



The PPPL Highlights for the week ending December 14, 2012, are as follows:

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

PPPL Engineers D. Loesser and M. Smith traveled to Cadarache to discuss ITER Organization decisions needed to define interfaces between the diagnostic first wall and the diagnostic shield modules.

The ITER Organization approved ITER Task Agreement C55TD37FU covering support for MSE conceptual design. A Quality Plan for this TA was submitted to the USIPO for approval.

A log for tracking a subset of the document deliverables for US Diagnostic Procurement Arrangements (PAs) was created. Including those documents defined in the recently signed PAs P3 and P4, there are currently 30 documents being tracked, spread between seven authors.

A LFS Reflectometer PA Progress Meeting was held. The Statement of Work for an R&D contract with UCLA was discussed. It was decided that for this work, a Quality Plan was not needed. This and other issues and actions were captured in the meeting minutes, circulated the same day.

NSTX (M. ONO):

NSTX-U is in the Upgrade Project outage in FY 2013

S. Kaye (PPPL) participated in the ITPA Coordinating Committee/IEA Joint Experiment meeting, which was held in Cadarache, France on December 10-12. In attendance were ITPA chairs, ITER IO representatives and representatives from the experimental projects participating in ITPA Joint Experiments and Activities. During the meeting, there were reports on the status of ITER construction from Motojima, and an update on the ITER R&D needs from Campbell. ITPA chair presented results of the Joint Experiments/Activities from 2012, and the plans for these for 2013. The group discussed these, and each project representative committed the level of involvement of the project to each Joint Experiment (JEX). There were also targeted discussions on the ITPA groups' assessment of whether installing the tungsten divertor from Day one presented any risk (and the answer was not enough of one to warrant a change in this plan), and there was a special report from Loarte on the cross-Task Particle Transport Working Group.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued with a successful review of the final design for the TF coil outer leg repairs. The

rebuild of the 2600 kW standby diesel generator is done, and run-up/power testing was completed this week.

ITER & TOKAMAKS (R. WILSON):

DIII-D (R. Nazikian):

A Physics Validation Review (PVR) for the high-speed (500KHz) data acquisition system for real-time ECE was held. The objective is to integrate the data into the PCS for NTM control. The PVR was successful in defining the needs of the acquisition system and a procurement is to follow soon which will enable the system to be installed and tested before the start of the 2013 run campaign.

B. Grierson has prepared a submission for the Journal Nuclear Fusion based on his recent IAEA, APS, and joint US-Japan Fusion Theory Workshop presentations. The article details the measurements of main-ion and impurity toroidal rotation, as well as inferred main-ion poloidal rotation in low torque deuterium DIII-D discharges. Measurements display an anomalous poloidal rotation at low ion collisionality that is more ion-diamagnetic than conventional neoclassical theory predicts. The effects of turbulence-driven mean-field poloidal rotation are the subject of further investigations.

Visitors from the KSTAR ECH and Control group came to DIII-D to learn about the NTM control hardware and software. E. Kolemen gave them a tour of the facilities and detailed information on how to implement a similar system at KSTAR. Tentative plans for a further visit to KSTAR by Kolemen to improve the collaboration were discussed.

Alcator C-Mod (R. Ellis):

D. Mikkelsen visited the C-Mod group to discuss simulations of electron-driven turbulence in Alcator C-Mod. These simulations include ETG turbulence (without including low-k turbulence, too) and dominantly TEM drive (without ETG-range turbulence).

International (J.R. Wilson):

J.R. Wilson travelled to Cadarache France where he participated in the ITPA-CC meeting and the IEA CTP executive committee meeting. Presentations on ITPA joint experiments in 2012, proposals for 2013 and member states program plans were given as well as a summary of personnel exchanges under the CTP agreement.

