BPA NEWS

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Setting Priorities for Large Research Facility Projects Sponsored by the National Science Foundation

The joint COSEPUP-BPA Committee on Setting Priorities for NSF-Sponsored Large Research Facility Projects, chaired by William F. Brinkman of Princeton University, released its final report in prepublication form on Wednesday, January 14, 2004, at a special briefing held at the National Academies' Keck Center. This article outlines the committee's key findings and recommendations.

In FY 1995, the National Science Foundation created the Major Research Equipment and Facilities Construction (MREFC) account to support the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets that cost more than several tens of millions of dollars. Although such large-facility projects represent less than 4 percent of the total National Science Foundation (NSF) budget, they are highly visible because of their large per-project budget, their potential to shape the course of future research, the economic benefits they bring to particular regions, and the prominence of the facilities in an increasing number of research fields.

The charge to the Committee on Setting Priorities for NSF-Sponsored Large Research Facility Projects was to examine NSF's current prioritization process and to provide recommendations for optimizing and strengthening that process. The study responds to a bipartisan request to the National Academies from members of the Senate Appropriations Committee and was also requested in the National Science Foundation Authorization Act of 2002.

The committee found that policy makers and researchers had a number of concerns about the existing process used by NSF and the National Science Board (NSB) to rank large-facility projects for funding. These concerns included:

- The ability of new projects to be considered for approval at the NSB level has stalled in the face of a backlog of approved but unfunded projects.
- The rationale and criteria used to select projects and set priorities among projects for MREFC funding have not been clearly and publicly articulated.
- The lack of funding for disciplines to conduct idea-generating and project-ranking activities.
- Once ideas have some level of approval, a lack of funding for conceptual development, planning, engineering, and design—information needed when judging whether a project is ready for funding in light of its ranking and for preparing a project for

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In this issue:

A New Era of Spectrum Management

Brian D. Dewhurst, BPA Program Associate

Since the passage of the Communications Act in 1934, the Federal Communications Commission (FCC) has been responsible for the licensing of spectrum use in the United States by any user with the exception of federal agencies. Such a system was effective through most of the twentieth century, as frequency space was available and the FCC served to prevent the overlap of services. However, as wireless technologies began to proliferate in the late 1980s and 1990s, the available frequency bands have diminished. Today's FCC must weigh the potential for new services against the needs of the established uses—making decisions that can affect billions of dollars worth of business in the U.S. economy. In this new wireless era, cracks are beginning to appear in the old regulatory process.

Recognizing the shift in usage, on June 6, 2003, the President issued a statement (http://www.whitehouse.gov/news/releases/2003/06/print/20030605-4.html) charging the Department of Commerce to head up a multiagency task force to review federal spectrum management policies. This task force has begun its work and is specifically addressing (1) facilitation of a modernized and improved spectrum management system; (2) facilitation of policy changes to create incentives for more efficient and beneficial use of spectrum and to provide a higher degree of predictability and certainty in the spectrum management process as it applies to incumbent users; (3) development of policy tools to streamline the deployment of new and expanded services and technologies, while preserving national security, homeland security, and public safety, and encouraging scientific research; and (4) development of means to address the critical spectrum needs of national security, homeland security, public

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Highlights of the Autumn Meeting of the Board on Physics and Astronomy

T.I. Meyer, BPA Program Officer

The Board on Physics and Astronomy (BPA) met October 31–November 1, 2003, at the Arnold and Mabel Beckman Center of the National Academies in Irvine, California. Chair Burton Richter and Vice Chair Anneila Sargent led the meeting. The meeting focused on a review of activities under the Board's auspices and discussions on several topics for potential new work.

After a hot breakfast, Burt Richter convened the meeting at 8:30 am with a welcome to the new members and a thank-you to all for traveling to attend the meeting. At the NRC, the BPA sits under the Division on Engineering and Physical Sciences (DEPS). Periodically, the Division reviews each of its Boards to assess its effectiveness, responsiveness, and the overall perception of the Board by others. The DEPS committee reviewing the BPA is chaired by William Press. Dr. Press attended the first day of the meeting in person to get an "eye-level" perspective of the Board's operations. During the morning executive session, the Board discussed the review process with Dr. Press. He emphasized that the review process is designed to be constructive. He explained that an important source of information for the review committee would be feedback from the science and policy communities with which the Board has interacted, including the federal research program agencies.

