2nd Announcement & Preliminary Program

Workshop on Burning Plasma Science: Exploring the Fusion Science Frontier

[http://w3fusion.ph.utexas.edu/bpsworkshop/]

11-13 December 2000
Austin, Texas

Sponsored by the University Fusion Association

IMPORTANT DATES AND NEW INFORMATION:

1) **BLOCKS OF HOTEL ROOMS AT SPECIAL RATES HELD UNTIL NOV. 30 - MAKE RESERVATIONS AS SOON AS POSSIBLE**

2) **PRE-REGISTER FOR THE WORKSHOP VIA WORKSHOP WEB PAGE: $15 PRE-REGISTRATION DISCOUNT FOR SIGN-UP BY DEC. 6.**

3) **PRELIMINARY PROGRAM OF PLENARY SPEAKERS AND BREAKOUT SESSIONS ISSUED.**

3) **FIVE BREAKOUT AREAS ESTABLISHED AND ORGANIZERS FOR EACH NAMED: CONTACT THE ORGANIZERS TO SUBMIT BRIEF ABSTRACTS FOR CONTRIBUTED PRESENTATIONS IN A BREAKOUT SESSION. SEE WORKSHOP WEB PAGE FOR MORE DETAILS.**

4) **FESAC PANEL ON BURNING PLASMA SCIENCE CHAIRED BY PROF. JEFF FREIDBERG WILL MEET AT AND ATTEND THE WORKSHOP.**

Purpose and Scope: Stimulated by the growing interest in the science of burning plasmas coming out of discussions at the 1999 Fusion Summer Study at Snowmass and the recent charge [5 Oct. 2000] to FESAC by the DOE Office of Science to "...address the scientific issues of burning plasma physics," the University Fusion Association (UFA) is sponsoring a Workshop on Burning Plasma Science, 11-13 December 2000, in Austin, TX, to provide a forum for in-depth community discussion of the critical scientific issues connected with burning plasmas. Based on progress achieved at this December workshop (which focuses on scientific issues), a follow-on workshop focusing on the technology of burning plasmas will be held next year.

The workshop is being organized by the UFA to be one of the primary sources of community input to the assessments of burning plasma science being carried out in the next year by FESAC and the Virtual Laboratory for Technology Next Step Options Advisory Committee. The emphasis of the workshop will be on burning plasma science issues in tokamak configurations, but discussion of burning plasma issues as they relate to other fusion concepts and more broadly to scientific areas outside of fusion energy will be strongly encouraged. Building on the progress made in discussing these issues at Snowmass 1999 as summarized in the report of the

Burning Plasma Physics Technical Subgroup and the Plasma Science Group [http://www.columbia.ap.edu/smproceedings or http://plasma.ep.wisc.edu/UFA/Download.html], the key questions which speakers and discussion leaders are asked to address are:

1) **What are the compelling scientific issues which could be addressed by a burning plasma experimental facility?**

2) **Identify those burning plasma scientific issues which are inaccessible for study in existing or near-term non-burning plasma experiments.**

3) **What is the present physics basis and confidence level in achieving burning plasma conditions? In particular, how have recent developments in theory and experiment affected our confidence in achieving burning plasma conditions?**

4) **How comprehensively can these burning plasma science issues be addressed establishing a firm basis for extrapolation in scale and magnetic configuration?**

5) **Are there compelling scientific issues outside of fusion energy which can be addressed by a burning plasma experimental facility?**

The workshop will be organized to provide time for in-depth discussion of proposed answers to these questions. A report summarizing the range of views and degree of consensus reached will be prepared.

Preliminary Program & Workshop Format: A mix of plenary and breakout sessions will be used (following the model developed at Snowmass), with parallel breakout sessions held in five topic areas. Two co-organizers for each breakout group will be responsible for arranging the program and leading the discussion. Prospective Participants interested in making presentations in one of the five topic areas are encouraged to send a title and very brief abstract of the proposed presentation by e-mail to the breakout area organizers listed below:

(1) Energetic Alpha-Particle Physics
Raffi Nazikian, PPPL (rnazikian@pppl.gov) and
James Van Dam, Univ. of Texas (vandam@peaches.ph.utexas.edu)

(2) Self-Heating, Transport, and Confinement at Reactor Scale
Bill Dorland, Univ. of Maryland (bdorland@kendall.umd.edu) and
Wayne Houlberg, ORNL (houlbergwa@ornl.gov)

(3) Macrostability in a Self-Heated Burning Plasma
Chris Hegna, Univ. of Wisconsin (hegna@cptc.wisc.edu) and
Ted Strait, General Atomics (strait@fusion.gat.com)

(4) Boundary Science
Daren Stotler, PPPL (dstotler@pppl.gov) and
John Wesley, General Atomics (wesley@apollo.gat.com)

(5) Relation of Burning Plasma Science to Other Fields
Amitava Bhattacharjee, Univ. of Iowa (amitava-bhattacharjee@uiowa.edu) and
Robert Rosner, Univ. of Chicago (r-rosner@uchicago.edu)

Preliminary Program

Monday, 11 December 2000

Plenary Session I [8:30 AM - 12:40 PM]

Stewart Prager, Univ. of Wisconsin, "How Generic is Burning Plasma Physics?"

