eNews

January 24, 2011 (Issue 51)

CONTENTS

Dear Burning Plasma Aficionados:

This newsletter provides a short update on U.S. Burning Plasma Organization activities. E-News is also available online. Comments on articles in the newsletter may be sent to the Editor (Tom Rognlien) or Assistant Editor (Rita Wilkinson). Thank you for your interest in Burning Plasma research in the U.S.!

Director's Corner by Jim Van Dam

Happy New Year

Welcome to 2011, which, in the Chinese zodiac calendar, is the Year of the Hare. People born in this year or previous hare years (1999, 1987, 1975, 1963…) are supposedly talented and ambitious, good-natured, savvy in business, and artistically sensitive. This would seem to be a good character profile for fusion scientists who investigate burning plasma physics and technology. Best wishes for a scientifically productive New Year.

ITPA Meetings

In recent issues of *eNews* and again in this issue, you will find summaries from the meetings of the seven topical groups of the International Tokamak Physics Activity. These summaries are condensed from the full reports of the meetings, written by the respective topical group leaders. We appreciate their cooperation in publishing these short summaries for the sake of keeping the broad fusion community informed.

The most recently updated schedule for the 2011 Spring meetings of the ITPA topical groups is listed at the back of this issue of *eNews* and posted on the USBPO web site.

FESAC Meeting

The next scheduled meeting of the Fusion Energy Sciences Advisory Committee will be held March 7 and 8 in Bethesda, MD. Topics to be discussed include the FY 2012 Presidential

Budget for the Office of Science and that for Fusion Energy Sciences. The response to the FESAC Committee of Visitors' Review of the Fusion Energy Sciences program will be presented, as well as an update on the status of the US ITER activities, and the Fusion Nuclear Sciences Pathways Assessment. Further details are posted on the FESAC web site.

Monaco Fusion Energy Days

A video of the speech given by HSH Prince Albert of Monaco at the Monaco ITER International Fusion Energy Days Conference, held November 23-25, 2010, can be viewed at the ITER Newsline web site. You can also view the speech by ITER Director-General Motojima. Representatives from each of the seven ITER Members gave presentations about long-term perspectives in energy development and the potential role of fusion energy; Dr. Ed Synakowski of the U.S. Department of Energy gave the U.S. presentation. Each of the seven Member also described Domestic Agency procurement processes and implementation status; Dr. Ned Sauthoff of the U.S. ITER Project Office gave the U.S. presentation. Monaco and ITER arranged for students from each Member to participate; the U.S. representative was Ryan Hunt, a graduate student in the Department of Nuclear Engineering at UCLA. The program for the conference can be viewed online.

2011 ITER International Summer School

This year, the School will be held June 20-24, in Aix en Provence, France. The theme of the 5th School will be "MHD and Energetic Particles." The registration deadline is February 25. Topics to be covered will include:

1. *Key energetic-particles issues for ITER*; **2.** *Theory of EP-driven modes and associated transport*; **3.** *Historical review of kinetic MHD*; **4.** *Kinetic linear stability of EP-MHD modes*; **5.** *Turbulent transport of fast particles*; **6.** *Diagnostics of EP-MHD modes*; **7.** *Experimental observation of EP-driven modes*; **8.** *Diagnostics for EP-driven modes*; **9.** *The use of fast particle driven modes for MHD spectroscopy*; **10.** *Modeling of EP-MHD modes*; **11.** *MHD modes driven by fast electrons*: *theory*; **12.** *MHD modes driven by fast electrons: experiment*; **13.** *Nonlinear dynamics of EP-driven modes*; and **14.** *Hybrid simulations of EP-MHD modes*.

You can find more information about the School at its web site.

Fusion Simulation Project

In this month's issue of *eNews*, we have a summary article about the status and goals of the Fusion Simulation Project planning effort. The Fusion Simulation Project will be an important activity for understanding burning plasma physics and integrated effects, and we look forward to coordinating our efforts in the US Burning Plasma Organization with this activity.

USBPO Topical Group Highlights

(Editors note: The BPO Modeling and Simulation Topical Group works to facilitate U.S. efforts to develop and apply numerical codes to understand present fusion-related experiments and to predict the performance of future experiments and devices [leaders are Dylan Brennan and Dave Mikkelsen]. This month's Research Highlight by Hank Strauss et al., summarizes MHD simulations that predict wall forces in ITER that would be produced by disruptions.)

