



The PPPL Highlights for the week ending July 4, 2014, are as follows:

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

PPPL signed a contract with the University of Texas for "Physics and Engineering Design Support for ITER Electron Cyclotron Emission (ECE) Diagnostic Front-End and X-Mode Radiometer." UT plans to subcontract with ECE experts at MIT and the University of Maryland for support in this work.

An award proposal package for "Design and Fabrication of the ITER Upper Port Visible/Infrared Wide Angle Viewing System" has been sent for approval to the Princeton DOE Site Office.

Updates to the US ITER Diagnostic Risk Management System were submitted.

Negotiations were completed for the remaining two U.S. ITER Diagnostics Procurement Packages. These will govern the provision of the equatorial port plug E3, the Motional Stark Effect System and the Core Imaging X-ray Diagnostic. Final documents will be distributed for review the week of July 7. Signoff is targeted for early August.

NSTX (M. ONO):

The paper 'Design and operation of a fast electromagnetic inductive massive gas injection valve for NSTX-U' by R. Raman et al. (Univ. of Washington) was published on-line <http://scitation.aip.org/content/aip/journal/rsi/85/11/10.1063/1.4885545>, in the Review of Scientific Instruments 85, 11E801 (2014). It describes the development and testing of the valve to be used on NSTX-U for Massive Gas Injection Experiments, and is similar in concept to the valve that is planned to be used on ITER. The NSTX-U valve uses a novel U-Cup Lip Seal, instead of conventional O-ring seals, for the sliding piston mechanism.

N. Bertelli (PPPL) visited IPP-Garching during the week of June 30, working in collaboration with Drs. R. Bilato and M. Brambilla. A benchmark of different ICRH codes (AORSA, TORIC v.5, TORIC v.6, and GENRAY) were performed in the mid and high harmonic regimes in view of NSTX-U operation.

J. Menard (PPPL) visited IPP-Greifswald following the EPS meeting in Berlin, Germany and toured the W7-X stellarator facility. J. Menard also gave a plenary presentation entitled "Rotation and kinetic effects on kink-tearing instabilities in NSTX plasmas" at the meeting of the

Max-Planck-Princeton Center held June 28 – July 1 at the Technical University of Berlin.

Weld repairs of the D-MG#1 rotor continues to make good progress with approximately 50% of the planned weld areas now addressed.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

L. Roquemore presented a successful DIII-D Lithium Granular Injector (LGI) FDR to both PPPL and DIII-D staff this week. Topics covered include the schedule and details for LGI assembly, assessment of the ambient magnetic fields and shielding requirements. Training for PPPL staff to operate and calibrate the LGI is scheduled for late August. A. Nagy presented the LGI installation CDR including vessel mechanical interface, planned platform improvements, and control signal interfaces.

The ECH Gyrotron 8 Vacuum System milestone has been met on time. All the vacuum system hardware, manifolds, gauges and supports are in-house. A test fit up has been completed for the main manifold including the roughing pump and system controller. The system completion and final installation is awaiting the gyrotron delivery expected in the Spring of 2015.

C-Mod (S. Scott and L. F. Delgado-Aparicio):

The C-Mod/PPPL MSE team successfully completed a two-shot microproposal (mP647) that studied the origin of one component of the MSE background light, the component that is highly correlated in time with the intensity of the plasma's H_α emission. The plasma configuration was swept from lower-single-null to upper-single-null and back again over a time period of ~400 ms in identical Ohmic shots in helium and deuterium. The DNB was not fired into these discharges, so the polarized signal observed by MSE is entirely due to background light. The behavior of the polarized background was radically different in helium versus deuterium, consistent with the conjecture that molecular deuterium emission (which has a forest of lines in the vicinity of the spectrum observed by MSE) is the source of the MSE background light that correlates with the H_α intensity.

L.F. Delgado-Aparicio presented a paper titled "Locked-Mode avoidance and recovery with ICRH in Alcator C-Mod", at the EPS meeting in Berlin, Germany. Additional experiments will also be conducted this summer at Alcator C-Mod. The conclusions of this work will contribute to the DOE FY14 JRT on the "Effects of 3D fields in tokamak plasmas" and to the overall understanding of the effects of kinetic profiles on the formation and active control of locked-modes. He was also invited to give a seminar at the EPFL-CRPP in Lausanne, Switzerland, where he presented his last results on the research of destabilization of internal kink by suprathreshold electron pressure. These two new results will be summarized in papers that he and his collaborators from Alcator C-Mod will submit to Physics of Plasmas and Physical Review Letters.

