international linear collider

ILC-Americas
FY10 Work Package Scope

Work scope period: 10/1/09 to 3/31/10
Laboratory: Cornell University Laboratory for Elementary-Particle Physics

The following document summarizes work carried out during the first half of FY10 for the work packages: Damping Ring Studies of Electron Cloud Instabilities (CESR-TA); Superconducting RF Development; and, Lithium Lens Development for the Positron Source.

1. CESR-TA

Work Package WBS Number: 1.4.1.1
Work Package Title: DR Studies of Electron Cloud Instabilities (CESR-TA)
Work Package Leaders: D. Rubin, M. Palmer

The vast majority of the CESR modifications required for the CESR-TA damping rings R&D program were completed during FY09. Thus the major focus of the FY10 program is to take full advantage of the new optics, beam diagnostics and electron cloud (EC) diagnostics to: achieve the lowest possible vertical emittance for the ring (targeting 20pm), to characterize the impact of the EC on the positron beam dynamics at ultra low emittance, to continue the studies of the growth of the EC to improve our ability to model it, and to characterize the efficacy of a range of EC mitigation techniques. The major activities undertaken during the first two quarters included:

- Switchover to a fully digital BPM system with improved resolution for low emittance optics correction in November 2009. Checks of the intrinsic resolution of the units indicated a nominal 10 micron single pass capability which was consistent with our target specification. The multi-bunch readout capability was used for the study of EC-induced beam dynamics in long bunch trains.
- Commissioning and refinement of the x-ray beam size monitor (xBSMs) operations for both the positron and electron beam lines continued. Prototyping work continued on readout electronics for 4ns bunch trains. The readout for 14ns spaced bunches was used for beam size measurements in trains and for emittance tuning.
- A 35 day experimental run was conducted in Nov-Dec 2009 with a focus on low emittance tuning, EC mitigation studies, and EC beam dynamics studies. A vertical emittance of 31pm, as measured by the xBSM was obtained. Comparisons of amorphous carbon, TiN and grooved surface EC mitigations were carried out. Finally, instrumentation and experimental setups were developed for ongoing EC beam dynamics studies.
- In January 2010, our in situ SEY station was deployed and the first detailed measurements of sample processing rates took place.

- Additional vacuum chambers with EC mitigations and measurement diagnostics were prepared during this half year period. These chambers included: a wiggler chamber with clearing electrode (CU/KEK/LBNL collaboration), a quadrupole chamber with TiN coating, a drift chamber with NEG coating and a second drift chamber with amorphous carbon coating (CERN). In the original schedule, installation was targeted for late March 2010. Due to various issues, this schedule was delayed slightly and final installation occurred in mid-April 2010.
- A significant electron cloud simulation effort continued throughout this period with specific efforts directed at: modeling of retarding field analyzer data in a wide range of magnetic environments; development of a full 3D synchrotron radiation simulation which includes a detailed model of reflection properties; modeling of coherent tune shift measurements to characterize the ring-wide EC build-up in CESRTA; and modeling of instabilities and incoherent emittance growth effects.
- Detailed updates on the status of the program and plans for the remainder of FY10 were presented in the damping ring session of the ILC10 workshop: http://ilcagenda.linearcollider.org/conferenceOtherViews.py?confId=4175&view=standard&showDate=all&showSession=5&detailLevel=contribution

2. Superconducting RF

Work Package WBS Number: 1.10.x
Work Package Title: Superconducting RF Development
Work Package Leaders: Georg Hoffstaetter and Zack Conway

