The PPPL Highlights for the week ending September 19, 2014, are as follows:

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

A draft Deviation Request was circulated for comment to the US design team for the ITER Low Field Side Reflectometer. The DR covers the change in the design direction from bistatic to monostatic launch/receive configuration. The monostatic approach permits the same measurement capability with fewer components. This change alleviates overcrowding in the port plug, interspace, and port cell region for equatorial port plug 11.

Bill DeVan, acting US ITER I&C Head, visited PPPL to discuss the strategy for most efficiently satisfying I&C design deliverables for US diagnostics.

NSTX (M. ONO):

Preparations for plasma operations in the NSTX-U configuration also continued. The fabrication of ex-vessel MPTS diagnostic equipment such as the Collection Optics Box and the Flight Tube Assembly is in progress in several PPPL shops. In the NSTX-U Test Cell, the in-vessel calibration of the bay B CHERS window was completed. Good progress is being made on the Power Supply Real Time Control (PSRTC) software specification. Real time control open issues are being addressed and retired.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

W. Solomon was assistant session leader and beam programmer for an experiment aimed at extending the previously demonstrated access to Super H-mode to higher betaN, energy confinement and normalized fusion performance. By ramping betaN up with increasing line density in a QH-mode plasma, discharges were maintained with a quiescent edge, high pedestal pressure, with betaN~3, betaT~3.6 and H98~1.4.

The Lithium Granule Injector (LGI) support stand fabrication is in progress following a successful FDR for installation on DIII-D. Final details of the control signals are being addressed, the HWA is being finalized, and 90 percent of the needed parts have been received. The LGI will be assembled and tested at General Atomics in September prior to installation on DIII-D.

A sample pole shield plate made of aluminum has been machined to test both the accuracy of the program to be used to cut the copper plates and act as a template to check the accuracy of the cooling tube bending process. Sample aluminum tubes have been bent as a check prior to bending the actual stainless steel tubing.

C-Mod (D. Mikkelsen):

D. Mikkelsen visited the C-Mod group to finalize the data preparation for TRANSP analysis of C-Mod plasmas that include a transition from L-mode to I-mode. The experimental conditions will be used in turbulence simulations, which will provide the input for synthetic diagnostic calculations that will be compared with the measured electron temperature fluctuations.

ADVANCED PROJECTS (D. GATES):

C. Kessel visited Oak Ridge National Laboratory in Oak Ridge, Tennessee to have discussions about the FNSF with the Fusion Materials group. Kessel gave a presentation on the features of the FNSF and the many materials related questions needed in the design. Lance Snead, Steve Zinkle, Arthur Rowcliffe, and Yutai Katoh gave presentations on the various materials program elements and specific progress on RAFM, SiC-composites, and other areas. The meeting is intended to continue strengthening the collaboration between design and fusion materials development.

On September 17, N. Pablant gave a Wendelstein-seminar remotely to an audience that included audiences at IPP-Greifswald, CIEMAT in Madrid, Spain, as well as people at PPPL. The talk was entitled "Evolution of the radial electric field in ECH heated plasmas on LHD based on XICS measurements" and covered work done on poloidal rotation and ion temperature data taken using the US XICS diagnostic on LHD. The talk concluded with a description of the US XICS currently under construction for W7-X. The talk generated many questions.

THEORY (A. BHATTACHARJEE):

W. Fox and A. Bhattacharjee were co-authors on an article recently appeared in PRL, "Magnetic reconnection between colliding magnetized, laser-produced plasma plumes", written in collaboration with colleagues at the University of Rochester Laboratory for Laser Energetics, and the University of New Hampshire. The paper reports the results of experiments conducted on the OMEGA EP laser facility through a project "Dynamics and Instabilities of Magnetic Reconnection Current Sheets in High-Energy-Density Plasmas" funded through the National Laser User Facility program. The paper describes how plumes of magnetized plasma are created by laser ablation of targets in concert with externally applied magnetic field, and a pair of oppositely magnetized ribbons are collided, forming a current sheet, and driving magnetic reconnection. The propagation and reconnection of the magnetized structures are observed with proton radiography, and in good agreement with particle-in-cell simulations.

PLASMA SCIENCE AND TECHNOLOGY (P. EFTHIMION):

Energy conversion processes during collisionless reconnection have been investigated in the MRX reconnection layer through careful 2-D measurements of all required physical quantities. Moreover, the first detailed energy inventory during collisionless reconnection has been made in a well-defined laboratory reconnection layer. This work has been published in Nature Communications .

They measured in-plane electric field which is three times larger magnitude than the reconnection electric field and is localized only in the exhaust region of the reconnection layer. The unmagnetized ions are accelerated by the in-plane electric field near the sepratrices and heated further downstream. Electrons are non-classically heated in the electron diffusion region. Furthermore, they have made the first quantitative energy inventory of the converted magnetic energy in the MRX collisionless reconnection layer by analyzing the Poynting vectors, energy flows, and heat flux in the ion diffusion region. More than 50% of the incoming magnetic energy is found to be converted to particle energy. Ions gain twice as much energy as electrons due to the large in-plane electric field. Thermal energy increase dominates the flow energy increase for both ions and electrons. The MRX results are compared with simulations and space measurements, for a key step toward resolving one of the most important problems in plasma physics. Recently, in a reconnection region of effectively similar size in the Earth's magnetotail, the energy partition was measured during multiple passages of the Cluster satellites. The observed energy partition is notably consistent with the present MRX data, more elaborate comparative study is underway.

