Two Papers for IPAC15

SYNCHROTRON RADIATION ANALYSIS OF THE SUPERKEKB POSITRON STORAGE RING

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

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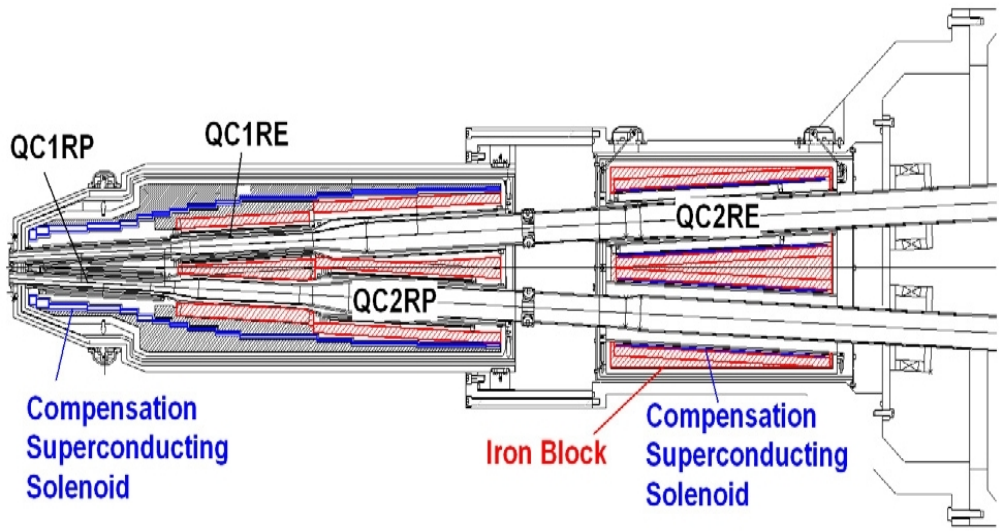
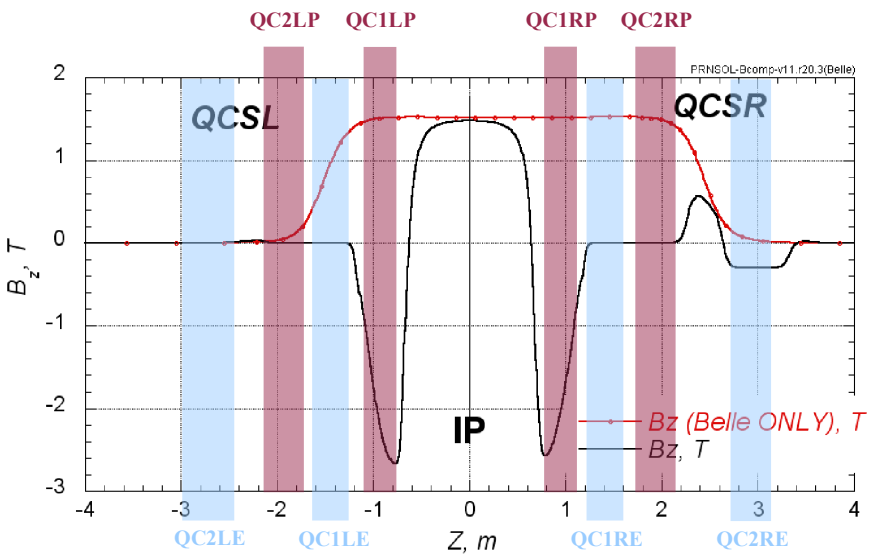
Jim Crittenden

Electron Cloud Meeting

22 April 2015

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 Model with Input Parameters from Synrad3D

Electron cloud simulation package ECLOUD

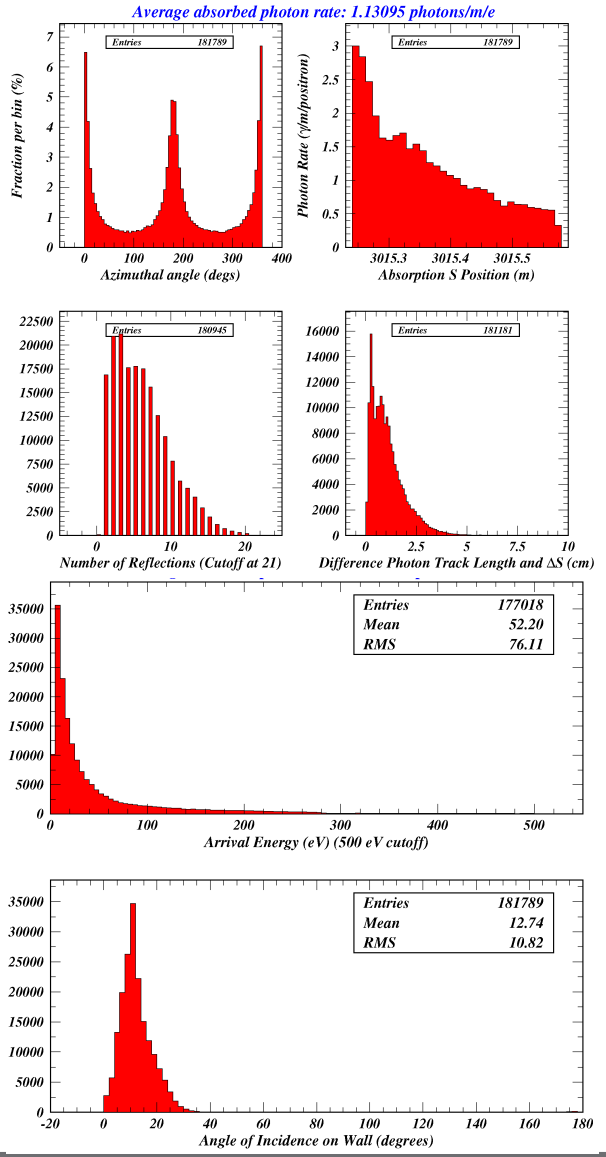
* Originated at CERN in the late 1990's
* Widespread application for LHC, KEK, RHIC, ILC …
* Under active development at Cornell since 2008
* Successful modeling of CESRTA tune shift measurements
* Validated with CESRTA measurements of electron trapping in a quadrupole magnet (PRSTAB 2015)

