

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY highlights



The PPPL Highlights for the week ending February 27, 2015, are as follows:

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

Agreement was reached this week on an improved optical design of the Upper Port Wide Angle Viewing Visible Infrared camera system. The accord was reached between members of USITER, IO, the Dutch firm TNO and the General Atomics based Upper Cameras team. This decision enables the mechanical design of the optical system to progress and allows for the physics team to focus on performance evaluation of one system.

Yuhu Zhai, the leader of the diagnostics engineering analysis team, presented an updated work flow for analysis of the diagnostics shield modules (DSM) and the diagnostics mounted inside the DSMs. The new paradigm involves studying the modal or vibrational characteristics of each system. If the design falls within certain fundamental frequency ranges a costly and time consuming transient structural analysis is not required and considerable money can be saved.

A revised end-to-end layout for the Toroidal Interferometer and Polarimeter (TIP) diagnostic was finalized this week at PPPL and transmitted to the TIP design team at General Atomics. This work was needed so that GA can focus on the layout of the TIP equipment in the TIP diagnostic room and to support optical ray tracing of the complete system. The sensitivity of the TIP optics to vibrations and misalignments can be assessed once these ray trace models are in place.

As part of the development for the Toroidal Interferometer/Polarimeter (TIP) diagnostic, Palomar Scientific and General Atomics experts are considering several digital signal processing approaches to real time phase demodulation. These will be tested with archived DIII-D interferometer data, and eventually with prototype interferometers in the laboratory and on the DIII-D tokamak.

NSTX (M. ONO):

Dr. Naoki Tamura of National Institute for Fusion Science, Japan visited PPPL/NSTX-U under the U.S.-Japan personnel exchange program. He collaborated on the physics of non-local transport including the analysis of the TFTR data with E. Fredrickson (PPPL).

The Digital Coil Protection System (DCPS) and the Power Supply Real Time Control (PSRTC) are complete and supporting Field Coil Power Conversion (FCPC) System dummy load testing.

Preparations for plasma operations in the NSTX-U configuration also continued. Field installation of gas delivery system piping, and re-commissioning of gas controls is in progress. The Vacuum Prep Laboratory is fabricating the Multipulse Thompson Scattering (MPTS) diagnostic exit tubes, and the MPTS exit tube supports are being installed in the test cell. Welding of the coaxial lines for the deuterated trimethylboron (dTMB) system in the test cell is in progress.

ITER & TOKAMAKS (R. HAWRYLUK):

R. Hawryluk was at JET chairing a review of their readiness for the DT campaign. This meeting focused on the gaps that need to be addressed prior to being ready for DT.

DIII-D (R. Nazikian):

The Helicon waveguide routing from the klystron power supply to the 180 midplane port on DIII-D has been tentatively established. The waveguide coax will be routed through the test cell wall to the 180R0 location using the same path presently used for ABB2 Fast Wave waveguide and hardware.

C-Mod (S. Scott):

During a recent calibration of the Motional Stark Effect (MSE) diagnostic, the photoelastic modulators (PEMs) were observed to behave erratically. The drive signal, which is supposed to be a square wave at a fixed frequency of ~20 kHz, would occasionally experience a 'stutter' wherein one period would be excessively long or short. In addition, the retardance imposed on the incident light by the PEM was a factor ~2 less than the commanded value. Two PEMs were returned to the manufacturer, Hinds instruments, for troubleshooting. The manufacturer has identified several problems in both the optical heads and associated drive electronics. Hinds will repair the optical heads. We will purchase new control electronics.

ADVANCED PROJECTS (D. GATES):

H. Neilson presented the weekly colloquium of Germany's Max Planck Institute for Plasma Physics on "Fusion Machine Engineering Studies at Princeton Plasma Physics Laboratory." The talk focused on the engineering design drivers for future fusion machines, which will have to operate with burning plasma on-times of months per year, breed tritium, and ultimately produce net energy. PPPL's work in this area, which is carried out through a portfolio of national and international collaborations, seeks to understand the engineering requirements for such machines, and to explore promising design solutions. Work performed by PPPL in collaboration with the U.S. fusion system studies team, with South Korea, and with China was highlighted in the talk.

A preliminary design review (PDR) of the Wendelstein 7-X (W7-X) TDU Scrapper Element (TDU-SE) project was held on February 18. The TDU-SE, a specially instrumented plasma facing component, will support U.S. research aimed at advancing the understanding of 3D divertors and edge physics as part of the U.S. collaboration on Germany's Wendelstein 7-X stellarator. Presentations by the U.S. design team, including a comprehensive analysis report by

PPPL's P. Titus, showed a design that has reached a high level of maturity and is fully capable of fulfilling its scientific purpose within the operating constraints of the W7-X system. The U.S. team proposes to fabricate and deliver two TDU-SE units and associate test samples, and PPPL's R. Strykowski presented a preliminary plan, including preliminary cost and schedule estimates, for carrying out the remaining work. Funding for the project is currently being considered by DOE. The PDR was conducted by an international review team, which is expected to issue its report in the next few days.

PLASMA SCIENCE AND TECHNOLOGY (P. EFTHIMION):

A short commentary (called "Perspective") has been published in the February 27 issue of Science by H. Ji and E. Zweibel: "Understanding Particle Acceleration in Astrophysical Plasmas". It comments a numerical work published by Matsumoto et al. in the same issue of Science on a new scenario to accelerate electrons to extreme energies by a strong collisionless shock undergoing turbulent reconnection. The first paragraph of this commentary reads "Energetic electrons are ubiquitous in astrophysical plasmas, as they are considered to be behind the surges of emission across the electromagnetic spectrum at wavelengths from radio to gamma rays. These dynamic phenomena include stellar flares, supernova explosions (see the figure) (1), gamma ray bursts, and extragalactic jets. Energetic electrons are also directly observed in situ during terrestrial substorms. Despite these rich observations and substantial progress in theory, numerical simulations, and laboratory experiments over the past few decades, the mechanisms by which the electrons obtain their energy still remain elusive. On page 974 of this issue, Matsumoto et al. (2) make progress toward resolving these issues." H. Ji and E. Zweibel, "Understanding Particle Acceleration in Astrophysical Plasmas", Science 347, pp. 944-945 (2015).

