Cornell University
Laboratory for Elementary-Particle Physics

ECLOUD Calculations of Coherent Tune Shifts in Dipole and Quadrupole Fields Over Many Turns

Followup to talks of 9 and 16 Dec 2009

8 March 2010: Corrected slide reference on slide 2

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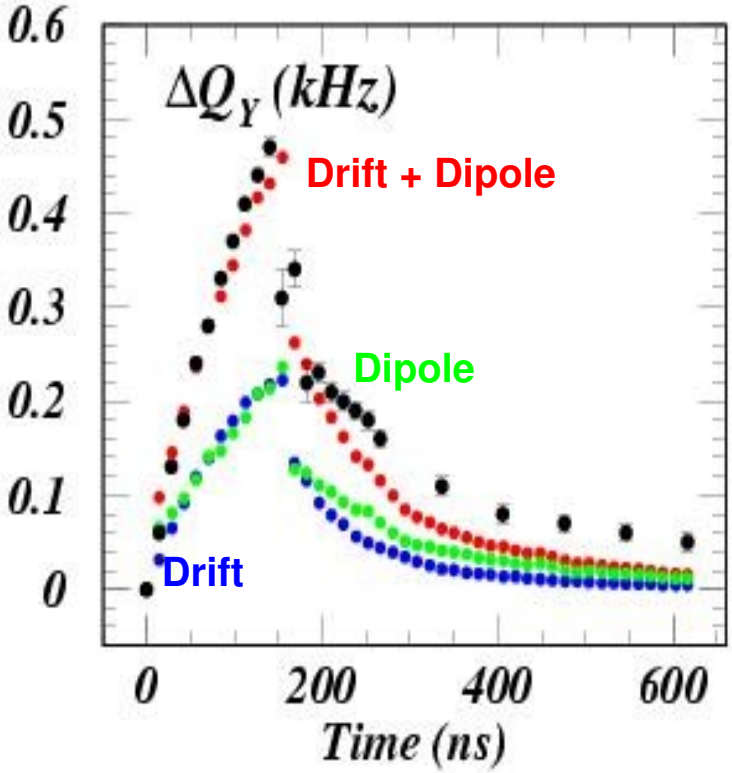
Electron Cloud Meeting

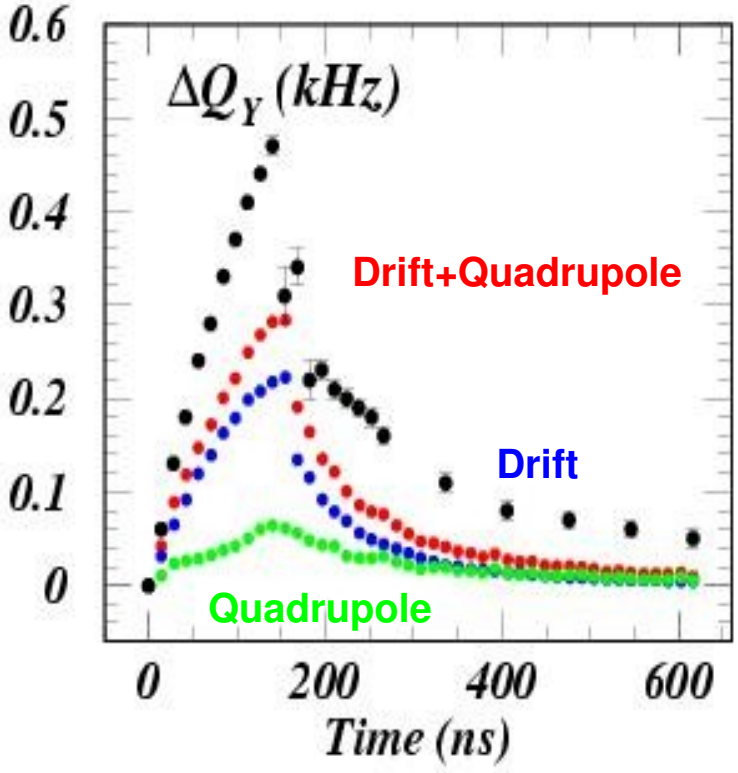
3 March 2010

Data from Fig. 2 of
PAC2009 FR5RFP044
5.3 GeV, 0.75 mA/bunch

Dipole (0.2 T)



