The PPPL Highlights for the week ending March 1, 2013, are as follows:

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

Preparations continued for the Preliminary Design Review for the Residual Gas Analyzer, scheduled for April 9-10 in France. A Readiness Review will be held at the US ITER Project Office on March 11.

A PPPL Requisition was submitted, triggering procurement activity for "Physics And Engineering Design Support And Diagnostic Hall Instrumentation Development For ITER Low Field-Side Reflectometry (LFSR) Diagnostic System".

A Report entitled "Survey of Interspace Dose Rates for USITER Equatorial Port Diagnostics" was completed and is ready for independent checking. The results indicate that target dose rates specified in the Procurement Arrangements for US diagnostics located in equatorial port plugs can be met.

A revised layout of the Low-Field-Side Reflectometer ex-vessel waveguides was completed. The revision was needed to make room for the H-alpha and Visible Spectroscopy detection systems located in the Port Cell region of E11.

Members of the SPEB are evaluating 11 bids for the ITER High Voltage Subsystem Transformers.

NSTX (M. ONO):

The paper by R. Kaita (PPPL) et al., "Characterization of Fuelling NSTX H-Mode Plasmas Diverted to a Liquid Lithium Divertor," Journal of Nuclear Materials (2013), 10.1016/j.jnucmat.2013.01.100, describes deuterium fueling experiments with the NSTX Liquid Lithium Divertor (LLD). With the diverted outer strike point on the LLD, the difference between the applied D gas input and the plasma D content reached very high values without disrupting the plasma, as would normally occur in the absence of Li pumping. When constant fueling was applied as the LLD temperature was varied to change the surface from solid to liquid, the D retention was relatively constant and about twice that achieved without Li PFC coatings.

The paper by M. Jaworski (PPPL) et al., "Observation of non-Maxwellian electron distributions in the NSTX divertor," Journal of Nuclear Materials (2013), 10.1016/j.jnucmat.2013.01.076, describes a kinetic interpretation for Langmuir probe data in NSTX that has yielded non-

Maxwellian electron distributions in the divertor. They are characterized by cool bulk populations and energetic tail populations with temperatures of 2– 4 times the bulk. Spectroscopic analysis and modeling confirms the bulk plasma temperature and density that can only be obtained with the kinetic interpretation.

The paper by T. Abrams (Princeton University) et al., "Response of NSTX liquid lithium divertor to high heat loads," Journal of Nuclear Materials (2013), 10.1016/j.jnucmat.2013.01.057, describes the results of samples of the NSTX Liquid Lithium Divertor (LLD) with and without an evaporative Li coating were directly exposed to a neutral beam ex-situ at power densities of 1.5 MW per square meter for up to 3 seconds. The lithium-coated sample had a lithium hydroxide coating, which did not change even when the front face temperature exceeded the pure lithium melting point. These results imply that heating alone may not expose pure liquid lithium if the melting point of surface impurities is not exceeded, and suggest that flow and heat are needed for future PFCs requiring a liquid Li surface.

R. Maingi and S. Kaye of PPPL participated in the first conference call February 26 of a USBPO-sponsored committee (chaired by R. Maingi) on US participation in ITER. The mandate of the group is to set out guidelines for the ways in which the U.S. community can provide input on ITER design and technical issues, and on developing guidelines for how U.S. fusion physicists can lead and/or participate experiments once ITER starts operating.

S. Kaye (PPPL) and D. Smith (University of Wisconsin) were asked to participate in an AAS/AIP committee on "Public Access to Research Results: Data Accessibility in Physics and Astronomy". The purpose of the committee is to provide guidelines and recommendations to Plasma Physics and Astronomy communities on the general topic of making published data publicly available through, as one example, on-line links between publications figures and the data that went into creating that figure. The committee will hold three workshops, and a report with these recommendations is expected by the end of 2013. The first conference call of this committee was held on February 26.

