Update to the ECLOUD/POSINST Comparison for the March 2010 On-axis Coherent Tune Shift Measurements

Figure 3 of the IPAC10 submission TUPD024

"Progress in Studies of Electron-Cloud-Induced Optics Distortions at CesrTA"

All material for this talk may be obtained at www.lepp.cornell.edu/~critten/cesrta/ecloud/26may10

The files for the IPAC10 paper are available at www.lepp.cornell.edu/~critten/cesrta/ecloud/ipac10

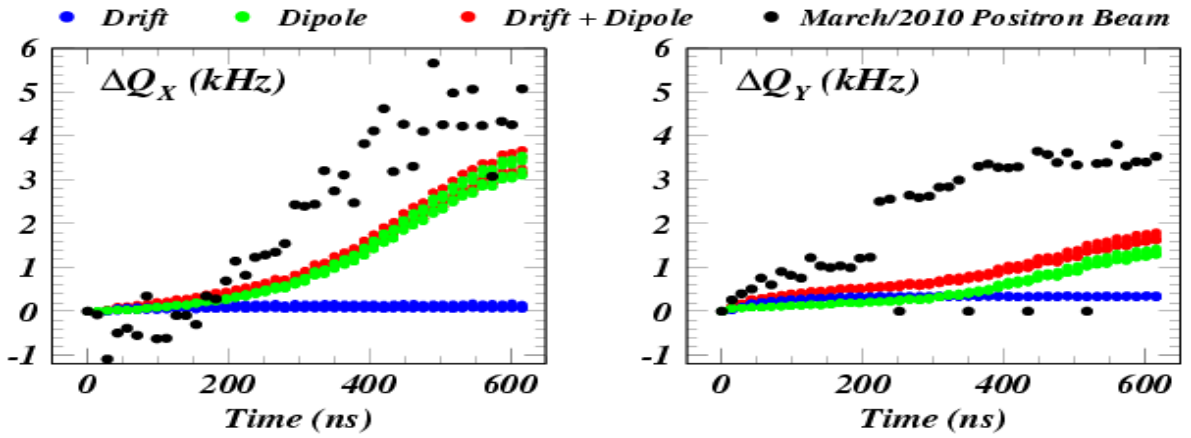
Jim Crittenden

Cornell Laboratory for Accelerator-Based Sciences and Education

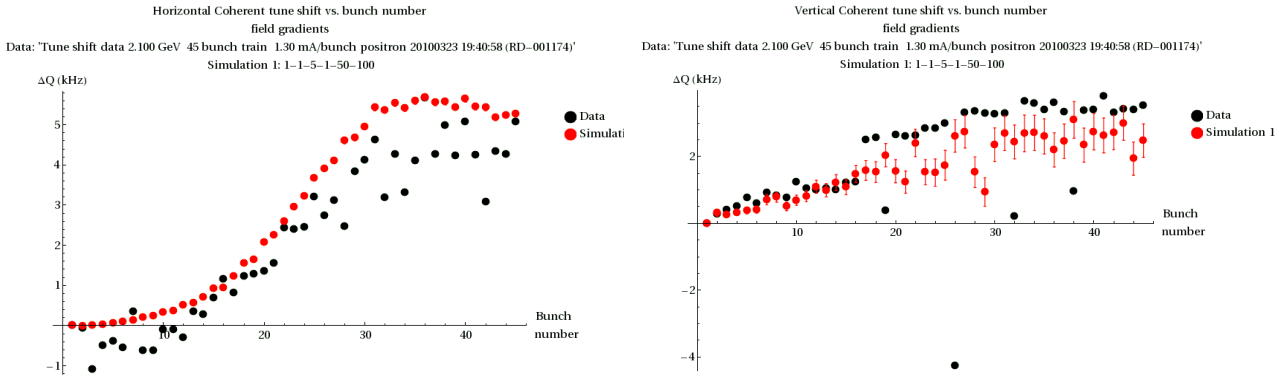
Electron Cloud Meeting

26 May 2010

ECLOUD
with
POSINST input parameters



POSINST
DLK Presentation 5 May 2010



The ECLOUD simulation yields smaller tune shifts and does not show the saturation effect which POSINST successfully models.