ADVANCED PROJECTS (H. NEILSON):

The Laboratory and Korea's National Institute for Fusion Science (NFRI) signed a research agreement this week for "cooperation in R&D for K-DEMO and strategic planning to expedite the realization of magnetic fusion energy." The envisioned K-DEMO facility is being planned in Korea as the next step on the roadmap to commercial fusion energy. It is intended to incorporate fusion power core and plant subsystems that are representative of those of a commercial plant.

Extrapolation of technologies from K-DEMO to a commercial reactor is to be straightforward, and extrapolation of performance parameters between K-DEMO and commercial reactors is to be minimized. In the first phase of work under the new agreement, PPPL will perform engineering analyses to support the selection of the design point for the K-DEMO device; tasks include system code analysis, machine configuration design, and structural analysis. The agreement provides an opportunity for U.S. fusion researchers to become involved in next steps on the path to DEMO beyond ITER, and allows Korea to benefit from U.S. capabilities in fusion reactor design and engineering.

The Large Helical Device (LHD) at Japan's National Institute for Fusion Science has completed its 2012 run, ending the first period of data collection using the upgraded U.S. x-ray imaging crystal spectrometer (XICS) diagnostic. This year N. Pablant, who is in charge of operating the diagnostic, was able to obtain excellent data both on the expanded Ar16+ (helium-like) and Ar17+ (hydrogen-like) systems. Measurements, including ion and electron temperatures, poloidal plasma flow velocity, and argon density, are available for every shot this year with full profile coverage. The ion-temperature profiles from the XICS system have recently been integrated with the TASK3D transport analysis suite at NIFS. This allows for the first time full transport analysis to be done in the absence of neutral beam injection, which was previously needed for Ti-profiles from charge exchange.

THEORY (A. BHATTACHARJEE):

The workshop of U.S.-Japan Joint Institute for Fusion Theory (JIFT) on "Neoclassical and Turbulent Flow Generation and Associated Transport" was held at Kyoto University, Japan on November 25-26 (http://www-fts.nifs.ac.jp/tomo/JIFT-WS2012/Welcome_to_JIFT_WS.html). This workshop followed the previous JIFT workshop on the same topic, which was held at Long Branch, New Jersey, in 2011. A total of about 30 scientists from the U.S., Japan and Korea participated. Twenty-two participants presented talks, covering theory, simulation and experiment, including four talks from PPPL participants B. Grierson, J.K. Park, Y. Ren and W. Wang. The PPPL theory department member W. Wang, jointly with Tomohiko Watanabe of NIFS, Japan, co-organized this two-day workshop.

A paper by N.N. Gorelenkov and R.B. White "Perturbative Study of Energetic Particle Redistribution by Alfvén Eigenmodes in ITER" is to appear in the Physics of Plasmas (PPPL preprint-4827). The paper elaborates on the modification of particle distributions by magnetohydrodynamic Alfvénic modes, which is an important topic for magnetically confined plasmas. Flattening of a distribution due to phase mixing in an island or due to portions of phase space becoming stochastic is a process extremely rapid on the time scale of equilibrium parameter changes in an experiment. In this paper the effect of toroidal Alfvén eigenmodes (TAE) and reversed shear Alfvén eigenmodes (RSAE) in ITER on alpha particle and injected beam distributions is studied using theoretically predicted mode amplitudes using the perturbative linear theory. It is found that for the equilibrium of a hybrid scenario even at ten times the predicted saturation level the modes have negligible effect on these distributions. A strongly reversed shear (or advanced) scenario, having a spectrum of modes that are much more global, is somewhat more susceptible to induced loss due to mode resonance, with alpha particle losses of over one percent with predicted amplitudes and somewhat larger with the assistance of toroidal field ripple. The elevated q profile contributes to stronger TAE (RSAE) drive and more

unstable modes. An analysis of the existing mode-particle resonances is carried out to determine which modes are responsible for the profile modification and induced loss. The losses are entirely due to resonance with the counter-moving and trapped particle populations, with co-moving passing particles participating in resonances only deep within the plasma core and not leading to loss.

