

# **Plasma2020 Decadal Survey**

**Fusion Energy Sciences Advisory Committee  
6 December 2018  
North Bethesda, MA**

**Mark J. Kushner, Co-Chair  
Gary Zank, Co-Chair**

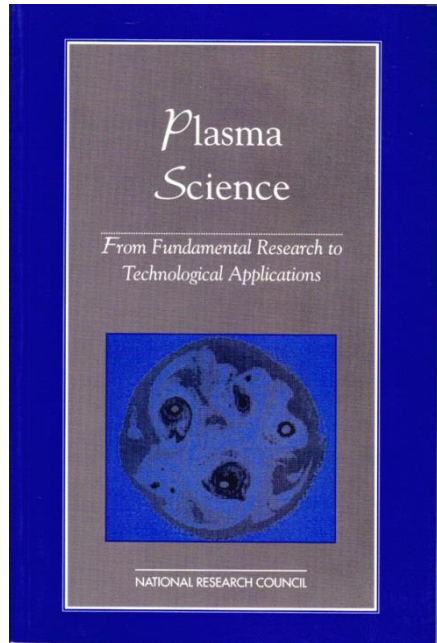
# PLASMA SCIENCE DECADAL STUDY

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- **...is the most influential assessment and projection for shaping the Federal government support structure for plasma physics.**
  - **Acknowledged as the authoritative publication for status of plasmas physics, and is heavily cited domestically.**
  - **Anticipated and frequently cited internationally.**
  - **Has multiple audiences.**
  - **Probably the single most found publication on the shelves of plasma focused agencies.**
  - **An opportunity to make a statement(s).**
- **Plasma 2020 will have credibility – enormously important to the field.**

# 1995 NRC REPORT: *PLASMA SCIENCE: FROM FUNDAMENTAL RESEARCH TO TECHNOLOGICAL APPLICATIONS*

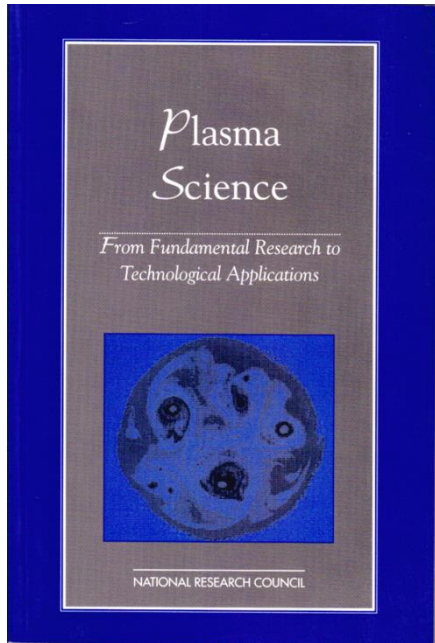
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- NRC Decadal Study on Plasma Science ([http://books.nap.edu/catalog.php?record\\_id=4936](http://books.nap.edu/catalog.php?record_id=4936))
- Recommendations
  1. To reinvigorate basic plasma science...emphasis should be placed on university-scale research programs.
  2. To ensure...availability of the basics...needed for the development of applications, [NSF] should provide increased support for basic plasma science.
  3. To aid the development of fusion and other...programs now supported by the DOE, BES with the cooperation of OFES, should provide increased support for basic experimental plasma science.

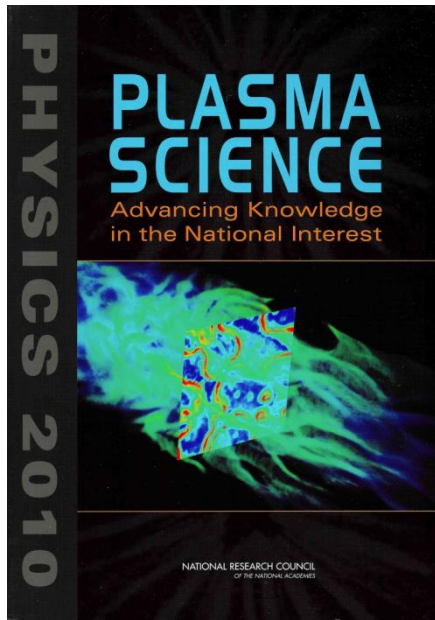
# 1995 NRC REPORT: *PLASMA SCIENCE: FROM FUNDAMENTAL RESEARCH TO TECHNOLOGICAL APPLICATIONS*

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4. **Approximately \$15 million per year for university-scale experiments should be provided...to...redress the current lack of support for fundamental plasma science. Funding ...should come from existing programs that depend on plasma science...**
5. **The agencies supporting plasma science should cooperate to coordinate plasma science policy and funding.**
6. **Members of the plasma community in industry and academe should work aggressively for tenure-track recognition of plasma science as an academic discipline, and work with university faculty and administrators to provide courses in basic plasma science at the senior undergraduate level.**