I. Generation of photoelectrons
- A) Production energy, angle
- B) Azimuthal distribution (v.c. reflectivity)

II. Time-sliced cloud dynamics
- A) Cloud space charge force
- B) Beam kick
- C) Magnetic fields

III. Secondary yield model
- A) True secondaries (yields > 1!)
- B) Rediffused secondaries (high energy)
- C) Elastic reflection (dominates at low energy)

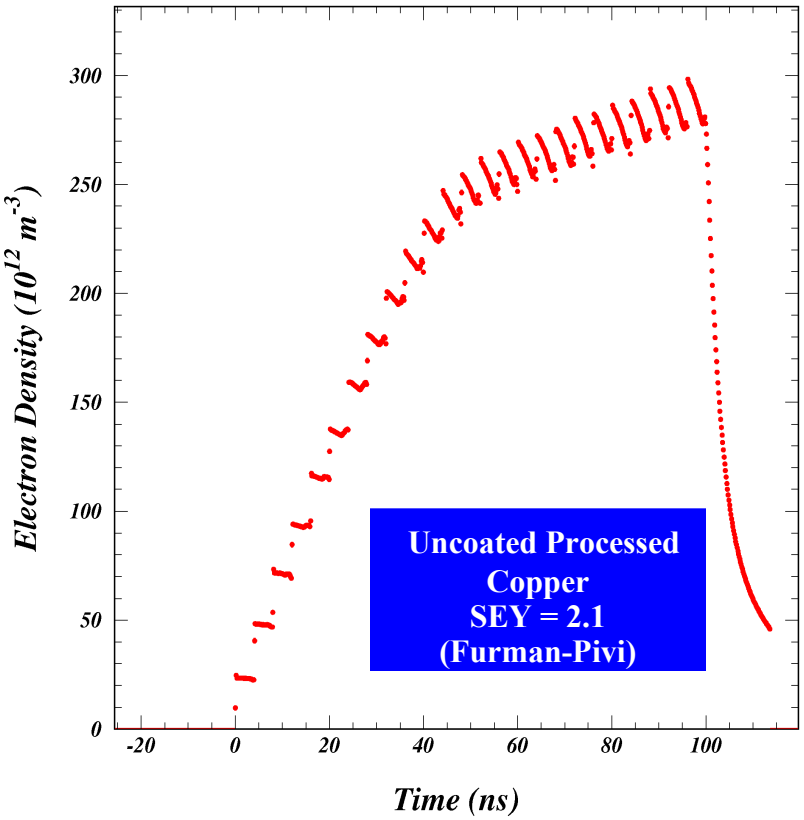
IV. Model for a stripline detector in a quadrupole field
- A) Acceptance vs incident angle, energy, B-field
- B) Charge entering holes removed from cloud
- C) Charge hitting wall creates secondaries

