ILC DR Working Group Introduction

M. Pivi SLAC

27-29 March, 2010

LCWS10 & ILC10 Beijing, China

AAP request

Request from Accelerator Advisory Panel (AAP) Review at TILC09:

- *"The AAP would like to see a plan laid out showing how the damping ring group plans to arrive at a decision for the viability of the ILC damping ring choice with respect to electron-cloud immunity. A clear set of criteria for the vacuum system should be developed that will lead to the choice of a baseline solution.."*

- *"The AAP notes that … the impact of the e-cloud must be reevaluated for the 12 ns and 6 ns bunch spacings … with half the number of bunches in the 6-km configuration, i.e. 12 ns bunch spacing would operate in a safer regime with regard to electron cloud. Reducing the positron ring circumference to 3-km may risk losing this back-up solution."*

Working Group

- Following the AAP request → ILC DR Working Group
- Working Group started working on November 2009
- Workforce resources: started with ~1 FTE, then more and more colleagues joined the work!

- WG collaborators: T. Demma, M. Furman, K. Ohmi, Y. Suetsugu, K. Shibata, J. Crittenden, K. Sonnad, G. Dugan, M. Palmer, O. Malyshev, M. Venturini, S Guiducci, L. Wang, K. Harkay, C. Celata, I. Papaphilippou, M. Pivi:

  Argonne, CERN, Cornell U., Frascati, KEK, LBNL, SLAC

Working Group Charges

We have been asked:

1. To evaluate the proposal and options to reduce the DR circumference to 3.2 km comparing with the 6.4 km ring and give our recommendation on reducing the ring circumference to 3.2 km with respect to the electron cloud formation and instability.

Timeline: March 2010.

Working Group Charges

Then,

2. To evaluate electron cloud mitigation techniques, simulations and code benchmarking for the AD&I option. In particular, evaluate the differences between mitigations as grooves clearing electrodes, coating (TiN, TiZrV NEG and amorphous Carbon) regarding their feasibility, effectiveness, impact on the vacuum system, on the beam impedance and on costs, for different regions of the ILC DR as drifts, arc magnets and wigglers. Timeline late 2010.

Working Group goals

Goals of the LC DR Working Group are:

- To give a recommendation on the feasibility of a shorter damping ring by comparing the electron cloud build-up and instability for the 6.4km and 3.2km rings with a 6 ns bunch spacing by March 2010, then
- Following the CesrTA program or by ECLOUD'10, to give our recommendation on e- cloud mitigations and continue evaluating the electron cloud in the shorter 3.2 km ring.
- Furthermore starting by end 2010, to fully integrate the CesrTA results into the Damping Ring design.

Two Main Deliverables

Recommendation for the reduction of the ILC Positron Damping Ring Circumference

By March 2010

Recommendation for the baseline and alternate solutions for the electron cloud mitigation in various regions of the ILC Positron Damping Ring.

By Late 2010

DR designs set of common parameters

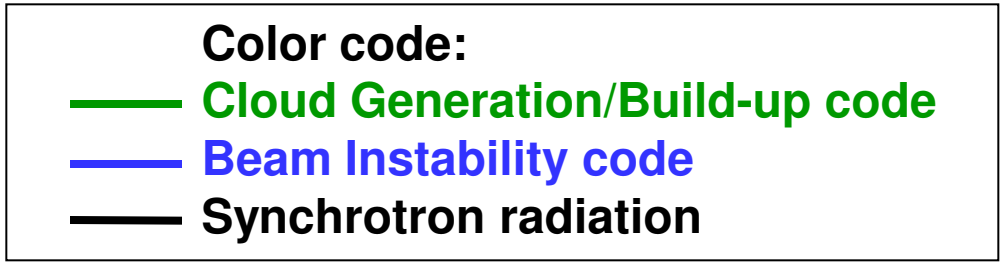
	6.4 km	3.2 km
DR Version Name	"DCO4" 90°	"DSB3"
Circumference (m)	6476	3238
Energy (GeV)	5	5
Bunch population	$2x10^{10}$	$2x10^{10}$
Beam sizes σx-σy	See next slides	See next slides
Emittance, εx (nm)	0.45	0.53
Emittance, εy (pm)	2	2
RMS Bunch length (mm)	6	6
RMS Energy Spread	$1.27x10^{-3}$	$1.2x10^{-3}$
Bunch spacing (ns)	6.2	6.2
Momentum compaction	$1.62x10^{-4}$	$1.33x10^{-4}$
RF frequency (MHz)	650	650
Harmonic number	14042	7021
Synchrotron tune	0.036	0.0166
Tunes Qx, Qy	71.109, 71.399	57.504, 32.954

Simulation input parameters for all cases
(mostly from M. Pivi, 17 Nov. 2009 et. seq.)