Asymmetric Wall Force Produced by ITER Disruptions

H.R. Strauss (HRS Fusion), R. Paccagnella (Consorzio RFX and Istituto Gas Ionizzati, Consiglio Nazionale delle Ricerche), and J. Breslau (Princeton Plasma Physics Laboratory)

A very critical issue for the ITER device construction is to evaluate the forces produced on the surrounding conducting structures during plasma disruptions [1]. Recent studies have documented results obtained from the Joint European Torus (JET) experiment [2]. A major concern is non-axisymmetric stresses caused by large-scale magnetohydrodynamic (MHD) instabilities [3]. These forces could be tens of mega-Newtons (MN), and might cause significant damage to the conducting structures surrounding the ITER plasma. These forces have not been studied much because they are small in present tokamaks.

Disruptions have been thought to be connected to stochastic breakup of magnetic surfaces and loss of MHD equilibrium. While this kind of disruption could be important in ITER, the worst-case scenario seems to be initiated by a vertical displacement event (VDE). The plasma is pushed against the vessel or limiter, and the edge is scraped off, lowering the magnetic safety factor q at the edge. When q drops to 2 or even 1, a kink mode is triggered. The VDE, with the kink mode superimposed on it, imprints a toroidally varying halo current on the wall. Halo current is poloidal current which flows normal to the wall; it directly carries the plasma current to the conductors surrounding the plasma.

We have found [4] that the wall force is largest in the regime $\gamma\tau_w \sim 1$, where γ is the mode maximum growth rate, and $\tau_w = \delta a/\eta_w$ is the penetration time of the magnetic perturbation into the wall, where a is the plasma minor radius, δ is the wall thickness, and η_w is the wall resistivity. This result offers a possibility of mitigation of the wall force by using a less resistive wall.

We have carried out simulational studies of vertical displacement events combined with disruptions [4,5]. The disruptions are simulated using the M3D code [6]. The code solves resistive MHD equations with parallel and perpendicular thermal transport. The plasma is bounded by a thin, resistive wall of thickness δ.

On the resistive wall boundary, integrating $\nabla \bullet \boldsymbol{B} = 0$ across the thin shell gives the requirement that the normal component of magnetic field is continuous at the wall. The jump in the magnetic field across the thin wall gives the wall current, $\boldsymbol{J}_w = (1/\mu_0\delta)\hat{\boldsymbol{i}}_n \times (\boldsymbol{B}^V - \boldsymbol{B}^P)$, where $\boldsymbol{B}^V$ is the vacuum magnetic field outside the wall, $\boldsymbol{B}^P$ is the magnetic field inside the wall, and $\hat{\boldsymbol{i}}_n$ is the outward normal to the wall. The magnetic field perturbations outside the wall are calculated with Green's functions [7]. Integrating $\boldsymbol{J}_w \times \boldsymbol{B}_w$ over the wall thickness δ gives the force on the wall, $\boldsymbol{F} = \delta\int dl\ R\ \boldsymbol{J}_w \times \boldsymbol{B}_w$, which is independent of δ, and dl is the length-element tangent to the wall. Of particular importance is the net horizontal force, F_x. Here F_x is obtained by forming the horizontal components of $\boldsymbol{F}$, $F_c = \int d\phi\ F_R \cos\phi$ and $F_s = \int d\phi\ F_R \sin\phi$, where the subscript R refers to the major radius direction, and ϕ is the toroidal angle. The net horizontal force is thus $F_x = (F_c^2 + F_s^2)^{1/2}$.

The M3D code models the open field line region inside the wall as a plasma with very large resistivity, small density, and low temperature. The resistivity varies as $T^{-3/2}$ self-consistently, where T is the temperature. In the simulation, the Lundquist number was chosen to be $S = 10^5$ on axis and $S = 10^2$ at the wall. The Lundquist number must be much lower than experiment for numerical reasons. It is expected that, in the future, higher S simulations could be done. The wall penetration time was chosen to have a range of values. In the following example, $\tau_w = 20\,\tau_A$, where $\tau_A = R/v_A$ is the toroidal Alfvén time and v_A the Alfvén velocity.

The wall-normal velocity boundary condition was $v_n = 0$. Although this choice has been standard in MHD simulations, it has recently been challenged [8]. We have argued that this choice is reasonable [9] unless a more convincing boundary condition is developed.

Disruption simulations were initialized with an ITER reference equilibrium, FEAT15MA. The initial equilibrium is VDE unstable. The initial equilibrium had q_0 = 1.1. The equilibrium was rescaled to generate a kink unstable equilibrium with q_0 = 0.8 on axis. Such a state might model the scrape off of current by a VDE. In future work we plan to carry out self-consistent simulations of the scrape-off process, but to date it has been technically difficult.

