FOLLOWUP TO MODELING OF ELECTRON CLOUD BUILDUP IN THE FINAL-FOCUS QUADRUPOLE MAGNETS IN THE SUPERKEKB POSITRON RING

(see talk of 4/22/2015)

-- Request from K. Ohmi at IPAC15 --

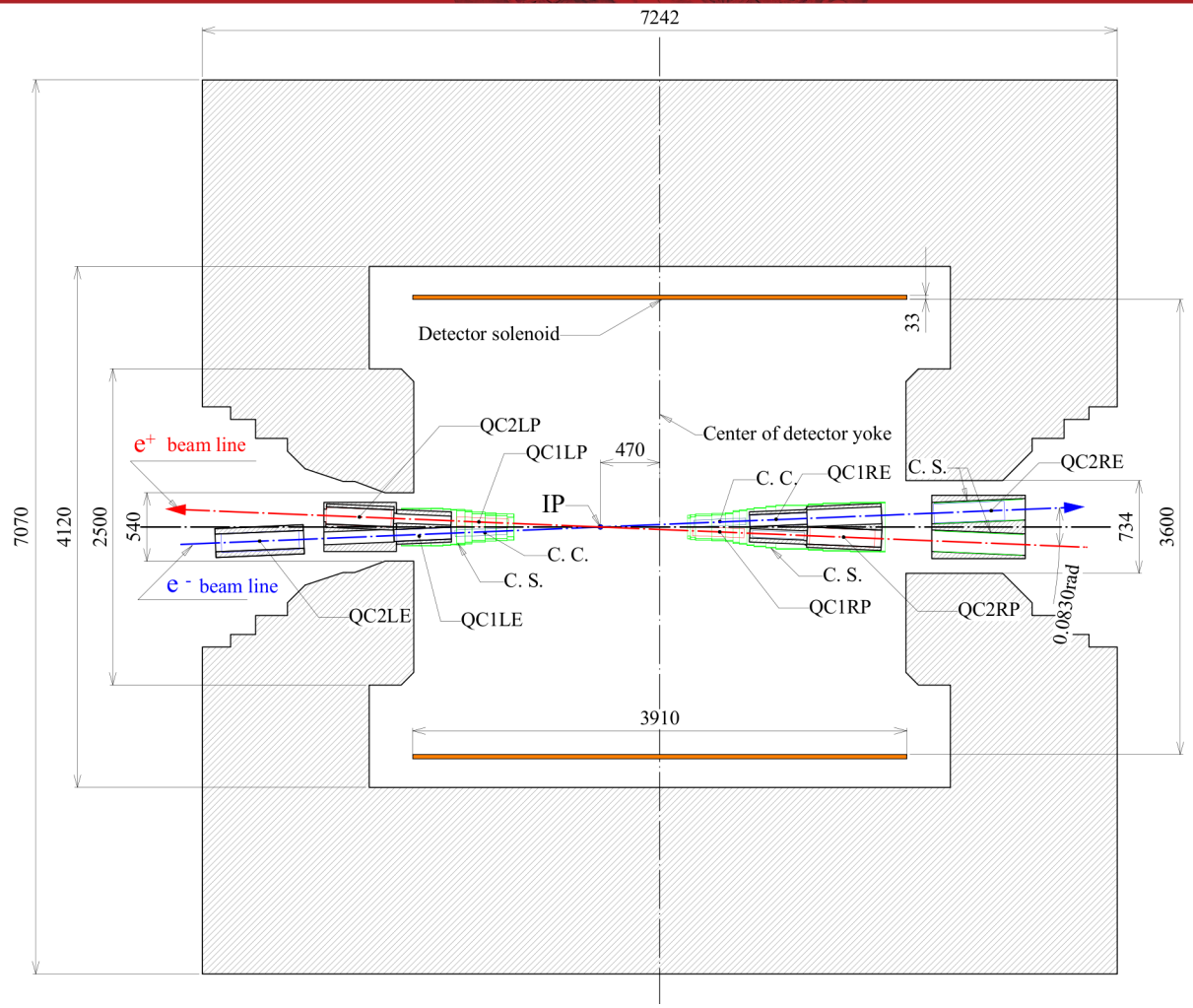
Jim Crittenden

Electron Cloud/Impedance Meeting

20 May 2015

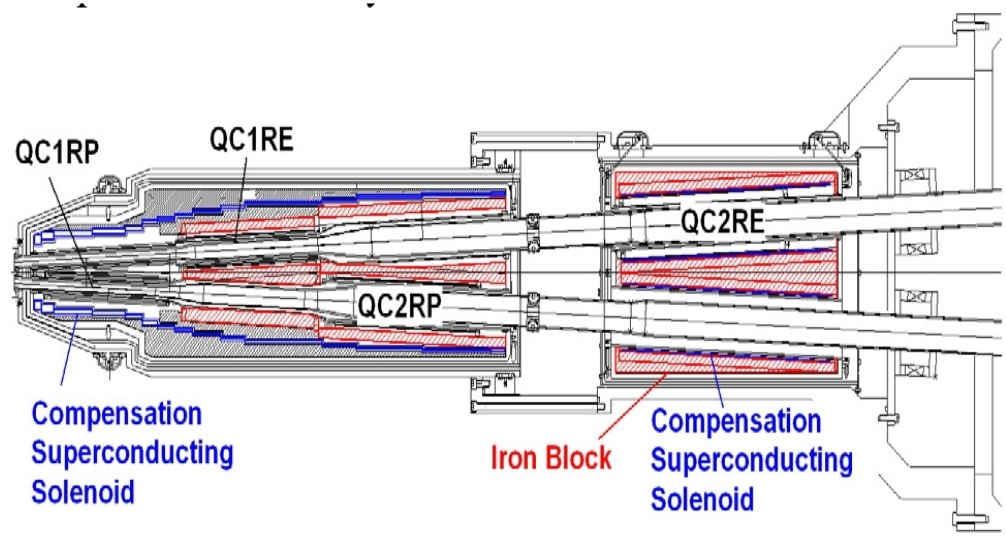
