The PPPL Highlights for the week ending May 5, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

For the production inner poloidal field (PF) coils, an award has been made for the production PF coil copper conductor. A draft source selection plan has been developed for the procurement of the production inner PF coils.

For the prototype inner PF coils, a critical lift procedure was drafted and circulated for peer review for the PF1A prototype sectioning. Sectioning will be completed on each of the prototype coils to help analyze the quality of fabrication and vacuum pressure impregnation (VPI).

Research:

The NSTX-related paper, “Energetic-particle-modified global Alfvén eigenmodes,” by J. Lestz, E. Belova, and N. Gorelenkov has been published in Physics of Plasmas and chosen as an “editor’s pick.”

T. Kunugi of Kyoto University, Japan, visited NSTX-U/PPPL on April 28 to discuss liquid metal diverter research. He met with a number of NSTX-U/PPPL researchers including H. Ji, E. Kolemen, R. Majeski, and M. Ono, and visited both the Liquid Metal Experiment and the Lithium Tokamak Experiment-Beta.

U.S. ITER FABRICATION (H. NEILSON)

An update on the status of modeling and seismic analysis of the low-field-side reflectometer (LFSR) ex-vessel waveguide support structure was presented by engineer M. Sibilia. The design must satisfy structural requirements associated with normal operation at ambient temperatures up to 50 degrees Celsius in the gallery surrounding the ITER tokamak, seismic loads due to earthquakes, and fire conditions. The structure will be suspended from embedded plates in the ceiling, with the waveguides supported on rollers to permit longitudinal thermal expansion and contraction, and with features to restrict lateral motion. An analytical model was constructed from the CAD model, with simplifications introduced to reduce model complexity and solution time. A modal analysis, characterizing the natural displacement modes and frequencies, was performed. A seismic analysis was performed, calculating the stresses and deflections in response to a so-called “SL-2” earthquake, i.e, an infrequent severe earthquake.
A subcontract deliverable for the low-field-side reflectometer (LFSR) project, “Back-End Instrumentation Design Report,” was received from General Atomics of San Diego, CA. The LFSR launches microwaves into the plasma and uses the phase-shifted reflected waves to measure the edge plasma density profile. The report provides specification guidelines for the microwave source/receivers (transceivers) and associated equipment. The hardware specifications are derived based on physics requirements for LFSR, but are shaped by operational experience with the prototype transceiver equipment installed at the LFSR Test Stand at General Atomics. Researchers found that, while some specifications are met by the current prototype design, improvements over the prototype design will be necessary. The necessary design improvements were clarified by the reported test results.

ITER & TOKAMAKS (R. Nazikian)

DIII-D (B. Grierson)

Research:

S. Haskey presented an invited talk at the High Temperature Plasma Diagnostics conference in San Diego titled, “Active spectroscopy measurements of the deuterium temperature, rotation, and density from the core to scrape off layer on the DIII-D tokamak.” The paper detailed the state-of-the-art in active spectroscopy of main ions, developed in the DIII-D tokamak. B. Grierson presented a contributed talk on a new and improved method of CER calibration using xenon emission that removes much of the variability between different beam lines observed when using helium calibration. The two conference papers were submitted for publication to Review of Scientific Instruments.

Operations:

Two experiments that are part of the NSTX-U National Campaign have been carried out on DIII-D. One experiment, led by A. Bortolon, focused on the injection of low-Z material to study a radiative divertor; another, led by R. Lunsford, focused on pedestal impurity transport. The two experiments were enabled by the newly installed impurity powder dropper, which was successfully employed to control delivery of boron, lithium and boron nitride. The experiments have been supported by a team of PPPL scientists including R. Maingi, E. Gilson, R. Lunsford, and J. Schwartz (Princeton University).

The newly installed DIII-D impurity powder dropper has been commissioned during machine startup operation, after a maintenance vent. The commissioning activity was combined with an attempt of real-time boronization. The reduction of oxygen levels and
the subsequent successful execution of QH-modes plasmas suggest that the injection of boron powder in tokamak plasmas can be effectively used for wall conditioning purposes.

