



The PPPL Highlights for the week ending March 23, 2019, are as follows:

NSTX-U RECOVERY (R. HAWRYLUK) AND RESEARCH (J. MENARD)

Recovery:

A successful basis of estimate review (BOER) was held at PPPL March 18-20. The nine-member BOER review panel affirmed that the NSTX-U recovery project cost estimate is well documented, comprehensive, accurate, and credible as defined by GAO-09-3SP and DOE Order 413.3B. Successful completion of the basis of estimate review by March 31 fulfills an FES notable Outcome for FY2019.

Center Stack Casing — A procurement package is under development based on bids received at the end of last week.

Magnets — The magnet team expects two of the PF1a conductors to be shipped via air freight from ICAS Tratos in Italy to arrive at PPPL on or around March 26. The Kapton glass insulation tape is being co-wound in the coil shop clean room, and the VPI flange modification drawings are complete.

Research:

Publications — The paper, “Emission in the ion cyclotron range of frequencies (ICE) on NSTX and NSTX-U,” by E. D. Fredrickson, et al., was published in *Physics of Plasmas*. The paper reports on observations of magnetic fluctuations in the ion-cyclotron frequency range on NSTX and NSTX-U. In many respects, the fluctuations appear similar to the ion cyclotron emission (ICE) seen in conventional tokamaks. However, a significant difference between previous observations of ICE and the ICE on NSTX is that the frequency of ICE in conventional tokamaks is typically near the ion cyclotron frequency of the energetic fast ions at the plasma edge.

U.S. ITER FABRICATION (H. NEILSON)

The ITER Low Field Side Reflectometer (LFSR) team is assessing solutions for so-called “captive supports,” referring to structures whose building interfaces will become obstructed by other equipment and would therefore be inaccessible when the diagnostic systems are installed. The LFSR includes a system of waveguides that must be supported from the ceiling of the gallery, the annular corridor that surrounds the tokamak. PPPL engineer M. DeLooz is investigating a solution based on a commercial off-the-shelf modular support system, consisting of structural members that can be bolted together in various configurations. Because the same system is of interest as a solution for many ITER diagnostic support needs, there is a potential for a cost-saving

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high-volume procurement if the design is structurally acceptable for LFSR. DeLooz has prepared a structural model and is beginning a comparative study through simulation of the bolted off-the-shelf design versus a welded tube-frame solution.

The LFSR project continues to make progress toward approval of its preliminary design review (PDR) deliverable documents and closeout of Category 1 PDR chits. This week a bill of materials, including quality and safety classification of all components, as well as a stray radiation protection report were approved by the U.S. ITER Project Office and submitted to the ITER Organization Central Team for their review.

ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

Research:

One plenary talk and two poster presentations were given this week at the US-EU Transport Task Force Workshop in Austin, Texas. A. Ashourvan gave a pedestal plenary session talk entitled, "Formation of a staircase pedestal in high-confinement DIII-D H-mode plasmas with RMP-suppressed edge-localized-modes." This talk presented the periodic widening and narrowing of the H-mode pedestal during the application of static 3D fields.

S. Haskey and B. Grierson gave poster presentations. Haskey showed that in conditions where the power balance ion heat flux through the pedestal is calculated to be negative, replacing the carbon ion temperature with the main ion temperature can remove this non-intuitive negative flux. Grierson displayed "predict first" simulations of the DIII-D co/counter off-axis NBI in steady-state scenarios using predictive TRANSP with TGLF and TEQ. By including an additional 4.0 MW of power at 81 kV from the off-axis NBI, steady-state scenario #147634 (Holcomb, et. al., *Nucl. Fusion* 54 2014) is expected to achieve $\beta_N > 4$ with fNI of 75-80%.