In Fig. 1 corresponding to the time $t = 46.18\tau_A$, the VDE and kink mode have developed nonlinearly, with the plasma in contact with the wall. Figure 1(a) shows a poloidal cross-section of the poloidal magnetic flux ψ penetrating the wall, and Fig. 1(b) shows the toroidal current.

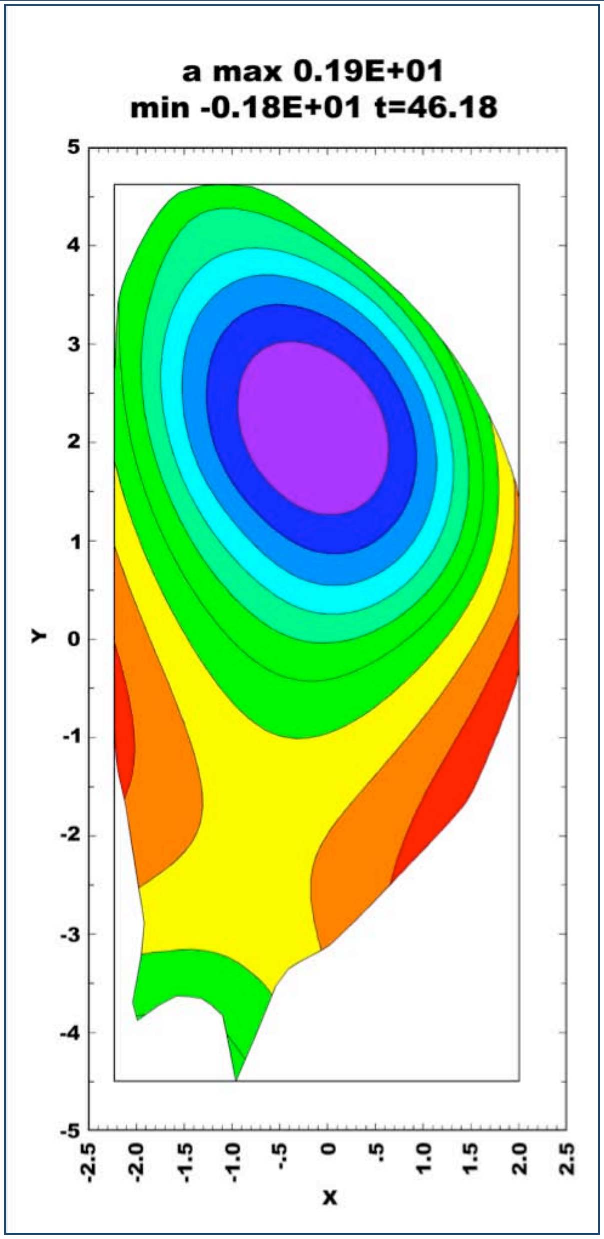

Fig. 1a Poloidal magnetic flux at t = 46.18τ_A

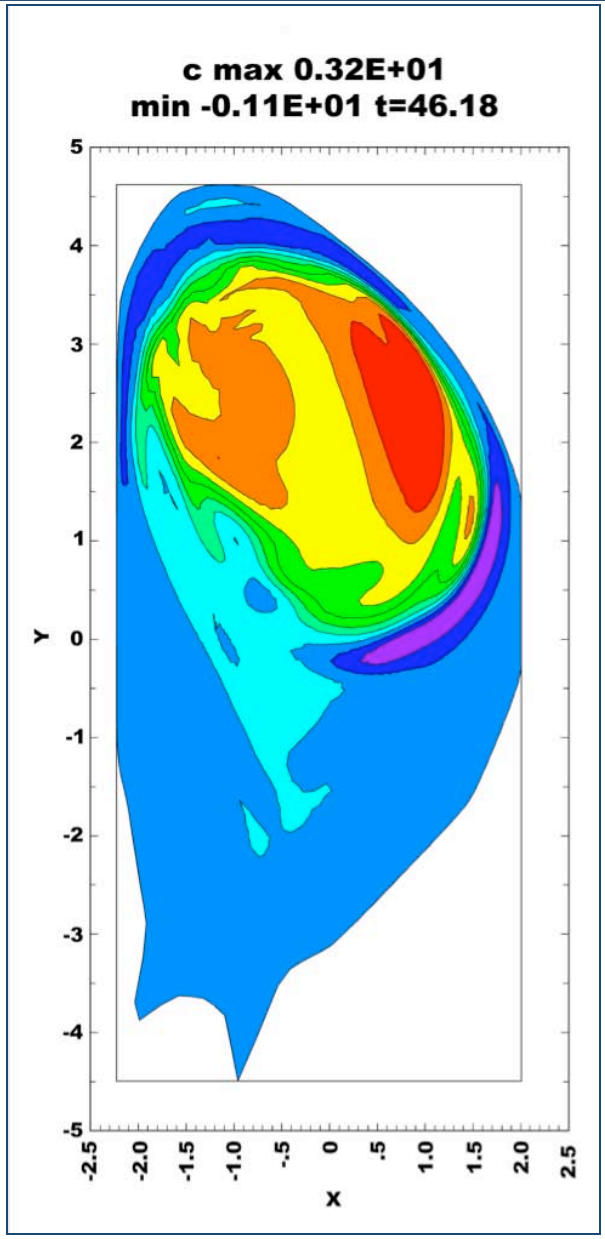

Fig. 1b Toroidal current at t = 46.18τ_A

The scaling of peak wall force with wall resistivity was obtained for the same initial conditions as above by varying τ_w. The results are shown in Fig. 1(c). The point "a" corresponds to the simulation shown above. In terms of ITER parameters, the horizontal wall force in case "a" is F_x^{ITER} = 70 MN. This is somewhat more than the predicted value used in the ITER design [10]. The total wall force F_x scales as I_ϕ^2. The ITER current is about 5 times greater than the JET current, so that the JET horizontal force in this particular case would be about 2.75 MN.

