Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending August 25, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

Director's Review preparation - Several Recovery Project departments prepared presentations for the Director's Review scheduled for September 5-7, 2018.

Magnets - The Sigma Phi prototype PF1A coil successfully completed the low power electrical test, and preparations began for turn-to-turn hi-pot testing. Vacuum pressure impregnation (VPI) results on the sectioned Sigma Phi coil were successful. The Tesla PF-1A prototype coil arrived at PPPL. TF Bundle megger testing was completed, and the results are under evaluation.

U.S. ITER FABRICATION (H. NEILSON)

The Low Field Side Reflectometer (LFSR) design team continues to complete deliverable documents as input to a preliminary design review (PDR) planned for later this year. This week the team made progress in its strategy for completing the LFSR Design Compliance Matrix (DCM) based on a meeting with U.S. ITER's System Engineering Manager. The DCM is a tool which maps each of the 260 LFSR system requirements to the project reports or drawings that document compliance. Documentation criteria were discussed and, with contributions from the entire LFSR team, a plan for a developing the DCM to PDR maturity has taken shape. In addition, U.S. ITER review comments for the Onsite Assembly Plan were discussed with subcontractor General Atomics. Based on the comments, topics for the complex LFSR system assembly were refined and agreed upon to allow a final edit of the document to proceed.

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ITER & TOKAMAKS (R. NAZIKIAN)

Machine Learning (W. Tang):

W. Tang visited the Lawrence Berkeley National Lab (LBNL) on August 15-17 at the invitation of LBNL Deputy Director H. Simon and NERSC Director S. Dosanj. He presented a very well-received invited talk titled, "Deep Learning Acceleration of Progress Toward Delivery of Fusion Energy." In addition to productive discussions with K. Yelick, Associate Lab Director for Computing Sciences and with B. Collins, Director for the Climate and Ecosystem Sciences Division, there were also quite stimulating technical as well as strategic collaboration discussions with a number of key machine learning experts at LBNL, such as Prabhat, the NERSC data and analytics group leader.

DIII-D (B. Grierson):

Research:
A. Diallo travelled to DIII-D to continue analysis of inter-ELM bursts and present a seminar at the DIII-D PedELM meeting. He discussed analysis workflow with the T. Rhodes and K. Barada, and met with R. Groebner to discuss tasks for the upcoming JRT 2019.

Operations:

International Long Pulse (F. Poli):

A preliminary model for a neural network for neutral beam heating and current drive has been developed for KSTAR by D. Boyer. The training dataset, based on about 3500 NUBEAM runs provided by H.-S. Kim, at South Korea's National Fusion Research Institute (NFRI), will soon be expanded to include additional scans over plasma shaping parameters. This work is in support of the fusion flight simulator project which aims to integrate PCS into TRANSP and to accelerate core TRANSP routines for fast turnaround of the simulations.

International 3D (J.-K. Park):

R. Nazikian and J.-K. Park participated in the experimental planning meetings hosted by NFRI to explain and discuss the proposed RMP ELM control experiments. The topics included the development of RMP scenarios for high beta poloidal, high beta normalized, low and high q95 plasmas to understand optimal KSTAR profile conditions for n=1 and/or n=2 ELM control, which will be tested in the coming campaign. Up to

three run days have been allocated to the PPPL experiments on KSTAR. As a preparation of KSTAR data analysis, OMFIT and GPEC modules were installed in a local KSTAR server (UKSTAR) by N. C. Logan and H.-S. Kim (NFRI).

KSTAR Stability (S. Scott):

Plans for the beam-into-gas calibration of the KSTAR MSE diagnostic and the MSE background polychromator are scheduled for next week. These calibrations are designed to measure Faraday rotation, any angular offsets imposed by birefringence in the vacuum window, and to optimize the position of the optical filter passbands relative to the MSE spectrum. A challenge is that previous beam-into-gas calibrations of the KSTAR MSE diagnostic identified a strong dependence of the measured angle on wavelength-offset of the filter center-wavelength (~5 degrees per nanometer offset of the filter), which imposes a tight requirement for control of the filter passband. By comparing the calibration results between the existing KSTAR MSE system and the new MSE- background polychromator — which use different technologies to vary the filter passband — we expect to determine if the filter passband is distorted by tilt-tuning in the existing KSTAR MSE system.

ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates):

A final design review (FDR) for the Wendelstein 7-X (W7-X) Probe Mounted Powder Injector (PMPI) was held on Aug. 20. Pending signatures on the PPPL-IPP loan agreement, the W7-X PMPI will be shipped to Greifswald, Germany, for use during the current experimental campaign. The function of the PMPI is to inject boron carbide powder into the W7-X plasma to test if it is possible to replenish the boron coating in the device during a discharge. Data from this experiment will be used to define the physics requirements for a planned system to implement long pulse (~30 minutes) boronization on W7-X in the future. The design review was judged successful pending resolution of a few chits aimed at meeting the quality assurance requirements.

This week marks the completion of a three-month summer internship undertaken by Joshua Swerdlow (Yale University ’19) at the Wendelstein 7-X stellarator under the mentorship of PPPL’s N. Pablant. During his internship, Swerdlow developed a python wrapper for the STRAHL impurity transport code. This wrapper, named PyStrahl, provides a generalized way of programmatically running the transport code STRAHL, and also implements a generalized framework for performing optimization of transport parameters based on experimental measurements. The architecture of PyStrahl has

been designed to allow multiple optimization and error determination techniques to be used interchangeably for a given optimization problem; in this initial version a Levenberg-Marquardt chi-squared minimization algorithm (MPFIT) has been implemented and tested. The ability to add Markov Chain Monte-Carlo and Gaussian Process algorithms has been explicitly provided for during the code development. This code is expected to be of general use for anyone using the STRAHL code for impurity transport, and is already being integrated into the impurity transport program at W7-X.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. BERNARD)

The Office of Communications posted two press releases to the PPPL website. The first focuses on a team of researchers led by R. Nazikian of PPPL and C. Petty of General Atomics who conducted research on the DIII-D tokamak. New experiments suggest that increasing the overall pressure of plasma makes the plasma far more responsive to small magnetic ripples known as resonant magnetic perturbations to better control edge-localized modes and produce the conditions needed for steady-state ITER operation. The second story explored the recent SULI summer internship poster session. Both stories were also posted to the *Newswise* and *EurekaAlert!* press release distribution services.

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