In open session, the Board heard a presentation about the final report of the Burning Plasma Assessment Committee (BPAC) from Raymond Fonck, new BPA member and co-chair of BPAC. The BPAC interim report played an important role in the Presidential decision for the United States to rejoin negotiations for the International Thermonuclear Experimental Reactor (ITER) project. The committee released its final report in prepublication form on September 26, 2003. During the ensuing discussion, Board members spoke of the importance of community-based priority setting for fusion science as well as the outlook for U.S. involvement in ITER amidst the tightening constraints on the budget. Members speculated about the role and potential success of a Department of Energy (DOE) Fusion Energy Science Advisory Committee-organized priority-setting exercise. Because of the importance of ITER to fusion science and the national science portfolio, the Board invited Michael Roberts from DOE's Office of Fusion Energy Sciences to speak about the status of international negotiations for ITER. (See "Burning Plasma: Bringing a Star to Earth" elsewhere in this issue for more details about this report and ITER.)

The Board then took up the topic of the next decadal survey of physics, tentatively entitled *Physics 2010*. It was widely felt that the Board should provide each of the eventual study committees that will be formed to assess each branch of physics with guidance in order to facilitate preparation of a coherent overview. In particular, the role of setting science priorities within each discipline was discussed. The regular process whereby the astronomy and astrophysics community establishes priorities for large-facility projects in its decadal survey was identified as exemplary. Each branch of physics, however, has a unique mix of culture and large-facility experience, making the problem more complex for physics. The role of the overview and synthesis volume was also discussed, and various members expressed strong support for the final wrap-up study addressing physics as a whole. The Board concluded that the draft guidelines for *Physics 2010* studies were a strong start and that each study committee should be encouraged to consider the question of scientific priorities.

Moving forward from the discussion on priority setting and the disciplines of physics and astronomy, Board member Lee Magid presented a status report for the Committee on Setting Priorities for NSF-Sponsored Large Research Facility Projects (chaired by William Brinkman of

Princeton University), on which she and Board member Joseph Taylor both serve. Because the committee's work was still in progress, the session was closed. Dr. Magid described the motivation for the study and the originating letter from members of the Senate Appropriations committee. She then described the draft recommendations of the committee and convergence on the key notions of roadmapping, large-facility portfolio planning, overlapping categories of criteria, and external review.

After lunch, the BPA heard a report from Michael Turner, newly appointed director of the Mathematics and Physical Sciences Directorate (MPS) at the National Science Foundation. Dr. Turner commented on the recent symposium *The Universe from the Ground Up*, citing it as a good outreach and education effort that raised the bar for these activities. He went on to describe a new task with which he and DOE Office of Science director Raymond Orbach had charged the joint DOE/NSF High Energy Physics Advisory Panel. The activity will be chaired by Persis Drell and will identify the leading questions that are driving high energy physics; the report will consider the breadth of approaches, which include both telescopes and accelerators, he said. Dr. Turner described the health of high energy physics as one of the challenges NSF faces because the field has been traditionally so dependent on DOE for large-facility funding. Other challenges that MPS faces are the maintenance and operation of existing large facilities, selection and construction of new large facilities, long-range planning, mid-scale instrumentation, and cyberinfrastructure needs. In particular, MPS is looking forward to the recommendations of the Brinkman committee as large-facility projects are a rapidly growing component of MPS activities. He also said that the relationship between the Major Research Equipment and Facilities Construction account and the Research and Related Activities account at NSF is being reexamined. New models for supporting long-term operations of facilities are under consideration; the model for "square pulse" construction funding may have to be revised. Finally, he suggested that, with the host of exciting science opportunities facing MPS, some prioritization and planning will be necessary to make the tough choices. Responding to a question from the Board about the placement of the Division of Materials Research within NSF, Dr. Turner said that he would be meeting with these parties soon to get acquainted with their perspectives and had no specific impressions yet.

Changing the subject to cosmology, Dr. Turner then presented a brief update on the problem of dark energy. He described the latest hot item, the Sachs-Wolfe effect, as a secondary effect on the general model of an accelerating universe; essentially, the Sachs-Wolfe connects the Doppler-shifting of a cosmic microwave background photon to its trajectory in such as way as to give rise to a correlation between the large-scale structure of the universe and the anisotropy of the cosmic microwave background, assuming the dark energy does not cluster. That is, in an accelerating universe, the blue-shifting and the red-shifting of the photon passing through clusters of galaxies do not exactly cancel. This subtle effect has been observed using the latest and highest quality data from the Wilson Microwave Anisotropy Probe and the Sloan Digital Sky Survey, but the errors bars still dominate the signal. Dr. Turner then commented on other recent evidence using the Hubble Space Telescope to study other supernovae; new data suggest that there was a period of past slowing in the expansion of the universe. During the ensuing question and answer period, Dr. Turner commented that NSF does not foresee a role for itself in the Joint Dark Energy Mission effort as there is no clear added-value if NSF were to participate. He did suggest that the Large Synoptic Survey Telescope might present such an opportunity.

