Weekly HIGHLIGHTS

The PPPL Highlights for the week ending October 21, 2017, are as follows:

NSTX-U (J. Menard)

Recovery Planning

In the magnet area, for the PF-1A prototype test Vacuum Pressure Impregnation (VPI) log, the bundle and mold have been placed in the VPI oven and the VPI plastic tubing is being cut to the proper lengths. The PF-1A prototype coil tooling design and fabrication is progressing. The VPI mold drawings have been approved and the requisition for external fabrication has been submitted. The winding mandrel is complete and has passed inspection. The winding mandrel components (tapered cylinder, wedge shims and flanges) will now be assembled to test their functionality. A kickoff meeting was held with the second vendor awarded a subcontract for fabrication of a PF-1A prototype coil.

In the Vacuum Vessel and Internal Hardware area, fatigue property data on SS, Inconel, and copper parts for the passive plates was collected, and ANSYS models run, and it was determined that Inconel bolts are needed and sufficient. 2D axisymmetric thermal modeling of the inboard divertor cooling plate based on updated tile and cooling plate designs were performed.

Research

Dry runs were held for invited, oral, and poster presentations for the APS-DPP meeting to be held in Milwaukee, WI, October 23-27, 2017.

ITER & TOKAMAKS (R. Nazikian)

DIII-D (B. Grierson)

Research:

A paper titled, "Deuterium charge exchange recombination spectroscopy from the top of the pedestal to the scrape off layer in H-mode plasmas," by S. Haskey, B. Grierson, L. Stagner, K. Burrell, C. Chrystal, R. Groebner, A. Ashourvan, and N. Pablant has been accepted for publication by the *Journal of Instrumentation*. This paper, based on a presentation at the 2016 European Conference on Plasma Diagnostics (ECPD), documents spectroscopic and collisional-radiative modeling done under Brian Grierson's Early Career Award for measuring the temperature, density and rotation of the main-ions in the H-mode pedestal.

A paper titled, "Orchestrating TRANSP Simulations for Interpretative and Predictive Tokamak Modeling with OMFIT," by B. Grierson et. al. has been accepted for publication by *Fusion Science and Technology*. This paper demonstrates a modern preparation, submission and visualization of TRANSP runs through the OMFIT workflow manager. Recently, in collaboration with J. Buchanan and M. Fitzgerald of CCFE, JET has begun using OMFIT for a large fraction of their TRANSP analysis, with an increasing user base now also contributing to the development of the application.

A recent DIII-D experiment was carried out to investigate the phenomenon of intrinsic toroidal rotation reversals and comparison with JET. During this experiment, led by C. Chrystal (GA), F. Nave (Instituto Superior Tecnico), B. Grierson and S. Haskey, new between-shot main-ion charge exchange recombination (CER) capabilities were used to track the core and edge main-ion toroidal velocity for revealing rotation reversals. The implementation of between-shot main-ion CER analysis is a technical milestone for the Early Career Award, achieved by exploiting the symmetries in the Stark emission spectrum, converting spectral analysis from IDL to C, and parallel computation. A 500-fold speedup in the computation of the main ion spectrum was achieved recently in order to provide between shot analysis.

JET-ITER: (F. Poli)

F. Poli traveled to Frascati, in Italy, to participate into the 19th meeting of the ITPA-IOS topical group. She presented plans for a joint modeling activity on the ITER termination phase and gave a short report on the use of electron cyclotron heating at half-field, discussing alternate routes to avoid parasitic absorption at the plasma edge. In addition to the reports from individual machines and on modeling for ITER, this meeting had a special focus on the first ITER plasma.

THEORY (A. Bhattacharjee)

On Wed. Oct. 18, V. Mikhailenko of Pusan National University in South Korea presented a special theory seminar titled, "The shearing modes approach to the theory of plasma shear flow." The abstract and presentation can be found on the Theory Department website: http://theory.pppl.gov/news/seminars.php?scid=1&n=research-seminars

On Friday, Oct. 20, A Research & Review Seminar titled "Quasioptics with mode conversion: theory and applications" was presented by Ilya Dodin. The abstract and presentation can be found on http://theory.pppl.gov/news/seminars.php?scid=2&n=rr-seminars

The paper, "Landau collision integral solver with adaptive mesh refinement on emerging architectures," by M. F. Adams, E. Hirvijoki *et al*. was accepted for publication in SIAM *Journal on Scientific Computing*.

The *Journal of Plasma Physics*' Editor's Choice Feature Article for October 2017 is "Diagnosing collisionless energy transfer using field–particle correlations: gyrokinetic turbulence" by K. Klein, G. Howes, and the theory department's J. TenBarge.

The paper titled "Three-dimensional magnetohydrodynamic equilibria with continuous magnetic fields" by S. Hudson and B. Kraus has been selected by the editorial board of the *Journal of Plasma Physics* as one of the featured articles from the 2017's issue 4. The article now appears on the front page of the JPP website.

J. Juno, A. Hakim, J. TenBarge, E. Shi, and B. Dorland published "Discontinuous Galerkin algorithms for fully kinetic plasmas" in *Journal of Computational Physics*.

