

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY highlights



The PPPL Highlights for the week ending January 10, 2014, are as follows:

U.S. ITER FABRICATION (D. JOHNSON):

For ITER 6.6kV Switchgear, proposals received and are under review by PPPL.

A pre-bid meeting with ~ 10 participants was held for RFP 14-009-F Physics And Engineering Design Support for ITER Toroidal Interferometer Polarimeter (TIP) Front-End and Provision of TIP Optical Relay and Diagnostic Hall Components. A table of questions and responses was generated and will be issued soon in an RFP amendment.

Response to RFP 13-082-F for Design and Fabrication of the ITER Upper Port Visible/Infrared Wide Angle Viewing System was received.

A meeting was held with Fusion For Energy Diagnostic management to discuss proposals for swapping responsibilities for provision of diagnostic shield modules in cases where each domestic agency is currently responsible for diagnostics housed in the other's port plug.

Meetings were held at the Oak Ridge National Laboratory between experts in standard vacuum components and diagnostics to discuss the shared interfaces with the RGA diagnostic.

NSTX (M. ONO):

NSTX-U researcher, M. Jaworski attended the Lorentz Center workshop meeting, "Where no Material Dare to go," held on Jan. 6 – 10 at the University of Leiden, the Netherlands (<http://www.lorentzcenter.nl/lc/web/2014/616/info.php3?wsid=616>). This workshop brought together researchers in areas of fusion energy, liquid metals for fusion applications, extreme-ultraviolet light production, welding and material synthesis to examine various aspects of materials in extreme conditions. Jaworski presented the talk, "Capillary-restrained liquid-metal PFCs for NSTX-U and next-step devices" at the meeting. He also participated on the scientific program committee.

Preparations for plasma operations in the NSTX-U configuration also continued with the ongoing rack and cabling reconfigurations in the Field Coil Power Conversion (FCPC) building. New fiberoptic cabling has been received, and the required new termination panels are being installed. Maintenance on switchgear for the FCPC primary power systems has been completed.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

B. Grierson participated in the installation of new fiber optics for the CER system on DIII-D. A total of 54 new fiber optic cables have been run from the charge-exchange spectroscopy (CER) laboratory to the DIII-D machine ports and installed in newly fabricated fiber optic clamps. 25 of the new fibers will be used for tangentially views of main ion emission (16) and impurities (9). Additionally, 19 new fibers will be used for vertical views of the impurity emission. These new fiber optic sightlines constitute an upgrade to the DIII-D CER system for a larger radial range for the pedestal ion temperature, velocity and radial electric field measurements.

W. Solomon led a Physics Concept Review to assess the merits and impact of the proposed fast wave helicon system on DIII-D, which is intended to demonstrate proof-of-principle off axis current drive in high performance plasmas. A key concern is whether an antenna can be placed at a fixed location that is useful for helicon tests while not negatively impacting the broader range of DIII-D experiments. If positioned at about 2.29 m, approximately 99% of DIII-D plasmas could still be run with the antenna in the shadow of the bumper limiter. The key action now is to identify whether a target plasma exists that could take advantage of an antenna at this location, while investigating further whether the helicon system could form the basis for a useful tool on DIII-D.

A. Nagy with General Atomics staff continued his support in the I-coil repair with dissection of the shorted I-coil elbow. The investigation found a hole in the charred Vespel insulation at the short location. The charred Vespel was found to not be electrically conductive and measured Megaohms with a DVM, a megger test is pending. The charred Vespel is thought to result from the 350C vessel bake temperatures over many cycles through a 12-year history. Water leaks appear to be the cause of the conductive path to ground. Leak checking the exposed copper is in progress. The team also refined the de-braze technique using an induction brazing machine to remove the rest of the coil parts without causing major damage. This is important for potential reuse of coil components.

International Collaborations (R. Hawryluk):

J. Hosea reports that PPPL/Princeton University entered a cost-sharing agreement with Pohang University in Korea on November 25, 2013 under which Pohang University contracted to provide \$200k to PPPL to match \$200k from the US DOE to support the development of water-cooled steady-state mirrors for the KSTAR ECH launchers, and the conceptual design of a two-channel steady-state 2 MW ECH launcher, over a 20-month period. This project is progressing smoothly: a steady-state design for the fixed mirror has been completed and reported on at the Asia Plasma and Fusion Association Conference in November 2013; a conceptual design for the steady-state steerable mirror is nearing completion and will be reviewed at KSTAR in February; and pre-conceptual designs for the two-channel steady-state launcher are underway.