The variation of the horizontal force with wall resistivity offers an important opportunity to ameliorate the sideways force of disruptions. If the wall can be made more conducting, it is possible to reduce the wall force by a large factor. Of course, there is a trade off of wall resistivity with other considerations such as neutron and heat fluxes, ash removal and the like.

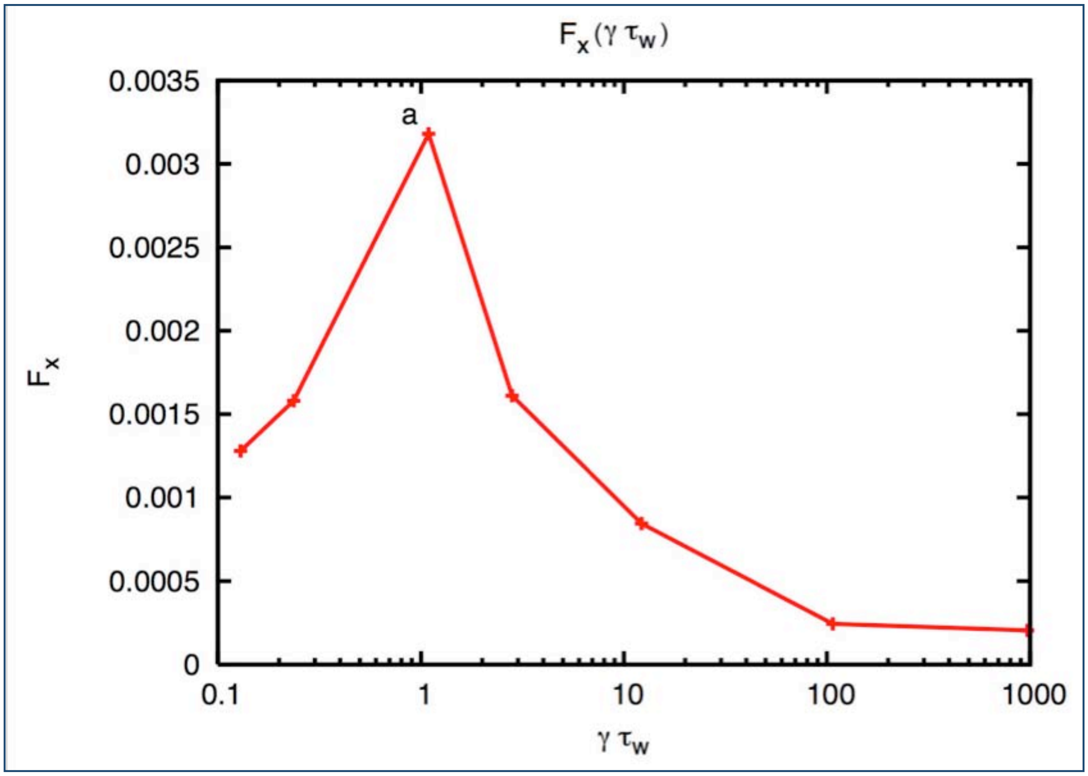

Fig. 1c Normalized net horizontal force in ITER for varying wall resistivity, where the maximum at point “a” corresponds to 70 MN

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ITPA Reports

Summary of the 5th Meeting of the ITPA MHD Stability Topical Group, Seoul, Korea

Abijit Sen (Institute for Plasma Research, India), Edward Strait (General Atomics), and Yuri Gribov (ITER Organization)

The ITPA Topical Group on MHD Stability held its fifth meeting at the Seoul National University (SNU), Seoul, Korea during October 18-20, 2010, following the IAEA Fusion Energy

Conference in Daejeon. The meeting was hosted by the Center for Advanced Research in Fusion Reactor Engineering, SNU, Korea, and included joint sessions with several of the other topical groups.