Links to all of the above mentioned papers can be found on the Theory Department website at http://theory.pppl.gov/news/seminars.php?scid=4&n=publications

ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates)

During a visit by H. Neilson to Germany's Max Planck Institute for Plasma Physics (IPP) in Greifswald, Wendelstein 7-X (W7-X), Project Director T. Klinger endorsed a package of twenty-one task agreements that cover the work currently in progress under the U.S.-IPP collaboration on W7-X. The tasks span a range of research and diagnostic operation tasks by seven U.S. institutions that together constitute the largest U.S. collaboration on an overseas fusion facility and a substantial research effort on an important optimized stellarator. At this time twelve U.S. researchers, including several students, are on site at IPP and playing key roles in the current W7-X operating campaign, OP1.2.

System Studies (C. Kessel)

A paper titled "Survey of heating and current drive for K-DEMO," by D. Mikkelsen, C. Kessel, F. Poli, N. Bertelli and K. Kim has been submitted to the journal *Nuclear Fusion*. The manuscript summarizes the results of heating and current drive calculations for burning plasma conditions in the K-DEMO tokamak reactor configuration. The multi-parameter surveys cover five types of systems: lower hybrid waves, ion cyclotron waves, helicon waves, electron cyclotron waves and neutral beam injection. Current drive efficiencies and profiles of driven current and heating are presented.

Weekly HIGHLIGHTS

ENGINEERING & INFRASTRUCTURE (V. RICCARDO)

W7X

H. Neilson and R. Feder visited W7-X this week to discuss design aspects and planning of a new Continuous Pellet Fueling System (CPFS) project. The CPFS project will be a collaboration between ORNL, PPPL, NIFS (Japan) and IPP W7-X. ORNL is supplying the continuous pellet production technology. PPPL will design the auxiliary vacuum systems and aspects of the instrumentation and control. PPPL will also handle project management. Feder is working with B. Blanchard on the design of the vacuum systems which are required to exhaust propellant and residual fueling gasses while guiding the pellet into the torus.

Plant I&C

R. Rozenblat and F. Laggner completed the development of the rt-MPTS analysis algorithm. Laggner, a physicist, certified that the implementation of the algorithm produces the same result as B. Leblanc's IDL-based post-shot routine, which is critical for NSTX-U plasma density measurements. This data is included in a poster being presented next week at the APS conference in Milwaukee. This poster describes the design of the prototype rt-MPTS system that is being developed by Roman and other members of the I&C group. The next step will be the optimization of code to reduce the execution time and improve determinism.

BUSINESS OPERATIONS (K. FISCHER)

Procurement

On Wednesday, October 18, 2017, A. White, as a member of the steering committee, participated in the DOE Office of Small and Disadvantaged Business Utilization (OSDBU) First Annual Future Small Business Symposium held in the main auditorium of the James Forrestal Building in Washington, DC. The small business outreach event was hosted by C. Smith, Director, director of OSDBU, and C. Jackiewicz, Deputy Director of OSDBU. Dr. L. Chatterjee, physicist and program manager at the DOE's Office of Science was the keynote speaker. Approximately 75 inner-city high school students and small businesses attended the event. PPPL, along with many other national laboratories and small businesses, contributed to the wonderful "goodie" bags that were given to the students.

In addition to the networking opportunity among the small businesses with DOE, the event was held to inspire, motivate and to offer tools necessary for high school students to consider avenues for becoming entrepreneurs.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted three press releases to the PPPL website. One noted that PPPL had concluded its arrangement to send a steady state electrical network (SSEN) equipment to ITER in France. PPPL had partnered with the DOE's Princeton Site Office to manage a five-year, $34-million project on behalf of US ITER to provide three quarters of the components for the SSEN. Another press release explained how PPPL research showed that loops of liquid lithium could protect the divertors and clean and recycle tritium in tokamaks. The third press release explained recent PPPL research involving new computer simulations of blob movement in the plasma edge. All stories were also posted on the Newswise and EurekAlert! press release distribution services.

G. Hammett and D. Battaglia hosted R. Sinclair, a physicist who worked at the Laboratory when it was called Project Matterhorn, on Sept. 29.

PPPL hosted a total of 160 people for Princeton University Freshman Family tours with two tours of 30 people each on Friday, Oct. 13, and one tour of 100 people on Saturday, Oct. 14. The Friday tours were hosted by J. Jackson DeVoe and R. Rosen with tour guides R. Camp, D. Battaglia, A. Brereton, J. Guttenfelder, K. Lamb, and E. Gilson. The Saturday tour was hosted by Rosen with tour guides Lamb, Brereton, B. Kraus, and A. Dominguez.

DIRECTOR'S OFFICE (R. HAWRYLUK)

On Oct. 18, Professor A. Zehnder, of Cornell University, presented a colloquium entitled, "Properties and Degradation of Polyimide in Extreme Hygrothermal Environments."

This report is also available on the following web site:

http://www.pppl.gov/publication-type/weekly-highlights