The third meeting of the Theory Department Plasma Material Interaction (PMI) Working Group was held on December 13 at PPPL. C. Skinner began with an overview of PMI issues and PPPL materials experiments. This was followed by more detailed presentations on those experiments by A. Capece and J. Roszell. The meeting closed with a summary by M. Jaworski of scrape-off layer and divertor modeling discussions at the recent European Fusion Physics Workshop in Portugal.

On December 14, Dr. A. Hakim gave a theory seminar entitled "An overview of discontinuous Galerkin algorithms with applications to (gyro) kinetic simulations of plasmas." Basic concepts and philosophy of discontinuous Galerkin methods were discussed and specific examples of their usage were given. The second part described progress in development of a new gyrokinetic code for the tokamak edge physics, which will make use of hybrid discontinuous/continuous Galerkin finite-element methods with reconstruction techniques from finite-volume schemes. Results from passive advection, nonlinear vortex merger (incompressible 2D hydrodynamics), drift-wave turbulence in the Hasegawa-Wakatani equations, and from 1D Vlasov-Poisson problems were also presented.

Two recent papers on gyrokinetic studies of turbulence have grown out of the Ph.D. research of J. Baumgaertel, which she completed earlier this year with advisors G. Hammett and D. Mikkelsen. "Gyrokinetic Studies of the Effect of Beta on Drift-wave Stability in the National Compact Stellarator Experiment" has just been published by Physics of Plasmas (<http://link.aip.org/link/?PHP/19/122306>). "Comparing linear microinstability of the National Compact Stellarator Experiment and a shaped tokamak" (<http://arxiv.org/abs/1210.6570>) demonstrates that although one might worry that the narrow cross section of NCSX at some locations causes steep local gradients that might drive turbulence harder, this is offset by other stabilizing effects (like reversed magnetic shear and a short connection length to good curvature regions) so that the NCSX design looks very competitive. Additional results are in Baumgaertel's full dissertation (<http://dataspace.princeton.edu/jspui/handle/88435/dsp010r9673776>)

COMPUTATIONAL PLASMA PHYSICS GROUP (S. JARDIN):

J. Chen, J. Lang, E. Feibush, and S. Ethier attended a 2-day GPU programming course presented by a training expert from the NVidia company and hosted by the Princeton Institute for Computational Science and Engineering (PICSciE). The first day introduced the attendees to the history of NVidia's Graphical Processing Unit (GPU) hardware, directive-based GPU programming with OpenACC, as well as basic CUDA programming. The second day was dedicated to advanced CUDA programming and optimization, and the use of profiling tools. Many of the PPPL codes can benefit from being ported and optimized on GPUs as they could achieve much higher performance (some PPPL codes have already been partially ported). This is especially important for the codes planning to run on the new Titan computer at ORNL, which

contains over 18,600 of the latest NVidia GPUs (one per node). In-house expertise will help speed up the port of these codes to Titan or other GPU-accelerated computers.

The 3D nonlinear extended MHD code M3D-C1 represents all scalar variables using three-dimensional high-order finite elements. This is in contrast to some other codes, such as NIMROD, that use a Fourier expansion in the toroidal direction. However, to aid in interpretation and assess toroidal resolution requirements, it is useful to decompose the solution in M3D-C1 into toroidal harmonics. J. Chen has now implemented this Fourier decomposition diagnostic into M3D-C1 and its IDL postprocessor. Implementation required our SCOREC collaborators to install MPI communicators to allow one to sum over finite element nodes at the same (R,Z) position but different toroidal angles. The first six spatial derivatives of all three scalar variables going into the representation of the velocity field had to be Fourier analyzed in order to accurately form the kinetic energy associated with each Fourier harmonic of the solution.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

A successful Lehman review was conducted on the NSTX Upgrade project. Primary focus centered on the budget uncertainty its impact on project schedule and personnel. Project continues to be on schedule and cost.

The JK cap is ready to be trial fit on the vessel.