James Langer, a condensed matter theorist from the University of California at Santa Barbara and vice president of the National Academy of Sciences, then spoke with the Board by telephone. He discussed the status of and prospects for a proposed study on large facilities. Everyone agreed that the project had significant merit in its goal of evaluating the case for large facilities in science. The Board concluded that the upcoming announcement by DOE's Office of Science about its 20-year facilities plan may reduce the need for such a study. The Board then discussed with Dr. Langer the issue of condensed matter theory and the difficulties in sustaining funding therein. These difficulties were felt to be a subset of the larger problem of how to support innovative research throughout physics and materials science. Even established researchers have trouble getting involved in a new field where other researchers hold sway or getting new ideas to be recognized, especially when resources are limited. The Board agreed that condensed matter theory and experiment should remain connected in the funding process. The discussion turned to how to

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Committees of the Board on Physics and Astronomy

Committee on Astronomy and Astrophysics
Wendy L. Freedman, Carnegie Observatories, and
Roger D. Blandford, California Institute of Technology, *Co-chairs*

Committee on Atomic, Molecular, and Optical Sciences
Pierre Meystre, University of Arizona, *Chair*

Plasma Science Committee
Cary B. Forest, University of Wisconsin at Madison, *Chair*

Committee on Radio Frequencies
Donald Backer, University of California at Berkeley, *Chair*

Solid State Sciences Committee
Lee Magid, University of Tennessee at Knoxville, *Chair*

Committee on Smaller Facilities
Robert Sinclair, Stanford University, *Chair*

Committee on Opportunities in High Magnetic Field Science
Peter B. Moore, Yale University, *Chair*

More information on BPA committees may be found on the BPA Web site at <www.national-academies.org/bpa>.

NSF Priorities (continued from page 1)

funding if it is selected.

Those concerns have eroded confidence among policy makers and the research community that large-facility projects are being ranked on the basis of their potential returns to science, technology, and society.

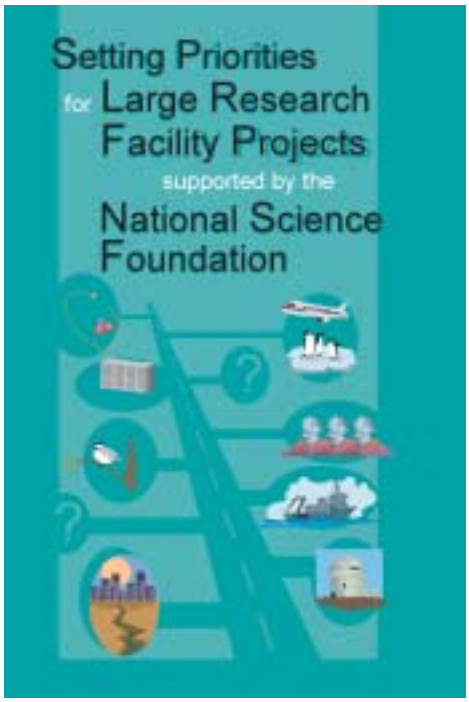
In its report, the committee develops five recommendations and proposes a six-step process to implement those recommendations. These committee recommends that

• NSB should oversee a process whereby NSF will develop a 10- to 20-year roadmap for large facility projects.
• Three categories of criteria—scientific and technical, agency strategic, and national—should be used to rank projects within disciplines, sets of disciplines, and across all fields.
• New starts should be ranked in the annual budget request using a clear rationale based on the roadmap.
• NSF should support enhanced project preapproval planning and budgeting.
• The new NSF deputy of large facility projects position should undergo internal and external review in 2 years.
• OSTP should coordinate roadmaps across agencies and countries.
• NSF leadership and NSB should pay careful attention to implementation of proposed reforms, as outlined in the committee's six-step process.

In studying existing roadmaps, particularly those in other countries, the committee found that roadmaps provided greater opportunities to involve the entire research community in the priority-setting process, presented a clear vision of the large research facilities likely to be needed in the future, provided increased emphasis on planning the best possible portfolio of facilities, and created a more visible image of the program. Roadmaps are an important approach for large-facility projects because such projects cannot be judged in isolation from the greater context and because a roadmap provides vision and rationale for management of a broad and sophisticated portfolio of activities.