**International:**

M. Knolker visited Garching, Germany to discuss divertor tile currents during edge-localized modes (ELMs) at ASDEX-U. On both DIII-D and ASDEX-U, large currents are measured during type-I ELMs with magnitudes up to 20 kA. Simulations with the JOREK code may provide answers to the effects of helical currents, and are a goal of this joint research. Collaboration will continue in the near future to investigate the effects tile biasing may provide on DIII-D for affecting ELMs.

Assembly of the new 15 channels of the MSE background polychromator for use on KSTAR is substantially complete. Testing, measurement of the filter transmission curves, and integration with computer control will take place over the next two weeks. We are on schedule to ship on or before May 4.

**ADVANCED PROJECTS (H. NEILSON)**

**Stellarators (D. Gates):**

R. Lunsford visited General Atomics to begin testing of a piezoelectric rotary motor for a probe-mounted powder injector that is being prepared for testing on Wendelstein 7-X during the next operating period. Motor tests were successful and operational viability of the vertical paddle wheel injector concept was confirmed. In addition, Lunsford and Senior Engineer A. Nagy reviewed the design presented by graduate student D. Mauzey for the compact injector integration that compresses the powder injector into a probe-mountable envelope. The design will be reviewed with W7-X personnel within the next two weeks with fabrication to start upon endorsement of design proposal.

N. Pablant visited General Atomics to collaborate with colleagues on the topics of stellarator transport, integrated analysis, and the main-ion charge exchange diagnostic. During this visit, Pablant received intensive training on the use of the OMFIT package. Discussions were held with S. Haskey, B. Grierson (PPPL), and S. Smith (General Atomics) regarding the use of OMFIT for the analysis of stellarator transport at W7-X. Pablant has now joined the OMFIT development group, and will continue evaluation of the use of this powerful tool for analysis at W7-X.
THEORY (A. BHATTACHARJEE):


Computational Plasma Physics Group (S. Jardin):

On May 2, E. Feibush presented a seminar titled, “Scientific Visualization with VisIt,” at the Princeton Institute for Computational Science and Engineering. The seminar described techniques for visualizing data that is f(x,y,t) and f(x,y,z). The attendees from PPPL and university departments worked with the software to create example images and movies. Advanced animation using Python scripting was introduced.

J. Chen investigated the performance of the linear solvers used in the M3D-C1 code and found that there is a strong dependence on the “restart” parameter used in GMRES. She found the optimal value of this parameter as a function of problem size. It was then observed that by using the optimal value, rather than the default value, production runs took 30-50% less time on the Cori-KNL computer at NERSC.

Office of Academic Affairs (N. Fisch):

S. Davidovits ‘17 was selected as a 2018 Howes Scholar in Computational Science. The Howes Scholars are chosen from recent graduates from the DOE Computational Science Graduate Fellowship Program. As part of this recognition, which includes a cash prize, Davidovits will deliver a talk at the 2018 DOE Computational Science Graduate Fellows Program Review. Davidovits received his Ph.D. last year from the Program in Plasma Physics. His thesis was titled, “Understanding turbulence in compressing plasma and its exploitation or prevention.”

Princeton graduate student H. Zhu received a Student Poster Award at the 2018 Sherwood Fusion Theory Conference for presenting a poster titled, “Wave kinetics of drift-wave turbulence and zonal flows beyond the ray approximation.” Zhu’s
collaborators on the poster were Y. Zhou (PPPL) and D. Ruiz (Sandia), as well as project supervisor, I. Dodin.

COMMUNICATIONS (L. BERNARD)


DIRECTOR’S OFFICE (R. HAWRYLUK)

M. Zarnstorff participated in the W7X Program Meeting that took place April 24-27 in Greifswald, Germany. On April 27, Lab leadership provided a mid-year assessment of PEMP, milestones, and opportunities, at the Laboratory Management Review (LMR) meeting. On April 30, R. Dimeo from the NIST Center for Neutron Research presented a colloquium entitled, “Science with Neutrons at the NIST Center for Neutron Research.” From May 2-4, T. Brog attended the NLCOO Site Manager's Meeting at Pacific Northwest National Laboratory.

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