Department of Energy
Washington, DC 20585

February 9, 2015

Dear Colleagues,

The Fusion Energy Sciences (FES) program is planning to hold a series of technical workshops this year in order to seek community engagement and input for future program planning activities. This letter describes the workshops, their objectives, and some of the organizational arrangements.

I had initially mentioned such workshops in my talk at the University Fusion Association Evening Session at the 56th Annual American Physical Society Division of Plasma Physics Meeting in October and also in my presentation at the Fusion Power Associates Annual Meeting in December. Subsequently we had a discussion in December with community leaders about these workshops, which was very helpful.

In addition, Congress has indicated its interest in scientific workshops for the FES program with the following language in the FY 2015 Appropriations Act: *"The Office of Science is further directed to seek community engagement on the strategic planning and priorities report through a series of scientific workshops on research topics that would benefit from a review of recent progress, would have potential for broadening connections between the fusion energy sciences portfolio and related fields, and would identify scientific research opportunities. The Department is directed to submit to the Committees on Appropriations of the House of Representatives and the Senate not later than 180 days after enactment of this Act a report on its community engagement efforts."*

The workshops are being planned in four areas. These are listed in the table below, along with the names of the chairs and co-chairs and the federal points of contact:

Workshop	Chair / Co-Chair	Federal POC
Integrated Simulations for Magnetic Fusion Energy Sciences	Paul Bonoli (MIT) / Lois Curfman McInnes (ANL)	John Mandrekas (FES), Randall Laviolette (ASCR)
Plasma-Materials Interactions	Rajesh Maingi (PPPL) / Steve Zinkle (U Tennessee)	Peter Pappano (FES)
Transients	Chuck Greenfield (GA) / Raffi Nazikian (PPPL)	Mark Foster (FES)
Plasma Science Frontiers	Fred Skiff (U Iowa) / Jonathan Wurtele (UC Berkeley)	Sean Finnegan (FES)

The first three of these workshops correspond to critical areas identified in the 2014 FESAC Strategic Planning and Program Priorities report as areas where increased emphasis would be beneficial as the fusion program moves further into the burning plasma science era:

- Developing an experimentally validated integrated predictive simulation capability that will reduce risk in the design and operation of next-step devices as well as enhance the value of participation in ITER,
- Understanding and controlling deleterious transient events that can disrupt plasma operation and damage fusion devices, and
- Addressing the extreme harshness of the burning plasma environment at the plasma-materials interface and finding solutions.

These three areas are very challenging scientifically and also offer opportunities to build upon U.S. strengths and potential partnerships with other Office of Science programs.

The fourth workshop area is that of Plasma Science Frontiers, which is comprised of the sub-areas of General Plasma Science, High Energy Density Laboratory Plasma, and Exploratory Magnetized Plasma. Given the FES stewardship of plasma science and the fact that Plasma Science Frontiers is a new category in the restructured FES budget, there is high value to holding a workshop in this area. Furthermore, given the very broad and diverse nature of this scientific area and the fact that two of the sub-areas have not yet had the benefit of a research needs type of workshop, the plan is to hold a series of two workshops in this area: the first one to identify compelling scientific challenges at the frontiers of plasma physics, and a second workshop to identify research tools and capabilities that exist presently, as well as the general requirements necessary to address these challenges in the next decade.

The objectives of the workshops being planned will depend on their specific topical areas. In general, the objectives will likely include elements from among the following: (1) review of progress and an update about new developments since the last time organized community input was obtained, (2) identification of gaps and challenges, along with specific parameters that would need to be achieved for addressing such gaps, (3) discussion of near- and long-term research tasks, such as experiments that could be performed on existing facilities, (4) descriptions of upgrades to existing facilities and diagnostic capabilities that would enable or enhance the research tasks, (5) identification of linkages to associated research areas, (6) descriptions and analysis of potential new activities for addressing the gaps and challenges, and (7) identification of areas for which modeling and simulation could be impactful.

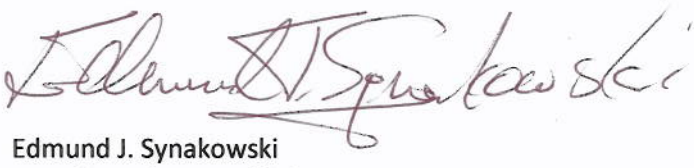
Enclosed with this letter are four "one pagers" that describe the background, objectives, and organization for each of the planned workshops.

