

PRINCETON PLASMA PHYSICS LABORATORY

WEEKLY highlights



The PPPL Highlights for the week ending February 28, 2014, are as follows:

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

In progress meetings this week, US concepts for upper and equatorial diagnostic shield modules (DSMs) were discussed with the IO. For the upper DSM, the design approach, based on welded, gun-drilled plates, appears stiff enough for the DSM to react the disruption loads from the diagnostic first wall to the port plug structure. For the equatorial DSMs, where the loads are higher, analysis completed this week shows that thicker walls will be needed to achieve the desired stiffness.

Using PPPL procedures, the Engineering Department is creating revised cost estimates for the diagnostic scope planned for PPPL - which includes the port plugs, most of the diagnostic front-ends, and the core imaging x-ray diagnostic.

Inquiries were made toward investigation of the use of B4C powder, encapsulated in stainless steel chambers, as bulk shielding in diagnostic shield modules, in order to meet shielding requirements and stay within weight restrictions.

A meeting held at PPPL with Siemens representatives to review fabrication and delivery scenarios. To avoid shipping cubicles, it was proposed that HV Control & Protection I&C cubicle consolidation and wiring will be switched from a US to a German location.

The diagnostic and SSEN risk registers were updated in preparation for the Risk Review at the USIPO scheduled for March 11-13.

NSTX (M. ONO):

On February 24, R. Raman (University of Washington) gave the talk "Overview of potential CHI contributions to the QUEST project" at the Workshop on QUEST and Related ST RF Startup and Sustainment Plasma Research (Feb 24-26), held at Kyushu University, Japan. The talk discussed the CHI system design for QUEST and described applications of transient CHI and related targets a CHI system could generate for RF (ECH) current drive applications.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

B. Grierson has collaborated with Ralph Dux (IPP-Garching) and N. Howard on the usage of the STRAHL code for impurity transport studies at DIII-D. STRAHL has been successfully used to interpret impurity transport coefficients and compare to neoclassical and gyrokinetic models on ASDEX-Upgrade, JET and Alcator C-mod tokamaks. STRAHL calculates the time-evolution of all ion charge-states, and simulates photoemission intensities and radiation based on ADAS rate coefficients. The computational cost of STRAHL is small enough to use in a least-squares minimization algorithm. Current usage of STRAHL on DIII-D is focusing on recent fluorine transport studies, and will be used in the future for higher-Z impurities.

A. Nagy and the I-coil repair team at DIII-D successfully repaired and reinstalled the damaged I-coil IU90 to allow for physics experiments with the full set of 12 I-coils in FY14. This coil was out of service since last March. IU90 was the first I-coil ground fault failure in the 12 years of successful operation of the I-coil system. The ground fault was due to a water leak in the copper water cooling channel.

The ECEI diagnostic system is located on DIII-D in front of the vessel entry port and the diagnostic needs to be removed for with every vent, leading to reinstallation and alignment issues. A. Nagy has developed a position location system using 1/8" thick stainless steel plates screwed to the floor, located under the ECEI system. Adjustable feet with pins are bolted to the ECEI assemblies that are inserted into the holes in the plate. This location system is currently being installed and will allow for improved reinstallation and realignment of the optical system. As part of the task the existing floor will be reinforced with stainless steel H-beam to reduce the current 2mm of floor deflect down to .001mm. The floor pieces have been prefabbed and are ready for installation next week.

ADVANCED PROJECTS (H. NEILSON):

The Fusion Energy Systems Studies team held a teleconference meeting on February 27. The team discussed the work plan for the project, which will examine tokamak and spherical tokamak (ST) options for a Fusion Nuclear Science Facility with moderate technical scope. The level of power plant relevant features versus a strictly neutron source capability are the challenge for defining the moderate scope for this facility. A preliminary experimental program on the FNSF was presented for discussion, outlining the phases with He/H, DD, and DT, and showing the neutron fluence and other parameters for each phase. Discussions included the possible need for longer life of the facility to prepare for the DEMO, dedicated time for blanket change-out, and how blankets would be tested.

