



Cornell University
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ECLOUD Calculations of Coherent Tune Shifts for the April 2007 Measurements

- This presentation limited to resolving drift/dipole weighting question -

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$$\Delta f_x = f_{\text{rev}} \frac{e}{4\pi E_{\text{beam}}} \oint \beta_x \left\langle \frac{dE_x}{dx} \right\rangle_{\text{beam}} ds \approx f_{\text{rev}} \frac{e}{4\pi E_{\text{beam}}} C \langle \beta_x \rangle_{\text{ring}} \left\langle \left\langle \frac{dE_x}{dx} \right\rangle_{\text{beam}} \right\rangle_{\text{ring}}$$

I. ECLLOUD input parameters

1. Sync rad photon rate per meter per beam particle at primary source point (Drift $R=0.23$, Dipole $R=0.53$)
2. Quantum efficiency (12%)
3. Beam particles per bunch ($1.2e10$)
4. Contribution of reflected sync rad photons uniform in azimuth (15%).
 - ECLLOUD subtracts this from the primary source point !
5. Secondary emission peak yield ($SEY=1.8$) at peak energy ($E_{\text{peak}} = 310 \text{ eV}$)

II. Field difference or gradient --> tune shift conversion parameters

1. $E_{\text{beam}} = 1.885e9 \text{ eV}$
2. $f_{\text{rev}} = 390 \text{ kHz}$
3. Ring circumference $C=768 \text{ m}$ ($C f_{\text{rev}} = c = 2.998e8 \text{ m/s}$)
4. Ring-averaged β values (from sync rad summary tables, see my presentation 18 Feb 09)
 - e+ beam: Drift $\beta_x(\beta_y) = 19.6(18.8)$, Dipole $\beta_x(\beta_y) = 15.4(18.8)$
 - e- beam: Drift $\beta_x(\beta_y) = 19.4(19.3)$, Dipole $\beta_x(\beta_y) = 15.3(19.4)$

III. Relative drift/dipole weighting (from sync rad summary tables)

1. Ring length fraction
 - Drift: $(22.8/(61.7+22.8)) = 0.270$
 - Dipole: $(61.7/(61.7+22.8)) = 0.730$
2. β -averaged photon rate values
 - e+ beam: Drift $R_x(R_y) = 0.987(1.061)$, Dipole $R_x(R_y) = 1.100(0.911)$
 - e- beam: Drift $R_x(R_y) = 0.957(1.030)$, Dipole $R_x(R_y) = 1.098(0.911)$



$$\Delta f_x = f_{\text{rev}} \frac{e}{4\pi E_{\text{beam}}} \oint \beta_x \left\langle \frac{dE_x}{dx} \right\rangle_{\text{beam}} ds \approx f_{\text{rev}} \frac{e}{4\pi E_{\text{beam}}} C \langle \beta_x \rangle_{\text{ring}} \left\langle \left\langle \frac{dE_x}{dx} \right\rangle_{\text{beam}} \right\rangle_{\text{ring}}$$

Example: $\Delta E/\Delta Y = 1000 \text{ V/m}^2$, $\beta_y = 20 \text{ m} \Rightarrow \Delta f = 253 \text{ Hz}$