Preparations for plasma operations in the NSTX-U configuration also continued with the planning for the calibration of the NSTX neutron detectors, and the ongoing assembly and testing of the new firing generators for the field coil power conversion system rectifiers.

ITER & TOKAMAKS (R. WILSON):

Alcator C-Mod (R. Ellis):

P. Heitzenroeder is assembling a review committee for the final design review of the Advanced Outer Divertor, tentatively scheduled for the beginning of April.

S. Scott presented a talk at the February 25 science meeting, “A Little Problem with the DTACQ-216”. It was discovered that, if our data acquisition hardware is configured to record both pre- and post-trigger samples, then it misses one and only one sample near the time of the trigger (within about 3 samples of the trigger). This explains some anomalous behavior that was observed during in-vessel MSE calibrations in December. The manufacturer recommends that going forward, we use only post-trigger samples.

Bob Mumgaard (PSFC) held a preliminary design review of a thermal stabilization system for the C-Mod Motional Stark Effect vacuum window. This window experiences significant temperature drift over the course of a C-Mod experimental run day which leads to thermal stress birefringence and to a drift in the MSE calibration. Liquid will be circulated through copper tubes that are held in good thermal contact with the port flange and vacuum window housing. We intend to fabricate the components in-house at the PSFC and install before April.

International (S. Sabbagh):

Five PPPL scientists collaborating with the Korean National Fusion Research Institute (NFRI) attended and made presentations at the annual KSTAR Conference, held in Buyeo, South Korea last week. Each also visited NFRI to advance continuing joint research. A sixth PPPL scientist made a poster submission to the meeting.

S. Sabbagh presented a talk summarizing the achievement of KSTAR surpassing the n = 1 ideal no-wall stability limit in a specific 2012 experiment, a milestone that signifies KSTAR producing advanced tokamak plasmas for the first time. Open-loop control of the CES measured rotation profile by applied n = 2 fields inducing non-resonant neoclassical toroidal viscosity (NTV) was also demonstrated, along with ELM mitigation by n = 2 fields generated by a midplane coil configuration. Specifications of a high bandwidth power supply to support KSTAR long-pulse advanced tokamak research based on 3D mode stability and control calculations were discussed with NFRI management, physicists, and engineers. Interfaces supporting KSTAR TRANSP runs with new data from 2012 were discussed with L. Terzolo. Initial implementation plans for a model-based RWM state-space controller were discussed with S.H. Hahn and M. Woo.

D. Mueller presented a talk on vertical control performance and improvements, and discussed these improvements with S.H. Hahn, formulating a plan to request additional flux loops to be installed closer to the plasma for use in vertical control. Moving away from reliance on feed-forward terms in the control system, and ways to preserve the plasma shape in spite of imperfect power supply response to the ohmic flux request were discussed. J.K. Park submitted a presentation on NTV physics and related experimental work on KSTAR.

C.S. Chang made a plenary presentation on edge physics understanding, and discussed theory and computational support for KSTAR with NFRI President M. Kwon, KSTAR Program Director J. G. Kwak, and the Theory Division Leader J.Y. Kim. C.S. and Robert Hager had multiple hands-on meetings with KSTAR theory members on collaboration using the XGC codes applied to KSTAR. Some advanced algorithms developed in the KSTAR theory department in support of the XGC0 and XGCa codes are being ported to the main PPPL version of these codes for more efficient simulations of 3D RMP penetration.

B. Ellis presented a talk on DIII-D ECH launcher upgrades and NTM stabilization, emphasizing the potential applications of this work to the KSTAR ECH program. Ellis, working with the plasma heating group and J. Hosea, installed an upgraded steerable mirror on the KSTAR ECH launcher. Hosea, along with Ellis, continued a dialogue with Y.S. Bae regarding future collaboration on steady state ECH launchers. The steady state launcher is important for supporting plans on KSTAR for heating and NTM stabilization in steady state advanced tokamak regimes.