Let me express our sincere appreciation to those who have agreed to assume leadership roles as chairs and co-chairs. We recognize that organizing these types of workshops requires a lot of time and effort, and it is our intention to help them in any way that we can. Each workshop has an FES point-of-contact person and, in the case of the integrated simulations workshop, we are pleased to partner with the Advanced Scientific Computing Research (ASCR) program within the Office of Science, which has provided an additional point-of-contact person.

We are counting on your assistance in making these workshops successful.

If you have any questions about the workshops, please feel free to contact any of the POCs.

Sincerely,



Edmund J. Synakowski
Associate Director of Science
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Office of Science

Enclosures

Workshop on Integrated Simulations for Magnetic Fusion Energy Sciences
Chair: Paul Bonoli (MIT), Co-Chair: Lois Curfman McInnes (ANL)

Background

Motivated by the opportunities afforded by the extraordinary advances in high-performance computing, the Fusion Energy Sciences (FES) program, in partnership with the Advanced Scientific Computing Research (ASCR) program, has supported a number of world-leading multi-institutional and interdisciplinary efforts in the last decade under the Scientific Discovery through Advanced Computing (SciDAC) program, addressing grand challenge problems in fusion energy sciences. While most of these efforts treat phenomena in relative isolation by taking advantage of scale separation, FES and ASCR have also supported efforts that have taken the first steps toward integration, recognized as the next necessary undertaking for developing credible predictive capability. FES and ASCR solicited community input several times during the last decade, including the 2007 Fusion Simulation Project workshop, a two-year fusion simulation planning study, the 2009 ASCR-led workshop on Scientific Grand Challenges and the Role of Computing at the Extreme Scale, and others. In addition, experimentally validated integrated simulation has been among the top recommendations of several Fusion Energy Sciences Advisory Committee (FESAC) and other community studies, including the Greenwald report, the ReNeW report, and the recent FESAC report on strategic planning.

Objective

The main goal of this workshop will be to review recent progress and identify gaps and challenges in fusion theory and computation directly relevant to the leading scientific opportunities for integrated simulations identified by previous community studies. In addition, the workshop should reassess these opportunities and adjust or broaden them appropriately, taking into consideration recent progress and using the criteria of urgency, leadership computing benefit, readiness for progress within a ten-year time frame, and world-leading potential.

The leading scientific opportunities identified by previous studies have been remarkably robust and consistent: the prediction, avoidance, and mitigation of major disruptions and the physics of the plasma boundary, with Whole Device Modeling as the long-term goal. These scientific priorities are also consistent with the findings of the recent FESAC report on strategic planning. The workshop will achieve its objectives by considering recent advances, including research tools and capabilities developed by the eight FES SciDAC Centers and computational expertise at the ASCR SciDAC Institutes; advances and associated challenges in emerging extreme-scale computing hardware; recent progress in verification and validation and uncertainty quantification; "big data" issues; and the emerging needs of ITER. Crosscutting issues such as the status of measurement capabilities that are relevant to the experimental validation mission will also be addressed through coordination with the other workshops in this series.

Organization

The workshop will follow the format of the successful Office of Science Basic Research Needs series of workshops. FES and ASCR will select the chair and co-chair(s), who will define the various workshop panels and sub-panels (including any crosscutting panels), and select the panel leads. The chair, co-chair(s), and panel leads will make up the Executive Group of the workshop. The panel leads will select the panelists and any sub-panel leads. The workshop report will be written by the chair, the co-chair(s), the panel leads, and by select panelists designated as writers. Input from the entire community will be solicited during the preparation for the workshop, and participation will be open, but the total number of attendees will be limited to preserve the "working meeting" character of the workshop. A substantial amount of work via teleconferences and other means will be done prior to the workshop to allow the preparation of a draft report during the last day of the workshop.

Workshop on Plasma-Materials Interactions (PMI)

Chair: Rajesh Maingi (PPPL), Co-Chair: Steve Zinkle (U Tennessee)

Background

Because of the importance of PMI science and the number of potential approaches to address the most relevant scientific issues, a multi-day workshop is planned in order to allow the research community to update and reassess the most critical scientific PMI questions that need to be answered (cf. MFE ReNeW report), and how best to answer these scientific questions.

