The PPPL Highlights for the week ending July 10, 2015, are as follows:

NSTX (M. ONO):

NSTX-U researchers attended the European Physical Society Conference on Plasma Physics, Lisbon, Portugal, on June 22-26. R. Perkins (PPPL) presented a poster titled "Searching for Enhanced RF Field Amplitudes in the SOL Using a Simplified Cold-Plasma Model." The high harmonic fast wave (HHFW) heating system on NSTX has been known to suffer from parasitic absorption of fast-wave power in the SOL, and both experimental data and full-wave simulations from the AORSA code suggest that this fast-wave propagation phenomenon. A cold-plasma model in cylindrical geometry has been developed to see whether similar effects can be found in this simplified geometry. Particular modes are found which propagate a significant fraction of wave power (> 50%) in the edge of the plasma. While these results are promising, more work is needed to relate these modes to experimental and full-wave simulation results. A. Diallo (PPPL) presented a poster entitled “Inter-ELM Pedestal Evolution and the Role of Edge Fluctuations in the C-Mod and DIII-D Tokamaks.” The paper highlighted similarities between the inter-ELM quasi-coherent fluctuations (QCF). Measurements on C-Mod showed correlations between the edge temperature and the onset of the QCFs. Furthermore, the QCFs are found to be field-aligned. Similarly, on DIII-D, the amplitude of the QCFs were shown track well the pedestal temperature gradient. QCFs are edge localized and electromagnetic of nature on both DIII-D and C-Mod tokamaks.

A. Diallo travelled to Culham Laboratory in the United Kingdom on June 18-19 to continue collaboration with MAST on the characterization of the pedestal. During his visit, Diallo met with Rory Scannell to discuss the characterization of edge polychrometer developed for MAST divertor. In addition, Diallo met with Pamela to discuss ongoing NSTX ELM simulations using JOREK. NSTX-U is currently discussing the development of an edge polychrometer capable to resolve electron temperature between 5 eV and 100 eV.

Yong-Su Na (Professor, Seoul National University, Korea) arrived last week to spend his sabbatical year at PPPL. He plans to work on advanced scenario development with the NSTX-U research team.

The NSTX-U Divertor Upgrade (Phase) 1 (DU1) project held a Conceptual Design Review and review of the System Requirements Document. Presentations were given by M.A. Jaworski and K. Tresemer and the review was chaired by B. Blanchard. The NSTX-U DU1 project encompasses the upgrade of a continuous row of plasma-facing component tiles in the outboard divertor of NSTX-U. The review was deemed a success pending the resolution of outstanding chits.

The control programs (LabVIEW Virtual Instruments or VI's) for the diagnostics on the Materials Analysis and Particle Probe (MAPP) have been successfully installed on a computer with a new operating system (Windows 7). The next task is to locate the computer in the NSTX-U data acquisition room (DARM), and establish remote communication (F. Bedoya, University of Illinois at Urbana-Champaign).

Alignment of the Multi-Pulse Thompson Scattering (MPTS) Nd:YAG laser paths continued. Progress was made on the adjustment of the secondary focal spot.

J.-M. Park of ORNL (on site at General Atomics) visited PPPL on June 25-26 and gave a presentation on FASTRAN, a fast transport solver. FASTEN uses numerical techniques that allow rapid convergence of stiff transport models such as TGLF, and has been shown to be a quite useful tool for time-slice temperature predictions of DIII-D steady-state plasmas, and subsequent comparisons to experimental data. There were discussions about how FASTRAN takes into account time-dependent terms for a non-stationary portion of the discharge, and how the required computational time for a converged time-slice FASTRAN calculation compares to the same for PT_SOLVER. A benchmarking of both "steady-state" and time-dependent time slices from DIII-D and NSTX will be performed to make this comparison between FASTRAN and PT_SOLVER. A consideration is to make FASTRAN a component of TRANSP that can be used in place of PT-SOLVER.

OH system rework and machine reassembly activities continued this past week. Installation of TF flex bus is in progress, and in-situ joint resistance measurements are being recorded. Daily inner and outer vacuum vessel electrical insulation checks (Hi-Pots) are being performed, and the OH, PF1A, PF1B, PF1C and PF2 coils were successfully Hi-Potted this week. Both neutral beam's cryo-pumps have been cooled to liquid helium temperatures to support ion source conditioning, and the cryo-operators are successfully balancing the Liquid He refrigerator to support two beam-line operations.