All but one of the umbrella legs has been replaced with the new legs. Installation of the weldments for the TF outer supports has been started. Modifications to the vessel leg mounts to accommodate the adjacent TF clevis pads continued and should be completed in the next week.

The final hardware for the new PF2/3 supports has been received and is being installed. Four (4) PF 4/5 supports completed brazing in the vacuum braze shop. Four more are in the furnace and will complete the braze cycle Friday afternoon.

Work continued on the category 3 racks and the rack to rack wiring for the vacuum/RGA/GDC racks.

Fabrication of a new lid for the quadrant mold continues in the shop.

A box of four conductors in the CAS building has been prepped for the CS winding area. A small crew will be working over the weekend in CAS building preparing soldered bars for bake, sandblast and priming.

In the winding area, a prototype cover was fit up to the quadrant mold. The cover hole locations were transfer punched to a template, which is being used to program the water jet-machining center for the cover fabrication. The quad mold flanges and ribs are being machined in the HAAS machining center.

Four more OTF weldments were received this week and eight (8) were shipped. The remaining weldments will be ready to ship next week, but will be held at the vendor until the lab is open in the New Year.

Facilities and Site Services Division (M. Viola):

Construction Management: A final walk-thru inspection of the Commons patio was performed which generated a short punch list of some minor items. HP Offices and Conference Room is proceeding well; we expect work to be completed next week with furniture move commencing on December 19 and punch list items upon return from the holiday break. Insulation work is commencing at D-Site next week starting with Mock-Up Building Stairwell piping repairs and replacements.

Telecommunications: The Telecommunications Office is meeting with Fran White and Site Protection personnel to discuss the installation of additional radio equipment. The proposed equipment is part of a project to improve radio communications with Princeton University's Department of Public Safety personnel and would be funded by PPPL's Site Protection.

BUSINESS OPERATIONS (E. WINKLER):

A Work for Others Agreement between PPPL and the National Fusion Research Institute (NFRI) in Korea was executed for the project titled "K-DEMO Engineering Analysis." The Principal Investigator is H. Neilson. The budget is \$100,000 for the eight-month period of performance.

The Procurement Division submitted the Laboratory's FY 2013 Small Business Subcontracting Plan for DOE approval.

N. Gnyp completed a course entitled "Leading with Emotional Intelligence" offered by the Princeton University Human resources Department as one of the electives in its Management Development Certificate program.

PPPL obtained DOE's approval to use the Open Skies agreement as an exception to the requirement to use US air carriers for DOE reimbursed air travel. The Open Skies agreement is a current federal policy that allows for travel on non-U.S. carriers between the U.S. and other countries with which the US has a bilateral/multilateral agreement as an exception to the Fly America Act. This policy applies to travel on airlines from the European Union, Australia, Switzerland, and Japan.

ENVIRONMENT, SAFETY, HEALTH & SECURITY (J. LEVINE):

ESU Engine 66 responded to Plainsboro for one mutual aid assignment, to C-Site Theory Wing for an odor of smoke, and to D-Site Sky Box for an activated smoke detector. Ambulance A166 responded to Plainsboro for two mutual aid assignments and to North Brunswick for one mutual aid assignment.

The Laboratory is closed during the holiday break.

SPD distributed an all-staff message on December 13 that provided information on the NFPA and U.S. Fire Administration collaboration to “Put a Freeze on Winter Fires”.

Members of Platoon C attended High-Static Magnetic Field safety training in reference to the PTOLEMY experiment. M. Schaefer of the Safety Division provided the training.

President Obama ordered all flags throughout the United States of America lowered to half-staff as a mark of respect for the victims of the senseless acts of violence perpetrated on December 14, in Newtown, Connecticut. Please visit <http://www.whitehouse.gov/the-press-office/2012/12/14/presidential-proclamation-honoring-victims-shooting-newtown-connecticut> to view the Presidential Proclamation.

A management safety walkthrough of the D Site TFTR test cell, test cell basement, upper and lower DARMs, tritium area and tunnel took place on December 12. Safety conditions in these areas were found to be very good.

