international linear collider

ILC-Americas
FY10 Work Package
Technical Progress Report

Laboratory: BNL
Work Period: September 1, 2009 to March 31, 2010

ART Program Management (WBS 1.1.1.3)

This is a level of effort work package in which Brookhaven has made available Mike Harrison to the GDE &ART Program Management at the 100% level. He is the GDE Americas Regional Director, and ART program Director.

BDS IR Design and Machine Detector Interface (WBS 1.6.1.6)

In FY10 work at BNL focused on winding 2.2 m long coil quadrupole patterns for the QD0 R&D prototype and design and production of a superconducting magnet upgrade of the final focus of ATF2, a linear collider test facility at KEK in Japan. The two approved ILC detector experimental collaborations are concentrating on optimizing their detector designs and there was less to do in the area of the Machine Detector Interface (MDI) than in previous years; however, some progress was made towards defining cryogenic infrastructure, that would be integrated with the on-board detector cryogenics. Some progress was made identifying cross-system requirements necessary for the two experiments to share a common detector hall in "push-pull" (i.e. IP sharing) operation. There was also some progress in defining the Detector Integrated Dipole coil configuration (in consultation with BNL SMD). There is also the beginnings of ILC/CLIC collaborative effort on areas of Beam Delivery System and MDI common interest.

For ATF2 production we completed and measured (warm) the main coil windings, a six-layer quadrupole and a four-layer sextupole. Note this represents an increase by two layers for each coil in order to reduce the excitation currents needed for normal operation and thereby dramatically reduce heat load from the current leads and the power supply requirements. We have had several meetings within the ATF2 superconducting upgrade magnet collaboration and KEK cryogenic experts (both face-to-face here at BNL and via webex and the internet). A major accomplishment was agreeing upon a cryogenic

interface between the BNL produced magnet coils in their cryostat and the cryogenic supply box that KEK will provide.

Another significant accomplishment is that magnetic field harmonic measurements made of the quadrupole and sextupole show that these are high-quality coils that met quite challenging harmonic content targets established to enable beam physics experiments testing "pushed beta IP optics" to be performed. CLIC IR optics have even tighter focusing requirements than the ILC and our producing the ATF2 magnets with very good harmonic field quality has led to strengthening the ATF2 SC Upgrade collaboration with CERN participation. Note such pushed optics are now also of interest for the ILC as the ILC looks to implement "traveling focus optics" as a cost cutting measure. The traveling focus permits relaxing some of the beam parameters while regaining otherwise lost luminosity via increased IP focusing.

The ATF2 work has been challenging due to a schedule which has BNL integrating the cryogenic supply and magnet subsystems and doing extensive testing while still shipping the completed system back to KEK for installation in 2012. Note however that at the present time, except for completing winding of the ATF2 correction coils (which would need to be completed in order not to interfere with long coil R&D prototype production) he are holding off on further ATF2 design work and materials purchases in light of new uncertainties for future ATF2 support by KEK in light of their near term funding challenges. A further review of the ATF2 SC Upgrade will take place at the end of June at KEK. At this time it is not knows of ATF2 operation will be supported beyond 2012. To this end we are also investigating a backup plan where our SC magnet tests could be pursued at other accelerators.

As stated earlier the other major activity during this fiscal year is the production and testing of long coil windings for the full length QD0 R&D prototype. After making extensive modifications to our winding machine infrastructure we did proceed with winding full length (2.2 m) quadrupole coils on a 3.5 m coil support tube (tube also shared with sextupole coil winding). Note the thin walled tube we are winding the coils on has only a 20 mm ID and flexes significantly both due to gravity and the stylus pressure used in the winding process. We tried to keep the tube in place via a system of rolling supports that make contact in the pole regions of the coils; however, magnetic measurements of these coils showed a distinctive set of harmonics that are consistent with significant support tube flexure. With our itterative winding procedure we might have tried to correct for these effect during winding the final coil sets; however, without even more painful process control improvements, we still would not be assured of adequately controlling these harmonic errors.

The judgment was made to go with a fixed set of coil supports where we could be assured of controlling tube placement. The down side of fixed winding supports, that we had tried to avoid with computer controlled moving supports, it that we cannot wind conductor past a fixed support; thus the 2.2 m continuous long coil is then replaced by two coils. each slightly shorter than 1.1 m, that are independently wound and later connected in

series. The fixed support machine modifications are complete and we are ready to resume the long coil winding program.