Bill Heidbrink, Univ. of California-Irvine
"Fast-Ion Physics: What, Where, and Why"

Bruno Coppi, MIT
"Meaningful fusion burning regimes, relevant window of parameters and unresolved problems

Stewart Zweben, PPPL
"Issues in Burning Plasma Science"

Ted Strait, General Atomics
"MHD Stability Issues in a Burning Plasma"

Ed Synakowski, PPPL on transport and confinement issues

Breakout Session I [2:00 PM - 6:00 PM]

(1) Energetic Alpha-Particle Physics

(2) Self-Heating, Transport, and Confinement at Reactor Scale

(3) Macrostability in a Self-Heated Burning Plasma

Tuesday, 12 December 2000

Plenary Session II [8:30 AM - 12:00 PM]

Robert Rosner, Univ. of Chicago
"Burning Plasma Science in Astrophysics"

Daren Stotler, PPPL on Boundary Science Issues

Breakout Group 1 Status & Discussion

Breakout Group 2 Status & Discussion

Breakout Group 3 Status & Discussion

Breakout Session II [1:30 PM - 3:15 PM]

(4) Boundary Science

(5) Relation of Burning Plasma Science to Other Fields

Breakout Session III [3:30 PM - 6:00 PM]

(1) Energetic Alpha-Particle Physics

(2) Self-Heating, Transport, and Confinement at Reactor Scale

(3) Macrostability in a Self-Heated Burning Plasma

Wednesday, 13 December 2000

Plenary Session III [8:30 AM - 12:00 PM]

Plenary discussion of answers to 5 key questions from all 5 breakout groups.

Formulation of draft workshop summary.

Place and Time of the Workshop: The workshop will be held in the Applied Computational & Engineering Sciences (ACES) facility at the University of Texas-Austin (SE corner of 24th and Speedway Streets) from 8:30 AM to about 5:30 PM on Monday and Tuesday, December 11 and 12, and concluding by 1 PM on Wednesday, December 13.

Hotel Information: Blocks of hotel rooms are being held at the La Quinta Hotel (512-476-1166 or 800-642-4239 mention Group Code: 907-45371 for $70 rate) and Doubletree Hotel (512-479-4000 or 800-222-8733 mention Group Code: BPS for $70 government rate or $99 reduced rate). These rooms are being held through November 30, so please make your reservations as soon as possible.

Organizing Committee:

Gerald Navratil, Columbia University, Chair	navratil@columbia.edu
Amitava Bhattacharjee, Univ. of Iowa	amitava-bhattacharjee@uiowa.edu
Ray Fonck, Univ. of Wisconsin	fonck@engr.wisc.edu
Earl Marmar, MIT	marmar@psfc.mit.edu
Raffi Nazikian, Princeton University	rnazikian@pppl.gov
Jim Van Dam, University of Texas	vandam@peaches.ph.utexas.edu
John Wesley, General Atomics	wesley@gav.gat.com

Description of Topical Breakout Groups:

(1) Energetic Alpha-Particle Physics

Raffi Nazikian, PPPL (rnazikian@pppl.gov) and
James Van Dam, Univ. of Texas (vandam@peaches.ph.utexas.edu)

This topical group will endeavor to address the five key questions underlying this workshop by exploring the following suggested list of issues:

* What surprises in alpha particle transport might be encountered at the reactor scale.
* What the effects of alpha particles will be on macrostability--e.g., sawteeth, fishbones, etc.
* Whether alpha diagnostics will be adequate for exploring scientific questions, and what new alpha diagnostic development might be needed.
* What the impact of Alfven eigenmodes (TAE, BAE) and Energetic Particle Modes will be on transport, profile evolution, etc.
* What new alpha physics regimes are accessible with innovative concepts, and what is the extent of commonality among various devices-e.g., ST, stellarator, FRC, RFP, tokamak, etc.
* How RF control of plasma and wave interaction with alphas could be useful, e.g., for current drive, transport control, etc.
* To what extent alpha simulation experiments could be performed in present facilities to elucidate the above physics issues.

Other issues may also be discussed, as appropriate. Please feel free to make recommendations to the topical group coordinators.

(2) Self-Heating, Transport, and Confinement at Reactor Scale

Bill Dorland, Univ. of Maryland (bdorland@kendall.umd.edu) and
Wayne Houlberg, ORNL (houlbergwa@ornl.gov)

Questions to be addressed in this area include: What are the outstanding confinement issues related to the design and operation of a burning plasma experiment? To what extent do recent experimental and theoretical advances support a generic burning plasma design point? How well do we understand H-mode confinement at small rho* and/or small Mach number? In particular, what have we learned about confinement as it relates to pedestal performance, high density phenomena, density profile control, and profile stiffness? Good confinement seems to require transport barriers, either internally or near the edge of the plasma. Can transport barriers be produced and controlled in burning plasma conditions?