Quadrupole (9.2 T/m)

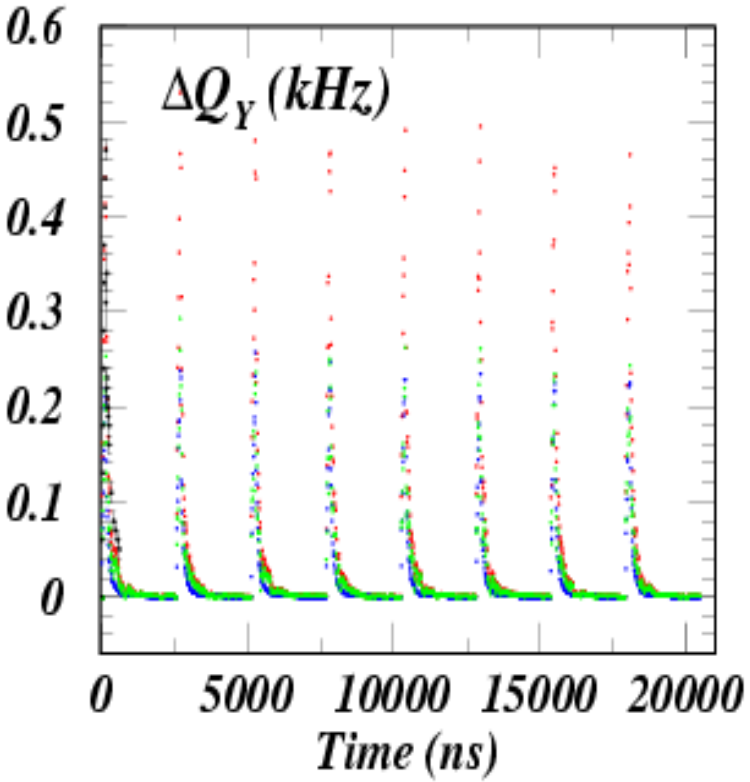


The assumption of dipole ring averages (61.5% occupancy and 1.16 photons/m/e) exaggerates the quadrupole contribution (8.5%, 0.78 photons/m/e) by more than a factor of 10. The quadrupole contribution thus calculated is nonetheless only about 20% of the dipole contribution during the passage of the filled bunches. It can be neglected at the 2% level.

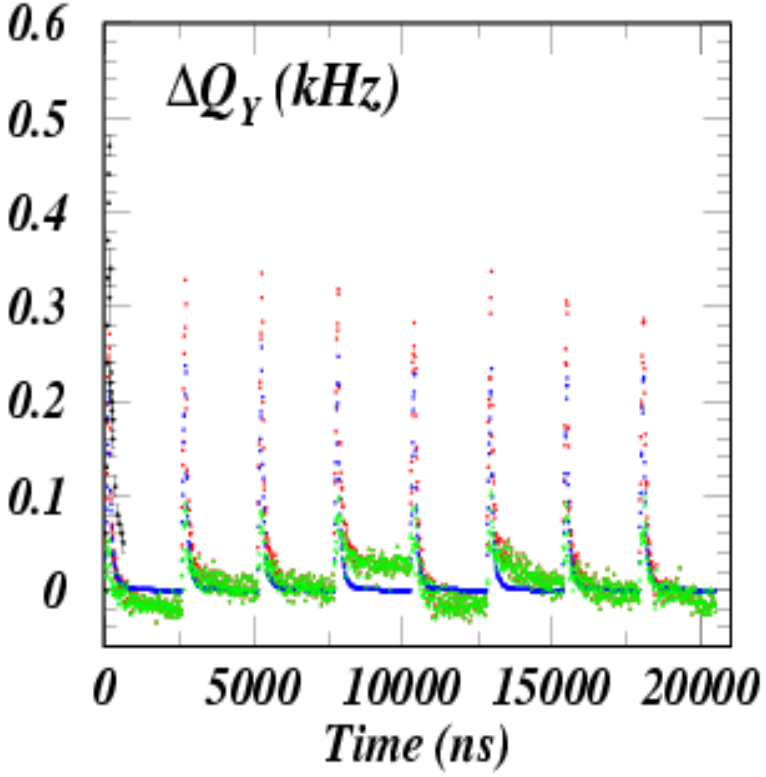
But does the quadrupole contribution accumulate over many turns?