ADVANCED PROJECTS (H. NEILSON):

J. Breslau reported progress in developing tools to design simpler stellarator coils that provide improved access for maintenance of in-vessel components. The COILOPT code has been upgraded to provide greater flexibility in choosing how the coils are represented. Instead of being restricted to Fourier representations, the new code allows an arbitrary mixing of Fourier and spline representation. The improvement allows the imposition of straight sections on the outboard leg of modular coils, a basic feasibility criterion for large-sector maintenance of in-vessel equipment. The code also allows the addition of local saddle coils to restore plasma shaping capability on the outboard side without impeding vessel access, since the saddle coils can be removed as part of a sector. These developments are an important step toward stellarator designs with improved engineering properties. J. Zheng, a visitor from the Institute of Plasma Physics of the Chinese Academy of Sciences (ASIPP), is a collaborator in this work.

A paper by S. Lazerson, et al. has been accepted for publication in Plasma Physics and Controlled Fusion and has been selected by the editors to be highlighted in the journal's "LabTalk" section. The paper, "A Magnetic Diagnostic Code for 3D Fusion Equilibria," documents work performed in collaboration with the LHD team at Japan's National Institute for Fusion Science that takes an important step in the development of 3D equilibrium reconstruction tools for stellarators and tokamaks.

FUSION SIMULATION PROGRAM (W. TANG):

B. Tang participated in the invitation-only meeting, "Summit on Extreme-scale Applications Software Productivity/Engineering" organized by the office of Advanced Scientific Computing Research (ASCR) on February 28 at the DOE facility in Germantown, Maryland. The meeting objective was to explore potential research challenges and opportunities in applications software productivity/software engineering at extreme-scale, in light of extraordinary advances in multi-core computing hardware, software tools, and programming paradigms. Possible strategies were also explored for enabling computer scientists and domain scientists to co-develop high-productivity applications software for complex multi-scale and multi-physics problems that take full advantage of recent advances in multi-core computing technologies and on-going best practices in HPC applications software development.

THEORY (A. BHATTACHARJEE):

A paper by L. Peterson and G. Hammett has just been accepted for publication in the SIAM Journal of Scientific Computing, on "Positivity Preservation and Advection Algorithms With Applications To Edge Plasma Turbulence" http://w3.pppl.gov/~hammett/gyrofluid/papers/2013/peterson_positivity.pdf . Peterson is a former PPPL graduate student and now a research physicist in ICF at LLNL.

E.H. Kim gave a seminar entitled “Role of Linear Mode Conversion Role of Linear Mode Conversion on Generation and Propagation of Space Plasma Waves” at Dartmouth College.

A series of innovative research on geometric theory and algorithms for kinetic system has been carried out recently by J. Squire, a third year Ph.D. student at Princeton University's Graduate Program in Plasma Physics and PPPL's Theory Department. A geometric integration algorithm of the Vlasov-Maxwell system with a variational particle-in-cell scheme has been developed and successfully tested [Phys. Plasmas 19, 084501 (2012)]. Using the formalism of discrete exterior calculus, the field solver, interpolation scheme, and particle advance algorithm are derived through minimization of a single discrete field theory action. As a consequence of ensuring that the action is invariant under discrete electromagnetic gauge transformations, the integrator exactly conserves Gauss's law. This intimate link between the gauge properties of a discrete system with its numerical properties has also been discovered for the variational symplectic algorithm of gyrocenter dynamics [Phys. Plasmas 19, 052501 (2012)]. For explicit algorithms, an instability arises because the discrete symplectic structure does not reproduce the continuous structure in the limit of zero step-size. This numerical instability can be avoided by introducing a generalized gauge transformation that places Lagrangian in an "antisymmetric discretization gauge", in which the discrete symplectic structure has the correct form. By designing a model discrete Lagrangian, the algorithms can be made approximately gauge invariant as long as scalar and vector potentials are relatively smooth. A gauge invariant discrete Lagrangian is indispensable for particle-in-cell algorithms because it ensures current continuity and preservation of Gauss's law. On the theoretical side, a new variational principle for the gyrokinetic system has been developed in the Eulerian frame and based on constrained variations of the phase space fluid velocity and particle distribution function [Phys. Plasmas 20, 022501 (2013)]. To explicitly derive the field theoretic Hamiltonian structure of the system, a Legendre transform with a modified Dirac theory of constraints is used to construct meaningful brackets from those obtained directly from Euler-Poincaré theory. Possible applications of these formulations include continuum geometric integration techniques, large-eddy simulation models, and Casimir type stability methods.