Beam energy	E_b=5 GeV
Bunch population	N_b=2x10^{10}
RMS bunch length	σ_z=5 mm
Bunch train	45 bunches (spacing t_b = 6.154 ns = 4 buckets)
Gap length between trains	15x4=60 buckets
Fill pattern simulated	5 x (train+gap)
Chamber radius	a=2.5 cm
Antechamber full height (if present)	h=1 cm
Antechamber clearing efficiency	η=98%
Quantum efficiency of chamber surface	QE=0.1
Radiation vertical spot size at wall	σ_y=1 mm
Photon reflectivity	R=0.9 (*)
Peak SEY values explored	δ_{max}=0, 0.9, 1.0, 1.1, 1.2, 1.3,1.4
Electron energy at δ_{max}	E_{max}=296 eV
SEY at E=0	$\delta(0)$=0.31xδ_{max}

(*) This means that 10% of the photoelectrons are generated localized at the right "edge" of the chamber, *whether or not there is an antechamber* (probably not realistic, but probably not very important for high values of R)

ILC DR Simulations

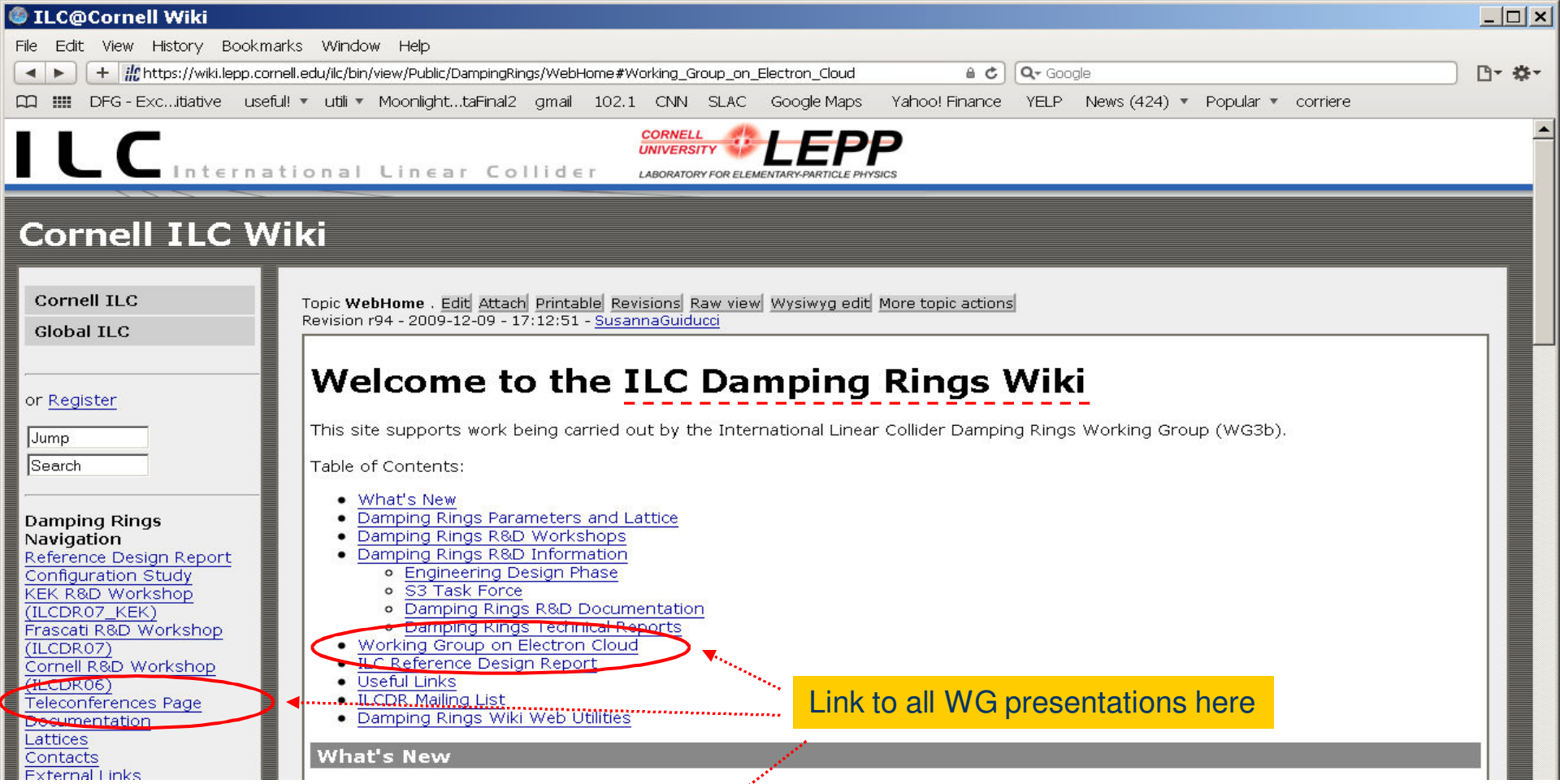


Simulation Codes:

