

# **Two Papers for IPAC15**

### SYNCHROTRON RADIATION ANALYSIS OF THE SUPERKEKB POSITRON STORAGE RING

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### MODELING OF ELECTRON CLOUD BUILDUP IN THE FINAL-FOCUS QUADRUPOLE MAGNETS IN THE SUPERKEKB COLLIDER

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Electron Cloud Meeting

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### **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 BELLE-II detector solenoid compensation field varies along the length of the QC1RP and QC1LP axes with magnitude up to 2.3 T. The direction of the field is rotated 83 mrad relative to the 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



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#### **SuperKEKB Positron Ring Operating Parameters**



Such electron cloud densities are very high. Head-tail instability thresholds are 2e11 (Ohmi).

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# Huge Tune Shifts ! Factor >10 larger than Ohmi (IPAC14)

**Uncoated Processed Copper SEY = 2.1 (Furman-Pivi)**  TiN-coated copper SEY = 1.0 (CESRTA)



Fractional tune shift =  $\Delta L^* dE/dY * \beta_v / (4\pi E/eV) = 2e-7 dE/dY (V/m^2) = 0.14$ 

 $(\beta_{V} = 3000 \text{ m !})$ 

Ohmi calculated maximum values of 0.0009 for  $\rho_{a} = 6e11$  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.