The PPPL Highlights for the week ending January 17, 2014, are as follows:

U.S. ITER FABRICATION (D. JOHNSON):

A peer review of recent diagnostic front-end designs in equatorial port plug 9 was attended by the full ITER design team and by other PPPL mechanical engineers not involved directly in ITER design. This review focused on TIP water-cooled first mirror design options and the shutter/mirror for the ECE diagnostic.

Initial Subcontract Proposal Review Board meetings were held for RFPs related to the TIP and Upper Camera diagnostics.

To progress the negotiation with the European and Russian domestic agencies on swapping of diagnostic shield module scope, an 'arrangement' document was drafted.

NSTX (M. ONO):

Preparations for plasma operations in the NSTX-U configuration also continued with the recommissioning of primary power equipment for the neutral beam systems. Bus ducts to connect the switchgear and autotransformers to the transformer/rectifiers were reinstalled this week, and new vacuum bottles are being installed in the Fast Vacuum Interrupters. Progress was also made on the commissioning of a new plasma current (Ip) calculator with completion of some design schematics and the start of fabrication of prototype circuit boards.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

R. Maingi made two presentations at the PPPL Research Seminar: "Re-cap of the 2013 ITPA Coordinating Committee Meeting", and a streamlined version of his invited review talk from the 2013 H-mode workshop: "Edge Transport Barrier Without Large ELMs, and Control and Performance Issues for ITER".

R. Hawryluk visited DIII-D this week and worked on data analysis related to his experiment on burn control by means of applying non-axisymmetric fields. While plasma stored energy is a reasonable proxy for fusion power in a power plant, fast ion and profile effects could, in principle, affect these experiments. TRANSP was used to examine these issues. TRANSP

analysis (without anomalous fast ion diffusion) performed by Brian Grierson shows that the ratio of computed stored energy (including fast ions) to total stored energy from magnetics does not change with the application of non-axisymmetric fields indicating that loss of fast ions is not appreciable. Preliminary TRANSP analysis indicates that the reduction in thermal plasma pressure is across the plasma profile and not only in the pedestal region. The ion pressure in the core decreases in response to the application of current in the I-coils on an energy confinement timescale.

ADVANCED PROJECTS (H. NEILSON):

In the Laboratory's collaboration with the Wendelstein 7-X (W7-X) project at Germany's Max Planck Institute for Plasma Physics (IPP), preparations for a conceptual design review of the x-ray imaging crystal spectrometer (XICS) project are nearing completion. The joint team completed documentation of the high-level requirements, description of the conceptual solution, and updates of the cost, schedule, and project execution plan. Agreements were reached on division of key scope responsibilities between IPP and PPPL. A charge for the review was issued, a committee was appointed, and the review date was fixed to be January 23.

THEORY (A. BHATTACHARJEE):

The theory seminar this week was presented by Lei Qi from Auburn University, entitled "GeFi Particle Simulation of Lower Hybrid Waves and Electron-ion Hybrid Instability". The abstract of the talk is "Lower hybrid wave (LHW) is a potential source to heat both electrons and ions to thermonuclear temperature and generate electric currents in fusion plasmas under Landau damping. Although linear Landau damping and nonlinear parametric instability of LHWs were well studied in theories, few particle simulations have been performed. In this talk, physics of LHWs is investigated with a gyro-kinetic electron and fully kinetic ion (GeFi) particle simulation model in the electrostatic limit. GeFi model is particularly suitable for plasma dynamics with wave frequencies lower than the electron gyrofrequency, and for problems in which the wave modes ranging from Alfvén waves to lower-hybrid/whistler waves that need to be handled on an equal footing with realistic electron-to-ion mass ratio. Firstly, the linear physics of lower hybrid waves and their nonlinear interactions with both electrons and ions through Landau damping are studied. Unlike most other wave modes, LHWs can resonantly interact with both electrons and ions, with the former being highly magnetized and the latter nearly unmagnetized around lower hybrid frequency. While the resonant electrons are trapped in the wave field in the nonlinear electron Landau damping, resonant ions are untrapped throughout the wave-particle interaction. Then, electron-ion hybrid instability driven by transversely sheared E×B flow, which plays an important role in laboratory and space plasmas, is studied by the GeFi model in the linear and nonlinear regimes. Electron-ion hybrid instability is in the lower hybrid frequency regime with $\rho e < LE < \rho i$, where ρi and ρe are the electron and ion Larmor radii, respectively, and LE represents the scale length of the shear flow profile. Realistic experimental parameters for Auburn Linear Experiment for Instability Studies (ALEXIS) device are adopted in GeFi particle simulations, and the results are compared with ALEXIS measurements."

W. Tang participated in the invitation-only DOE Advanced Scientific Computing Research (ASCR) Workshop on "Software Productivity for eXtreme-Scale Science (SWP4XS)," held at the Hilton Washington DC/ Rockville hotel, January 13-14. The workshop engaged computational scientists from academia, industry, and national laboratories to identify the major challenges of large-scale application software productivity on extreme-scale computing platforms.