N. Pablant and L.F. Delgado-Aparicio visited the DECTRIS installation in Baden, Switzerland. L. F. Delgado-Aparicio gave a seminar entitled "Present and future uses of Pilatus and Eiger Si

and CdTe detectors”. New silicon (Si) and Cadmium telluride detectors have recently become available and will be calibrated and tested at PPPL and Alcator C-Mod before the end of the fiscal year. Novimir worked on a new Python scripts to perform the multi-energy calibrations of the CdTe detectors. The latter can be used to detect non-Maxwellian tails generated by RF heating techniques such as ECRH, ECCD and LHCD, as well as to study production of anisotropic hard x-ray distributions during electron runaway generation and its mitigation.

International (D. Mansfield):

Though the East Lithium Granule Injector (LGI) has been refurbished to the point where it is ready for installation, EAST is not in ready to use the LGI. Therefore, laboratory dropping-rate calibrations and injection tests will be carried out in the coming week or two. These tests should inform the operations of the EAST, DIII-D and NSTC injectors.

Li granules in sufficient numbers for both the EAST and DIII-D run campaigns have now been generated, sorted by size and shape, tested for vacuum cleanliness and stored in hermetically sealed bottles.

ADVANCED PROJECTS (H. NEILSON):

A paper entitled "Quasilinear Carbon Transport in an Impurity Hole Plasma in LHD", written by D. Mikkelsen, N. Pablant and co-authors from NIFS, has been accepted by the journal Physics of Plasmas. Quasilinear estimates of carbon transport were made from gyrokinetic linear stability calculations based on measurements in LHD. The measured carbon density profile is 'hollow' and the carbon flux is outward, but in these conditions the predicted carbon flux is inward so the microturbulence studied in this work does not generate the impurity hole.

N. Pablant visit to Griefswald, Germany after the EPS meeting to collaborate on the XICS design process in support of the final design review scheduled for later this month. Novimir held several meetings with physics and engineering collaborators at IPP regarding progress of the XICS design and installation. The supporting plates for the XICS installation have now been welded in place onto the W7-X cryostat, which completed the W7-X machine modifications required for the XICS installation. The design, manufacturing and installation schedule are still on track for an installation of the XICS system before first plasma in Spring 2015. During his stay in Berlin and Griefswald Novimir was also able to hold several discussions with colleagues from NIFS, regarding ongoing research into heat transport and radial electric fields at LHD. Finally N. Pablant and L. Delgado-Apraicio traveled to Dectris in Baden, Switzerland, to discuss detector development needs for fusion science and to prepare a new detector technology for use in experiments on Alcator C-Mod. During the visit the new CdTe detector that is being developed at Dectris was characterized and calibrated for use in a novel multi-energy configuration that will allow 2D spectroscopy of high energy x-rays (10-100 keV). It is expected that this detector will allow some of the first detailed measurements of the non-thermal electron temperature distribution created by LHCD. As part of the visit, Novimir was invited to give a general physics seminar at Dectris entitled "Fusion Science and Plasma Spectroscopy".

C. Kessel gave a webinar to the USBPO about the Fusion Nuclear Science Facility, its characteristics and challenges for physics. The context for the FNSF in the fusion development

path, the features of FNSF that separate it from ITER, and a number of physics topics were discussed. The significant change in the device layout and materials used was stressed, as well as the high demands on plasma pulse length and duty cycle. Ultimately the FNSF configurations will be made available for physics analysis by the plasma science community, and input from the community will be sought on many physics issues.

THEORY (A. BHATTACHARJEE):

A paper titled "Two-stream instability with time-dependent drift velocity" by H. Qin and R. C. Davidson was published in *Physics of Plasmas* <http://dx.doi.org/10.1063/1.4885076>. In this paper, the classical two-stream instability driven by a constant relative drift velocity between two plasma components is extended to the case with time-dependent drift velocity. A solution method is developed to rigorously define and calculate the instability growth rate for linear perturbations relative to the time-dependent unperturbed two-stream motions. Stability diagrams for the oscillating two-stream instability are presented over a large region of parameter space. It is shown that the growth rate for the classical two-stream instability can be significantly reduced by adding an oscillatory component to the relative drift velocity.

A. Reiman presented a poster at the European Physical Society (EPS) meeting, held June 23-27 in Berlin, Germany, on "A Cross-Benchmarking and Validation Initiative for Tokamak 3D Equilibrium Calculations". The initiative involves eleven codes: two tokamak perturbative equilibrium codes, three time-dependent extended MHD codes, a gyrokinetic code, and five stellarator codes. Disagreements between some of the codes appear to arise from differences in their handling of localized currents at low order rational surfaces. Comparison of synthetic diagnostic data generated by the codes with experimental data may provide indirect evidence of the existence or nonexistence of such localized currents in contemporary experiments. Dedicated experiments for the purpose of generating data for code validation were performed on the DIII-D tokamak in May. As a first step towards analysis of the data, kinetic EFIT reconstructions are currently being generated for a selected set of shots and time slices within those shots.