SuperKEKB Interaction Region

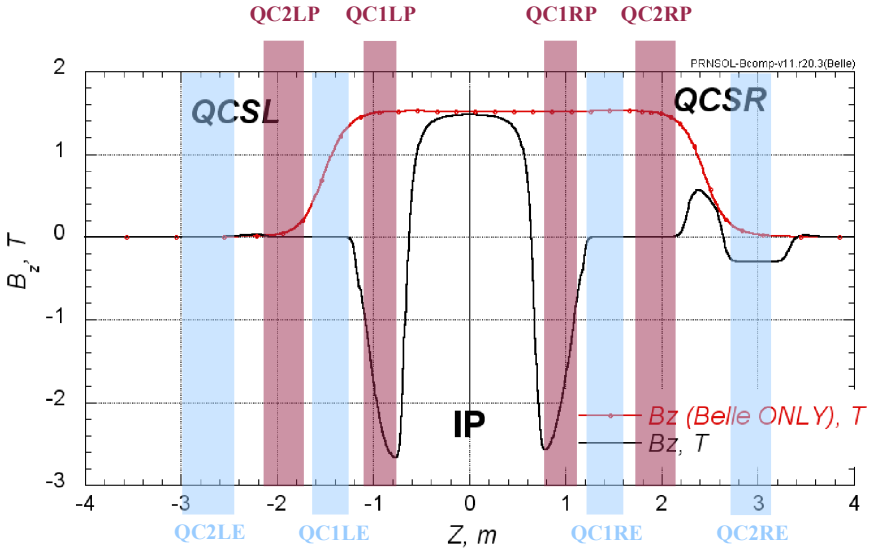
(Y. Arimoto et al, IPAC14, WEPRI086)



The BELLE-II solenoid is offset by 470 mm relative to the IP in the flight direction of the 7-GeV electron beam. The final-focus quadrupole QC1RP for the 4-GeV positron beam is in the region of uniform solenoid field.