Edge localized mode (ELM) physics and heat loads were discussed in a joint session with the Divertor/SOL and Pedestal Physics groups. A detailed overview of current MHD modeling of ELMs in the linear and nonlinear regimes provided an assessment of their capabilities and limitations, thus helping to identify some key unresolved issues regarding the onset, evolution and control of ELMs. Current progress on integrated MHD+transport modeling of ELM losses was also reported.

Disruption-related issues were discussed jointly with the Divertor/SOL and Energetic Particles groups. Localization of radiation associated with massive gas injection to minimize the impact of disruptions is an urgent issue for ITER, with important implications for the number of injection ports on ITER. Related experimental observations on radiation asymmetries from gas injection were presented from several tokamaks. The physics of runaway electron generation and loss, as well as control of the post-disruption runaway channel, were discussed. A new proposal for suppression of runaway electrons through repetitive injection of gas jets in the current-quench phase of a disruption will be tested in several tokamaks.

Fast particle interactions with MHD modes were discussed jointly with the Energetic Particles group. The physics of runaway electron confinement and loss during disruptions is an urgent issue for ITER; modeling results predict very little effect of resonant magnetic perturbations on runaway electron formation / loss in ITER. Other key topics included fast ion transport generated by sawteeth modes and Alfvén eigenmodes, the interaction of resistive-wall modes with fast ions and fast ion-driven modes, and kinetic stabilization of resistive-wall modes.

As planned in the previous topical group meeting at Naka, Japan, a special session was also devoted to discussing three-dimensional effects and their relevance to ITER. The results of a task agreement to revise the earlier magnetic error field study of ITER by including the ideal plasma response using the IPEC code were reported. The importance of including the resistive response of the plasma (through 3-D effects on tearing modes) was highlighted in error field threshold scaling studies for ITER low torque H modes. Recent modeling also shows the important role of toroidal plasma rotation and screening at rational magnetic surfaces in determining the plasma response to magnetic perturbations.

In the remaining sessions the meeting reviewed the progress of the various joint experiments and working groups. The work of several groups on error fields, MHD stability control, and disruptions is nearing completion. Three new working groups were proposed on resistive-wall mode feedback control, radiation asymmetry during massive gas injection, and error field criteria for ITER.

The next meeting of the MHD Topical Group will be held in Ahmedabad, India on March 1- 4, 2011, with the Institute for Plasma Research as the local host.

Summary of the 19th Meeting of the ITPA Pedestal Topical Group, Seoul, Korea

Phil Snyder (General Atomics)

The 19th meeting of the ITPA Pedestal Group was held in Seoul, South Korea on October 18-20, 2010, hosted by Seoul National University (10/18) and Hanyang University (10/19-10/20). The meeting was productive and well attended, and benefited from a large number of joint sessions on the first day, followed by more detailed discussions of recent results and plans on the second and third days.

The initial session on edge localized mode (ELM) Physics and Heat Loads was held jointly with the Divertor/SOL and MHD ITPA groups. A presentation on ELM heat load deposition patterns highlighted several observations from the JET, MAST, AUG and DIII-D tokamaks. Notably, the wetted area of ELMs on the divertor plates is found to generally increase with ELM size, an observation that has significant implications for the scaling of ELM heat loads on ITER. A second presentation reviewed what is known about energy losses for both natural and mitigated ELMs, including observations that electron and ion temperature changes during ELMs are generally similar, and that particle losses are roughly independent of ELM size, and hence that ELM energy loss scales with the fractional decrease in the pedestal temperature. Both simple and non-linear models are able to capture a number of these characteristics, but require extension to treat kinetic effects, and account for the stochastization of the edge that is thought to occur during ELM events. A detailed review of MHD simulation of ELMs was also presented, indicating that linear MHD has been quantitatively successful in predicting Type I ELM onset, and the associated pedestal constraint, and that significant progress has been made toward more realistic non-linear simulations of the ELM event itself, reproducing qualitatively several observed ELM characteristics. A new model combining parallel heat flows at the sound speed with a model for the broadening of the strike point during an ELM was also presented, finding good initial agreement with observed Type I ELM heat deposition on JET.