N. Fisch attended the International Workshop on Runaways at Chalmers University in Gothenburg, Sweden, where on June 19 he gave an invited talk on "Backwards Runaways". Together with H. Qin, W. Wu, and J. Liu, Dr. Fisch then gave a poster at the EPS meeting in Berlin, Germany on "Velocity Space Signature of Backwards Runaways."

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: CHERS and tFIDA calibrations have been completed. RF antenna installations have been completed. RF Langmuir probe, sFLIP and SSNPA installations continue. Re-machining of the PF pockets on the centerstack casing continues. Fabrication of new bushings and o-rings for the centerstack ceramic breaks continues. Cable verifications and terminations for the vacuum and gas injection systems continue. The IR camera AC power installation has been completed. The installation of supports for the cooling hoses in the NTC has been started.

CS Upgrade: The OH Coil was removed from the mold early this week, and inspections indicate that the epoxy VPI is of high quality. A successful preliminary megger test was performed and all of the cooling passages were checked and found to be free of epoxy. The resin rich areas of the coil are being sanded down to reduce the epoxy buildup. The flux loops were installed on the PF1A Upper coil. Kapton and Wet Wrap insulation of the CHI Bus bars continued this week with Powers Electric taking over the work and will continue the week of July 7. The OTF finger supports were received from Hollis this week along with the associated fasteners from Ocean Technologies. A peer review was held to discuss the changes required to the OH Coil Bussbar terminations to fit the as built condition of the coil. New termination blocks are being fabricated in the Tech Shop. Daily meetings are being held to work through the PF1C cover closure weld issues. A test of the weld cross section was fabricated and welded. The weld created some charring that was not acceptable. A second weld test is planned for next week to try to reduce the heat transfer to the insulation. Major Tool completed the weld on the first Passive Plate and it has passed inspection. The second passive plate jumper has been machined and inspected. The first passive plate is on track to ship July 7 and the second on July 20.

NBI Upgrade: TVPS Fore line installation has started. The pre-job brief for the TVPS installation was held. Source SF6 piping installation has started. An MPC for the Armor manifold IP and installation is complete. The NB Controls fabrication and installation cabling work on rack connections, cable runs, and BL wiring continued in NTC and gallery. Telemetry fiber optics end to end testing continues in NTC. Additional NB installation procedures are in development and review. The NBI Ion Source Operator training course was held this week.

Digital Coil Protection System: Study and comparisons of the NSTX-U Design Point Spread Sheet, calculations data, and DCPS parameter tree content continue to clarify data, calculations, algorithms, and consistency.

BUSINESS OPERATIONS (K. FISCHER):

DOE approved a Work for Others agreement titled "Self Powered Kr-85 Wireless Sensor/Detector" with Ayers Group, LLC. Ayers Group has been awarded an STTR grant from DOE. The Principal Investigator is C. Gentile and the PPPL budget is \$32,000.

DOE approved a Work for Others agreement titled "Rayleigh Relaxation Centrifuge for Aluminum Purification" with Nova Photonics, Inc. Nova Photonics has been awarded a STTR grant from NSF. The Principal Investigator is H. Ji and the PPPL budget is \$90,000.

PPPL submitted its FY15 execution Field Work Proposals (FWPs) to the DOE. The purpose of these FWPs is to describe the work to be performed in FY15 at the project funding levels included for PPPL in the President's budget for FY15.

RFP 14-051U (for the Business System Upgrade) has been posted on the external PPPL Procurement Website. The Federal Business Opportunities website has also been updated to include the release of this solicitation. To date, 19 vendors have shown interest in this solicitation.

PUBLICATIONS:

Raman, R. (Univ. of Washington); et al., 'Design and operation of a fast electromagnetic inductive massive gas injection valve for NSTX-U,' Review of Scientific Instruments 85, 11E801 (2014) <http://scitation.aip.org/content/aip/journal/rsi/85/11/10.1063/1.4885545>

Qin, H. and Davidson, R.C., "Two-stream instability with time-dependent drift velocity," Physics of Plasmas <http://dx.doi.org/10.1063/1.4885076>

This report is also available on the following web site:

<http://www.pppl.gov/publication-type/weekly-highlights>