D. Darrow visited the Quantum Devices group at NIST, Boulder, Colorado in November to discuss fabrication of thin film Faraday cup stacks for fast ion loss measurements in JET, NSTX-U and other fusion research devices. The group has an extensive set of tools and experience that could contribute to the thin film Faraday cup detector effort. Fruitful discussions were held, and a collaboration to build a prototype detector for use in JET is being pursued.

A teleconference was held to initiate a study taking data from a recent DIII-D/EAST joint experiment (executed as a prototype for future steady-state long-pulse experiments on EAST). Detailed profile analysis of the existing experimental data has begun in preparation for TRANSP simulation and validation before projecting to actual EAST conditions. Initial attempts at running TSC using an input file provided by EAST have proven challenging so far, and further debugging is still needed.

ADVANCED PROJECTS (H. NEILSON):

The Laboratory's collaboration with the Wendelstein 7-X project at Germany Max Planck Institute for Plasma Physics (IPP) passed two important milestones this week. It was reported by IPP that the fifth and last U.S.-supplied trim coil was installed on the W7-X device. Also, the fifth and final trim coil safety disconnect switch was installed. With the completion of all PPPL manufacturing and documentation tasks, the trim coil sub-project was officially closed. In the trim coil power supply sub-project, all PPPL tasks are completed except for on-site commissioning at IPP, currently scheduled for April 2104. Subcontracting arrangements are being made to carry out that task. These accomplishments are important steps in the integration of U.S. contributions into the W7-X program.

Good progress was made in the conceptual design activities for two of the newer W7-X projects—the x-ray imaging crystal spectrometer (XICS) and the TDU scraper element. In the XICS project, a concept for the instrument is established and current efforts are focused on preparing the technical specifications and developing a support concept in preparation for a Conceptual Design Review scheduled for 23 January. PPPL contributed to the ORNL-led scraper element project with a presentation by D. Gates on the diagnostics requirements to accomplish the goals of the TDU scraper element.

D. Gates was appointed by IPP to the W7-X experimental planning task force. The current focus, as stated by task force leader Dr. A. Dinklage, is to "develop a consistent and feasible physics program proposal for OP-1 [the first operating campaign] of W7-X."

A paper by G. H. Neilson, *et al.*, "Next Steps in Quasi-Axisymmetric Stellarator Research," was accepted for publication in a special issue of *IEEE Transactions on Plasma Science*, selected papers from the 2013 Symposium on Fusion Engineering.

THEORY (A. BHATTACHARJEE):

The Letter by F. Ebrahimi and co-authors entitled "Magnetic reconnection process in transient coaxial helicity injection" <http://dx.doi.org/10.1063/1.4821974> was selected for the 2013 PoP editor's list of top-ten letters.

An experiment conducted by W. Fox, A. Bhattacharjee, and collaborators at the University of Rochester Laboratory for Laser Energetics was chosen as the December "centerfold" for the 2014 LLE calendar. The purpose of the experiment is to study magnetic reconnection between counter-propagating, magnetized laser produced plasmas. The calendar is available for download at http://www.lle.rochester.edu/publications/calendars/2014_calendar.php

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

NSTX Upgrade (R. Strykowski, E. Perry, L. Dudek, T. Stevenson):

Construction: Installation of the Mirnov coils continues in-vessel - installation of the TAE antenna and passive plate accelerometers is next. Measuring for the new RWM coils at Bays J, K and L is in progress as is the installation of thermal paste between the bakeout tubing and the outside of the vacuum vessel. Torquing of the TF outer leg supports has been completed.

