



The PPPL Highlights for the week ending September 7, 2012, are as follows:

NSTX (M. ONO):

NSTX-U is in the Upgrade Project outage in FY 2012

The paper "Study of Chirping Toroidicity-induced Alfvén Eigenmodes in NSTX" by M. Podestà (PPPL) et al. has been published in Nuclear Fusion 52, 094001, 2012 (<http://stacks.iop.org/0029-5515/52/094001>). The paper summarizes recent results on chirping TAE modes commonly observed in NSTX plasmas. The modes are characterized in terms of frequency and amplitude evolution under different plasma conditions. It is shown that the broad radial mode structure remains largely unaffected even during strong avalanches, in spite of the strongly non-linear mode dynamics. Mode-mode coupling between TAE modes and lower frequency, kink-like modes is also investigated.

A new NSTX paper "Local Effects of Biased Electrodes in the Divertor of NSTX" by S.J. Zweben (PPPL) et al., has been published in Plasma Phys. Control. Fusion 54 105012 (2012) and can be found at: <http://iopscience.iop.org/0741-3335/54/10/105012/>. The goal of this paper was to characterize the effects of small non-axisymmetric divertor plate electrodes on the local scrape-off layer plasma. When these electrodes were biased positively near the outer strike point they caused changes in the local plasma which were qualitatively consistent with the expected upward and downward vertical motion due to a convective cell generated by the electrodes.

Steve Sabbagh and Jack Berkery of Columbia University participated in a joint experiment MP2012-83-02 on DIII-D on August 29 to further validate kinetic RWM stabilization effects. As in past experiments, target plasmas were produced with a normalized beta of 2.4. The value was further increased to 3.5 to verify and expand results produced in July. The higher normalized beta values exceed the nominal $n = 1$ no-wall stability limit. Low frequency MHD spectroscopy demonstrated increased plasma response at increased normalized beta, and mode activity at reduced $B_t < 1.5T$. S. Sabbagh delivered a DIII-D Science Meeting presentation the week prior to illustrate and discuss RWM dynamics in NSTX, and make comparisons to an initial analysis of the first half day run of MP2012-83-02 from July.

A more detailed study of scrape-off layer heat transport, divertor radiation, and pedestal profiles in the snowflake divertor configuration was performed on August 24 in a half-day experiment at the DIII-D National Fusion Facility. The experiment session leaders were NSTX-U researchers Vlad Soukhanovskii (LLNL, participated off-site from PPPL) and Egemen Kolemen (PPPL, participated on-site at DIII-D), while LLNL and GA staff assisted with experimental and diagnostic arrangements at DIII-D. Divertor heat fluxes between and during Type I ELMs were

documented using fast infrared thermography in both the snowflake minus and plus configurations. As previously observed in the initial snowflake divertor experiment at DIII-D, a significant reduction of between-ELM peak divertor heat fluxes in the snowflake-minus configuration was measured at core density of ~50 % of the Greenwald density under attached divertor conditions. A density scan was performed to compare divertor radiation distribution and the outer strike point detachment threshold between the standard and snowflake-minus configurations. The snowflake-plus and an ideal snowflake configurations were also obtained for hundreds of milliseconds, enabling a more systematic assessment of divertor and pedestal properties. Finally, pedestal profiles were documented in both the snowflake-minus and snowflake-plus configurations. Preliminary analysis suggests there is a reduction of the ELM energy in the snowflake phases.

M. Ono visited Tokyo University's UTST and TST-2 groups on September 3-4. He discussed the recent UTST results with Prof. Y. Ono, Dr. Yamada, and four students who presented their respective research summaries. The USTS group has been successful in starting up the ST discharges with a technique called double null merging where two spherical torus plasmas are created. The TST-2 group has recently started a lower hybrid current drive experiment using a ceramic waveguide launcher system with the 200 kW system. The group has done a very nice job in building the ceramic waveguide system. He discussed various rf related topics with the TST-2 staff including Prof. Y. Takase, Dr. Ohwasa, and the TST-2 students. He then gave a seminar on NSTX-U summarizing the recent progress on the NSTX upgrade project and the NSTX-U research activities.