Access to the NSTX-U Test Cell is expected to be available this coming week. Access must be arranged through Work Permits approved by the D-Site Shift Supervisors.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

L. Cui is working with W. Solomon to develop a database for high beta EAST demonstration discharges on DIII-D. The aim is to develop a better understanding of how transport and confinement vary with changes in the applied torque and plasma rotation. In particular the formation condition for internal transport barriers will be assessed and compared to TRANSP+TGLF modeling in a range of plasma conditions.

Madeline Vorenkamp continued to work with A. Nagy and W. Brown on the photoelectric detection of the granules for the LGI device. Her analysis showed that the size of the granule can be determined with high accuracy based on the depth and duration of the shadow cast by the dropped granule. This information will be used to generate an automated detection algorithm for

the granule timing and size.

Madeline Vorenkamp also successfully designed, fabricated, and tested to 5kV DC break shield that will prevent refracted ECH power from affecting the LGI DC break. The shield is the same diameter as the moveable Torus Interface Valve shield.

International (R. Hawryluk):

C. Kessel and F. Poli attended a face-to-face meeting for the ITER Task Agreement on "Heating and Current Drive applications", which was held in Barcelona, Spain at the F4E headquarters on July 2-3. Kessel gave an overview of the characterization of the scenarios to be developed. These include the commissioning phase, as well as operations in L-mode. Kessel presented development of new scenarios at 12.2 MA and 4.3 T in He, D and DT and discussed access to H-mode and Neutral Beam accessibility. Poli presented TRANSP simulations of the baseline scenario and the Deuterium plasma at half field and discussed real-time control of NTMs and power requirements for pre-emptive and for active control.

F. Poli visited the ITER Organization on July 6-10. She has worked with S. H. Kim on the implementation in IMAS of a translator between the ITER Data Structure (IDS) and TRANSP. The translator, which has been developed by Jin Chen (CPPG) has been adapted to be an 'actor' in the IMAS Kepler workflow. This workflow reads data from IDS and write UFILES to initialize the TRANSP simulation using Kepler. The translator is the first step in the implementation of TRANSP as a component of IMAS.

R. Hawryluk attended and ITER External Management Advisory Board meeting at the IO, July 8-10.

ADVANCED PROJECTS (H. NEILSON):

Under a Strategic Partnership Project (SPP) agreement with the Chinese Academy of Sciences' Institute for Plasma Physics (ASIPP), PPPL collaborates in the evaluation of design options for China’s Fusion Engineering Test Reactor (CFETR). At a joint project team meeting on July 7, PPPL provided comments, requested by ASIPP, of the CFETR Blanket Design Description Document. PPPL team members commented on the thermal-hydraulic, neutronics, and structural mechanics aspects of the design. The primary purpose of the document review, namely to identify priorities for further analysis, was accomplished. A list of future blanket analysis tasks was developed. Plans for system code analyses of Phase I and Phase II CFETR mission goals were also agreed upon. It is a planned that an ASIPP team will visit PPPL in late September for a working visit and face-to-face project meeting, continuing the collaboration on CFETR.

THEORY (A. BHATTACHARJEE):

On July 8, Michael Mascagni (Florida State University) presented a theory seminar on Monte Carlo methods and partial differential equations: algorithms and implications for high-performance computing. We give a brief overview of the history of the Monte Carlo method for the numerical solution of partial differential equations (PDEs) focusing on the Feynman-Kac

formula for the probabilistic representation of the solution of the PDEs. We then take the example of solving the linearized Poisson-Boltzmann equation to compare and contrast standard deterministic numerical approaches with the Monte Carlo method. Monte Carlo methods have always been popular due to the ease of finding computational work that can be done in parallel. We look at how to extract parallelism from Monte Carlo methods, and some newer ideas based on Monte Carlo domain decomposition that extract even more parallelism. In light of this, we look at the implications of using Monte Carlo to on high-performance architectures and algorithmic resilience.