Other issues may also be discussed, as appropriate. Please feel free to make recommendations to the topical group coordinators.

(3) Macrostability in a Self-Heated Burning Plasma

Chris Hegna, Univ. of Wisconsin (hegna@cptc.wisc.edu) and
Ted Strait, General Atomics (strait@apollogat.com)

The Macrostability Topical Group will address the five questions of the workshop as they relate to issues of ideal and non-ideal MHD stability. (Issues of the interaction of MHD modes with alpha particles will be covered mainly in the Energetic Alpha-Particle Physics group.) The following questions may serve as a partial guide to the discussions:

* How confidently can we predict stability limits and growth rates in a burning plasma?
* Does possible scaling of MHD stability properties with rho-star (normalized ion gyroradius) or S (magnetic Reynolds number) require a burning plasma-class device to investigate?
* How might neoclassical tearing mode physics (threshold beta, seed island formation) vary in a burning plasma?
* What are the consequences of MHD instabilities (sawteeth, ELMs, tearing modes, etc.) in a burning plasma?
* What aspects of disruption physics (e.g., runaway electron generation) differ in a large, low collisionality plasma?
* Are proposed methods of active MHD control compatible with a burning plasma?
* What is the effect on MHD stability of core pressure profiles determined by alpha heating? of bootstrap current profiles consistent with alpha heating?
* Can the rotation profile of a self-heated plasma be predicted? How will it affect MHD stability?
* Which issues of MHD stability in a burning plasma are generic, and which are specific to particular magnetic confinement configurations?
* What are the opportunities and limitations for addressing any of these questions in existing devices?

Please note that this is not meant to be a complete list of issues, and suggestions for other relevant topics are welcomed.

(4) Boundary Science

Daren Stotler, PPPL (dstotler@pppl.gov) and
John Wesley, General Atomics (wesley@apollo.gat.com)

The edge parameters of current tokamaks are more than two orders of magnitude smaller than those required in a reactor. To bridge this gap, we will need well-tested predictive models of the plasma boundary. Some aspects of these models can be developed using non-burning plasma devices.

Others, such as those listed below, can only be tested in a D-T fueled, predominantly alpha-heated device. Only in such a device can the boundary and core plasma consistency required in a reactor be examined. Similarly, the effects of disruptions and related 'off-normal' plasma events at reactor scale will require a burning-plasma-capable device to assess.

Topics for presentation and discussion:
- Power and particle exhaust in the burning plasma regime
  * Characterization of PFC responses to plasma fluxes, including spatial and temporal peaks,
  * Understanding of radiative scenarios,
  * Development of models adequate for lower collisionality, e.g., that associated with advanced tokamak operation
- Consistency of boundary behavior with core plasma confinement,
  * Can no longer study the two independently since good core operation implies higher power levels,
  * Fueling and particle control needs for achieving required (e.g., higher than Greenwald) densities at high confinement.
- Tritium retention and removal
  * Makes use of graphite questionable
  * Options for burning plasma - compatible PFC materials and/or concepts
- Disruption effects at reactor-scale energies and ensuing plasma perturbations (impurity influx, runaway electron conversion)
- He transport, enrichment, pumping
- Impact of lost alphas on PFCs

Other issues may also be discussed, as appropriate. Please feel free to make recommendations to the topical group coordinators.

(5) Relation of Burning Plasma Science to Other Fields

Amitava Bhattacharjee, Univ. of Iowa (amitava-bhattacharjee@uiowa.edu) and Robert Rosner, Univ. of Chicago (r-rosner@uchicago.edu)

There are a number of physics issues in a burning plasma experiment that can possibly provide common ground between fusion and space and astrophysical plasma physics despite the fact that the plasma parameters in these diverse environments are often profoundly different. These include:

* the interaction of trapped and circulating alpha particles with Alfven waves and what such studies can teach us about the microstability of solar coronal and solar wind plasmas or the ballooning stability of magnetotail plasmas
* collisionless reconnection mechanisms underlying sawtooth oscillations (which can have a potentially deleterious effect on alpha particle confinement) and what they can teach us about analogous space and astrophysical phenomena such as magnetospheric substorms, impulsive solar flares, and the dynamo effect
* the transport of particles, energy and radiation in burning plasmas, involving, for instance, high-Z particle and radiation transport in a weakly collisional regime, the generation of energetic electrons in a high-current disruption, or the effect of local gradients of plasma flow on energy transport, and the implications of such findings in several space and astrophysical contexts.

If you have other ideas, please contact the topical group coordinators.