

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY highlights



The PPPL Highlights for the week ending February 7, 2014, are as follows:

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

PPPL engineers participated in a ITER working group on the design of diagnostic shield modules (DSMs). Various concepts for DSM construction have been proposed by different domestic agencies. The need to evaluate the structural stiffness of these designs, to assure that they can effectively transfer the disruption loads from the diagnostic first wall to the port plug structure was acknowledged.

Concepts for the final steering mirrors of the toroidal interferometer/polarimeter were reviewed. These mirrors need to be actively cooled to avoid distortion under surface and volumetric heat loads. Capability to initially align these mirrors must also be included in the designs.

NSTX (M. ONO):

Preparations for plasma operations in the NSTX-U configuration also continued with the ongoing preparations for the contract weld repairs of the spider arms on MG Set #1. The Statement of Work and required weld/inspection procedures have been reviewed and approved.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

The ECE Imaging system must be removed and reinstalled on DIII-D each vent period in order to provide access for vessel entry. An issue for the system is the accurate reinstallation of the optical components and the realignment required after each vent. In order to facilitate reinstallation and realignment, A. Nagy is working with Ben Tobias to install an indexing plate on the platform. The plate would accurately locate the lens boxes to the floor. In addition the floor stiffness is being increased by installation of five stainless steel joists to keep vertical displacements to less than 1mm while personnel operate the system and make adjustments. The indexing system and joists will be installed in early March.

C-Mod:

R. Ellis visited Alcator C-Mod to discuss areas in which PPPL could provide collaborative support to their program. There was interest in engineering support for RF and diagnostic

operations, and mechanical design and analysis for several other systems at the laboratory.

The MSE diagnostic was brought on line this week. The detectors and filter ovens were tested and the software was updated to reflect recent calibrations. The diagnostic is near ready for plasma operation requiring only minor control software updating. An operation to observe the beam is planned for the week of February 10.

The recently upgraded MSE vacuum window thermal stabilization system and the in-vessel-calibration system were tested. The diagnostic was triggered while observing the in-vessel system approximately every minute across two 24-hr periods, one with the VW stabilization system operational and one with it disabled. This data will allow the effectiveness of the stabilization system to be quantified. Results will be analyzed over the weekend to inform further refinements to the system in the coming week.

J. C. Wright and N. Bertelli published an article entitled "The effects of finite electron temperature and diffraction on lower hybrid wave propagation" in Plasma Phys. Control. Fusion. The abstract states: "In this paper we show that the commonly used cold plasma dispersion relation for plasma waves in the lower hybrid range of frequencies (LHRF) produces a wave trajectory that is notably different than when thermal corrections to the Hermitian part of the dielectric tensor are retained. This is in contrast to the common implementation in LH simulation codes in which thermal effects are retained only for the anti-Hermitian part of the dielectric tensor used for damping calculations. We show which term is the critical one to retain in the dielectric tensor and discuss implications for modeling of LHRF waves in present day and future devices. We conclude with some observations on the effects of diffraction that may be isolated once thermal effects are retained in both ray tracing and full-wave approaches."

ADVANCED PROJECTS (H. NEILSON):

As part of the U.S. collaboration with the Wendelstein 7-X (W7-X) project at Germany's Max Planck Institute for Plasma Physics (IPP), PPPL has performed scoping calculations to support the design of a "divertor scraper element" for the initial phases of the W7-X program. The U.S. effort in this area is led by Oak Ridge National Laboratory. The Laboratory's P. Titus has performed thermal calculations using a preliminary one-dimensional model of a plasma-facing carbon tile, support structure, and its attachment to the vacuum vessel. The results are being used to guide material choices, dimensions, and requirements. Thermal-mechanical calculations have been performed to estimate tile deflection for various tile support configurations. The results are being used by the ORNL team to establish the conceptual design.

THEORY (A. BHATTACHARJEE):

On February 4, we had two short special theory seminars presented by M. Choi, from POSTECH, entitled "Improved estimation of the tearing mode stability parameters (D' and w_c) with the 2D ECEI data in KSTAR" and by Dr. Y.S. Park from Columbia University, entitled "Investigation of Plasma Rotation Control by $n = 2$ NTV and Resistive MHD Stability in KSTAR". The abstract of M. Choi's talk is "The 2-D ECE images of the tearing mode with high spatial and temporal resolution provided the data set that can overcome the resolution limit of the

conventional 1-D data in estimation of two important tearing mode stability parameters. The experimental images are directly compared with the synthetic ones based on a tearing mode model. An excellent agreement has been found between the measured images and synthetic ones from the model. The confidence level in the estimated tearing mode parameters has improved significantly and the estimated is consistent with the ideal MHD theory."