# ***2007 NRC Report: PLASMA SCIENCE: ADVANCING KNOWLEDGE IN THE NATIONAL INTEREST (PLASMA 2010)***



- **NRC Decadal Study on Plasma Science** ([http://www.nap.edu/catalog.php?record\\_id=11960](http://www.nap.edu/catalog.php?record_id=11960))
- ***Principal Conclusion:*** The expanding scope of plasma research is creating an abundance of new scientific opportunities and challenges. These opportunities promise to further expand the role of plasma science in enhancing economic security and prosperity, energy and environmental security, national security, and scientific knowledge.
- ***Principal Recommendation:*** To fully realize the opportunities in plasma research, a unified approach is required. Therefore, the Department of Energy's Office of Science should reorient its research programs to incorporate magnetic and inertial fusion energy sciences; basic plasma science; nonmission-driven, high-energy-density plasma science; and low-temperature plasma science and engineering.

# PLASMA 2020: STATEMENT OF TASK

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- 1. Engage stakeholders to collect perspectives on major achievements and challenges of past decade and most exciting and promising areas of plasma research for the next 10 years.**
- 2. Assess achievements of plasma science over the past decade.**
- 3. Identify major scientific questions and new opportunities noting connections to and the influence on other disciplines.**
- 4. Discuss the nature and importance of the U.S. role in multi-national plasma research activities.**
- 5. Assess the scope of international research across the breadth of plasma science and discuss the relative standing of U.S. activities.**
- 6. Discuss how plasma science contributes to U.S. national needs.**
- 7. Assess the present plasma science workforce.**
- 8. Assess opportunities for, universities in large national programs.**
- 9. Assess structure, program balance, and level of the current U.S. research effort in plasma science.**

# PLASMA 2020: STATEMENT OF TASK

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- Additional Requirement (and comments)

The study committee's recommendations should not alter recommendations from the *Decadal Strategy for Solar and Space Physics*, the mid-decadal assessment of that report, or the ongoing study on *Strategic Plan for U.S. Burning Plasma Research*. The committee may make recommendations or offer comments on organizational structure, program balance, and funding, as appropriate, with discussion of the evidentiary bases.

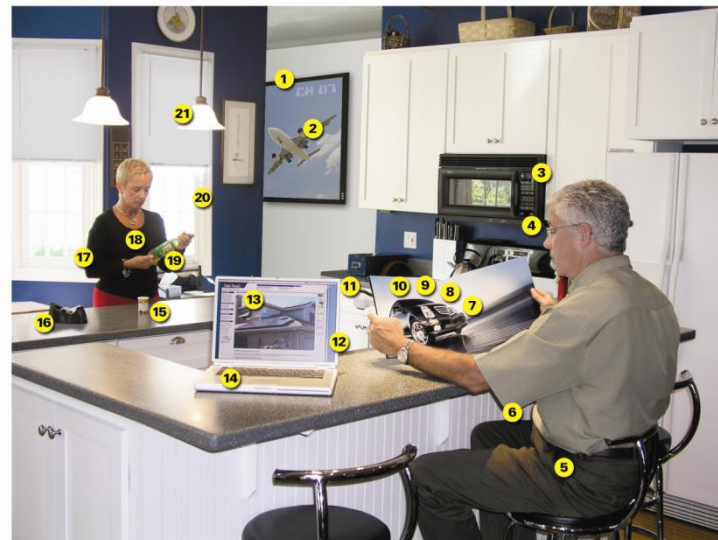
- **Comments**

- **Committee has been briefed on Burning Plasma Study – and will formulate policy on addressing recommendations based on released report (December 2018 – January 2020).**
- **DOE Office of Fusion Energy Science Planning Study recently launched – discussions ongoing with leadership.**



# PLASMA 2020: RELEVANCY AS A THEME

- The time may have passed when significant increases in support for plasma physics can be justified based solely on a problem being interesting or intellectually challenging.
- Moving forward, the plasma physics topics that will garner attention and support are those that:
  - Address fundamentally important science challenges
  - Address national needs.
  - Are relevant to something else – it probably cannot be just interesting science.
  - *A major theme of Plasma 2020 will be Relevancy.*



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|--|--|---|
| 01—Plasma TV                                   | 09—Plasma-aided combustion                           | 16—Plasma-treated polymers                            |
| 02—Plasma-coated jet turbine blades            | 10—Plasma muffler                                    | 17—Plasma-treated textiles                            |
| 03—Plasma-manufactured LEDs in panel           | 11—Plasma ozone water purification                   | 18—Plasma-treated heart stent                         |
| 04—Diamondlike plasma CVD eyeglass coating     | 12—Plasma-deposited LCD screen                       | 19—Plasma-deposited diffusion barriers for containers |
| 05—Plasma ion-implanted artificial hip         | 13—Plasma-deposited silicon for solar cells          | 20—Plasma-sputtered window glazing                    |
| 06—Plasma laser-cut cloth                      | 14—Plasma-processed microelectronics                 | 21—Compact fluorescent plasma lamp                    |
| 07—Plasma HID headlamps                        | 15—Plasma-sterilization in pharmaceutical production |   |
| 08—Plasma-produced H <sub>2</sub> in fuel cell |  |   |

## From Plasma 2010 Report:

Figure 1.3...Plasmas and the technologies they enable are pervasive in our everyday life. Each one of us touches or is touched by plasma-enabled technologies every day.