INFORMATION TECHNOLOGY (S. BAUMGARTNER):

S. Deluca is wrapping up the engineering effort on the G.A. Integrator Board job. The prototype Type 1D Integrator board has been evaluated at G.A. - it passed electronic tests but had minor issues; PPPL recommending a 2nd prototype. Type 3B board fabrication-prep complete and ready for procurement, via G.A.

A remote PCI chassis being considered for real-time control applications has passed its initial evaluation. Preliminary results indicate a higher-than-expected 25-microsecond latency – further analysis and tests are being considered.

Preliminary software design for the NSTX-U Digital Coil Protection System is underway. K. Erickson and G. Tchilinguirian are the principals. A software PDR is scheduled for first quarter, CY13.

Members from IT met with representatives from Microsoft to receive an overview of Windows 8 on PC's, tablets and phones and strategies for deployment. Discussions also centered on the upcoming renewal of our Enterprise licensing agreement and options to reduce licensing costs going forward.

OFFICE OF COMMUNICATIONS: (K. MACPHERSON):

C. Cane posted numerous stories to the homepage, as well as the Lab's Facebook and Twitter accounts. He participated in a monthly call with the DOE Web Council.

J. Jackson DeVoe organized a tour of nine students from the Rutgers Material Science and Engineering Club along with a Princeton University student and her father, both from Australia, on December 7. J. DeLooper served as the tour guide.

DeVoe and J. Greenwald co-authored a Weekly article on Ed Synakowski's talk at the All-Hands meeting on December 12.

J. Greenwald used Drupal software to put seven news releases from other laboratories and universities on the new PPPL homepage under the section marked "News from Other U.S. Fusion Labs."

K. MacPherson attended the annual Fusion Power Associates meeting in Washington, D.C., on December 5-6, where she gave a presentation on a developing communications effort for the U.S. magnetic fusion program. She also prepared two items for the PPPL blog and tweeted about the event.

On December 12, MacPherson hosted a visit by Princeton University President Shirley M. Tilghman's staff, who met at the Lab. J. DeLooper led the group on a tour of the NSTX control room, NCSX and NSTX upgrade activities, and the Science Education Lab.

As the chair of a subcommittee of the National Labs' Chief Communications Officers Working Group, MacPherson hosted a teleconference on December 12 to discuss the possibility of a collaboration on a public exhibit. Other participants on the call included: David Keim of ORNL; Lisa Rosendorf of LANL; David Behrmann of PNNL; and Kerry Masson of NREL.

With the help of PPPL physicist S. Gerhardt, MacPherson was able to provide Robert Arnoux, the editor of ITER newswire, with a high-res image of a research photo.

E. Starkman took numerous photos, including: Ed Synakowski's All Hands lecture; a new headshot of H. Neilson; a group photo and other stills of Princeton University President Shirley M. Tilghman's staff who toured PPPL last week; and several other staff photos. She also photographed multiple images of the NSTX upgrade and produced 16 packets of photos for the participants in the DOE Lehman Review, as well as an electronic gallery members could access for uploading to their reports. Starkman also designed and produced the PPPL holiday card featuring elves wearing safety harnesses guiding a floating neutral beam.

DeVoe, Greenwald and MacPherson also attended a monthly meeting of the Princeton SPIN group that represents best practices of public information and communications officers throughout the university at the Frist Campus Center on December 7.

DIRECTOR'S OFFICE (B. SOBEL):

On December 12, Dr. Vic Reis presented a colloquium entitled "Small Modular Reactors, National Security and Clean Energy: A U.S. National Strategy".

On December 13, A. Cohen had various meetings in Washington DC.

On December 14, S. Prager, A. Cohen, M. Zarnstorff, and S. Smith attended the Laboratory Evaluation Meeting held at the Forrestal Building in Washington.

This report is also available on the following web site:
<http://www.pppl.gov/polWeeklyHightsExternal.cfm>