Space Charge Electric-Field Calculations for Coherent Tune Shift Estimations using the Electron-cloud Modelling Algorithm

ECLOUD

Jim Crittenden

Cornell Laboratory for Accelerator-Based Sciences and Education

Electron Cloud Simulations Meeting

Wilson Lab

14 January 2009
CesrTA Electron Cloud Simulation wiki page: Simulation Guidance Parameters TS0407

CESR measurements in CESR-c configuration in April, 2007
1.89 GeV - Ten 0.75 mA bunches, followed by ten empty bunches, 14 ns spacing
Beam RMS size 0.16 x 0.016 x 12.6 mm.
ECLOUD bunch time +- 3.4 sigma: 0.29 ns
Elliptical beam pipe 4.5 x 2.5 cm
QE 10%, 0.23 s.r. photons per beam particle (mistake: should have been 0.53 for dipole)
25k macroparticles generated per filled bunch
SEY parameters: SEY=1.8, Epk = 310 eV
150 steps per bunch length, 300 steps between bunches
11 field calculations during each of 20 bunches
Transverse field grid 7x7 spanning +- 3 sigma
Field calculation includes beampipe image charges, no contribution from beam
Four data sets: e+ & e-(+- 5mm/grid sources), e+(+-0.5mm/grid sources), e+(+-5mm/cloud sources )
Ten runs per data set: zero beam offset, +- X and Y beam offsets, each for both drift and 715 G dipole volumes
Beam offset observed in cloud particle energies
No pinch effect present
Marco found a gradient about 25% larger for this case.
Grid Field Sources (21x21)

Macroparticle Field Sources

TS0407_p_drift (2D Averages): Vertical Field $E_Y$ (V/m)

TS0407_p_driftgy2 (2D Averages): Vertical Field $E_Y$ (V/m)
$e^+,$ Horizontal Field, Drift, Beam X +- 5 mm

Some pinch effect present
Gradient factor 3 smaller than vertical
Some “pinch effect” present
Gradient factor 6 larger than for offset +- 5mm (?)
Some “pinch effect” present
Gradient again factor 6 larger than for offset +/- 5mm (?)
No pinch effect present
Marco found a gradient about 25% larger for this case
Some pinch effect present
TS0407_e_driftpx (3D Averages): Electric Field and Gradients at X=Y=0

- $E_x$ at Center (V/m)
- $E_y$ at Center (V/m)
- $dE_x/dX$ at Center (V/m²)
- $dE_y/dY$ at Center (V/m²)

Time (ns)