A. Reiman and a group of collaborators have submitted a proposal for a series of experiments on DIII-D that would provide data for validation for a set of eleven codes presently being cross-benchmarked. The collaborators on the proposal are: T. Evans, A. Turnbull, N. Ferraro, J. King, M. Lanctot and F. Turco, all from GA. Dr. Reiman has given presentations on the proposal to the DIII-D Research Opportunities Forum, to the FY14 Joint Research Target (JRT) working group, and to the 3D Plasma Response Task Force for DIII-D experimental planning.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

NSTX Upgrade (R. Strykowsky, E. Perry, L. Dudek, T. Stevenson):

The DOE Office of Project Assessment (OPA) has scheduled a review of the NSTXU centerstack fabrication and assembly process for February 4. This one-day review will help DOE assess the rate of progress to date and judge the reasonableness of the schedule to complete.

Construction: In-vessel installations continue with work on the TAE antenna, flux loops and passive plates with accelerometers. The last day for in-vessel installations will be March 14. Installation of thermal putty between the bakeout tubing and the vessel exterior continues. Insulation will be re-installed on the vessel at the end of the month. A mockup of a PF4/5 column at bay B has been modified to account for all concerns in that location. A permanent column will now be fabricated. The custom PF4/5 column for bay L has been fabricated and is now being fit-up. Measuring continues for the replacement RWM coils for bays J through A. Diagnostics are being re-installed on the outside of the vessel. Associated cabling is being re-installed and terminated. The 109" EL platform has been extended at bay E. Rework of the centerstack casing studs continues in the south high bay of the NSTX Test Cell.

CS Upgrade: The OH winding proceeded smoothly this week. Over 120 turns of the first layer has been wound, the third and fourth inline brazes have been completed and tested. Winding will restart once the primer has cured Friday afternoon. Next week, two shift operations will commence with four technicians on each shift. At Everson the first PF1B coil was injected with epoxy to fill voids left after the potting operation. The voids that ran parallel to the conductors filled nicely but there are many other voids left that will need to be addressed. During a site visit, Everson drilled additional holes and injected epoxy on Friday while being witnessed by PPPL Engineering and QA. Another day or two of injecting the holes will be required before PPPL can accept the coil. The second PF1B has been wound and is scheduled to be potted next week. A count was taken of the Centerstack tiles that smell of sulphur when wetted. Almost all of the ATJ tiles (over 100) were found to exhibit the characteristic. An oven run with RGA analysis on a few samples is planned to determine if the sulphur will come off the tiles in vacuum. If required Graftech, the graphite supplier, has a purification procedure using heat and halogen gas, that can be used to remove the sulphur.

NBI Upgrade: Progress on DI water manifold fabrication and installation continued for BL2. The NBI Armor shine through tiles were machined for the as-built gaps and await bakeout and final assembly. Work continues on the subcontract cable installation. Major cable pulls are nearing completion; smaller cable pulls have started and fiber optics cable pulls are planned. Cable tray divider installation is in progress and nears completion. Control rack wiring has resumed in the Gallery racks and the NBPC Building 138L. Packages are ready to go to install the NB Duct. A few final support parts are required and Tech Shop work orders are planned. The vacuum system packages are being prepared and await a few final drawings. Management and CAMs have evaluated bottom-up Control Account ETCs and EACs for the Project Office.

DIRECTOR'S OFFICE (C. AUSTIN):

S. Prager attended a meeting at the Max Planck Society in Munich, Germany on January 13. The purpose of the meeting was to discuss the joint centers that the Max Planck Society operates with institutions in other nations.

On January 14, the monthly PPPL Research Meeting was held. The meeting was chaired by Fatima Ebrahimi - M. Zarnstorff provided a research update, and R. Maingi presented a summary of the ITPA Coordinating Committee and an H-Mode Plenary talk.

PUBLICATIONS:

The following PPPL Reports were posted to the web:

A Nonlinear PIC Algorithm for High Freqency Waves In Magnetized Plasmas Based on Gyrocenter Gauge Kinetic Theory PPPL-4973
Authors: Jian Liu, Zhi Yu and Hong Qin
Submitted to: Communications in Computational Physics (September 2013)

Analytical Methods for Charged Particle Dynamics In General Focusing Lattices Using Generalized Courant-Snyder Theory PPPL-4974
Authors: Hong Qin
Submitted to: Physical Review Special Topics - Accelerator and Beams (December 2013)

Variational Integrators for Perturbed Non-Canonical Hamiltoniaan Systems PPPL-4975
Authors: Joshua W. Burby, C.L. Ellison and H. Qin
Submitted to: Journal of Computational Physics (January 2014)

Initalizing and Stabilizing Variational Multistep Algorithms For Modeling Dynamical Systems PPPL-4976
Authors: C.L. Ellison, J.W. Burby, J.M. Finn, H. Qin and W.M. Tang
Submitted to: Journal of Computational Physics (January 2014)

Energy-resolved X-ray Imaging For Magnetically Confined Fusion Plasmas: Measurement Of Impurity Concentration And Thermal And Non-Maxwellian Electron Distributions PPPL-4977

Authors: L. Delgado-Aparicio, et. al.
Submitted to: PPPL Reports

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