On June 30, Loïc Hausammann, a visiting student from the École polytechnique fédérale de Lausanne (EPFL), defended his Master's thesis entitled "Development of a Synthetic Diagnostic for Beam Emission Spectroscopy", which was work done with the EPSi group, advised by M. Churchill and C.S. Chang. The abstract is as follows: This thesis will cover the main aspects (and approximations used) of the development of a synthetic diagnostic for beam emission spectroscopy (BES), for comparing outputs from gyrokinetic turbulence codes such as XGC1 to experimental BES measurements. The BES diagnostic consists of an optical setup collecting the Balmer-alpha light from a neutral beam that is excited by collisions with plasma electrons and ions, allowing measurement of the plasma density fluctuations (line-integrated, resulting in a 2D image). The code is a modular, Python code, part of the Fusion Plasma Synthetic Diagnostics Platform (FPSDP) [L. Shi, APS 2014]. The synthetic diagnostic uses an interpolation along the magnetic field line, a full 3D computation for the optics, and simulates the neutral beams as a gaussian beam with multiple energy components. Beam stopping coefficients and photon emission rates are computed with the help of the ADAS database. This thesis shows the accuracy required for the BES diagnostic, and the importance of the full sampling volume around the pedestal, the method of computation of the beam density (from the equilibrium profile or with the fluctuations too) and the effect of the excited neutral finite lifetime on the spatial and temporal correlation functions.

W. Fox, Y.-M. Huang, and A. Bhattacharjee (PI) were awarded a DOE ASCR Leadership Computing Challenge grant for 45 M hours for 2015-2016 on the Titan supercomputer facility at Oak Ridge National Laboratory. This project, "Dynamics of Magnetic Fields in High-Energy-Density Plasmas from Fusion to Astrophysics" will enable detailed 2-D and 3-D simulations of two important problems bridging fusion and astrophysics, including magnetic reconnection and the ion-Weibel instability, through a full suite of simulations including MHD, extended MHD, and Particle-in- cell techniques. These simulations will also be compared directly against on-going experiments in laser-produced plasmas, in a close collaboration of theory and experiment at national facilities led by the group.

BUSINESS OPERATIONS (K. FISCHER):

PPPL is a collaborator on a proposal submitted by Lawrence Berkeley National Laboratory (LBNL) to the DOE Office of Advanced Scientific Computing in response to program announcement number LAB 15-1344, Dynamic Distributed Resource Management, titled "Agile Resource Management with Object Streaming in Large Distributed Analyses". The Principal Investigator for the PPPL work scope is C.S. Chang. The requested budget for the three-year period of performance is $125,000 per year.

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

B. Slavin and J. Levine visited Brookhaven National Laboratory (BNL) to meet with their ES&H professionals on several topics, including recent BNL safety program initiatives and construction safety and contractor assurance experiences. In addition, the PPPL representatives experienced BNL's slip simulator, which trains people to walk properly on slippery or hazardous surfaces to avoid accidents and injuries.

BEST PRACTICES, EXTERNAL AFFAIRS, & SITE PROTECTION (J. DELOOPER):

A. Zwicker, A. Dominguez, and Professor Jeremiah Williams (Wittenberg University) led a workshop on plasma physics for faculty interested in creating laboratories and demos using plasmas. Sponsored by the Advance Laboratory Physics Association, the workshop used a DC glow discharge developed at PPPL and focused on electrical breakdown, plasma spectroscopy, and a Langmuir probe diagnostic. Participating universities included Cecil College, Howard University, Valparaiso University, Massachusetts College of Liberal Arts, Clemson University, Hope College, Harvard University, and Johns Hopkins University.

OFFICE OF ACADEMIC AFFAIRS (N. FISCH):

On June 22, N. Fisch gave the Alfven Lecture at the EPS in Lisbon, Portugal. The title of the talk was: "Controlling Plasma with Waves – and Vice Versa." An abstract follows: Waves can produce enormous effects in plasma, thereby controlling it. For example, waves injected into magnetically confined plasma can heat the plasma to thermonuclear temperature and can drive mega-amps of current. Waves might also divert mega-watts of power. These effects might expedite the achievement of economical fusion power. Conversely, the plasma might produce enormous and unusual effects on waves. For example, plasma, irradiated and thereby energized by a long moderately intense laser beam, might greatly amplify a short counter-propagating beam, forcing it to contract further as it propagates. This effect may lead to the next generation of laser intensities. In a second example, plasma undergoing compression might amplify embedded waves, but these waves might suddenly lose energy to the plasma. In a third example, irradiated plasma might even asymmetrically reflect waves, much like a one-way wall. Thus, the wave-plasma interaction is a game played in either direction, featuring huge effects, fascinating phenomena, and very diverse practical applications.

On June 29, N. Fisch gave a colloquium at the Instituto Superior Técnico, in Lisbon, Portugal, on "Compressing light in plasma."

On July 7-10, N. Fisch served as a panelist for the DOE Basic Research Needs for Environmental Management Workshop.

DIRECTOR'S OFFICE (C. AUSTIN):

On July 10, S. Prager attended a National Laboratory Directors Council (NLDC) retreat in Dulles, Virginia.

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