Data from Fig. 2 of
PAC2009 FR5RFP044
5.3 GeV, 0.75 mA/bunch

Dipole (0.2 T)



Quadrupole (9.2 T/m)



Not for 11-bunch trains.
What about for 45-bunch trains, where secondary emission dominates?

Does the quadrupole contribution accumulate over many turns for 45-bunch trains?

Data from Fig. 2 of
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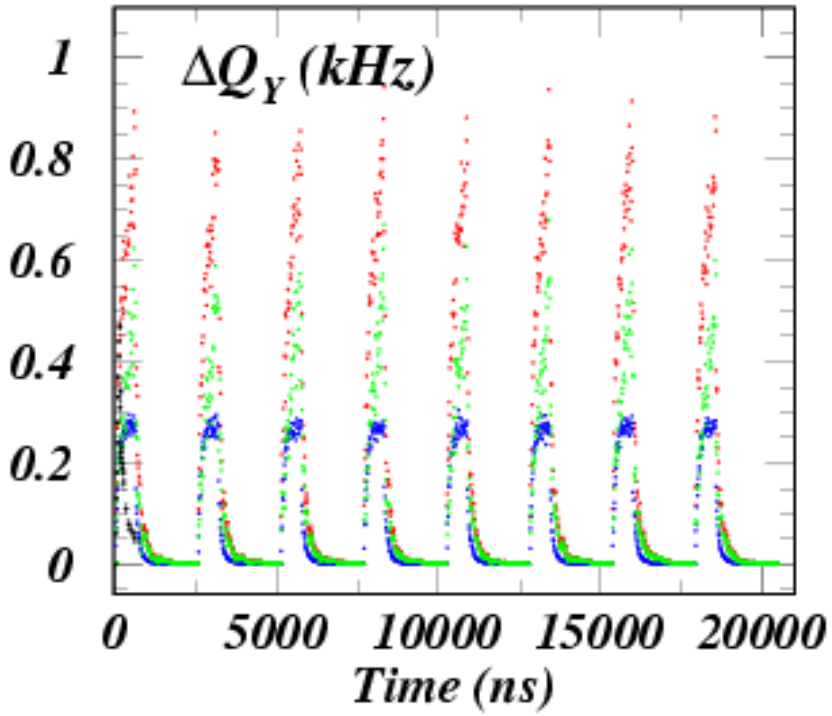
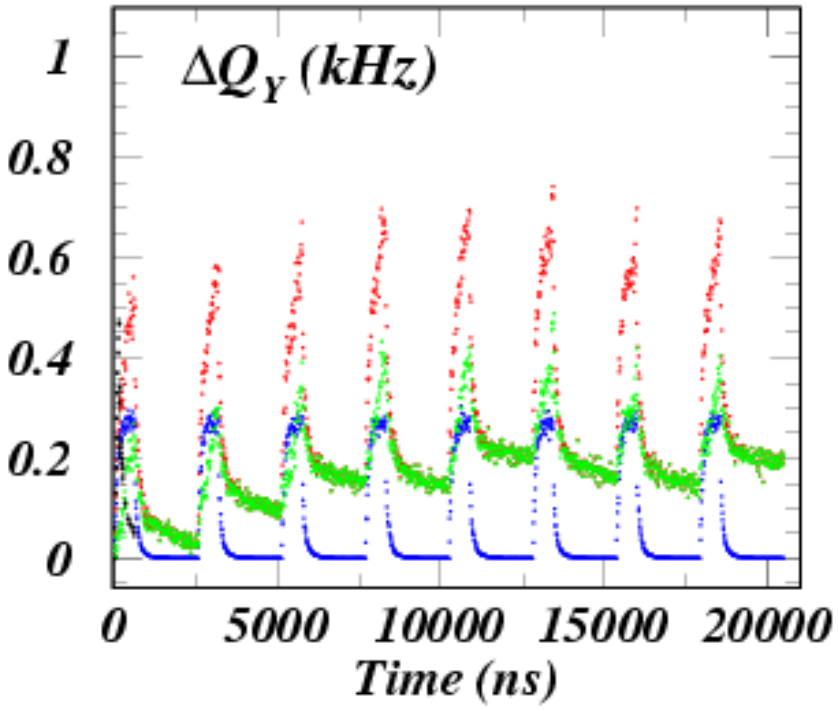
5.3 GeV, 0.75 mA/bunch