COMPUTATIONAL PLASMA PHYSICS GROUP (S. JARDIN):

S. Ethier gave a mini-course entitled "Introduction to Parallel Debugging" as part of the series of mini-courses hosted by the Princeton Institute for Computational Science and Engineering (PICSciE). The lecture introduced the Princeton University participants to different approaches in tackling the task of debugging parallel applications, including the use of open source tools and advanced parallel debuggers, such as Totalview and DDT. The students and researchers attending the lecture were from a wide span of science departments, including chemistry, political sciences, geosciences, physics, and electrical engineering. This shows the major role that advanced parallel computing plays in scientific research across all the departments at the university.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: The new bay L nozzle installation has been completed. The upper umbrella stiffeners have been bolted in place and are now being weld prepped while the lower ones are being reworked and bolted in place. Installation of cable trays and racks in the NSTX test cell

continues. Machining to repair two outer TF legs continues in the south high bay area.

Center Stack Upgrade: On February 25, the first NSTXU quadrant was placed inside the oven for epoxy Vacuum Pressure Impregnation (VPI). By March 1 the epoxy injection was successfully completed and the quadrant has completed the epoxy gell cycle. The oven temperature is now ramping up and will complete the cure cycle over the weekend. Once the coil is cooled to room temperature next week it will be removed from the oven. Everson Tesla has completed the rolling of the outer TF conductors. The remaining quadrant five conductors, seven pieces, were delivered from MTM. All of the bids are in for the inner PF coils contract and we expect to award that contract next week. The OH mold bids will be in next week for evaluation. The Centerstack Casing Assembly Stand, received last week, was inspected successfully and was delivered to the CS Winding area for installation. The bus bars upgrade work continues. We have a new designer and he is catching up very quickly. We are currently working on the design of the TF Bus Bars. When the TF model is ready, we will send it for final analysis.

NBI Upgrade: Calorimeter Vee leak check and hydrostat tests were performed successfully on A and C side vees. Repairs and tests on the central B vee are in progress. The Decon and removal of BL component stands, equipment, and floor areas is in progress in the TTC paving the way for HVE relocations and Power cable installations later this year. Preparation of parts for lifting HVE segments continues. The water system piping procurement requisition was released and approved. The Power system requisition package is in preparation. Fabrication and leak checking of LHe cryo line continues in the NB shop. LHe cryogenics line installation and welding on the TFTR Test Cell South wall continues. Fabrication continues on the central spool section for the NBI duct and other flanges in the Tech Shop. The Tech Shop braze oven has been returned to service so work has resumed on the Armor backing plates. BL2 Cryogenics platform preparation and installation in the NTC is underway. Duct fabrication continues. Work necessary to analyze and reinforce the SFLIP port area on midplane between Bay I and J was approved.

Office of Project Management (T. Stevenson):

The next Work Planning Review Board meeting has been scheduled for mid-March. System engineer training with the online package continued this week with several more completions. Followup with system engineers to review preventive maintenance lists is planned. Testing for work planning system email notifications and other features was performed this week. More tests are planned. Several fixes and changes were implemented. Planning for the upgrade to the online WP system has started with the gathering of requirements. Development of the COG/RLM online package continues. Several more topics will be addressed based on recent input.