SuperKEKB Interaction Region
Solenoid and quadrupole magnetic fields





Final-focus Quadrupole Magnets for the 4 GeV Positron Beam

QC2RP: 0.410 m 28 T/m **QC1RP: 0.334 m 69 T/m**

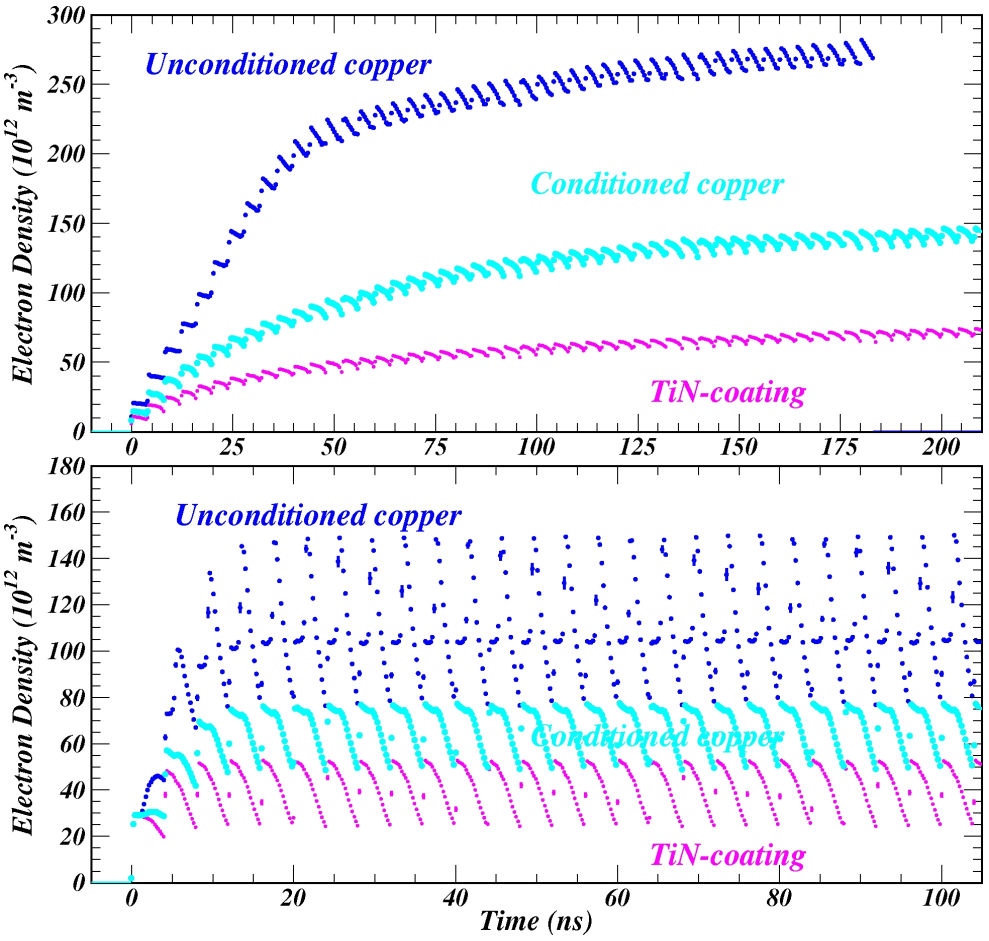
QC2LP: 0.410 m 28 T/m **QC1LP: 0.334 m 69 T/m**

The combined BELLE-II detector solenoid and compensation solenoid fields produce a field which varies along the length of QC1RP, ranging from about 0.6 T to about 2.4 T. The direction of the field is rotated 83/2 mrad relative to the LER beam axis.

Electron cloud buildup results with and without quadrupole and solenoidal magnetic fields

SuperKEKB Positron Ring Operating Parameters

4 GeV 2500 bunches @ 9.4e10 e+ σ_z = 6 mm 4 ns spacing



B' = 69 T/m
B_z = 2 T

B' = 0 T/m
B_z = 0 T

B_z is oriented along the BELLE-II axis, i.e. it is rotated around the vertical axis by 83/2 mrad relative to the LER beam axis.

The model does not account for the longitudinal variation of B_z

Nor for any radial component associated with that variation.

The magnetic fields prevent the cloud from dissipating between bunch passages.