CS Upgrade: The OH winding proceeded smoothly this week. Approximately 25% of the first layer has been wound, the first inline conductor braze was completed and tested and the second braze is in process and should be complete by the end of day, January 10. At Everson the NCR to cover the rework to the first PF1B coil was submitted and approved. The second PF1B is proceeding smoothly. A peer review was held to go over the outer TF extension finger supports. Some minor changes are being implemented to improve the manufacturability. Machining of the TF bundle crown G10 pieces and mating threaded inserts continued through the week. During the installation of the row 1 diagnostic tile TCs, a slight odor of sulphur was noticed when wetted with DI water. A call to the supplier, Graftech, revealed that the presence of sulphur in small quantities in the graphite is normal and will not affect the mechanical properties. The sulphur could be removed using a regraphitization process but that would likely reduce the mechanical properties by 10%. Engineering is working with IH to determine if there may be any health issues from the slight odor and if engineering controls are required before proceeding. Martinez and Turek just received confirmation on Delivery of the raw CuCrZr material for the Outer TF extensions. The material supplier, Cadi Company, will have the material ready to ship the week of January 27. Depending on what day they ship it Martinez should have the material in house by the week of February 3.

BUSINESS OPERATIONS (K. FISCHER):

R. Templon, K. Tafe and J. Hammill participated in the monthly phone conference conducted by the DOE Procurement Evaluation and Reengineering Team (PERT). Agenda topics included planning for upcoming peer reviews at West Valley, Oak Ridge, Savannah River and Brookhaven; subcommittee reports on various procurement policy initiatives, and planning for the PERT technical meeting scheduled for February 18-19 at the Nevada Test Site offices in Las Vegas, Nevada.

INFORMATION TECHNOLOGY (S. BAUMGARTNER):

The communication cables for reconnecting the NSTX-U Gas Injection CAMAC crates were received. Significant progress was made over the holiday break in software development for the NSTX-U.

OFFICE OF COMMUNICATIONS: (K. MACPHERSON):

J. Greenwald's article on the Princeton Center for Heliospheric Physics appeared in the January 6 issue of DOE Pulse.

K. MacPherson visited DOE communications officials in the Forrestal Building in Washington, D.C., on December 19. She met with Rick Borchelt, the director of communications in the Office of Science. She met with Jeff Salmon of SC and Jeff Sherwood of Public Affairs in DOE. She also met members of the PA staff at DOE Headquarters, including Secretary Moniz's speechwriter, Sean Sullivan, and Ben Dotson, who heads up web content strategies.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

On Saturday January 11, the first Science on Saturday lecture was given. Walter Gettenfelder from PPPL presented "Containing a Star on Earth Understanding Turbulence at 100 Million Degrees" to 311 individuals.

DIRECTOR'S OFFICE (C. AUSTIN):

January 7-10, A. Cohen and M. Viola participated in a DOE Infrastructure Meeting at Oak Ridge National Laboratory. The purpose of the meeting was to assess the infrastructure needs of the national laboratories across the DOE complex, and match those needs with the future. PPPL will be a pilot site for this effort. The PPPL campus strategy should be in place by April/May 2014.

Dr. Sarah McGregor, Dartmouth College, presented a colloquium on January 8 entitled, "On Tracing the Origins of the Solar Wind".

PUBLICATIONS:

The following PPPL Reports were posted to the web:

The Physics of the Second-order Gyrokinetic MHD Hamiltonian: μ Conservation, Galilean Invariance, and Ponderomotive Potential, PPPL-4951

Author: J.A. Krommes ; Submitted to: Physics of Plasmas

The Physics Basis for an Advanced Physics and Advanced Technology Tokamak Power Plant Configuration, ARIES-ACT1, PPPL-4952

Authors: C.E. Kessel, F.M. Poli, K. Ghantous, N.N. Gorelenkov, M.E. Rensink, T.D. Rognlien, P.B. Snyder, H. St. John, A.D. Turnbull; Submitted to: Fusion, Science & Technology (October 2013)

Non-axisymmetric Magneto-hydrodynamic Equilibrium in the Presence of Internal Magnetic Islands and External Magnetic Perturbation Coils. PPPL-4953

Authors: B.J. Tobias, M.E. Austin, I.G.J. Classen, C.W. Domier, N.C. Luhmann, Jr., J-K Park, C. Paz-Soldan, A.D. Turnbull, L. Yu, and the DIII-D Team
Submitted to: Plasma Physics and Controlled Fusion (August 2013)

Three Dimensional Equilibrium Reconstruction on the DIII-D Device

Authors: S.A. Lazerson and the DIII-D Team, PPPL-4954
Submitted to: Nuclear Fusion (September 2013)