Facilities and Site Services (M. Viola):

Material Services: PPPL's new contractor for ordering office supplies began on March 1. Our new online user accounts have been set up and are now ready to be used.

Facilities Services: The maintenance manager attended the OSHA 510 course which was significantly more intensive and informative than previous versions. HVAC responded to a problem with the TFTR test cell supply fan. It was discovered that the fan motor was single phasing. A coordinated effort with AC Power and Facilities ensued to correct the problem. Engineering Services: A very productive meeting was held to review conceptual drawings for the

CMG repurposing and Lab Wing Renovation, there was a review of the General Requirements Document Draft and a discussion of Deliverables for the DOE. The Dry Run CDR was set for June 5 and an internal CDR for June 12. The Statement of Work for the ESU repairs was approved. Active Radon monitoring has been installed by the Health Physics Group in the OMO.

Energy Management: The PPPL FIMS records for C64 (Warehouse/Receiving 1), C65 (Warehouse/Receiving 3) and C73 (Material Control Support Facility) have been consolidated into record C64 (renamed to Material Services Building) in support of our pursuit of High Performance Sustainable Building - Guiding Principles (HPSB-GP) compliance by FY15.

Telecommunications: The telecommunications office, computer services and facilities met with Verizon Engineer, Bill Foley, to survey the existing underground Verizon cable and conduits. The survey is required information for the SLI Project. The group agreed on an option to re-route the underground copper cable and fiber. Telecommunications has requested cost estimates from the various vendors to complete the project and is awaiting the results.

BUSINESS OPERATIONS (E. WINKLER):

Members of the Accounting Division met with representatives from the Baker Tilly, LLC accounting firm, to discuss the DOE Statement of Costs Incurred and Claimed (SCIC) reconciliations and then, in a separate meeting, to discuss the payroll process and any changes in internal controls since the last audit was conducted.

T. Gillars participated in a conference call conducted by the DOE Office of Financial Risk, Policy and Controls. The purpose of the call was to provide a general overview of the Entity Assessment Tool and its intended purpose as part of the DOE Internal Controls Program.

U. Patel has joined the Procurement Division as a Subcontract Administrator. Prior to her employment at PPPL, Ms. Patel worked in contract administration for Lockheed Martin Corporation. Ms. Patel's office is EWA 145, and her phone extension is 2011.

R. Templon participated in a Director's review at the Thomas Jefferson National Accelerator Facility. The purpose of the review was to examine the communication interfaces between the J-Lab Procurement Department and its project customers, and recommend areas for improvement. J. Peterson traveled to the Whitsons' facility in New York to perform on-site audit work, specifically obtaining and reviewing documentation that had not been provided to the BakerTilly auditors during the initial fieldwork and performing alternative test steps where the documentation was no longer available.

An amendment to the Work for Others Agreement with UCLA titled "Micro-Engineered Material Surfaced for Electric Propulsion and Pulsed Power" was executed. This amendment provides Year 2 funding in the amount of $135,000. The PPPL Principal Investigator for this project is Y. Raitses.

DOE approved an amendment to the Work for Others Agreement with Tri Alpha Energy, titled "Plasma Physics Topic of Importance to Advancing the C-2 Program." This amendment increases the total budget from $627,000 to $657,000. The Principal Investigator is L.

Roquemore.

The United States Department of Agriculture (USDA) provided $5,477 for continued work on "RF Applications for the Sterilization of Foods." N. Greenough is the Principal Investigator and the period of performance is through September 30.

A Work for Others Agreement was executed with SRI International (Sarnoff). S. Cohen, the PPPL Principal Investigator, will support SRI by performing research using the PFRC and MNX devices. The total budget for the three-year period of performance is $649,700.PPPL responded to a DOE-CH call regarding options for the recasting of work for others uncosted balances to new DOE program values in FY2014.