The theory seminar on February 6, was presented by Dr. Frank Cheng from Institute of Space and Plasma Sciences, National Cheng Kung University, Taiwan, entitled "Physical Picture of 2-1/2D Driven Collisionless Magnetic Reconnection". The abstract of his talk is "The physical picture of how electrons and ions flow, how the electric and magnetic fields change, and how particles gain energy will be presented for the 2-1/2D collisionless driven magnetic reconnection. The 2-1/2 dimensional collisionless reconnection studies are performed using the particle simulation PASMO code [1] and theoretical analysis. In particular, we will provide the physical mechanism of how the poloidal current (including the Hall current in the downstream region) is generated and how the electrostatic potential is produced in the poloidal plane. The physical picture of how the quadrupole magnetic field and electrostatic potential are generated in the 2-dimensional (poloidal) plane is different from the one presented by Uzdensky and Kulsrud [2]. [1] H. Ohtani and R. Horiuchi, Plasma Fusion Res., 4, 024 (2009), [2]. D. A. Uzdensky and R. M. Kulsrud, Phys. Plasma, 13, 062305 (2006)"

W. Tang visited the Lawrence Berkeley National Laboratory (LBNL) to participate in the National Energy Research Scientific Computing Center (NERSC) 40th Anniversary meeting and presented an invited talk on "Scientific & Computational Advances in Fusion Energy Sciences & Key Partnerships with NERSC."

COMPUTATIONAL PLASMA PHYSICS GROUP (S. JARDIN):

S. Ethier attended the annual NERSC Users Group meeting held in Berkeley and Oakland, California, on February 3-6. NERSC was celebrating its 40th anniversary with two days of science talks and retrospective on NERSC's accomplishments. The first day was a training day for new users of NERSC, followed by the 40th anniversary celebrations. The last day was dedicated to the "business meeting", during which the NERSC staff present the status and plans for the supercomputer center, and seek feedback from the user community on how to best support and enhance scientific discovery through high performance computation and storage. As the FES representative and chair of the NERSC Users Group Executive Committee, Ethier chaired the business meeting, which addressed important issues, such as the new data management requirements.

A teleconference was held on Feb 6 between the PPPL TRANSP group and Simon Pinches, Head of the ITER Confinement and Modeling group, and Frederic Imbeaux, Leader of the team developing the ITER Data Model (IDM). The subject of the call was to discuss a path forward for interfacing TRANSP input and output with the IDM, and the related goal of making TRANSP available to the ITER staff. It was decided that the TRANSP developers would begin by familiarizing themselves with the IDM by working through some example exercises on the ITER restricted web site. This requires that the TRANSP developers get accounts not only on the ITER site, but also on the ITER UNIX cluster. This process has begun and we plan to have another call in 1-2 months to discuss the next steps.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: Termination of all in-vessel cables is underway as is the re-installation of diagnostic flanges on the vessel. All vessel windows have been collected for inspection (and testing as required). Insulation is being installed on the vessel exterior and lower thermocouple cabling is underway. In the south high bay area the cooling tubes are being welded to the centerstack casing and they will be pressure tested next week. Work on the new RWM coils for bays J-A continues. The electricians continue to work category 3 cabling and lighting for the gas tank area in the Gallery.

CS Upgrade: The layer 1 to layer 2 transition was completed. The layer to layer braze joint was changed from a solder/TIG braze to a Torch braze which will result in a much stronger braze than originally planned. The tape spools are being reloaded the morning of February 7 with winding scheduled to startup again in the afternoon. Two-shift operation is set to restart on the February 10 second shift.

Bids for the CHERS Passive Plate fabrication were opened and evaluated. A decision was made to award a contract to Major Tool, which provided a sound proposal and was low bidder.

PF1B Lower is being prepped for megger test at PPPL. The second PF1B coil failed hipot test at 100 volts at Everson. The coil passed a test before potting and movement of the leads affects the electrical reading, indicating a short to the casing where the leads emerge. Everson has provided a plan to clear the short and reinsulate the lead stem to coil case. An NCR addressing this issue has been generated and is the approval process.