NSTX Upgrade construction activities continued this week and are highlighted in the Engineering section below.

Preparations of non-upgrade equipment for plasma operations in the NSTX-U configuration also continued. The IT group continued on the development of Plasma Control System Algorithms and Data Acquisition System protocols for the proposed power, gas, and magnetic diagnostic system configurations. Painting and general maintenance of outdoor equipment also continued.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.

ITER & TOKAMAKS (R. WILSON):

DIII-D (R. Nazikian):

Alex Nagy led the DIII-D Fast Wave team to complete three 1/2-day experiments in this experiment campaign. 1.6-1.9 MW combined coupled Fast Wave power was achieved into ITER Baseline Plasmas to determine core electron heating compared with ECH. In spite of several system troubles the run was successfully completed. An assessment is scheduled in two weeks.

Michio Okabayashi participated in an experiment to explore the interaction of off-axis fishbone modes with ELMs for comparison with results on JT-60U in wall-stabilized high beta plasmas. The triggering of ELMs by the off-axis fishbone occurred when the frequency of the fishbone bursts exceeds the natural ELM frequency. The appearance of the density snake following the

fishbone burst coincides with a large outward flux of beam ions. It is hypothesized that this enhancement of beam ion flux affects ELM stability.

Egemen Kolemen participated in an experiment to study "catch & subdue" control of the 2/1 NTM. Suppression of the 2/1 NTM was achieved. Turning on the gyrotrons at the onset of the 2/1 mode helped to avoid disruptive locked modes.

Brian Grierson participated in beam into gas experiments yielded injected neutral beam profile, beam divergence, and species mix for six of the eight neutral beams on DIII-D. The beam into-gas measurements will be used to characterize the ion source mix of full, half and third energy components to update modeling codes if necessary.

Alcator C-Mod (R. Ellis III)

The one-channel MSE real-time background polychrometer has been completely assembled and aligned. This system will provide a real-time measurement of the polarized background emission using exactly the same viewing sightlines as are used for the beam-induced MSE signal itself. It will also provide a simultaneous measurement of the sigma- and pi- MSE lines, thereby doubling the effective MSE intensity.

The system will be integrated into the full MSE diagnostic later this week and an initial evaluation of its effectiveness will be performed either late this week or early next week.

JET (H. Neilson):

The Laboratory has continued its R&D efforts working with industry to optimize the manufacturing process for ELM control coils that are under consideration by the JET program as a possible upgrade. The design makes use of a polyimide resin that can operate at high temperatures to avoid the need for water cooling and its attendant mechanical complications. The most recent test samples are cut from a fully representative coil bundle that is comprised of Kapton coated copper turns wrapped in glass and held together in a polyimide matrix. Follow-up mechanical testing of these samples has commenced, including shear loading of a short section to determine the turn-to-turn bond strength at both room temperature and 350C. In addition, a larger section of the coil bundle is subjected to a three point bend test to failure at room temperature in order to determine the beam (coil) strength. These results are compared to the in situ loading that these coils will experience during actual service so that operational safety factors can be calculated.

ADVANCED PROJECTS (H. NEILSON):

At the 20 ANS Technology of Fusion Energy (TOFE) Conference, held August 27-30 in Nashville, TN, Chuck Kessel presented the description of steady state, transient and off-normal heating loading prescription for an ARIES power plant. This work is part of the expansion of ARIES studies to include the edge plasma and PFCs, and their implications on the power plant regime. For an aggressive plasma physics and technology design, the steady state heat loads in the divertor, with narrow scrape-off power widths, reach 13.5 MW/m², with 90% radiated power in the divertor. These high radiated powers are supported by UEDGE/fluid neutral analysis