Figure 3 of TUPD024

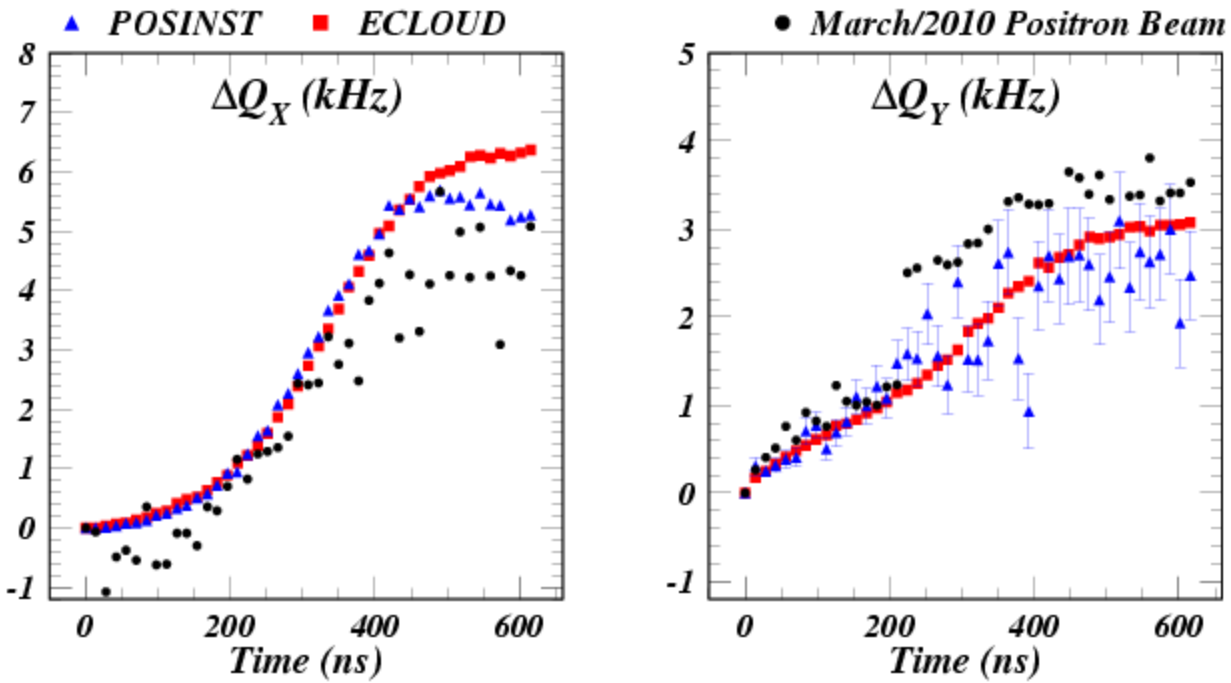


Figure 3: Comparison of the measured and simulated horizontal and vertical tune shifts along a train of 45 14-ns-spaced positron bunches carrying 2.1×10^{10} each at 4.0 GeV. The POSINST and ECLOUD codes approximately model the apparent saturation of the large tune shifts along the train.

Two days prior to the submission deadline, I found that offsetting the beam in ECLOUD by 10 microns both horizontally and vertically reproduced the saturation effect seen in both POSINST and the tune shift measurement for this large bunch current (1.3 mA). Since this offset is so small, it appears likely that this is a systematic problem in ECLOUD, perhaps related to the presence of a space-charge grid node at the center of the vacuum chamber.

After requesting input from the authors, I included this result in the paper because the effect is physically interesting at a bunch current similar to the ILC damping ring design. (Note, however, that the bunch spacing is 14 ns rather than 6 ns.)

The ECLOUD input parameters used for the paper differ slightly from those of the POSINST simulation.