ITER-JET (F. Poli):

A. Teplukhina attended the workshop "RAPTOR optimization weeks" March 4-15, at the Swiss Plasma Center in Lausanne, Switzerland. As a former member of the RAPTOR code (a fast real-time and off-line plasma transport simulator) development team, she worked closely with the EUROfusion MST1 team from SPC, IPP and DIFFER during the workshop. She contributed to the development of the interface between the code and machine databases that, in particular, will allow scientists to use the code as a routine tool for predictive simulations of JET plasmas. Opportunities for further joint application of TRANSP and RAPTOR for the JET optimization scenario program were discussed. This

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collaborative work will help to increase the use of TRANSP as a predictive tool at JET (TRANSP is currently used only for interpretive simulations), by leveraging effectively the TRANSP higher fidelity models and the RAPTOR high speed runs for JET scenario optimization.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates)

On March 18 and 19, D. Gates visited the Institute for Plasma Physics of the Czech Academy of Sciences (IPP-CAS) in Prague, Czech Republic. The purpose of the visit was to finalize a draft of a memorandum of understanding between PPPL and IPP-CAS that will be submitted to DOE for approval. Additionally, a list of possible collaboration topics for COMPASS-U, a new tokamak being designed by IPP-CAS, was generated during discussions with the scientific and engineering staff at the Institute. This list will be used to consider possible topics for collaborations between researchers from PPPL and IPP-CAS on the COMPASS-U device.

THEORY (S. HUDSON)

The paper titled, "Collisional enhancement of energetic particle Alfvénic resonance width in tokamaks," by R. White, V. Duarte, N. Gorelenkov and G. Meng has been published in *Physics of Plasmas*: <https://doi.org/10.1063/1.5088598>.

V. Duarte gave a contributed talk at the Transport Task Force (TTF) meeting in Austin, Texas titled, "Verifying reduced quasilinear models for fast ion relaxation." M. Churchill gave a plenary talk entitled, "Pressure balance in a low-collisionality tokamak scrape-off layer," at the Austin meeting.

On March 12, N. Ferraro was invited to present a talk entitled, "Progress and plans for APS-DPP community planning process," at the FESAC meeting in North Bethesda, Maryland.

On March 14 in Washington, D.C., N. Ferraro attended Fusion Day, a congressional outreach event in which S. Hudson and several other lab staff and graduate students talked to congressional staff about the research at PPPL.

TRANSP (F. Poli):

F. Poli attended the US-TTF workshop in Austin, Texas, March 18-21. She presented a poster on the short- and long-term planning for TRANSP. Topics include the modernization of the architecture for compatibility to HPC, integration of self-consistent anomalous fast-ion transport induced by low-n MHD and Alfvénic instabilities and



coupling of a transport model for the scrape-off layer. Poli also chaired a session on turbulence simulations and reduced models.

ENGINEERING (V. RICCARDO)

On March 12, G. Tchilinguirian and S. Daskoczynski of the engineering department along with D. Stotler of the theory department judged the indoor bottle rocket event at the 2019 New Jersey Science Olympiad. Rockets were successfully flown by over 25 teams.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

SCIENCE EDUCATION (A. Zwicker):

The 18th Annual Young Women's Conference in STEM sponsored by PPPL was held on Friday, March 22. Some 750 young women, from grades 7-10, from about 75 different schools, spent the day with scientists and engineers from universities, museums, government agencies and other institutions from the New Jersey area. The students experienced a variety of hands-on projects and demos, listened to women describe their path and advice on how to pursue their own STEM careers. K. Wagner, of the Princeton University Chemistry Department, demonstrated the wonders of chemistry, and the day culminated with a keynote address by T. Ma of Lawrence Livermore National Laboratory. Coincidentally, NASA live-streamed a space walk by female astronaut A. McClain repairing parts of the International Space Station, and the students were treated to a live view throughout the morning. Some 50 PPPL staff members volunteered to help inspire these young women and make the event a huge success.

COMMUNICATIONS (L. Bernard)

The Office of Communications posted two press releases to the PPPL website. One examined research by physicist J. Menard into compact tokamaks with high-temperature superconducting magnets. Menard first presented the paper, now published in *Philosophical Transactions of the Royal Society A*, to a Royal Society workshop in London that explored accelerating the development of tokamak-produced fusion power with compact tokamaks.

The second press release focused on PPPL's Young Women's Conference in Science, Technology, Engineering, and Mathematics that took place on March 22 on the Princeton University campus. The 750 girls in attendance talked to female scientists and engineers, watched eye-catching and booming chemistry experiments, and talked to early-career scientists and engineers about their careers. These 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>