A joint session with the Transport and Confinement group explored the impact of 3D magnetic field structures on the L-H transition and H-mode confinement. L-H transition physics in stellarators was reviewed, noting the role played by poloidal flow and windows in rotational transform. A review of tokamak results on JT-60U, JET, MAST, DIII-D and NSTX noted that a higher L-H power threshold is generally found in the presence of resonant magnetic perturbation (RMP) fields, with a required threshold in RMP field strength identified on DIII-D. In contrast, magnetic ripple is found to have little effect on the L-H transition. A theory presentation suggested that magnetic perturbations which cause stochastization can drive flows that short out zonal flows and geodesic acoustic modes (GAMs).

A joint session with the Integrated Operation Scenarios (IOS) group focused on pedestal evolution, and coupling pedestal physics into global integrated modeling. The need for models that can characterize the pedestal in the early H-mode and current ramp-up phases as well as in fully developed H-mode was emphasized, as was the issue of connecting predictions of models like EPED, which predict pressure at the pedestal top, to core models which sometimes employ a boundary condition further in. A survey of observations on several devices reported a wide range of observed profile dynamics following the L-H transition, and varying requirements for achieving high confinement (H=1).

A new cross-ITPA working group on particle transport and fuelling was created, led by A. Loarte (ITER Organization). This group will study the physics of edge particle transport and fuelling, including recycling neutral fuelling as well as pellet fuelling, and fuelling effects on ELMs and ELM control. The physics of screening high-Z impurities from the core, and the relation between edge and core density profiles will also be studied, as well as the physics of particle transport and fuelling of He discharges of interest for initial ITER operation.

Several recent results were presented on the effects of lithium coating on ELM behavior and pedestal transport on NSTX, noting a broadening of pedestal pressure and density profiles in the presence of lithium coatings, which corresponds to higher edge stability limits and a lack of ELMs.

A number of recent experimental and theoretical results on the impact of 3D fields were presented. Progress on 3D MHD equilibrium calculations for ITER in the presence of toroidal magnetic field ripple and blanket module field perturbations was presented, and the importance of including the plasma response was noted. The MARS-F code has been used to model RMP penetration on MAST, finding significant screening of RMP fields on rational magnetic surfaces, and a correlation between the poloidal distribution of the computed normal displacement and the observed density reduction (pump out). Recent studies of RMP penetration using the XGC0 particle code coupled to an Ampere's law solver find strong screening of resonant magnetic fields across the edge transport barrier, but penetration of the field to the core-side of the barrier region, leading to enhanced transport and particle "pump-out". Both trapped particles and strong electric fields are found to lead to strong deviations from Rechester-Rosenbluth predictions of stochastic particle transport. Results from NSTX show that the observed divertor heat deposition patterns for both n=1 and n=3 perturbations match expectations from vacuum field calculations, where n is the toroidal mode number. It was also found that the heat flux pattern of ELMs triggered by the n=3 coils is phase-locked to the applied field.

Progress on theoretical models for the pedestal structure and tests of these models against experiment was also reported. The present version of the EPED model calculates both the peeling-ballooning and kinetic ballooning mode constraints directly and has no fitting parameters. The EPED model has been successfully compared to observations on DIII-D, JET, and C-Mod and used to predict and optimize the ITER pedestal. The effects of poloidal and toroidal plasma rotation on peeling-ballooning mode stability were also discussed, with a finding that poloidal rotation introduces a dependence in the direction of the toroidal rotation. A model based on paleoclassical transport was presented, and compared to the measured pedestal structure in DIII-D discharge 98889.

Progress on re-implementing a measurement of the edge current in DIII-D using a lithium ion beam was also discussed.

Plans for a L-H transition database were discussed including adding edge profile data to the scalar database. In a joint session with the Divertor/SOL group, a new model of the L-H transition was discussed, based on an earlier hypothesis that the transition occurs when shear Alfven waves and turbulence can compete in the edge. Divertor modeling using both the B2SOLPS5.2 Braginskii code and the XGC0 particle code were presented, focusing on the scaling of the scrape-off-layer width and implications for ITER.

The final day of the meeting focused on discussion of the progress and plans of each of the Pedestal working groups (RMP ELM Suppression, Pedestal Structure, L-H Transition, Ripple, and Pellet Pace-Making), and plans for joint experiments.

The next meeting of the ITPA Pedestal group will be held at MIT in Cambridge, MA from March 30 – April 1, 2011.

