Electron Cloud Experimental Plans at Cesr-TA

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Electron Cloud Group Charge

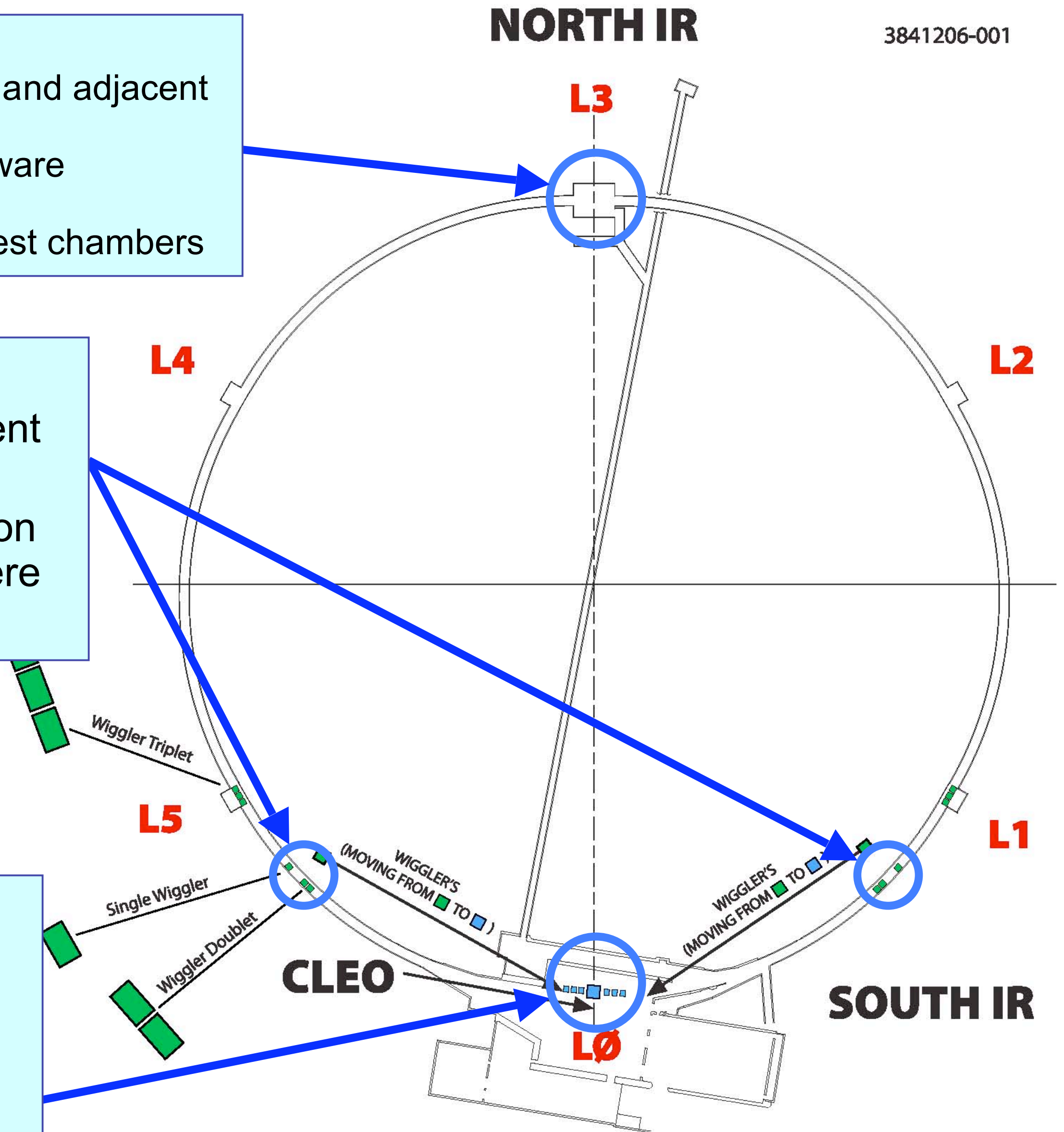
The charge to the Electron Cloud working group is to review the status of electron cloud simulations, both for electron cloud growth and for electron cloud induced beam dynamics, the benchmarking of the major codes against each other, and benchmarking of the codes against experiment. The group should also review the status of electron cloud measurement and mitigation techniques. Finally, the group should look at the world-wide experimental program and inputs that are required for the ILC and CLIC damping ring designs, paying particular attention to identifying tests that are needed as part of the CesrTA program.

CESR EC experimental areas

- L3 Straight Experimental area
  - Instrument large bore quadrupoles and adjacent drifts
  - Install of PEP-II experimental hardware (including chicane) in early 2009
  - Provide location for installation of test chambers

- Arc experimental areas
  - Instrument dipoles and adjacent drifts
  - Provide locations for installation of test chambers, in drifts where wigglers were removed.

- L0 Wiggler Experimental area
  - All wigglers in zero dispersion regions for low emittance
  - Instrumented wiggler straight and adjacent sections



WP 3.3.1: CesrTA

1. *Validation of electron cloud modelling tools* (including build-up and instability simulations) in a parameter regime relevant for the ILC damping rings.
2. *Demonstration of techniques for mitigation of electron cloud effects*, which will allow operation of the ILC damping rings meeting specifications for beam quality and stability.
3. Demonstration of tuning techniques to achieve vertical emittance below 10 pm.
4. Development of x-ray beam-size monitor to characterise ultralow emittance beams.

Potential EC Experiments

Probes of time-averaged cloud features at localized points

- RFA measurements at localized regions in L0, L3, arc experimental areas:
  - **Code validation** by measuring cloud-induced energy-differential current density in drifts, dipoles, quads, wigglers
  - **Evaluation of mitigation techniques**
    - Coatings-TiN, NEG
    - Solenoids
    - Clearing electrodes-resistive electrodes

    by RFA measurement of cloud-induced energy-differential current density
- Cross-check **code validation** and **mitigation techniques** using microwave dispersion measurements in the same localized regions
  - Specialized ports and dedicated receivers?

Potential EC Experiments

Probes of ring-averaged time-dependent cloud features

- **Code validation** by measuring, as function of particle species, energy, bunch pattern and charge, beam size, synchrotron tune, momentum compaction
  - Coherent tune shifts-time dependence using witness bunches
  - Growth time and mode spectrum of coupled bunch instability for long trains
  - Threshold of fast head-tail instability for long trains
  - Incoherent emittance growth-time dependence using witness bunches

Key questions for experimental planning

- **Code validation**
  - What specific experiments are required to best determine each feature of the codes?
  - Cloud growth-
    - What experiments will best pin down the SEY model parameters? The photoelectron generation model parameters?
  - Interaction of the cloud with the beam
    - How can we test that the effects of the "pinch" are being properly modeled?
    - How can we best establish confidence in the instability predictions? The predictions for emittance growth?
  - Are there other bench measurements (eg, SEY secondary spectrum) which could help establish code parameters?

Key questions for experimental planning

- **Mitigation demonstration**
  - What additional experiments are needed to establish high confidence in the proposed mitigation techniques to be used in the ILC damping ring?
  - How do we characterize the effect of these mitigation techniques in terms of changes in code model parameters?
  - What types of RFA measurements (or bench measurements) are needed to fully characterize the proposed mitigation techniques?