Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending October 13, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

Magnets - The procurement plan for the Inner PF Coils has been completed. Meetings with coil vendors were held and are planned to discuss coil sectioning and inspection. The Tesla coil is being sectioned this week for further Vacuum Pressure Impregnation (VPI) inspection, and the final coil testing report was signed off and issued. Corona testing for the PF1A prototype is planned, and the final procedure is complete. Samples have been cut from the PPPL PF1A prototype to use for push-out tests.

Management - J. Menard and G. Swider travelled to Argonne National Laboratory Oct. 10-11 to observe the DOE/SC CD-2 Review of the Advanced Photon Source Upgrade (APS-U) Project to aid preparation for the NSTX-U Recovery CDE-2 review.

Research:

Collaboration Activities - The Final Report for the FY-18 Joint Research Target (JRT) was submitted to FES. NSTX-U/PPPL physicists M. Podestà and N. Gorelenkov coordinated the JRT activities among GA, MIT and PPPL. The milestone was fulfilled by completing a detailed assessment of the predictive capabilities of reduced-physics models for energetic particle (EP) transport by MHD instabilities based on data from NSTX/NSTX-U and DIII-D. The TRANSP code was used as the main platform to conduct the research. Results indicated that the models considered for the JRT work ("kick" and RBQ-1D models developed at PPPL) can reproduce the experimental level of EP transport when the proper parameters of the instabilities - such as frequency, mode number spectrum and amplitudes - are used as input. For predictive simulations, however, those parameters need to be inferred from the simulation itself rather than from experimental data. Uncertainties in the modes' parameters can propagate to the transport models, which may result in inaccurate predictions. The main sources of uncertainty have been identified during the JRT work and are being addressed for further improvements of the models.

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U.S. ITER FABRICATION (H. NEILSON)

The ITER prototype Diagnostic Residual Gas Analyzer (DRGA) was installed on the Wendelstein 7-X (W7-X) stellarator at Germany's Max Planck Institute for Plasma Physics earlier this year. It has operated throughout the current OP1.2b experimental campaign providing mass spectrometry measurements with 1-second time resolution and making important contributions to the physics research program. Key aspects of DRGA performance for ITER are being verified, and the data being acquired on W7-X will be used to build a model for gas throughput and inventory. Design and fabrication of the DRGA prototype was carried out by Oak Ridge National Laboratory staff a few years ago, under U.S. ITER sponsorship.

PPPL engineer H. Schneider chaired a conceptual design review of the ITER Diagnostics Ex-Vessel Electrical Services (PBS 55.NE.X0) on Sept. 24-25. The scope of this review included low-voltage power supplies, power distribution, cabinets, and cabling supporting ITER diagnostics. The review closed on Oct. 9 with a closeout briefing led by Schneider.

The Low Field Side Reflectometer (LFSR) team continues its preparations for next month's preliminary design review. Important deliverables including the Design Compliance Matrix, the System Design Description, and about 20 assembly drawings were transmitted to the ITER Organization Central Team after being reviewed by the U.S. ITER Project Office.

ITER & TOKAMAKS (R. NAZIKIAN)

International Long Pulse (F. Poli):

During the past two weeks, D. Boyer and X. Yuan (PPPL) have developed and tested the TRANSP-Simulink TCP/IP interface for external steering of TRANSP runs. Previously, data was exchanged between TRANSP and Simulink by the reading and writing of shared files. The new approach exchanges data directly between Simulink and TRANSP, creating a more flexible and robust communication interface that will make the testing of control algorithms easier and more reliable. The interface also allows monitoring of the evolution of plasma quantities while the simulation is running, enabling modification of control parameters during a run. A next step is to implement in TRANSP the neural net NUBEAM module developed for KSTAR to accelerate the simulations.

International 3D (J-K. Park):

T. Liu, a Ph.D. student from Dalian University of Technology (DUT), and Z.R. Wang (PPPL) collaborated to develop an equilibrium refiner for MHD physics studies based on a new method that substantially improves the convergence of the reconstructed equilibrium in the edge region. The goal of this development is to improve the calculation of MHD stability and plasma response to 3D fields by improving the convergence of the equilibrium in the plasma edge. The new method can greatly reduce the edge error by about 3 to 5 orders of magnitude, which makes the accuracy of the equilibrium in both the core and edge regions of the same order. At present, T. Liu and Z.R. Wang are working on the improvement of the code efficiency for better computational performance and then plan to apply the code to MHD stability and response calculations.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates):

C. Zhu attended the Chinese Physical Society Fall Meeting in Dalian, China, to accept the Cai Shidong Award for plasma physics. The award was established in 1998 and is given annually to a recent graduate for outstanding research. He also presented an invited talk entitled, "A new method for designing three-dimensional coils in advanced stellarators," at the meeting Sept. 14-16. Zhu then visited Southwest Jiaotong University in Cheng, China, Sept. 17 - 23 and presented a seminar on the same topic. He attended the weekly meeting of the CFQS team and discussed the analysis of error field sensitivity on CFQS modular coils. Zhu then visited Zhejiang University in China and presented a seminar. He also presented the recent progress on exploring configurations for U.S. next-generation quasi-axsiymmetric stellarators.

This week S. Lazerson organized and conducted experiments on W7-X to investigate energetic particle physics. In these experiments, microwave heating was used to form a plasma and neutral beam injection (NBI) was then used to extend the plasma operation in the absence of microwave heating. NBI pulse length was extended from 500ms to a full 5s of possible operation. These discharges were able to reach record plasma densities in W7-X and allowed a first attempt at OXB heating. Experiments to investigate impurity transport and neutral beam deposition were also conducted.

TRANSP (F. Poli)

TRANSP version v18.2 was released on Oct. 8. This version includes new fits for tritium reactivities, an updated pedestal module that includes a neural network based on EPED1 calculations, and an option to extend the grid to calculate fast ion losses to the limiter. Documentation for the new modules and options can be found on the new TRANSP website: https://transp.pppl.gov, also launched this week.

OFFICE OF ACADEMIC AFFAIRS (N. FISCH)

J. Squire, who earned his Ph.D. from the Program in Plasma Physics in 2015, worked on problems in gyrokinetics with H. Qin and others, and did his thesis with A. Bhattacharjee, has won a 2018 Rutherford Discovery Fellowship from New Zealand: https://royalsociety.org.nz/news/2018-rutherford-discovery-fellowships-to-accelerate-research-careers-announced

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. BERNARD)

The Office of Communications posted one press release on the PPPL website. It focused on R. Hawryluk being named interim deputy director of operations and chief operating officer. The story was also posted to the *Newswise* press release distribution service.

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