- **Cloud Generation/Build-up code:** POSINST (LBNL/SLAC), ECLOUD (CERN), CLOUDLAND (SLAC)
- **Beam Instability code:** CMAD (SLAC)
- **Synchrotron radiation:** Synrad2D (Cornell)

Simulation work by:

T. Demma **Frascati**, M. Furman **LBNL**, M. Pivi, L. Wang **SLAC**, J. Crittenden, K. Sonnad **Cornell U.**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Revision r94 - 2009-12-09 - 17:12:51 - SusannaGuiducci
Welcome to the ILC Damping Rings Wiki
This site supports work being carried out by the International Linear Collider Damping Rings Working Group (WG3b).
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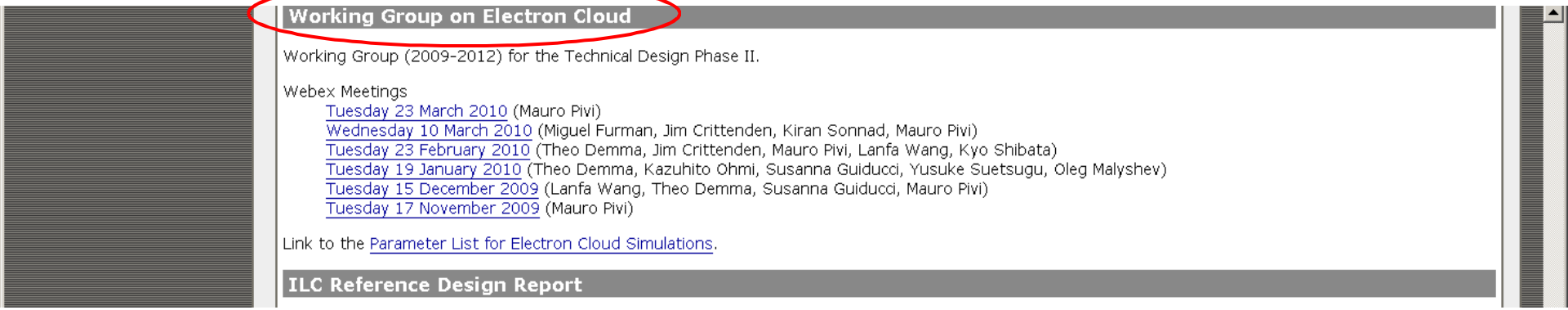
Working Group on Electron Cloud
Working Group (2009-2012) for the Technical Design Phase II.
Webex Meetings
Tuesday 23 March 2010 (Mauro Pivi)
Wednesday 10 March 2010 (Miguel Furman, Jim Crittenden, Kiran Sonnad, Mauro Pivi)
Tuesday 23 February 2010 (Theo Demma, Jim Crittenden, Mauro Pivi, Lanfa Wang, Kyo Shibata)
Tuesday 19 January 2010 (Theo Demma, Kazuhito Ohmi, Susanna Guiducci, Yusuke Suetsugu, Oleg Malyshev)
Tuesday 15 December 2009 (Lanfa Wang, Theo Demma, Susanna Guiducci, Mauro Pivi)
Tuesday 17 November 2009 (Mauro Pivi)
Link to the Parameter List for Electron Cloud Simulations.
ILC Reference Design Report

Beyond Beijing: Mitigations for ILC DR

DR element	% ring	Antechamber need	Coating	Mitigation	Additional Mitigation
DRIFT in STRAIGHT	54	No	NEG & Carbon	Solenoid	Grooves
DRIFT in ARC	33	Downstream of BEND only	NEG	Solenoid	Grooves
BEND	7	Yes	TiN	Grooves	
WIGG	3	Yes	TiN	Clearing Electrodes	
QUAD & SEXT	3	Downstream BEND / WIGG	TiN	Grooves	

Color code: Green = defined, Red = not yet defined.

In strict collaboration with CesrTA, the goal is to define mitigations by 2010 as input for ILC TD Phase 2.