Community Reports

Status and Plans of the Fusion Simulation Program

The FSP Planning Team[1]

Goals and Motivation

The goal of the Fusion Simulation Program (FSP) is to foster scientific discovery that emerges only upon integrated, multi-physics, multi-scale simulation of magnetically confined fusion plasmas. Its aspiration is to deliver simulation software with unprecedented fidelity in physics models, solution accuracy, and geometric representation. The FSP is conceived as an ongoing research program, melding expertise in plasma physics theory, fusion computation, applied math, computer sciences and experimental validation at a scale of effort and level of organization beyond current activities. The program would develop codes built with common physics components, operating in a common software infrastructure, and rigorously and routinely tested. Integral to the FSP mission will be a strong collaboration with the experimental community to validate and to motivate improvements in the codes that are produced.

The needs of US-ITER research provide one of the strong motivations for the FSP, where the codes would be used for scenario development, discharge optimization and for interpretation of experimental results—all aimed at better exploitation of ITER run time. To that end, the FSP will have a substantial "production" component; that is, it will provide and support its codes for a large user base, well beyond the community of developers. In the end our aim is that the simulation codes will be a durable embodiment of the theoretical and experimental understanding of magnetically confined thermonuclear plasmas and an essential element in the design of future burning plasma devices.

Status

Responding to a DOE Office of Fusion Energy Sciences solicitation, the FSP planning team is currently about 1½ years into a two-year planning activity that will complete in July 2011. While a few aspects of the program are yet to be decided, plans for the technical core are reasonably mature. Key to meeting FSP objectives will be a set of Integrated Scientific Application (ISA) development groups, each developing and delivering codes that address well-defined and well-motivated physics problems. (For more detail see the web site links below.) The ISA teams would be multi-disciplinary, comprised of 8-12 members with expertise in fusion computing, applied math, computer sciences, software engineering and experimental validation. The number and size of the ISA teams is expected to grow over time consistent with a ramp-up in funding over the first 5 or 6 years of the program. To provide common services, tools and infrastructure and to maintain coherence between the ISA teams, a set of cross-cutting groups will be responsible for coordinating development of physics component codes and software frameworks, managing the software development environment, developing methodologies for verification, validation and uncertainty quantification, maintaining a common data management infrastructure and providing user support. Some members of the cross-cutting groups will be "embedded" within the ISA teams to provide targeted expertise.

Required Coordination Amongst the FSP and Other Programs

The FSP will clearly need to work closely with other elements of the fusion program and with the community funded by the DOE Office of Applied Scientific Computing Research. To provide early deliverables, the first physics software components employed will be largely adapted from physics codes already in use. The FSP would partner with existing groups, responsible for these codes, to adapt each to the frameworks and I/O standards required. Later on, development of new components could be carried out via similar partnerships or by groups working entirely within the FSP. New physics components may also require new physics formulation—the FSP will need to work closely with the theory community for these formulations, for providing analytic solutions for code verification and for interpretation of simulation results. Engagement with researchers in applied math and computer science will be essential to solve critical challenges including development of advanced components, along with methodologies for physics integration, verification and uncertainty quantification. Efficient exploitation of emerging high-performance computing platforms at the sustained petascale level and beyond (exascale platforms are likely to appear circa 2020) will require new algorithms and approaches. As with the physics components, this research would be carried out through a mix of partnership and dedicated development within the FSP. Next, there must be a close and ongoing collaboration between the FSP and the experimental facilities that provide essential run time for testing the codes. The FSP thus expects to work with facilities to plan, execute and analyze experiments, and to help define diagnostic needs. Finally, the FSP will need to work with a large user community—gathering and addressing problems, addressing their needs for new tools and assessing their priorities for new development. The BPO could be especially helpful in the coordination of FSP activities related to ITER and other international efforts.

Future Planning Activities

The FSP planning team has outlined a series of steps required to complete its task by July 2011.

1. Complete a first draft of the scientific program plan by January 30.
2. Work with DOE to develop the FSP management plan.
3. Hold a community workshop, February 8-11. This workshop will focus on:

a) Identifying challenges facing the FSP where research in applied math and computer science would be most appropriate and useful.

b) Assessing priorities and opportunities for experimental validation of FSP codes.

4. Final FSP Physics Advisory Committee meeting in March.
5. "Red" team assessment in April—a review by experts outside the fusion community.
6. Delivery of the final FSP plan to DOE, July.
7. DOE assessment and review, July-August.

Useful Links and Contacts

- FSP home page
- Science Drivers (The motivation, roadmap and resource requirements for a group of 6 potential ISA's were developed and extensively documented here.)