In the end of August, a new paper on magnetic reconnection was published in Phys. Rev. Lett. entitled, Laboratory Study of Magnetic Reconnection with a Density Asymmetry across the Current Sheet by MRX group, J. Yoo, M. Yamada, H. Ji, J. Jara-Almonte, C. E. Myers, and L-J. Chen Phys. Rev. Lett. 113, 095002 (2014).

Magnetic reconnection at the dayside magnetopause occurs mostly with a significant density asymmetry across the current sheet. This so-called asymmetric reconnection is generally different from reconnection with the same physical quantities on the both sides of the current sheet. In MRX, the density asymmetry across the current sheet was systematically varied (the ratio can be changed up to a factor of 10) to study its effects on magnetic reconnection and the key features of asymmetric reconnection were systematically measured. Despite a significant upstream density asymmetry, the reconnecting magnetic field profile is not significantly altered. On the other hand, the out-of-plane magnetic profile is considerably modified; it is almost bipolar in structure with the density asymmetry. The in-plane ion flow pattern and the electrostatic potential profile are also affected by the density asymmetry. An asymmetric ion flow profile shows that the ion stagnation point is shifted to the low-density side. This work has been achieved with a significant collaboration with space physicists and our collaborative work with space physics will continue. Systematic studies of asymmetric reconnection in MRX provide insights, which will enable a clearer understanding of both Cluster and MMS (Magnetospheric Multi-Scale mission) spacecraft data. By analyzing waveforms from four sample measurement points in a tetrahedral configuration and comparing them with the measured global structure, they can even help design an optimized algorithm for analysis of magnetic data from MMS.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: The installation of tiles and diagnostics on the centerstack casing is nearly complete. The lower PF1C coil has passed leak checking and it is being assembled to the lower ceramic break so they can be trial fit to the vessel. The welding of the upper PF1C can is in progress in the Tech Shop. The installation of cooling water hoses for the PF coils continues. The 109' platform at bays A and L is being removed for the installation of the centerstack pedestal and the in-vessel floor is being removed in preparation for the installation of the centerstack. Electricians are installing the new category three-quarter ground bus and the RGA rack. Bus fit-ups continue under the vessel. However, the CHI bus has been removed to facilitate the centerstack installation.

NBI Upgrade: Services work included SF6 solenoid installation which was completed, platform and SF6 piping drawings, BL2 backing system drawings and parts, and removal of the turbopump isolation valve flange for modification and use with the new turbomolecular pump. This flange was decontaminated in the Source Shop Decontamination Room. Health Physics supported the NSTX Test Cell line break to remove the flange and the decontamination work. Power system work focused primarily on fiber optic termination testing, remedial polishing and re-termination if needed, and channel assignment and testing; this work tests the hundreds of fibers that extend from NBPC 138 feet level to the NBPC 100 feet level and to the NTC BL2 HVEs. Control work continues with installation of cabling, installation of brackets and studs on BL2 for cable tray supports, installation of junction boxes, purchase of instrumentation cabling, terminations, and gallery rack wiring. LCC work includes installation of new oscilloscopes needed for testing and operations. Progress continues on developing specifications for the north door shield wall and Statement of Work. Cryogenics maintenance and repairs in preparation for operations continues. The Preoperational Test Procedure development continues.

Digital Coil Protection System: Work continues on some known bugs such as the watchdog timer glitches. Additional Concurrent Inc. software support is warranted and a requisition is in the system for this Information Technology support. Hardware testing made rapid progress in general but required DTACQ workarounds to continue. Those workarounds were made. Hardware errors were found, required changes assessed, and solutions started to fix one individual PCB. Autotester support for testing continues. Hardware and software testing needs and tools were identified, promulgated, and discussed. Meetings associated with RTC have also touched on DCPS issues, which are being evaluated also. Another feature for algorithms has been discussed pertaining to needs driven by centerstack concerns. A start-up script was proposed and requested which will eventually become part of the operating procedures for DCPS. More iterations on the Data Dictionary took place.

DIRECTOR'S OFFICE (C. AUSTIN):

September 16, S. Prager, M. Zarnstorff, J. DeLooper, and A. Dominguez participated in National Laboratory Day on the Senate side of Capitol Hill in Washington, DC. The event was sponsored by the U.S. Department of Energy. It included a panel discussion with Secretary Ernest Moniz,

meetings with members and staff of the House of Representatives and Senate, and tours of National Laboratory Day exhibits.

PUBLICATIONS:

G. Fiksel, W. Fox, A. Bhattacharjee, D. H. Barnak, P.-Y. Chang, K. Germaschewski, S. X. Hu, and P. M. Nilson, "Magnetic Reconnection between Colliding Magnetized Laser-Produced Plasma Plumes," Phys. Rev. Lett. 113, 105003 (2014).

M. Yamada, J. Yoo, J. Jara-Almonte, H. Ji, R. Kulsrud, and C. E. Myers; "Conversion of magnetic energy during magnetic reconnection in a laboratory plasma", Nature Commun. 5:4774, doi:10.1038/ncomms5774 (2014)

Laboratory Study of Magnetic Reconnection with a Density Asymmetry across the Current Sheet by MRX group, J. Yoo, M. Yamada, H. Ji, J. Jara-Almonte, C. E. Myers, and L-J. Chen Phys. Rev. Lett. 113, 095002 (2014).

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