Dipole (0.2 T)



Quadrupole (9.2 T/m)

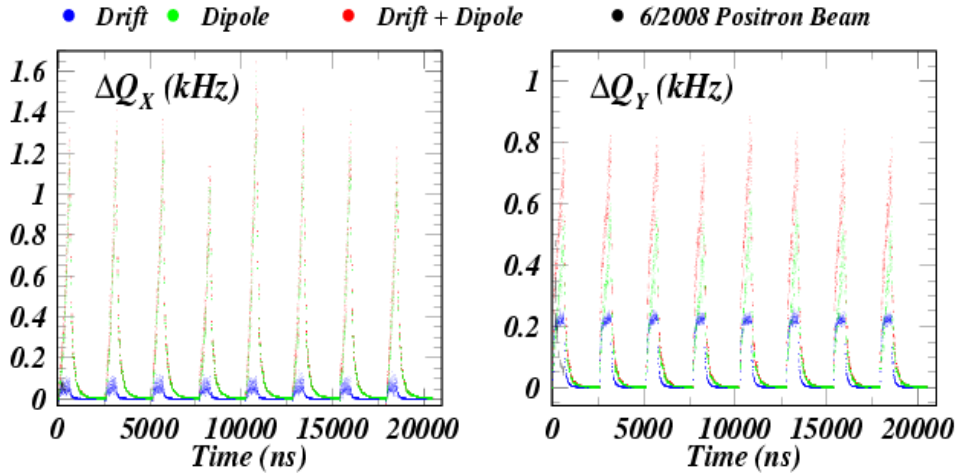


The cumulative effect slows after about six turns. Here only 45 of 183 bunches are filled.

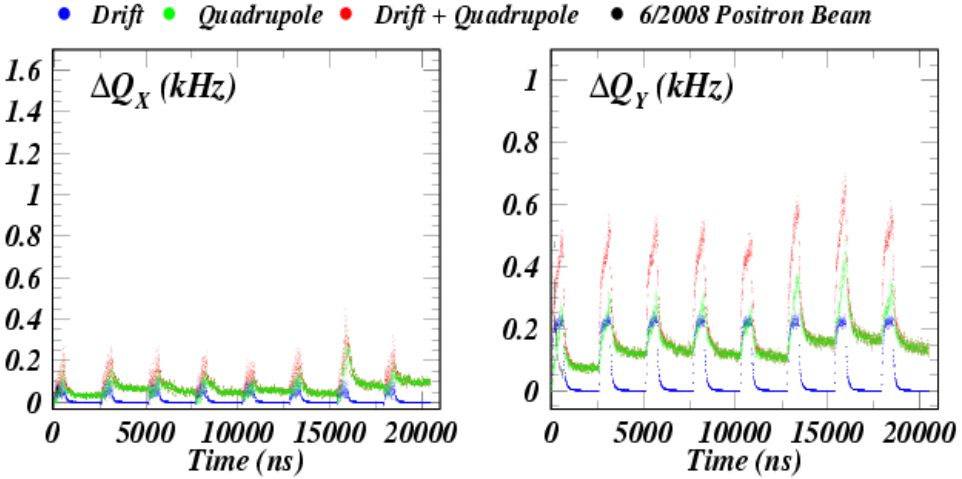
NB: A circular beam pipe would reduce the average secondary yield.

Field Gradients at the Center of the Vacuum Chamber

Dipole (0.2 T)



Quadrupole (9.2 T/m)



The tune shifts calculated from the field gradients at the center of the vacuum chamber show turn-to-turn buildup behavior similar to that for those calculated with offset beams.

Again conclude that the quadrupole contribution can be neglected at the level of a few percent.