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: Final installation of TF bus inside both umbrellas continues at a rate of two shifts a day during seven days of the week. Hydro tests of cooling loops inside the umbrellas is being done daily due to the large amount of activity in these areas. Installation and welding of the TF lead supports has been started. Installation of outboard mounting blocks for the new lower umbrella lid has been started. Installation of gas delivery system piping continues.

CS Upgrade: Welding of the lower umbrella lid mounting blocks is underway. Fitup of the OTF lead extensions continued this week. Installation of the OTF finger supports in the umbrella started. After staff cleaned up a water leak in one of the TF rectifiers in the FCPC building and replaced a broken valve in the DI water system, the dummy load tests of the FCPC power system upgrades continued.

NBI Upgrade: DI water system treatment and fill and flush continued this week. Stack duct installation continued in the NTC. Control cabling ring out in support of various stages of pretesting is underway. M/R power supply testing and tuning continues on dummy load. PLC software pretesting is in progress. Procurement of an IR camera for Bay L 7:30 port to view the

armor is in progress. The NTC North door gate installation is complete. The operating procedure revision and approvals are in progress.

Digital Coil Protection System: Dummy load testing PTP-ECS-039 continued with DCPS JA in full support. The action algorithm correction was made to the code and is undergoing PTP tests on FCC Warthog in local mode with Autotester 2 prior to deployment. Parameter tree development to support dummy load testing continues. DCPS extension and summing chassis implementation continues. Development of OP-DCPS-779 set up and startup continues with comments for WPLC and PDP and approval is imminent. Spares are in development. The TF < OH aquapoxy algorithm change is being designed and developed.

Startup: Preparations for machine startup continue with the dispositioning of outside reviewers recommendations, ongoing pre-operational systems testing (NSTX-02), and PPPL Activity Certification Committee (ACC) validation reviews. First plasma for NSTX-U is still forecast for early April 2015. DOE and PPPL are finalizing plans for a May 2015 DOE led project close-out review that will mark the official completion of the NSTX-U Construction project.

OFFICE OF COMMUNICATIONS (K. MACPHERSON):

C. Cane attended the DOE Powerpedia event on February 23 at the DOE HQ, Forrestal in Washington, D.C.

Stories about the Science Bowl appeared in the Princeton Packet, <http://www.centraljersey.com/articles/2015/02/23/topstory/doc54eb9214e1e63989902507.txt>, and Packet publications the Register News, the Independent Press, The Messenger Press; The Times of Trenton, http://www.nj.com/mercer/index.ssf/2015/02/princeton_plasma_physics_lab_hosted_regional_sci.html, The Independent Press (<http://www.northjersey.com/news/education/team-takes-2nd-at-science-bowl-1.1278341>), and The Item of Millburn and Short Hills (<http://www.northjersey.com/news/education/team-takes-2nd-at-science-bowl-1.1278341>)

K. MacPherson participated in a national teleconference on February 27 with the SC Communications Office along with other communications leaders from the National Laboratories.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

On February 28, Professor Rob Goldston presented the Science on Saturday lecture, “Zero-Knowledge Arms Control: Proving a Warhead is Real While Learning Nothing About It.”

On February 20-21, PPPL hosted the Annual NJ Regional Middle and High School Science Bowls. Over 300 participants, coaches, parents and guests attended the two-day event. Approximate 40 volunteers from PPPL and outside collaborators served as officials during the competitions.

On February 25-26, A. Dominguez traveled to Baltimore, Maryland and attended the National Society of Black Physicists Conference as a panelist as well as a posters judge.

The publication of the article, "The suitability of 3D printed plastic parts for laboratory use", by A. Zwicker, J. Bloom, R. Albertson, and S. Gershman in the American Journal of Physics (Vol.83, Issue 3) has led to several news stories.

OFFICE OF ACADEMIC AFFAIRS (N. FISCH):

On February 25, N. Fisch gave the MIT Plasma Science & Fusion Center Seminar on, "Alpha channeling and lower hybrid current drive." On February 26, together with Ian Ochs of Harvard University, Fisch discussed with the C-MOD team opportunities on lower hybrid heating and current drive. Relatedly, Ian Ochs presented a seminar, "Coupling of alpha-channeling to k_{\parallel} parallel upshift in lower hybrid current drive," based on joint work with N. Bertelli and N. Fisch, conducted largely when Ian was a NUF student at PPPL last summer.

DIRECTOR'S OFFICE (C. AUSTIN):

M. Zarnstorff attended the National Labs CRO meeting in Washington on February 24-25.

On February 24-25, A. Cohen hosted a Project Director's Review of the IOI Project in the Engineering Conference Room. Michael Bebon (Brookhaven), Jack Stellern (ORNL), Chris Ackerman (DOE-Office of Science), and Craig Ferguson (Ferguson Solutions) participated as reviewers.

On February 27, A. Cohen traveled to Germantown, Maryland for a de-briefing with DOE about the IOI Review that occurred earlier in the week.

PUBLICATIONS:

H. Ji and E. Zweibel, "Understanding Particle Acceleration in Astrophysical Plasmas", Science 347, pp. 944-945 (2015).

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