performed by LLNL. Transient loading from ELMs indicate that, with the recently observe footprint spreading, tungsten will not reach its melting temperature for large ELMs. The issue of greatest concern for ELMs is the cycling, with a power plant reaching $> 10^8$ cycles per year, and the associated crack formation. Worst case disruptions lead to melting in the tungsten divertor, possible melting of a tungsten FW and melting of ferritic steel or SiC FW. Thermal quench mitigation could remove the divertor damage, and avoid FW melting with tungsten, while ferritic steel and SiC FW's would reach melting. Of greatest concern for disruptions is the generation of runaway electrons, which can provide both a melting and penetration damage. These loading conditions are being examined in the power plant regime to better understand difference between a power plant and ITER, and help define the priorities in PFC research.

In the Wendelstein 7-X (W7-X) Trim Coil project, Mike Mardenfeld presented an overview of the recent cooling system flow tests performed at Everson Tesla, Inc. on the third Type "A" coil. The results confirm Mardenfeld's previous calculations which showed that the flow was well within acceptable levels for the coil. Those calculations were based on flow tests performed on prior coils at approximately half of the full design differential pressure across the coil. Everson Tesla has recently upgraded its flow test equipment to support this testing at full pressure. With the completion of acceptance testing, the third coil is now being crated for shipment to the W7-X project site in Greifswald, Germany. A peer review of the trim coil instrumentation interface with the W7X central control system has been scheduled for September 18. Additionally, a supplier's preliminary design review for the power supplies. has been scheduled for September 20. At that review, representatives of the supplier, Applied Power Systems of Hicksville, NY, will travel to PPPL to present their design solution to the technical requirements.

FUSION SIMULATION PROGRAM (W. TANG):

Bill Tang participated in the invitation-only Chinese-American-German Cyberinfrastructure and E-Science (CHANGES) Workshop (link below):

http://www.fz-juelich.de/conferences/changes2012/EN/Home/home_node.html

held at the Juelich Supercomputing Center in Juelich, Germany on September 3-5. He presented an invited talk on "Extreme Scale Computational Algorithms in Fusion Energy Sciences" and engaged in productive discussions with leading international scientists (with expertise in computer science, applied mathematics, and key domain applications areas) regarding possible future collaborations targeting the development of advanced simulations at the extreme scale.

This international conference was co-sponsored by the U.S. NSF's National Center for Supercomputing Applications (NCSA), the Chinese Academy of Sciences' Computer Network Information Center (CNIC), and Germany's national Juelich Supercomputing Center (JSC).

THEORY:

Version 4.5 of the DEGAS2 Monte Carlo neutral transport code (<http://w3.pppl.gov/degas2>) was released on August 24 by Daren Stotler. DEGAS2 can now be run in a time-dependent mode and arbitrary volumetric sources of neutral particles can be specified. Time dependence was also incorporated into the DEGAS2 interface to the XGC0 guiding center neoclassical particle transport code being developed within the Partnership for Edge Physics Simulation (EPSI; PI: C. S. Chang, PPPL). The corresponding modifications to XGC0 were released to EPSI team

members on August 15. The principal new capability is a fully time dependent coupling between XGC0 and DEGAS2, with the spatial distribution of the neutral atoms simulated by DEGAS2 being determined self-consistently between the two codes.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

TF Conductors: All of the TF conductors for the first quadrants have been completed including insulation. Three TF conductors have been post solder baked to 170 degrees C and two of the three (3) conductors baked have had their sharp edges removed. Three TF conductors have been soldered. Cleaning will occur next week. Setup is beginning for the Aquapour tests, including heating controls for bakeout. A delivery of five (5) TF conductors from Major Tool is expected by end of next week.

Centerstack Casing: Martinez-Turek has received the replacement Inconel for the centersection, and it has been rolled to shape.