Results of the row 1 tile RGA takeout indicate the presence of hydrocarbons. An additional test is planned at Solar Atmospheres, including a high temperature purification run to verify the presence of the hydrocarbons and then the removal during the bake out.

The OH mold rework continued in the Tech Shop, half the holes in the mold cover were completed this week.

NBI Upgrade: Progress on DI water manifold fabrication and installation continued on BL2. The NBI Armor shine through tile bakeout has been delayed; bakeout is expected to be finished this week. The Bay H port cover lift fixture preparation continued. Subcontract cable installation has been completed. Subcontractor triax terminations are planned next week. Mod/Reg controls work continues. RWM coil fit-up continues for the Bay JK area. A few final duct support parts were completed. Management conducted a monthly job status with active job reporting status and plans.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

A. Zwicker attended a meeting of student participating in the 2014 "Science Action" science

video communication competition. Teams of undergraduate and graduate students are producing 3-5 minute videos on topics related to Climate Change, Fusion Energy, or Engineering. A screening of all films is planned for later in the semester.

A. Zwicker was the keynote speaker at the launch party for Innovation magazine, created by Princeton students presenting scientific results for a non-scientific audience. His talk was on "Innovation in Science Communication for the Non-Scientist."

On February 8, William Jones of Princeton University presented "Uncovering Our Cosmic Origins: What We Know, What We Can Know and What Limits We May Face," to 358 individuals at the Science on Saturday Program.

DIRECTOR'S OFFICE (C. AUSTIN):

February 3-4, S. Prager attended the Laboratory Director's Strategy Workshop in Denver, Colorado. The purpose of the workshop was to discuss high-level strategic recommendations for DOE Secretary Moniz.

PUBLICATIONS:

Wright, J.C.; and Bertelli, N., "The effects of finite electron temperature and diffraction on lower hybrid wave propagation," Plasma Phys. Control. Fusion 56 (2014) 035006

The following PPPL Reports were posted to the web:

State of the Art Neoclassical Tearing Mode Control in DIII-D Using Real-time Steerable Electron Cyclotron Current Drive Launchers PPPL-4978

Authors: Egemen Kolemen, et. al.

Submitted to: Nuclear Fusion (January 2014)

Particle Heating and Acceleration During Magnetic Reconnection in a Laboratory Plasma PPPL-4979

Authors: Jongsoo Yoo, et. al.

Submitted to: Physics of Plasmas (January 2014)

Response of Impurity Particle Confinement Time to External Actuators in QA-mode Plasmas on DIII-D PPPL-4980

Authors: B.A. Grierson, et. al.

Submitted to: Nuclear Fusion (December 2013)

The Double Well Mass Filter PPPL-4981

Authors: Renaud Gueroult, et. al.

Submitted to: Physics of Plasma (December 2013)

Nonmodal Growth Of The Magneto-rotational Instability PPPL-4982

Authors: J. Squire and A. Bhattacharjee

Submitted to: Physical Review Letters (January 2014)

A New Class of Magnetic Confinement Device in the Shape of a Knot PPPL-4983

Authors: Stuart Hudson, et. al.

Submitted to: Physics of Plasmas

Observation Of Edge Instability Limiting The Pedestal Growth in Tokamak Plasmas PPPL-4984

Authors: Ahmed Diallo, et. al.

Submitted to: Physical Review Letters (October 2013)

Suitability of 3D Printed Plastic Parts for Laboratory Use PPPL-4985

Authors: Andrew P. Zwicker, Josh Bloom, Robert Albertson and Sophia Gershman

Submitted to: American Journal of Physics (February 2014)

Electrostatic Detection of Stainless Steel Dust Particles For Fusion Applications PPPL-4986

Authors: P. Landy, C.H. Skinner and H. Schnieder

Submitted to: Review of Scientific Instruments (January 2014)

Kinetic Neoclassical Transport In The H-mode Pedestal PPPL-4987

Authors: Devon Battaglia, et. al.

Submitted to: Physics of Plasmas

Linear Mode Conversion of Langmuir/z-mode Waves To Radiation In Plasmas With Various Magnetic Field Strength PPPL-4988

Authors: Eun-Hwa Kim, Iver H. Cairns and Jay R. Johnson

Submitted to: Physics of Plasmas (July 2013)

This report is also available on the following web site:

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