The research needs for this issue are extraordinary, inviting innovation and vision for the development of solutions, while also achieving world-class scientific understanding. The recent Fusion Energy Sciences Action Committee (FESAC) strategic priorities report noted the importance of plasma-materials interactions science and proposed near term initiatives utilizing a linear divertor simulator, computation, and existing domestic and international toroidal facilities to help study this crucial area of fusion research. Previous community reports have also noted the need for a dedicated toroidal device to study PMI (cf. Research Needs for Magnetic Fusion Energy Sciences 2009, Opportunities for Fusion Materials Science and Technology Research Now and in the ITER Era 2012, Fusion Nuclear Science Pathways Assessment 2012, Prioritization of Proposed Scientific User Facilities for the Office of Science 2013), as well as calling for a linear device to unfold the science of plasma-materials interactions and boundary layer physics.

Objective

The goal of this multi-day workshop will be to engage the community of scientific experts working in the fields of materials, plasma-materials interactions, and boundary/edge plasmas and identify:

1. Compelling scientific questions in PMI that must be addressed in order to advance the field and achieve new scientific understanding and,
2. Options for addressing these scientific questions, including but not limited to new facilities, upgrades of existing facilities, validated computation, and international partnerships.

The community shall reassess the current state of knowledge and urgent scientific issues encompassed by the PMI thrusts from MFE ReNeW:

- Unfold the physics of boundary layer plasmas (Thrust 9)
- Decode and advance the science and technology of plasma-surface interactions (Thrust 10)
- Improve power handling through engineering innovation (Thrust 11)
- Demonstrate an integrated solution for plasma material interfaces compatible with an optimized core plasma (Thrust 12)
- Develop the materials science and technology needed to harness fusion power (Thrust 14)

Organization

The workshop to be held in the Spring of 2015 will be set up following the format of the successful Office of Science Basic Research Needs series of workshops and will serve as the primary means for broad community input. FES has selected the chair and co-chair, who will define the various workshop panels and sub-panels (including any crosscutting panels) and select the panel leads. The chair, co-chair, and panel leads make up the Executive Group of the workshop. The Executive Group selects the panelists and any sub-panel leads. The final report will be written by the chair, the co-chair, the panel leads, and by select panelists designated as writers. Participation in the workshop will be open, with a final report deadline at the end of June. A substantial amount of work via teleconferences and other means will be done prior to and after the workshop.

Workshop on Transients
Chair: Charles Greenfield (GA), Co-Chair: Raffi Nazikian (PPPL)

Background

It is well known that transient events such as disruptions and Edge Localized Modes can have deleterious effects on tokamak plasmas, with the potential to cause damage to plasma facing components and first wall structures, as well as degrading plasma performance. Although these events are generally tolerated in present tokamaks, they are predicted to have more severe impacts on ITER and future burning plasma devices. If not prevented or mitigated, these events will have unacceptable impacts on the operational availability of these devices and shorten the lifetime of the in-vessel components. It is critical to develop the means to minimize these events and their consequences when they do occur.

The fusion community, through the comprehensive ReNeW process (*Research Needs for Magnetic Fusion Energy Sciences,* 2009), developed a proposed research thrust in this area – "Control transient events in burning plasmas". Subsequent Fusion Energy Sciences Advisory Committee (FESAC) reports (*Report of the FESAC Subcommittee on the Priorities of the Magnetic Fusion Energy Science Program,* 2013 and the *Report on Strategic Planning: Priorities Assessment and Budget Scenarios*, 2014) have endorsed this as one of the highest priority magnetic fusion research topics. Several workshops have already been held to examine in more detail the underlying physics issues and specific aspects of the ITER disruption mitigation system, and the U.S. Burning Plasma Organization (USBPO) currently has an active task force coordinating research on this topic.