External Heating and Current Drive Source Requirements towards Steady-state Operation in ITER, PPPL-4955

Authors: F.M. Poli, C.E. Kessel, P.T. Bonoli, D.B. Batchelor, R.W. Harvey and P.B. Snyder
Submitted to: Nuclear Fusion (September 2013)

Design and Construction of Faraday Cup Ion Detectors using Thin Film Deposition, PPPL-4956

Authors: G.A. Szalkowski, D.S. Darrow, and F.E. Cecil; Submitted to: Review of Scientific Instruments (October 2013)

Neoclassical Toroidal Viscosity in Perturbed Equilibria with General Tokamak Geometry, PPPL-4957

Authors: Nikolas C. Logan, et. al.; Submitted to: Physics of Plasmas (October 2013)

Generation of zonal flows through symmetry breaking of statistical homogeneity, PPPL-4958

Authors: Jeffrey B. Parker and John A. Krommes; Submitted to: New Journal of Physics October 2013

On The Nature Of Kinetic Electrostatic Electron Nonlinear (KEEN) Waves, PPPL-4959

Authors: I.Y. Dodin and N.J. Fisch; Submitted to: Physics of Plasmas (October 2013)

Theory Verification and Numerical Benchmarking on Neoclassical Toroidal Viscosity Torque, PPPL-4960

Authors: Z. Wang, et. al.; Submitted to: Physics of Plasmas (October 2013)

Emission Processes at the Deposit in the Carbon Arc Discharge for Nanotube Synthesis, PPPL-4961

Authors: J. Ng and Y. Raiteses; Submitted to: Carbon (November, 2013)

Field-line Resonance Structures in Mercury Multi-ion Magnetosphere, PPPL-4962

Authors: Eun-Hwa Kim, et. al.; Submitted to: Earth, Planets, Space (June, 2013)

Influence of Emitted Electrons Transiting Between Surfaces on Plasma-Surface Interaction, PPPL-4963

Authors: M.D. Campanell and H. Wang; Submitted to: Applied Physical Letters, (August 2013)

Active Radiative Liquid Lithium Divertor Concept, PPPL-4964
Authors: Masayuki Ono, et. al.; Submitted to: Fusion Engineering and Design (November 2013)

Simulation of Localized Fast-ion Heat Loads in Test Blanket Module Simulation Experiments on DIII-D, PPPL-4965
Authors: G.J. Kramer, et. al.; Submitted to: Nuclear Fusion October 2013

Understanding High Harmonics Ion Cyclotron Heating Losses in the Scrape-off Layer of Tokamak Plasmas, PPPL-4966
Authors: N. Bertelli, et. al.; Submitted to: Physical Review Letters (November 2013)

PPPL Annual Site Environmental Report for Calendar Year 2012, PPPL-4967
Authors: Virginia Finley; Submitted to: PPPL Reports

Adaptive Grids in Simulations of Toroidal Plasma Starting From Magneto-hydrodynamic Equilibrium, PPPL-4968
Authors: Xujing Li, Leonid E. Zakharov and Sergei A. Galkin
Submitted to: Journal of Plasma Science and Technology (December 2013)

Progress on Ion Cyclotron Range of Frequencies (ICRF) Heating Physics and Technology In Support of the International Tokamak Experimental Reactor (ITER), PPPL-4969
Authors: J.R. Wilson and P.T. Bonoli; Submitted to: Physics of Plasmas (December 2013)

Development Of An Electrostatic Detector for Tungsten Dust, PPPL-4970
Authors: Kenneth C. Hammond and Charles Skinner; Submitted to: PPPL Reports

Response of a Partial Wall to an External Perturbation of Rotating Plasma, PPPL-4971
Authors: L. Zakharov and C.V. Atanasiu; Submitted to: Physics of Plasmas (August 2013)

Turbulent Optimization of Toroidal Configurations, PPPL-4972
Authors: H. Mynick, et. al.; Submitted to: Plasma Physics and Controlled Fusion (December, 2013)

LEADERSHIP POSITIONS:

Jaworski M., Lorentz Center workshop meeting, "Where no Material Dare to go," at the University of Leiden, member, scientific program committee.

This report is also available on the following web site:
<http://www.pppl.gov/publication-type/weekly-highlights>