LBNL mid FY10 report on ILC Damping Rings

LBNL ILC - FY2010 (October - March 2010)									
		Oct - March FY2010							
	FY09 carryover (K$)	Sum of FY2010 FTE**	Sum of FY2010 Dir Labor (K$)	Sum of FY2010 Dir M&S (K$)	Sum of FY2010 Indir (K$)	Sum of FY2010 Total (K$)	Distribution based on initial FIN plan	FY2010 Actuals through 3/31/2010	*Carryfoward to FY2010 Q3*
Vacuum hardware	113.16	0.75	52.65	12.89	44.40	109.94	125.00	109.94	*128.23*
Modleing and simulations	5.64	0.62	53.74062	1.26	47.77	102.77	228.00	102.77	*130.86*
Instrumentation & diagnostics	19.70								*19.70*
**FTE based on 6 month average									

Modeling and simulations

ILC proper:

A fairly extensive set of EC build-up simulations was carried out in order to ascertain the effects of the following variables in the ILC damping ring designs:

1. lattice DC04 vs. DSB3;
2. secondary emission yield (SEY) values = 0, 0.9, 1.0,...1.4;
3. field-free region vs. dipole bends;
4. with antechamber vs. without.

We did the simulations for all possible combinations of the above variables (total of 2x7x2x2 = 56 cases), but did not explore numerical simulation parameters (although we used simulation parameters that we believe should yield stable results). In each case, we simulated the build-up for 5 bunch trains. For each case, we obtained the following quantities among many other physical quantities:

- time-averaged, space-averaged e-cloud density;
- time-averaged e-cloud density within the 10-beam-sigma ellipse;
- e-cloud density within the 10-beam-sigma ellipse just before a bunch arrives.

As a by-product of this exercise, we concluded that, for the dipole bending magnets, the antechamber provides a significant beneficial e-cloud suppression factor (factor ~40) relative to the no-antechamber case, only if the peak SEY is below a certain value (~1.2 for DSB3, ~1.3 for DC04). If the peak SEY exceeds this critical value, the antechamber appears to offer no benefit. For the field-free regions, the antechamber proved to be of significant beneficial value (factor ~40 suppression) for all cases explored.

Cesr-TA:

We started to perform simulations for the transmission of idealized TE waves using the WARP code, and a theory for the effect on the wave from interactions with non-uniform electron cloud distributions in the presence of a magnetic field has been developed. Differences originating from specific magnetic field orientations and beam pipe geometries are being considered. We have continued to perform 3D simulations of electron cloud build-up in wigglers with particular focus on electrons accumulating near the magnetic field null. We carried out a detailed orbit analysis showing that the dynamics of these electrons is determined by gyrocenter drifts induced by the magnetic field gradient and curvature. These electrons have a tendency to become trapped and persist for long time after the passage of a bunch train. Their possible impact on the beam dynamics is still under investigation as we are applying the recently developed Warp/POSINST capabilities to compute the tuneshift they induce along the bunch train.

Instrumentation and DIagnostics

TE Wave method: we performed new measurements in the L0 (wiggler) and L3 (chicane) regions during Nov-Dec run. In both regions measurements are now fully automated and integrated in the control system, and data is continuously collected. The quantitative extraction of the e-cloud density from TE wave data has been perfected and our results recently submitted for publication in PRST-AB, in addition to being planned for presentation at IPAC 2010. TE wave resonance in the chicane was further investigated. Due to beam conditions we don't have conclusive results yet.

Shielded pickups (SPU): The first SPU unit was successfully commissioned in sector 15W (aluminum chamber) during the Nov-Dec run. Various readout electronics were tested for signal maximization and time resolution, reaching a response time of a few nanoseconds. SPU measurements yielded interesting details on the dynamics of the e-cloud density accumulation during a train passage. Results will be presented at BIW 2010. Since later measurements suggest the SPU might be able to resolve the contribution from primary and secondary electrons, we designed and assembled a new SPU to be installed in a pre-existing RFA port in the L3 region (NEG chamber). This new SPU was delivered and installed at the end of April.

Participation will continue in the Cesr-TA runs in May and July, as will design effort for the new SPU.

Vacuum Hardware

Over the course of FY10 LBNL produced one wiggler chamber for electron cloud studies as part of the Cesr-TA program. The wiggler chamber incorporated a clearing electrode inside the vacuum chamber, designed by a collaboration of LBNL, Cornell, and KEK staff. The clearing electrode design process included multiple steps in testing of coatings, feedthroughs, and handling processes such as welding. Copper samples with the proposed Alumina/Tungsten coating were produced by KEK and tested by both LBNL and Cornell. LBNL did multiple tests, including heat and welding tests to determine the durability of the coating. Two scaled prototypes were made by LBNL after the sample tests were completed, and prototypes were put through the same fabrication steps as the final chamber will be subject to. The halves were sent to KEK for coating and returned to LBNL where they were electron-beam welded by a subcontractor and also welded at LBNL. These prototypes were then electrically tested. The prototyping process was instrumental in the final determination of electrical feedthrough design and fabrication processes. The full size wiggler chamber was then put into production: this chamber was successfully delivered to Cornell, as scheduled, at the beginning of April 2010. The clearing electrode chamber was installed and will be evaluated during the next CesrTA run.
As mentioned above, LBNL contributed to the design of a new shielded pickup beam position monitor, which was produced by LBNL and shipped to Cornell for installation in the middle of April 2010.