THEORY (A. BHATTACHARJEE):

The theory seminar on February 27 was presented by Dr. Haihong Che from NASA/GSFC, entitled "Electron Fluid Description of Wave-Particle Interactions in Strong Buneman Turbulence". The abstract of the talk is "To understand the nature of anomalous resistivity in

magnetic reconnection, we investigate turbulence-induced momentum transport and energy dissipation during Buneman instability in force-free current sheets. Using 3D particle-in-cell simulations, we find that the macroscopic effects generated by wave-particle interactions in Buneman instability can be approximately described by a set of electron fluid equations. These equations show that the energy dissipation and momentum transports along current sheets are locally quasi-static but globally non-static and irreversible. Turbulence drag dissipates both the streaming energy of current sheets and the associated magnetic energy. The decrease of magnetic field maintains an inductive electric field that re-accelerates electrons. The net loss of streaming energy is converted into the heat of electrons moving along the magnetic field and increases the electron Boltzmann entropy. The growth of self-sustained Buneman waves satisfies a Bernoulli-like equation that relates turbulence-induced convective momentum transport and thermal momentum transport. Electron trapping and de-trapping drive local momentum transports, while phase mixing converts convective momentum into thermal momentum. The drag acts like a micro-macro link in the anomalous heating process. The dissipated magnetic energy is converted into the electron heat moving perpendicularly to the magnetic field and this heating process is decoupled from the heating of Buneman instability in the current sheets."

On February 27, A. Reiman gave a talk via videoconference for CWGM13, the Coordinated Working Group Meeting for Stellarators, which implements and coordinates international collaborations in [stellarator](#) research. The meeting was taking place in Kyoto, Japan. The topic of the talk was "a validation and cross-benchmarking initiative for 3D equilibrium calculations", describing an ongoing initiative. Following the talks in the session there was a discussion on the topic of international collaboration on the benchmarking of 3D equilibrium codes.

W. Tang participated in the invitation-only International Big Data and Extreme Computing (BDEC) Workshop, which was sponsored by the National Science Foundation (NSF) and held in Fukuoka, Japan, on February 26-28. This was the second in a series of two-day workshops to help plan how the international community could build a partnership to provide the next generation of HPC software to support big data and extreme computing to aid scientific discovery. He also participated in the Japanese Extreme Big Data Projects Workshop on February 26.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

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

Construction: Installation of diagnostic flanges and cabling continues. Installation of TIV and thermocouple cabling also continues. Insulation has been replaced on the vessel in all locations except where the new RWM coils go. The PF5 support at bay B has been installed. Rework of the centerstack casing tubing continued this week. The trial fit of the new centerstack pedestal is underway, as is the trial fit of buswork in the NSTX test cell.

CS Upgrade: OH Coil layer 2 is completed except for the layer-to-layer connections. The first cut was made Friday morning in preparation for the braze to be made on March 1. A requisition was written to perform radiograph NDE on the two PF1B coils for comparisons of the insulator locations inside the coils. The vendor believes the short on the PF1B upper was caused by a G10 insulator that shifted during winding or potting. PPPL will use the radiographs to determine if a

similar condition may exist on PF1b Lower. A batch of tiles is being readied for shipment to Solar Atmospheres for takeout to remove traces of hydrocarbons in the graphite. The diagnostic TCs and Mirnov coils need to be removed before shipment. The PF4/5 Support column was annealed at Solar and released for shipment back to PPPL. The outer TF flag Finger support drawings were released for fabrication. Drawings were submitted to Carolina Fabricators to prepare a bid proposal.

NBI Upgrade: The NBI Armor shinethrough tiles were successfully baked and installed in the VV. The Bay H port cover lift has been planned for the week of March 3. DI water manifold installation is on hold and is awaiting welding coverage. Work continues on water pump pads in the Pump Room. Triax terminations were installed and air bushings reassembled in the M/R and were completed. Mod/Reg controls work and preparation continues. HVE low voltage wiring terminations in the service boxes were completed. The HVE high voltage connectors were removed from the HVEs for cleaning and reassembly. NBPS water skid maintenance is in progress awaiting tanks. VV RWM coil fit-up continues for the Bay JK area. The NBI/TVPS duct flanges were tested with new seal thicknesses but larger seal thicknesses will be probably be required. Additional seals were fabricated and tested. The NB Controls tray work resumed in the NTC.

