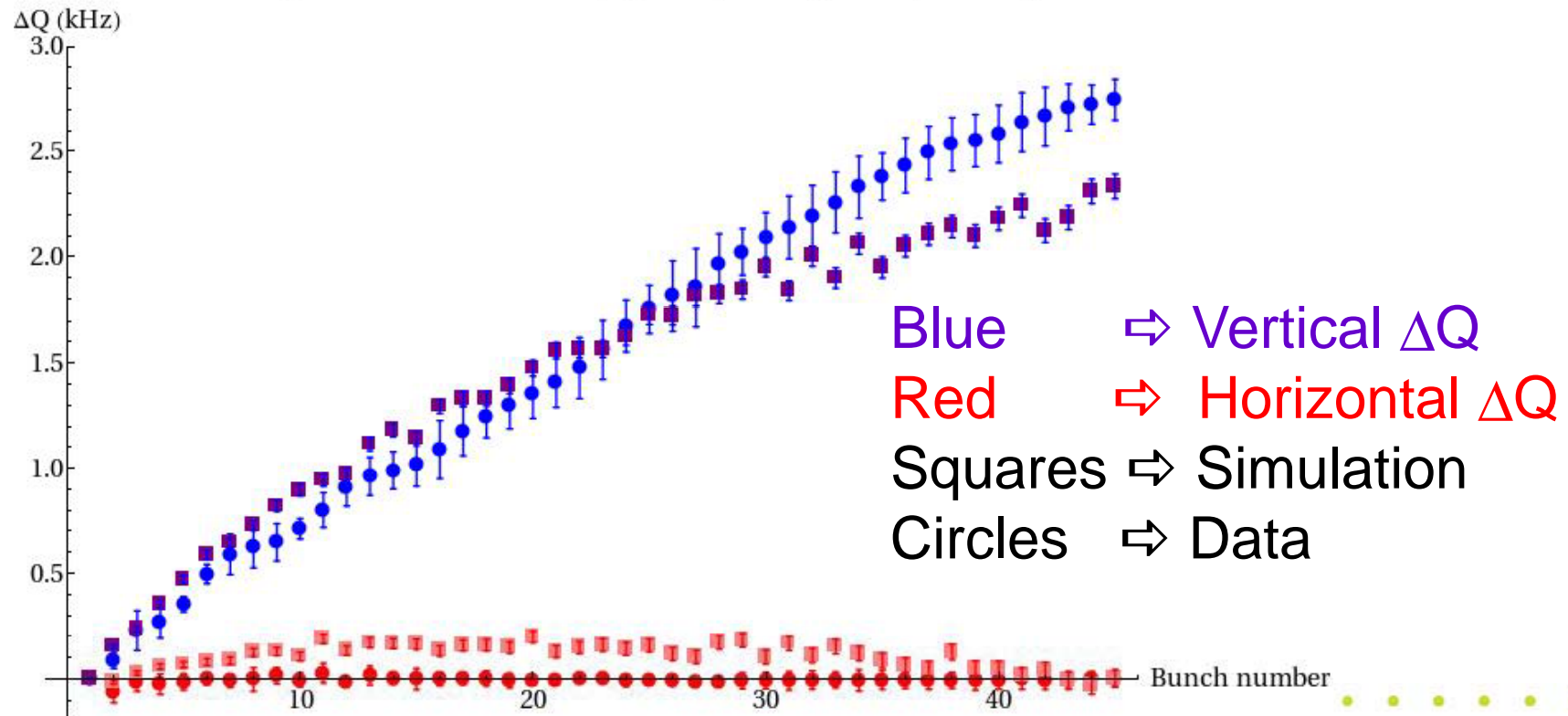
Red circles: data, horizontal tune shift

Simulation,

CESR-TA drift at 1.885 GeV: SEY=2.0, epk=310, r=15%, QE=12%, 51 nicks, pa=1

CESR-TA dipole at 1.885 GeV: SEY=2.0, Epk=310, r=15%, QE=12%, 51 nicks, p

## Positron Beam



Blue  $\Rightarrow$  Vertical  $\Delta Q$   
Red  $\Rightarrow$  Horizontal  $\Delta Q$   
Squares  $\Rightarrow$  Simulation  
Circles  $\Rightarrow$  Data



# Summary

- Experimental Run
  - **Successful tune-up of low emittance lattice**
    - Within roughly a factor of 2 of our target vertical emittance (<20pm)
    - Touschek and beam size measurements in nominal agreement
  - **xBSM tool is coming on line and is providing valuable data**
    - Basics are now coming together
    - Further optics calibration/checks required
    - Considerable ongoing work for bunch-by-bunch readout and the transition to having a true operational device
  - **Instrumentation and feedback upgrades**
    - Critical studies completed for 4ns operation
    - Upgrades and testing are ongoing
  - **EC Measurements and Diagnostics**
    - Working on detailed comparisons of RFA and TE Wave Measurements
    - Next generation of test chambers
- 2<sup>nd</sup> major upgrade down underway
- Further experimental details
  - **For those interested, a much more detailed discussion will take place at next Tuesday's CesrTA Collaboration WebEx meeting**
  - **5pm US EST (password: cesrta)**