[1]For Further Information Contact

Bill Tang – Princeton Plasma Physics Laboratory
John Cary – Tech-X Corporation
Vincent Chan – General Atomics
Martin Greenwald – Massachusetts Institute of Technology
Jeff Hittinger – Lawrence Livermore National Laboratory
Arnold Kritz – Lehigh University
Doug McCune – Princeton Plasma Physics Laboratory
Arnold Siegel – Argonne National Laboratory and University of Chicago
Xianzhu Tang – Los Alamos National Laboratory

Announcements

Submit BPO-related announcements for next month's eNews to Tom Rognlien.

Upcoming Burning Plasma Events

2011 Events

March 1-4, 2011 NEW
ITPA MHD Topical Group Meeting
Ahmedabad, INDIA

March 7-8, 2011 NEW
Fusion Energy Science Advisory Committee (FESAC)
Bethesda, Maryland, USA

March 30 - April 1, 2011 NEW
ITPA Pedestal and Edge Topical Group Meeting
Cambridge, Massachusetts, USA

April 4-5, 2011
ITPA Transport & Confinement Topical Group Meeting
San Diego, California USA

April 6-9, 2011 NEW
Joint US-EU Transport Task Force (TTF) Workshop
San Diego, California USA

April 11-13, 2011 NEW
ITPA Energetic Particles Topical Group Meeting
Frascati, ITALY

April 11-14, 2011 NEW
ITPA Integrated Operation Scenarios Topical Group Meeting
JET, Culham, UNITED KINGDOM

April 11-14, 2011 **abstract deadline Dec. 23, 2010 email: sfp@fz-juelich.de**
Workshop on Stochasticity in Fusion Plasmas (SFP 2011)
Jülich, Germany

May 2-4, 2011 UPDATED
2011 International Sherwood Fusion Theory Conference
Austin, TX USA

May 9-13, 2011
13th International Workshop on Plasma-Facing Materials and Components for Fusion Applications (PFMC-13) and 1st International Conference on Fusion Energy Materials Science (FEMaS-1)
Rosenheim, Germany

May 15-19, 2011
15th International Conference on Emerging Nuclear Energy Systems (ICENES)
San Francisco, CA USA

May 16-19, 2011 NEW
ITPA SOL and Divertor Topical Group Meeting
Helsinki, FINLAND

May 23-26, 2011 NEW
ITPA Diagnostics Topical Group Meeting
FOM, NETHERLANDS

June 1-3, 2011
19th Topical Conference on Radio Frequency Power in Plasmas (CK Phillips and JR Wilson PPPL)
Newport, RI USA

June 20-24, 2011 NEW
ITER International Summer School on MHD and Energetic Particles
Aix en Provence, FRANCE

June 26-30, 2011
38th IEEE International Conference on Plasma Science (ICOPS) and the 24th Symposium on Fusion Engineering (SOFE)
Chicago, IL USA

Jun 27-Jul 1, 2011 NEW
38th European Physical Society Conference on Plasma Physics
Strasbourg, FR EPS

Fall 2011 NEW
ITPA Diagnostics Topical Group Meeting
CHINA

Sep 5-7, 2011 NEW
IAEA Technical Meeting on Theory of Plasma Instabilities
Austin, TX USA

Sep 8-10, 2011 NEW
IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems
Austin, Texas USA

TBA---tentatively scheduled NEW
ITPA MHD Topical Group Meeting
Padova, ITALY

Sep 11-16, 2011
10th International Symposium on Fusion Nuclear Technology
Portland, Oregon USA

Sep 19-21, 2011
Plasma Edge Theory Meeting
South Lake Tahoe, CA USA

October 5-7, 2011 NEW
ITPA Transport & Confinement Topical Group Meeting
Cadarache, FRANCE

October 5-7, 2011 NEW
ITPA Pedestal and Edge Topical Group Meeting
York, UNITED KINGDOM

Oct 16-21, 2011 UPDATED
15th International Conference on Fusion Reactor Materials (ICFRM-15)
Charleston, SC USA

October 18-21, 2011 NEW
ITPA Integrated Operational Scenarios Topical Group
Kyoto University, JAPAN

Nov 14-18, 2011
53rd APS Division of Plasma Physics Annual Meeting
Salt Lake City, Utah USA

December 2011 or January 2012 NEW
ITPA Divertor and SOL (PSI Selection Committee) Topical Group Meeting
Jüelich, GERMANY

December 12-15, 2011 NEW
ITPA CC & CTP-ITPA Joint Experiments Meeting
Cadarache, FRANCE

Directories of Other Plasma Events

IEEE Directory of Plasma Conferences
Fusion Ignition Research Experiment (FIRE) Physics Meetings

Please contact the administrator with additions and corrections.