Objective

Building on the ReNeW effort, other workshop results, and the ongoing USBPO disruptions task force plans, this workshop will review recent progress and identify the remaining science and technology challenges that must be addressed to demonstrate that magnetically confined tokamak plasmas with the characteristics desired for a fusion power plant can be robustly produced, sustained, and controlled without deleterious effects on the device's materials and structure. Based on thorough understanding of the remaining science and technology challenges, the workshop will identify specific research opportunities that can address these challenges in the next decade. These may include both domestic research and international partnerships and will be informed by the requirements of ITER and future burning plasma devices.

Organization

The workshop will be set up following the format of the successful Office of Science Basic Research Needs series of workshops. Fusion Energy Sciences will select the chair and co-chair(s) who will define the various workshop panels and sub-panels (including any crosscutting panels) and select the panel leads. The chair, co-chair(s), and panel leads make up the Executive Group of the workshop. The panel leads select the panelists and (if necessary) any sub-panel leads. The workshop report will be written by the chair, the co-chair(s), the panel leads, and any panelists designated as writers. A multi-day workshop will be held that will allow for a vigorous discussion of the scientific and technical issues and opportunities in this area. A substantial amount of work via teleconferences and other means will be done prior to the workshop to allow the preparation of a draft report during the last day of the workshop. Input from the entire community will be solicited during the preparation for the workshop, and participation will be open, but the total number of attendees will be limited to preserve the "working meeting" character of the workshop.

Since transient events will also be a subject of interest to the integrated simulations' effort, the activities of this workshop should be coordinated as appropriate with related activities of the integrated simulations workshop, including sharing participants and possibly establishing cross-cutting panels.

Workshop on Plasma Science Frontiers
Chair: Fred Skiff (U Iowa), Co-Chair: Jonathan Wurtele (UC Berkeley)

Background
The reorganization of the Fusion Energy Sciences (FES) budget structure in FY 2015 brings together three program elements at the frontiers of plasma science–viz., general plasma science, high energy density laboratory plasmas, and exploratory magnetized plasma. These three activities support a rich and diverse portfolio of plasma science, sharing many common intellectual threads with the potential for broadening connections between the fusion energy sciences portfolio and related fields.

Objective
The Plasma Science Frontiers (PSF) activities in FES seek to engage the community of scientific experts working in the fields of general plasma science, high energy density laboratory plasmas, and exploratory magnetized plasma in a series of two community-led workshops to identify:

1. Compelling scientific challenges at the frontiers of plasma physics, and
2. Research tools and capabilities that exist presently, as well as the general requirements necessary to address these challenges in the next decade.

The report(s) generated from these workshops will inform FES in planning and executing its strategic vision for the FES stewardship of the PSF activities, taking into consideration the recommendations from the Fusion Energy Sciences Advisory Committee [1] and the National Research Council [2].

Organization
The first workshop, "Scientific Frontiers," will focus on identifying the grand scientific challenges in plasma science. The starting point will be the six critical plasma processes that were identified in the 2007 National Research Council plasma science report [2] as being not well understood: explosive instabilities, magnetic self-organization, turbulence and transport, correlations in plasmas, multiphase plasma dynamics, and particle acceleration and energetic particles. The goal of the workshop will be to bring together input received from across the community (via one-page white papers) on updates to the state of the art and where the frontiers are since the 2007 report.

The second workshop, "Research Needs," will focus on identifying the research needs required to address scientific challenges at the forefront of plasma physics. It will specifically address existing experimental tools and capabilities, as well as future performance requirements at the intermediate scale and computational hardware and software needs.

Both workshops will follow the format of the successful Office of Science Basic Research Needs series of workshops. FES will select the chair and co-chair(s), who will define the various workshop panels and sub-panels (including any crosscutting panels) and select the panel leads. The chair, co-chair(s), and panel leads will make up the Executive Group of the workshop. The panel leads will select the panelists and any sub-panel leads. The workshop report will be written by the chair, the co-chair(s), the panel leads, and any panelists designated as writers. Input from the entire community will be solicited during the preparation for the workshop, and participation will be open, but the total number of attendees will be limited to preserve the "working meeting" character of the workshop. A substantial amount of work via teleconferences and other means will be done prior to the workshop to allow the preparation of a draft report during the last day of the workshop.

[1] "Report on Strategic Planning: Priorities Assessment and budget scenarios" (2014)
[2] "Plasma Science: Advancing Knowledge in the National Interest" (2007)