Procurements: The purchase order for the TF Flex buss has been awarded to Zenox. The purchase order for the PF1A and PF1C copper has been awarded to Luvata. Major tool will supply PPPL with some spare helicoils to repair insert that had backed out after delivery to PPPL. Major tool will upgrade IDC and MIT plan to reflect additional inspection of conductors. After third quadrant is completed Major tool would like to delay any additional conductor delivery for two to three weeks because of conflict with other project machining operations. Recent restirs at the FSW supplier have had a high rejection rate (four out of four attempts). The PF 4/5 column supports were received from Carolina fabricators.

TF Quadrant Mold: Upgrades and rework to the TF bundle quadrant mold continued in RESA shop.

NBI Upgrade: NSTX machine platforms have been removed at bays J, K and L in preparation for moving the second neutral beam-line into the test cell. External decontamination of NB2 equipment continues to make good progress, and is on track to be ready to install NB2 in the test cell by late September.

Office of Project Management (T. Stevenson):

A Project Status Review Board (PSRB) is scheduled for September 11.

Facilities and Site Services (M. Viola):

Energy management: We are having a mandatory load shed test this coming September 12 from 12pm-1pm. Since our PSEG reward is based on the amount of reduction accomplished during the reduction period, anything we can do to reduce load without negatively impacting productivity is appreciated. Please turn off all lighting, personal computers and other electrical equipment that may be de-energized without serious impact to PPPL during that hour.

Janitorial Staff and Waste Management: Think Before You Throw. PPPL's Office July recycling rate went up by 16%, showing that we can reduce waste to the landfill and increase our recycling

efforts. The August office trash doubled the amount for July, bringing our recycling rate from 77% in July to 69% in August. With composting and single stream collection, PPPL has the potential to end this Fiscal Year FY12 with a 70% recycling rate. In FY11 our GHG (Green House Gas) reduction from recycling was equivalent to removing 1,094 vehicles off the road. Thanks to everyone and we encourage all to continue to support our recycling efforts here at the lab.

Roof Projects: Work on the MG Low Roof is progressing. The project is now scheduled to be completed by Sept 13 - due to rain delays. Work on completing the drainage problem at the Commons Deck resumed September 7 and is scheduled to be completed by September 27, weather permitting.

Material Services: Property Management completed 99% of the Wall-to-Wall Inventory and will be closing the inventory this month, after forwarding remaining asset information to upper management for review and assistance next week.

Telecommunications: The Telecommunications Office is continuing to expedite and escalate a resolution to the phone system problem associated with intermittent dead analog phone lines. Avaya has created a software revision to hopefully resolve this issue. The revision should be available the week of September 10. Altura will initially install the new firmware update to the phone system Gateway #1 to see if this software will resolve the problem. A conference call with PPPL's Procurement Office, Telecommunications Office and Altura was held September 6 to discuss the issues.

Boiler Room: The boilers have been filled and treated with chemical in preparation for the closing of the fire side and test firing mid September.

Maintenance: The stream trap replacement project continues. 20 remain.

BUSINESS OPERATIONS (E. WINKLER):

The Accounting Division completed Princeton University's sponsored research salary certification for the spring semester (February 1 – June 30) in academic year 2011-2012. This process was put in place to ensure labor costs are charged to the correct project grant accounts.

The Procurement Division issued guidance to all PPPL employees on the fiscal year end cutoff dates for procurement requisition submittal, purchase order posting, and the initiation of FY 2013 procurement activity in the Business Computing System. The final date for submittal of requisitions and posting of purchase orders is September 20. The Division expects to commence normal procurement posting for FY 2013 on October 2.

The PCard System Administrator issued end-of-year instructions for processing FY 2012 PCard transaction accruals to PCard holders and their Approving Officials. She also issued guidance to eWay system authorized users for FY 2012 costing of office supplies orders.

The Procurement Division placed three new blanket purchase agreements for preventative maintenance, remedial repairs and inspections of industrial and construction equipment. The new

BPA's incorporate enhanced requirements for maintenance personnel credentials and onsite escort procedures.