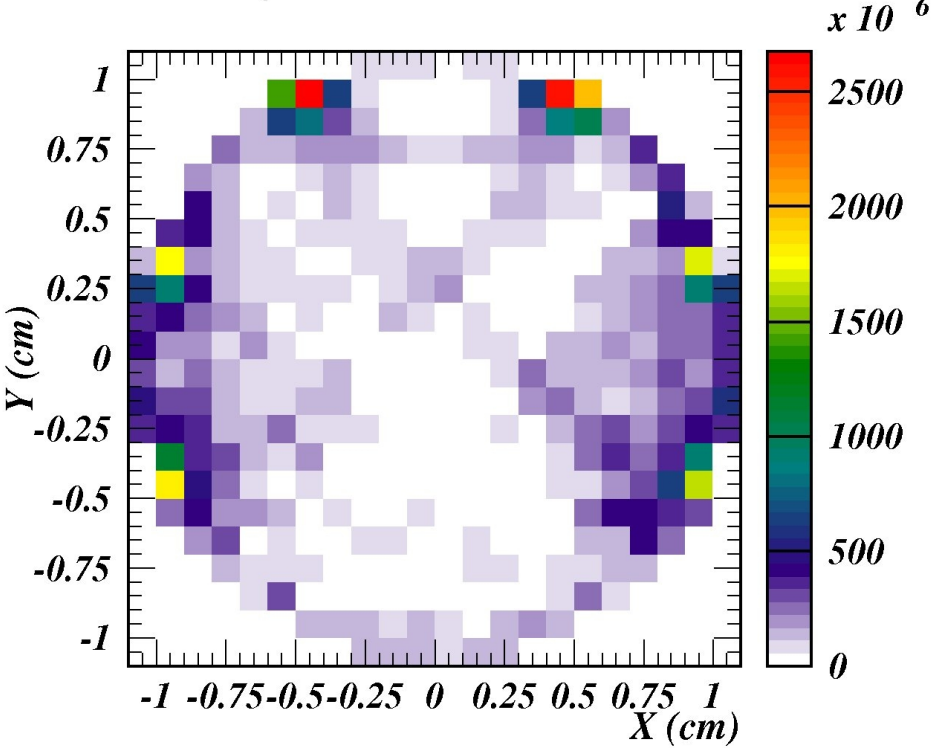
Such electron cloud densities are 3-4 orders of magnitude higher than the ring average estimated by the KEK vacuum group.

Transverse snapshots of cloud distribution

(Vacuum chamber diameter 21 mm. Unconditioned copper surface.)

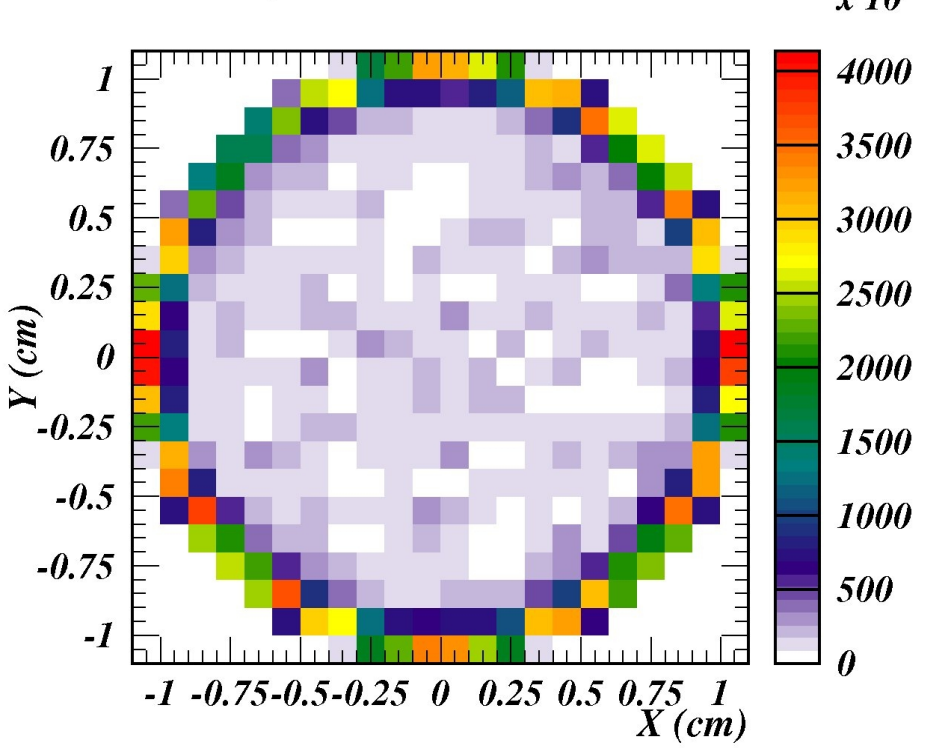
B' = 69 T/m B_z = 2 T

Cloud charge (N_e) snapshot after bunch 14 at time = 56 ns



B' = 0 T/m B_z = 0 T

Cloud charge (N_e) snapshot after bunch 14 at time = 56 ns



The quadrupole symmetry is broken by the rotated longitudinal magnetic field. The magnetic fields causes hot spots near the top of the chamber. With no magnetic field there are hot spots near the sides of the chamber. The hot spots are a factor of six more dense with the magnetic field, reaching more than 2.5x10^9 electrons in one 1-mm by 1-mm bin. The overall cloud density is a factor of three higher.