# COMMITTEE MEMBERS

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**Mark J. Kushner (NAE)**, *Co-Chair*, University of Michigan

**Gary Zank (NAS)**, *Co-Chair*, University of Alabama in Huntsville

**Amitava Bhattacharjee**, Princeton University

**Peter Bruggeman**, University of Minnesota

**Troy Carter**, University of California Los Angeles

**Christine Coverdale**, Sandia National Laboratory

**Cameron G. R. Geddes**, Lawrence Berkeley National Laboratory

**Gail Glendinning**, Lawrence Livermore National Laboratory

**Daniel M. Goebel (NAE)**, Jet Propulsion Laboratory

**David B. Graves**, University of California Berkeley

**Judith T. Karpen**, National Aeronautics and Space Administration

**Edward E. Thomas, Jr.**, Auburn University

Four additional members have been nominated and are awaiting approval (HED/ICF, MCF/Computations, Non-Neutral, AMO)

# PLASMA 2020 AUDIENCES

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- **Sponsors: DOE, NSF, AFOSR, NRL**
- **Federal agencies now focused, should be focused or utilize plasmas in applications: NNSA, ARO, EPA, NIH, FDA, USDA, FAA, NASA, NIST, National Labs**
- **Policy Advisors: OSTP, Other NRC Studies**
- **Congress – Members, committees, staffers**
- **US Professional Societies and NGOs: AAAS, APS, IEEE, WHO, AGU, EPS, AVS, and corresponding international organizations**
- **Industry: Materials, microelectronics, biotechnology, space, defense, advanced manufacturing, agriculture, energy, ...**
- **Private Science and Foundations: Alternate paths to fusion**
- **Related scientific fields to inform on potential benefits (e.g., plasma medicine, plasma-soft materials, quantum sciences)**
- **Computational Sciences and Advance Computing**

# ACTIVITIES SO FAR

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- **Committee Meeting: October 10-11, 2018 (Washington DC)**
  - **Sponsor perspectives**
  - **Briefing on Burning Plasma study**
  - **Congressional staffer briefing on recent legislation**
  - **Steve Cowley (Plasma2010 Chair)**
  - **Organizational discussions**
- **Town Hall: November 6, 2018, American Physical Society Division of Plasma Physics/Gaseous Electronics Conference, Portland, OR**
- **Briefing to Board on Physics & Astronomy, November 28, 2018**

## Upcoming

- **Committee Teleconference: December 7, 2018**
- **Committee Meeting: January 9-10, 2019 (Irvine, CA)**
  - **Presentations from topical experts**
  - **Committee discussions, writing assignments...**

# GATHERING INPUT

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- **Plasma 2020 website for submission of white papers**
- **Broadcast e-mailings to solicit white papers**
  - **Professional organizations and meetings**
  - **Societies**
  - **Personal distribution lists**
- **Town Hall Meetings**
  - **APS DPP/GEC, November 2018**
  - **Other meeting sites to be determined**
- **Virtual Town Halls**
- **Invitees to future meetings**
- **Visiting nexus of plasma physics - regionally**

# PROPOSED TOPICAL AREAS

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- ***Low Temperature***
  - Peter Bruggeman (Lead)
  - Dan Goebel
  - Mark Kushner
  - David Graves
- ***High Energy Density & Inertial Fusion***
  - Gail Glendinning (Lead)
  - Christine Coverdale
  - Cameron Geddes
  - *Nominated\**
  - *Nominated\**
- ***Magnetic Fusion***
  - Troy Carter (Lead)
  - Amitava Bhattacharjee
  - Ed Thomas
  - *Nominated\**
- ***Accelerators and Laser-Plasma***
  - Cameron Geddes (Lead)
  - Dan Goebel
- ***Space and Astrophysical***
  - Judy Karpen (Lead)
  - Amitava Bhattacharjee
  - Troy Carter
  - Gary Zank
- ***Basic Plasma Science and Computational Plasma Physics***
  - Amitava Bhattacharjee (Lead, Theory and Computation)
  - Troy Carter (Waves and flows)
  - Peter Bruggeman (Multi-phase)
  - Ed Thomas (Dusty/Complex)
  - *Nominated\** (Instabilities)
  - *Nominated\** (Spectroscopy)
  - *Nominated\** (Non-neutral)

\*Awaiting approval

# REPORT TIMELINE

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- **Current timeline is admittedly aggressive – dictated by 2-year funding window from start of activities.**
- **Current timeline provides less than 1 year for actual study, and so anticipate timeline will slip.**
- **Budget implications will be addressed**
  - **Zeroth Draft: April 15, 2019**
  - **First Draft: May 31, 2019**
  - **Draft for Review: July 31, 2019**
  - **Final draft of text after Review: October 31, 2019**



**For more information, please visit the study  
website at:**

**<http://nas.edu/plasma>**