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

ESU Engine 66 responded to Plainsboro for one mutual aid assignments and two calls on site; the RF and C-Site for fluid spill assessment. ESU Ambulance A166 responded to Plainsboro for one mutual aid assignment.

Emergency Services Officer Ani Malool attended the EMT Continuing Credit and Refresher Course at Bergen County Medical Center.

On August 29, SPD staff met with GFDL managers to discuss lessons learned from the power outage the previous week. Additional meetings to improve the effectiveness of emergency response will be held in coming weeks.

On August 30, SPD and PSO participated in an after-action debriefing regarding the Y-12 incursion by the DOE investigative team.

Captain Darren Thompson and SPD Training Coordinator Jamie Alkhateeb completed another review of the bailout training

ESU personnel had a meeting with Plainsboro fire department to discuss providing fire extinguisher training to members of Plainsboro Township's CERT Unit.

INFORMATION TECHNOLOGY (S. BAUMGARTNER):

Paul Henderson attended a PICSciE meeting on main campus to discuss implementation of the ZFS filesystem for research data, as has been done at PPPL.

Craig Loomis of the Princeton University Astronomy Department met with Cassandra Pugh and Paul Henderson to study PPPL's data network design and implementation. Primary focus is to use our design to enhance their storage and network capabilities.

OFFICE OF COMMUNICATIONS: (K. MACPHERSON):

Chris Cane posted a web highlight on Dr. Bill Brinkman, featured in a story outlining efforts by the DOE's Office of Science to enhance the United States' energy security.

John Greenwald completed an article about PPPL's new nanolab and submitted it to Innovation magazine, which reports to a readership of some 60,000 investors about developments at DOE national laboratories. His article about PPPL's process for producing a radioactive element vital to medical exams appears in the current issue of Innovation magazine. Greenwald also wrote a blog for PPPL's website about Mike Zarnstorff's interview with a writer for a science site that questioned Zarnstorff about whether it could be possible to destroy the sun.

Elle Starkman edited a video taken by the Engineering staff of NSTX-U and shot various photos of Lab staff.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

The following PPPL Reports were posted to the web:

Particle Deconfinement in a Bent Magnetic Mirror PPPL-4805

Authors: Renaud Gueroult and Nathaniel J. Fisch

Submitted to: Physics of Plasmas (August 2012)

TF Inner Leg Space Allocation for Pilot Plant Design Studies+ PPPL-4806

Authors: Peter H. Titus and Ali Zolfaghari

Submitted to: Nuclear Technology Magazine (August 2012) TOFE 2012 Conference, Nashville, TN (August 27-31, 2012)

The Evaluation of the Heat Loading from Steady, Transient, and Off-Normal Conditions in ARIES Power Plants PPPL-4807

Authors: C.E. Kessel, M.S. Tillack and J. Blanchard

Submitted to: TOFE 2012 Conference, Nashville, TN (August 27-31, 2012)

Design and Analysis of the ITER Vertical Stability Coils PPPL-4809

Authors: Peter H. Titus, et. al.

Submitted to: Nuclear Technology Magazine (August 2012) TOFE 2012 Conference, Nashville, TN (August 27-31, 2012)

DIRECTOR'S OFFICE (B. SOBEL):

On September 5-7, Princeton University conducted a Safety Peer Review at the Laboratory. The review was headed by Dr. Karen Downer, former Director of ES&H at Oak Ridge and INL and member of the PPPL Advisory Committee. She was assisted by Jack Anderson, COO of Fermi National Laboratory, Gregory Player, Manager Corporate Health and Safety Public Service Electric and Gas, and Rodger Demareski, Assistant Vice President for Facilities, Princeton University. The preliminary results were reported to Stewart Smith, Dean of Research.

On September 7, Mike Zarnstorff, Hutch Neilson, and Randy Wilson attended a meeting of I&T and Advanced Projects at DOE in Washington,DC.

This report is also available on the following web site:

<http://www-local.pppl.gov/director/highlights/2012-highlights.htm>