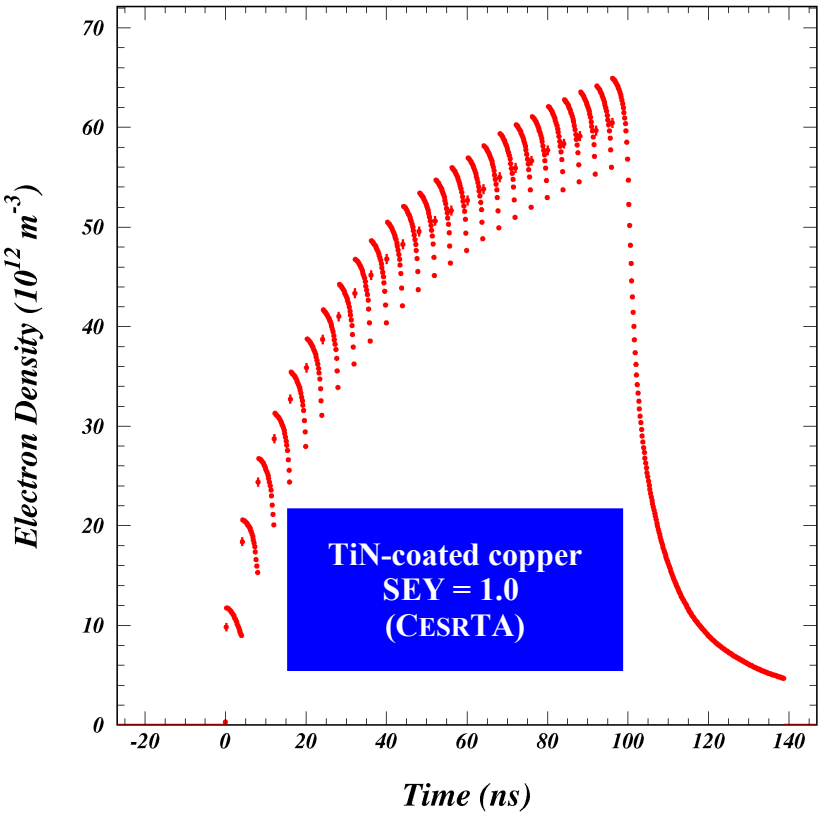


Electron Cloud Buildup Model Results

SuperKEKB Positron Ring Operating Parameters

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



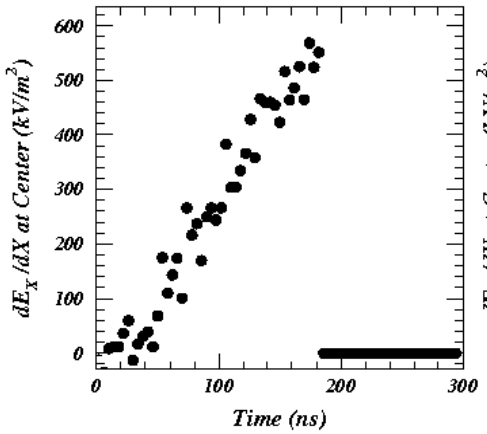


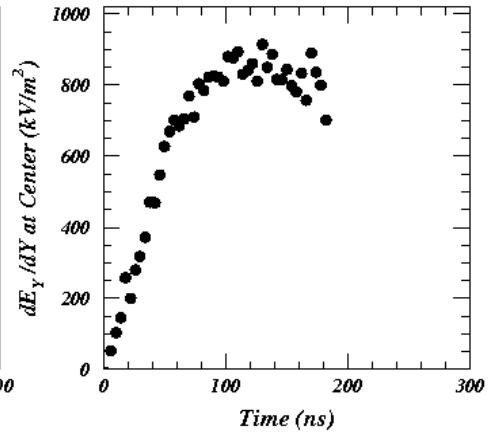
Such electron cloud densities are 3-4 orders of magnitude higher than the ring average estimated by the KEK vacuum group.

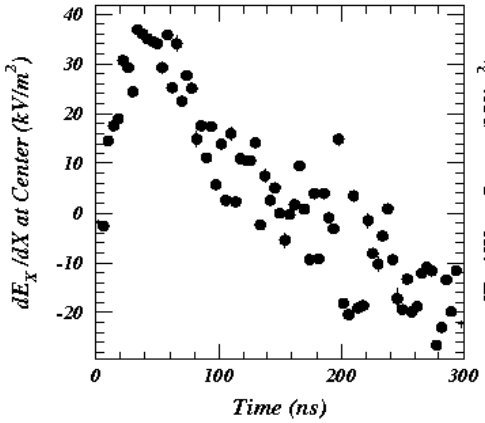
Huge Tune Shifts !
Factor >100 larger than Ohmi (IPAC14)

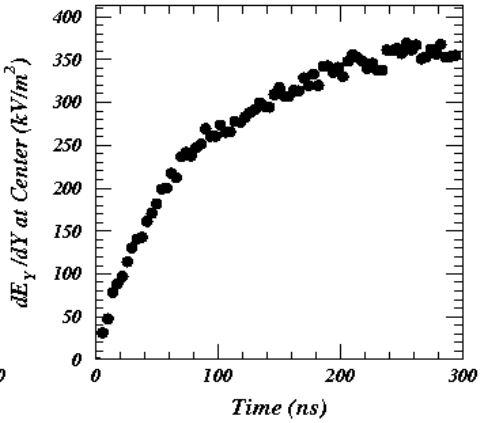
Uncoated Processed Copper
SEY = 2.1 (Furman-Pivi)

TiN-coating
SEY = 1.0
(CESRTA)









Fractional tune shift = $\Delta L * dE_Y/dY * \beta_Y / (4\pi\ E/eV) = 2.0e\text{-}7\ dE_Y/dY\ (V/m^2) = 0.16$

(β_Y = 3000 m !)

Ohmi calculated maximum values of 0.0009 for ρ_e = 6e11 m-3 about 30 m from the IP (IPAC14).

No electron cloud production in the final-focus quadrupoles was taken into account, since no photon scattering simulation had been done.