Cornell University's ILC-ART SRF efforts in FY2010 are focused on: (1) the temperature mapping of multi-cell 1.3 GHz ILC cavities, (2) the repair of ILC 9-cell cavities, (3) the continued development of the Cornell-OST quench location system, (4) the proving and industrialization of Vertical Electropolishing (VEP), and (5) the processing and testing of single-cell cavities in support of ILC 9-cell cavity work. (1) At the start of FY2010 we had ~5000 carbon Resistive Temperature Detectors (RTD) in hand for large surface area temperature mapping (>one 1.3 GHz-cell). We have now assembled and will test, the first week of May, a multi-cell temperature mapping system with 1210 carbon thermometers covering a 5-cell TESLA-style 1.3 GHz cavity. This is the final test before extending the new T-Mapping system to 9-cell ILC cavities. (2) We have commenced tumble polishing AES5, a 9-cell ILC cavity defect limited to E_{acc} = 21 MV/m (measured at JLAB). Once this is finished it will receive a heavy (~200μm VEP), be sent to JLAB for H-degassing, and then processed/tested at Cornell. This is the first of 4 cavities we are going to tumble polish, VEP, and testing; the others being TB9ACC010, ACCEL9, and TB9AES015. (3) The Cornell OST system has been modified to work with helium jacketed cavities. We could only use two transducers at a time but we were able to measure usable and repeatable signals, which are useful in locating cavity defects. We are working on shrinking the size of the transducers, enabling the use of more than 2 per jacketed cavity test. The new transducers should be ready sometime in late FY2010. (4 & 5) We are actively working toward proving VEP as a reliable method for the production of ILC 9-cell cavities. We have reduced our VEP process temperature to 20-25^{o}C (from 32^{o}C in FY2009) and have processed the 9-cell cavities TB9ACC010 and LR9-1 (AES reentrant) at the reduced temperature, where we found that the cavity performance improved by reducing the rate of electrolyte mixing while polishing at 20-25^{o}C. TB9ACC010 and LR9-1 were limited by weld defects to E_{acc} = 28MV/m and will be tumbled and reprocessed. We also processed 3 single cell cavities with the new parameters. Two of the single cells have been tested and were found to have lower surface residual resistances (0.9 nΩ in once case! 2 nΩ in the second) than higher temperature processed VEP cavities, both achieved E_{acc} > 40 MV/m. Work in this area will continue with 1 more single and 4 more nine-cell cavities being processed and tested.

3. Lithium Lens

Work Package WBS Number: 1.1.x
Work Package Title: Lithium Lens Development
Work Package Leaders: Alexander Mikhailichenko and Maury Tigner

After completion of a conceptual design in FY09, work during the first half of FY10 focused on development of a detailed model of the lithium flow magneto-hydrodynamics and associated thermodynamics evaluation. This work revealed several interesting phenomena in the dynamics of the lens. In particular, vortex circulation of the liquid lithium due to the magnetic forces was found to drastically reduce the temperature in the central regions with the windows due to forced mixing. The presence of toroid-like buffer volumes helps to enhance this process. The pressure and temperature profiles that resulted from these calculations indicate that the basic parameters of the lens are technically achievable. Several modifications to the overall design were suggested by the simulations. Details of this work can be found at:

http://www.lns.cornell.edu/public/CBN/2010/CBN10-3/CBN_10-3.pdf

4. Laboratory Budget Summary

The FY10 budget summary for the above three work packages is as follows:

WBS	Description	Work Package Leader	FY09 Carry-over (K$)	FY10 Budget (K$)	Total FY10 Budget (K$)	FY10 Direct Labor (K$)	FY10 Direct M&S (K$)	FY10 Indirect Labor (K$)	FY10 Indirect M&S (K$)	FY10 Total Expenses (K$)	Open Com-mitments (K$)
1.1.x	Li Lens	Mikhailichenko/ Tigner	89	0	89	50	0	29	0	79	3
1.4.1.1	CesrTA	Rubin/Palmer	1564*	2245†	3809	66	2	27	1	96	4
1.10.x	SRF	Hoffstaetter/ Conway	19	650	669	38	6	22	4	70	0
Totals			**1672**	**2895**	**4567**	**154**	**8**	**78**	**5**	**245**	**7**

* FY09 carryover is designated for use during the April 2010 down and Apr-May 2010 run (Experimental Run #6)

† FY10 distribution has not yet been received. These funds are designated for use during the July 2010 CesrTA run, August down, and September run