ECLOUD with POSINST input parameters

0.102 γ/m/e

σ_x = 887 μ

σ_y = 65 μ

σ_z = 1.34 mm

ECLOUD with updated SYNRAD ring averages

0.095 γ/m/e

σ_x = 898 μ

σ_y = 98 μ

σ_z = 1.34 mm

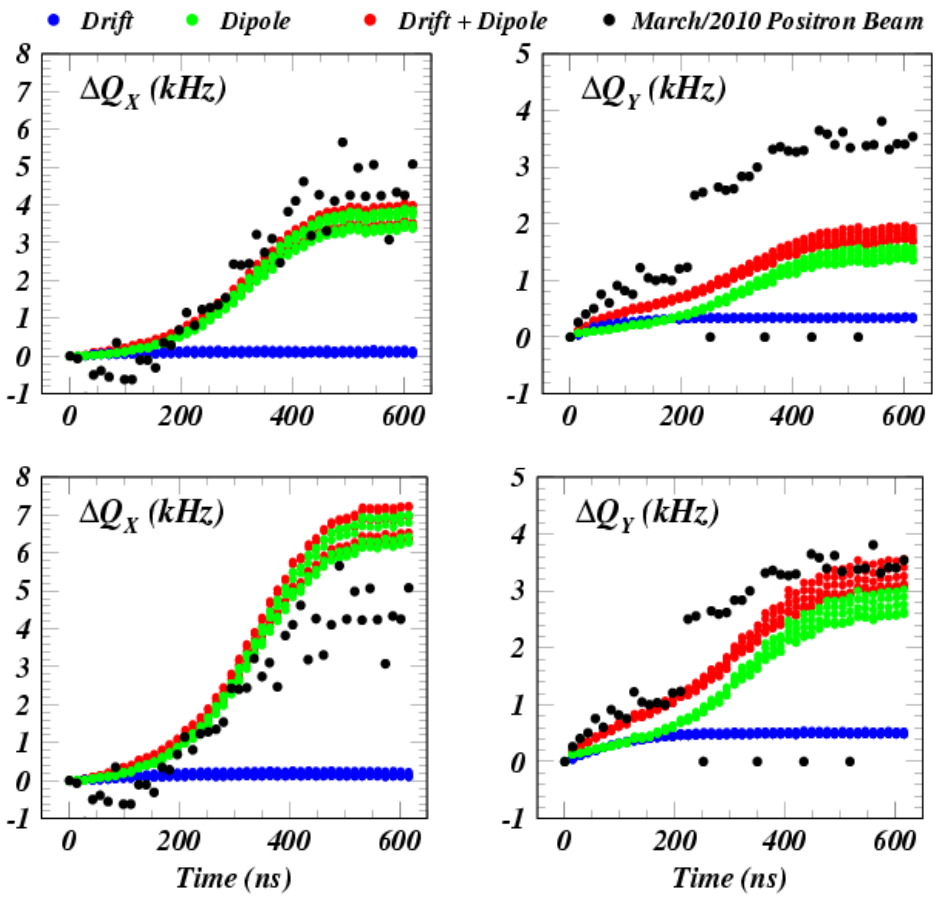
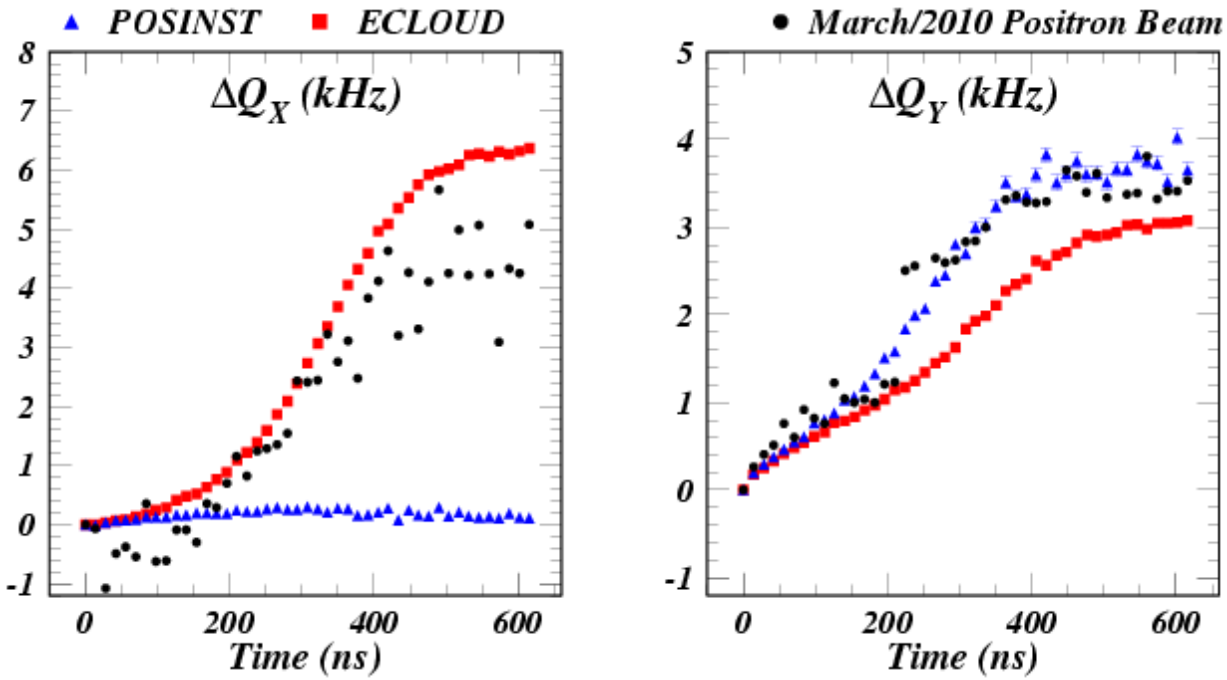


Figure 3 of TUPD024 showed tune shifts calculated only immediately prior to the bunch passage. Here the variation during the bunch passage is shown as well. There remain some differences between ECLOUD and POSINST, most likely due to the method of averaging the field gradient over the transverse extent of the beam.

Thought-provoking (irrelevant?) POSINST result for 2-mm offset beams



Dave's POSINST simulations (May 5) also calculated the coherent tune shifts in the way we used for the pinged data, i.e. with the beam-averaged field differences for simulations with beams offset by 2 mm.
Here is Fig. 3 of TUPD024, but with the POSINST result of the calculation using offset beams.
The suppression of the horizontal tune, the original motivation of this method, is familiar (and known to be wrong here).
The agreement with the measurement of the vertical tune is astonishingly good. Fortuitous?