

ASD Quarterly Bulletin October - December 2014

Accelerator Systems Division provided excellent support for APS operation and finished Run 2014-3 with 128 hours of the Mean Time Between Faults (MTBF) and 98.96% of the Machine Availability. Several other developments and events took place in the last quarter of 2014 and are highlighted here.

The Diagnostic Group continued its push for the beam stability improvement in the storage ring experimenting with the orbit feedback and also exploring state-of-the-art fast DSPs and FPGAs to communicate between machine sectors; began evaluating NSLS-II double cell controller bpm as alternative to Libera units and continued R&D for a grazing incidence x-ray beam position monitor (GRID XBPM); continued experimenting with the precision mechanical motion measurement system installed in S27. The group also provided engineering support for the storage ring Sector 35-Sector 31 stripline relocation. The group continued active participation in the APS Upgrade conceptual design and supported impedance test stand development for evaluating the effects of NEG coatings on the vacuum chamber impedance; worked on analysis of BESOCM measurement accuracy for a high charge injector operation; assisted PS group with the precision power supply current measurements; designed the button electrode for MBA beam position monitors.

The Magnetic Devices Group assembled and tested the SCU1. The excellent cryogenic and magnetic performance of the device has been confirmed and it has been installed at Sector-1. The first APS revolver undulator-prototype has gone through the comprehensive mechanical and magnetic testing and now installed at Sector-35.



Michael Merritt inspects the revolver undulator.

The procurement of components for the DCX beamline revolver undulator is in progress. Users of new RIXS IDs installed in September confirmed the predicted increase in the flux and brightness at their beamline.

The performance of a new 2.8 m long undulator-prototype with the horizontal main magnetic field has been extensively studied.

This development, funded by the LCLS-II, will continue in FY15 with the building a preproduction-type prototype of a nominal 3.4 m length. A new magnet measurement system for the characterization of the storage ring magnetic components has been

assembled and tested. It will be mostly used for the measurements of magnet prototypes for APS Upgrade.

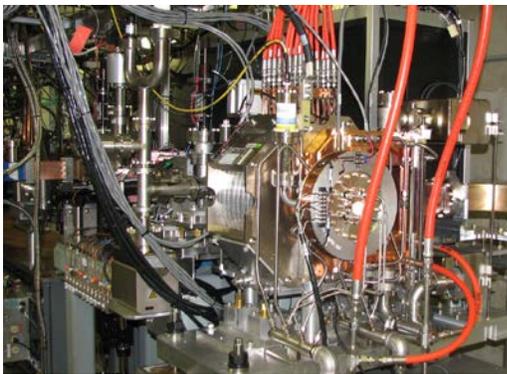
The Power Systems Group continued upgrading the old IGBTs in the storage ring quad converters utilizing the machine intervention periods; continued to work on a new Booster kicker power supply: the power supply relay rack has been powered up and the PLC controller has been programmed and checked out on the bench. The group continued the R&D for the APS Upgrade power supplies evaluating a voltage-regulated commercial power supply with external current regulation loop: the test sample, a TDK-Lambda Genesys power supply with a BiRa controller, have shown excellent stability of a few parts per million of the full scale. The group is also evaluating the fast high voltage pulser made by the FID Technology: to date, the pulser has accumulated more than 20 million pulses at the voltage above 15 kV.

The Accelerator and Operations Group worked on updating and completing the APS-U Conceptual Design Report, namely on injection issues, tolerances, impedance, machine protection, and instabilities. Haissinski solver code was upgraded for using harmonic cavity in bunch lengthening mode. Several AOP members took part in NSLS-II commissioning, helped to resolve orbit reproducibility problem using SDDS EPICS tools. AOP supported ongoing work on SCU1 installation: Physics Requirements Document was prepared, and AOP members participated in the installation reviews. Several AOP members participated in ISO9000 review in MCR. Prepared IEX for the first user run with Quasi mode on, which successfully started on December 8. Provided programming support for storage ring unified orbit correction studies.

The RF Group dealt with several operational issues. An intermittent connector was found on the Fundamental PAR RF drive cable that connects the LLRF output to the power amplifiers in the hallway and was replaced. RF3 klystron began producing severe sidebands at approximately +/- 580 kHz on either side of the carrier which were suppressed by a slight increase in RF drive power and output reflected power. RF1 klystron (Thales s/n 089043) started to intermittently producing severe sidebands which occurred only during injection when the stored beam current exceeded 100mA. Intervention periods were utilized to test RF1 with beam, and a stable operating point was achieved on October 14th. RF4 tripped on a mod-anode interlock after a beam loss caused by the failure of a Diagnostics IOC power supply. A radiation-damaged fiber optic cable was replaced.

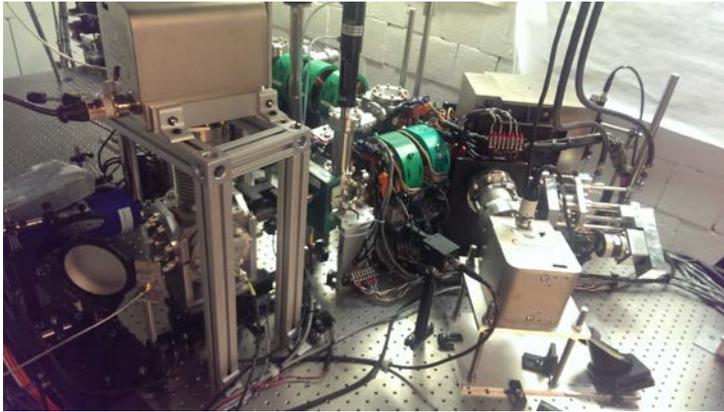
A beam loss was caused by RF4 tripping on a fused disconnect E-stop fault. Further investigation revealed that an intermittent door panel interlock switch in the matching transformer enclosure was the cause of the trip. Linac modulator L2 failed due to an intermittent trigger signal and high-voltage damage to a thyatron grid voltage divider resistor. Repairs were made and the system was placed back in service. In the other development, a network analyzer bead pull program with LabView is being developed and tested using APS traveling wave accelerating structures located in 400A-3. It will be used to verify and/or tune existing linac accelerating structures as necessary and to tune the Tcavity cell to cell phase advance of the $2\text{Pi}/3$ mode to be 120° .

All ASD groups and several AES groups worked together on preparation for installation, actual installation and commissioning of a new LCLS type photo-cathode (PC) gun including auxiliary beamline and diagnostics equipment and power supplies. This work also included magnetic measurement and characterization of the solenoid (done earlier in a year). The PC gun was fully rf conditioned in the linac tunnel, the high power laser was aligned to the gun cathode and first 50-pC photo-electron beam was generated on December 12, 2014.



The phot-cathode gun in the Linac tunnel

The PS, AOP and DIAG groups and several AES groups contributed to a successful joint experiment with RadiaBeam for generation of T-rays (THz radiation) in the Injector Test Stand.



After careful tuning of the electron beam, a bright THz radiation beam was observed on the pyro detector and a narrow band (~10%) spectrum was measured using interferometer at a design frequency.

A new equipment from RadiaBeam installed in the ITS