INFORMATION TECHNOLOGY (S. BAUMGARTNER):

B. Davis' manuscript "Fast 2-D Camera Control, Data Acquisition, and Database Techniques for Edge Studies on NSTX" has been accepted for publication in Fusion Engineering and Design.

BEST PRACTICES & EXTERNAL AFFAIRS (J. DELOOPER):

More than 250 individuals attended the Science on Saturday program given by David Schheinker, a joint Fellow at the MIT Sloan School of Management and Massachusetts General Hospital. His talk was "Can Studying Infinite Dimensional Space Help Us Improve Health Care."

DIRECTOR'S OFFICE (C. AUSTIN):

On February 24 and 26, M. Zarnstorff attended the ARPA- Energy Innovation Summit in Washington, DC. He also attended the CRO (Chief Research Officers) meeting in Denver, Colorado on February 28.

On February 25, Professor Juan Maldacena from the Institute for Advanced Study presented a colloquium entitled, "Quantum Mechanics and Spacetime Geometry".

On February 26, Professor Gregory Lang presented a colloquium entitled, "Genetic Hitchhikers".

PUBLICATIONS:

The following PPPL Reports were posted to the web:

The Effects Of Finite Electron Temperature And Diffraction On Lower Hybrid Wave Propagation PPPL-4989

Authors: J.C. Wright and N. Bertelli

Submitted to: Plasma Physics Controlled Fusion (February 2014)

Estimation of Heavy Ion Densities From Linearly Polarized EMIC Waves At Earth PPPL-4990

Authors: Eun-Hwa Kim, Jay R. Johnson and Dong-Hun Lee

Submitted to: Geophysical Research Letter, (February 2014)

Experimental Test Of Whether Electrostatically Charged Micro-organisms And Their Spores Contribute To The Onset Of Arcs Across Vacuum Gaps PPPL-4991

Authors: L.R. Grisham, A. vonHalle, A.F. Carpe, K.R. Gilton, Guy Rossi and T.N. Stevenson

Submitted to: Physics of Plasmas (October 2013)

Aerodynamic Focusing Of High-Density Aerosols PPPL-4992

Authors: D.E. Ruiz, N.J. Fisch, et. al.

Submitted to: Journal of Aerosol Science (TBD)

The Virtual-casing Principle For 3D Toroidal Systems PPPL-4993

Authors: S.A. Lazerson

Submitted to: Plasma Physics and Controlled Fusion (September 2012)

Edge Equilibrium Code (EEC) For Tokamaks PPPL-4994

Authors: Xujing Li, Leonid E. Zakharov, and Vladimir V. Drozdov

Submitted to: Physics of Plasmas (October 2013)

On The Toroidal Plasma Rotation Induced By Lower Hybrid Waves PPPL-4995

Authors: Xiaoyin Guan, Hong Qin, Jian Liu and Nathaniel J. Fisch

Submitted to: Physics of Plasmas (October 2013)

Multi-threaded GPU Acceleration of ORBIT with Minimal Code Modifications PPPL-4996

Authors: Ante Qu, Stephan Ethier, Elliot Feibush and Roscoe White

Submitted to: PPPL Reports

Canonicalization And Symplectic Simulation Of The Gyrocenter Dynamics In Time-independent Magnetic Fields PPPL-4997

Authors: Ruili Zhang, Jian Liu, Yifa Tang, Hong Qin, Jianyuan Xiao and Beibei Zhu

Submitted to: Physics of Plasmas (December 2013)

Enhanced Efficiency of Internal Combustion Engines By Employing Spinning Gas PPPL-4998

Authors: Vasily Geyko and Nathaniel J. Fisch

Submitted to: Physical Review App. (February 2014)

Effect of Deuterium Gas Puff On The Edge Plasma In NSTX PPPL-4999

Authors: S.J. Zweben, et. al.

Submitted to: Plasma Physics and Controlled Fusion (February 2014)

TRANSP Tests Of TGLF and Predictions For ITER PPPL-5000

Authors: Robert V. Budny, [et.al.](#)

Submitted to: ESP Expo Finland (June 2013)

Self-organisation Processes In The Carbon ARC For Nanosynthesis PPPL-5001

Authors: Jonathan Ng and Y. Raites

Submitted to: Journal of Physics D: Applied Physics (February 2014)

This report is also available on the following web site:

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