April 2007 Conditions

Positron beam beam-averaged field values for vertical offsets $\pm 5 \text{ mm}$

$\Delta E/\Delta Y$ averaged over bunch 11

Drift: $9.356\text{e}3 \text{ V/m}^2$

Dipole: $2.421\text{e}3 \text{ V/m}^2$

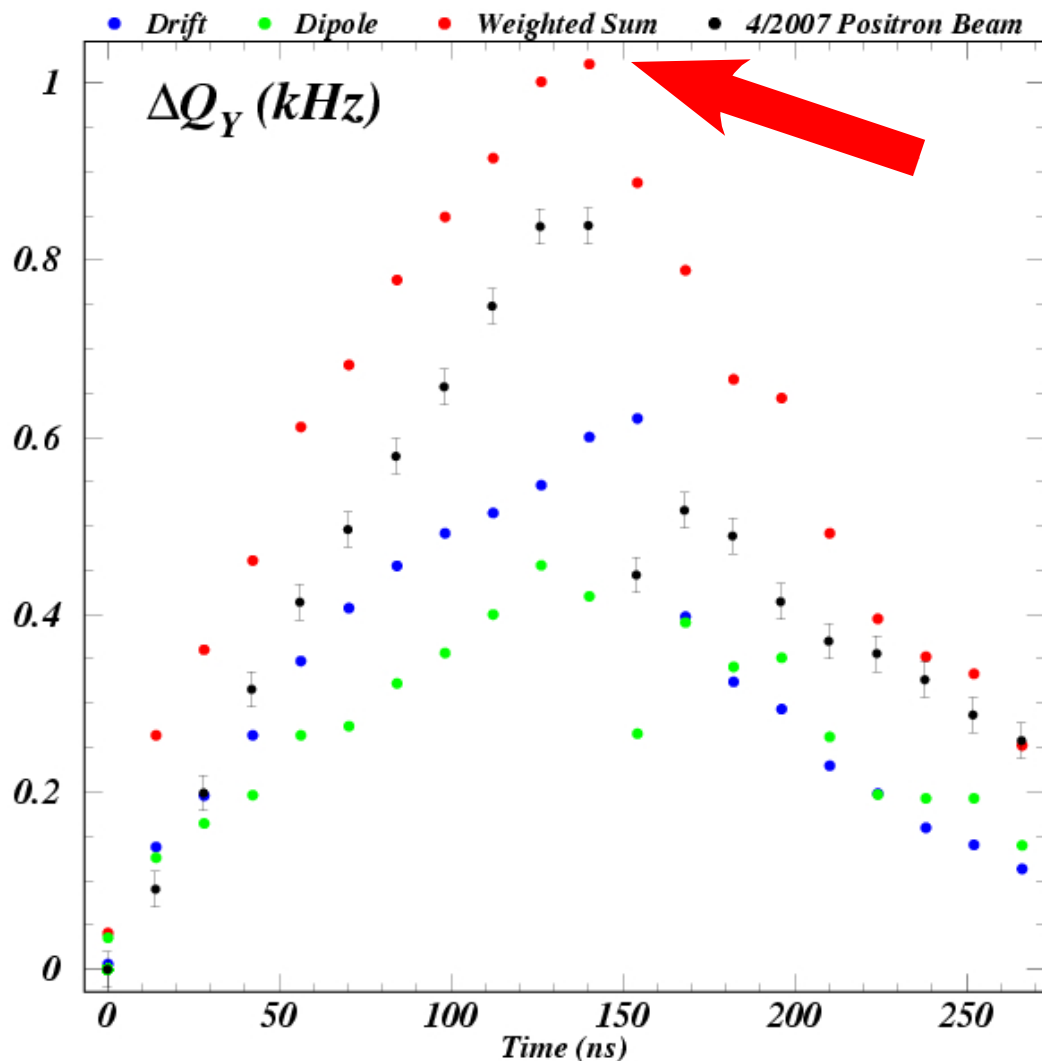
(Omit β -weighted photon rate correction for purposes of this comparison)

$$\Delta f_y = \frac{2.998\text{e}8}{4\pi 1.885\text{e}9} (0.27 * 18.8 * 9.356\text{e}3 + 0.73 * 18.8 * 2.421\text{e}3)$$

$$\Delta f_y = 1.022 \text{ kHz}$$



TS0407_REFL15_Epk310: Coherent Tune Shifts



GD LBNL/Cornell POSINST Comparison

11 Feb 09

11 bunches offset, bunch 11

Drift $\Delta Y = +5\text{mm}$

	E_Y	Δf_Y
Cornell:	42.35 V/m	0.426
LBNL:	-41.06 V/m	0.445
ECLLOUD:	44.46 V/m	0.601

Dipole $\Delta Y = +5\text{mm}$

	E_Y	Δf_Y
Cornell:	13.77 V/m	0.589
LBNL:	-11.52 V/m	0.40
ECLLOUD:	12.59 V/m	0.421

*We need to understand these differences
before continuing our comparisons.*