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

B. Slavin chaired a meeting of newly constituted Safety Review Committee.

Emergency Services Engine 66 responded to PPPL C-Site for an anticipated smoke condition. Ambulance 166 responded to Plainsboro for three mutual aid assignments and to PPPL C-Site for two assignments.

During the Middle School and High School Science Bowls, Site Protection provided logistic and security support throughout the site.

SPD issued all staff e-mail messages regarding the aggressive wildlife on the PPPL campus (Eastern Wild Turkeys) and an electrical odor.

J. Jackson-DeVoe interviewed F. White for an article on the recent extension of Wi-Fi service on the PPPL campus.

All SPD staff received fuel dispensing recertification, provided by M. Lawson of Materiel Services.

Platoons A and B have completed advanced NightOwl operations training.

OFFICE OF COMMUNICATIONS: (K. MACPHERSON):

K. MacPherson represented PPPL and C. Cane, and J. Greenwald attended a DOE teleconference on March 1, hosted by DOE Public Affairs at Headquarters in Washington, DC. The conference, involving Communications Offices from all the DOE National Laboratories, was set up to give guidance on messaging to the press.

G. Czechowicz designed a poster for the Program in Plasma Science and Technology's 2013 Internship Program for Princeton undergraduates.

J. Jackson DeVoe helped host Chaoying (Alex) Lai from United Daily News, a Taiwanese news service, who is based in Washington, D.C. Lai is interested in writing an article on the difference

between fusion and fission and the need for fusion in Taiwan. He was the guest of W. W. Lee and was given a tour that included NSTX by M. Ono.

J. Greenwald hosted Research-SPIN, a group of Princeton University science communicators, at PPPL, on February 28, assisted by C. Cane. Representatives from Princeton University's Office of the Dean for Research, the School of Engineering, the Department of Chemistry, the Department of Public Affairs, and the Writing Program attended. Members of the PPPL Communications team attended, as well. The discussion centered around the uses of social media for communicating science. J. DeVoe, K. MacPherson, and E. Starkman also attended.

K. MacPherson hosted a teleconference of the Magnetic Fusion Communications Working Group on February 28, which was attended by communications leaders from General Atomics, MIT, and U.S. ITER, to further develop a draft plan.

E. Starkman provided photos of the Science Bowl to several news agencies and worked with the author Dan Clery to provide historical photos of PPPL for his book project.

J. Jackson DeVoe organized the following tour:

Al Von Halle gave an extensive tour to seven Princeton University Arts students and their two instructors on February 26. The students will be sketching and painting at PPPL for a few weeks. They sketched the old C Site - MG room and will be returning on March 5.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

More than 360 individuals attended the Science on Saturday program on March 2. Professor C. Gmachi of Princeton University presented, "Light and Nanotechnology – Engineering and So Much More."

A. Zwicker gave a tour for about a dozen high school students from the Princeton Learning Community School.

A. Zwicker met with a team of undergraduates that are producing a video on fusion as part of the Science Action competition. http://www.princeton.edu/scienceaction/

A. Zwicker began a collaboration with a jewelry designer from New York City, Sam Abbay, on how precious metals behave when used as electrodes in a plasma speaker. Metals used included 24K gold, a variety of gold alloys, platinum, and palladium. Initial measurements focused on plasma stability and found good results with 24K gold and palladium. Upcoming experiments will focus on sound production as a function of electrode material.

DIRECTOR'S OFFICE (B. SOBEL):

February 26-28, A. Cohen attended a US ITER Meeting and a meeting with the Deputy Director for Field Operations, Joe McBrearty. The meetings were held at Oak Ridge National Laoratory in Tennessee.

On February 28, Professor Nicholas K. Coch, Queens College - C.U.N.Y. presented a colloquium entitled "The Unique Vulnerability of the NY-NJ Metro Region to Hurricane Destruction.

On March 1, S. Prager and M. Zarnstorff attended an Open House for the MITRE Corporation in Princeton.

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