The roadmap recommended by the committee would be based on broad input from the research community and take into consideration the need for continued funding of existing projects. It would provide a set of well-defined projects for the near term (0-10 years) and incorporate a reasonable projection of the large facility project budget over the next two decades. Potential new-start projects would be ranked against others according to where they are positioned in time on the roadmap.

Once a roadmap is in place, NSF, with the approval of NSB, should base its annual MREFC budget submission on the roadmap. The budget submission should include a 5-year outlook with yearly expenditures as well as a detailed rationale for each project and its ranking. Any differences between the roadmap and budget submission should be carefully explained.



The committee determined that three overlapping categories of criteria should be used to rank proposals for large research facility projects.

In the first stage of review and ranking, researchers in a given field or interdisciplinary area should determine which proposals have the greatest scientific potential within that domain. Reviewers also should assess the technological readiness of proposals, the scientific credentials of a project's leading scholars, and the proposal team's project-management capabilities. The second stage of ranking should take place within NSF's seven major units, or directorates. Each directorate oversees work in a set of related scientific fields. A proposal that survives the first stage would be sent to the senior leaders of the appropriate directorate, who should determine—with guidance from the directorates' advisory committees—how well the proposal meets NSF's strategic goals. The directorates should consider the potential impact of projects on scientific advances within related fields, and whether proposals include opportunities to aid researchers from multiple disciplines or to facilitate interdisciplinary research. The potential for U.S. workforce development and for interagency or international collaboration should also be key criteria at this stage.

In the third and final stage of ranking, NSB, working with NSF's director and its senior staff, should assess all proposals that withstood the directorates' review, using criteria that emphasize broad, national goals. Reviewers should consider, for instance, whether proposals are in new or emerging fields of research that could transform science or engineering and whether projects could help maintain U.S. leadership in critical areas. In this final stage, the board also should consider the impact of various projects on current national priorities and on the balance of research across fields in NSF's portfolio. NSB should then, in consultation with NSF's director and its senior staff, select and rank projects for funding. The crriteria could change as government-wide initiatives and unexpected events shift priorities. NSB could decide to place greater emphasis on certain issues at particular times. But key questions and issues should generally be identified before the ranking process begins.

In its report, the committee outlines a six-step process that provides actions NSF and the NSB could take to enhance the existing process based on the committee's recommendations:

1. Involve the broad research community in identifying, evaluating, and rank-

ing ideas for large-facility projects.
2. Select projects for conceptual or proposal development.
3. Develop and maintain a comprehensive long-term roadmap.
4. Support the development of a technical definition and implementation plans for projects on the roadmap.
5. Use the roadmap to develop annual budget requests and 5-year projections for large-facility projects.
6. Conduct internal and external oversight of the implementation of large-facility projects.

The development of the technical definition and implementation plan for projects is critical for the ultimate success of the projects on the roadmap. These projects may or may not have been approved by NSF for inclusion in the budget, but the development work on them should still take place.

First, project development should be phased and guided by the roadmap. Projects that appear early in the roadmap should be more advanced than those that appear later. The importance of carefully defining the project's technical scope and implementation plan cannot be overemphasized. The near-term projects should move from preconceptual phase to a clear technical definition of what is to be built and what is to be achieved. Further, implementation plans should be developed that clearly describe how the project will be constructed, managed, and operated. This process should be overseen by the NSF deputy for large-facility projects to ensure readiness for construction and operation.

Once a project has been funded, internal and external oversight of the implementation of the project are needed. During construction and operation, projects should be reviewed periodically by an independent panel of science, engineering, and project management experts appropriate to the project. Once the facility is in operation, review panels should supplement normal internal reviews to assess progress and project performance and provide evaluations to NSF and NSB.

NSF's deputy for large-facility projects should oversee the each project's implementation and monitor the transition from construction to operation. The deputy for large-facility projects should have adequate staff and resources to assure NSF and NSB that proper project management is in place and that work is progressing on schedule and budget. (Mark Coles was appointed as the first NSF deputy for large-facility projects in June 2003.) Because of the importance of this new position, the office and its personnel should be reviewed in 2 years by a committee of internal and external experts.

NSF now has an opportunity to strengthen the program further by incorporating the preparation of a roadmap into its planning process and by involving the research community more fully in the generation and ranking of ideas for large research facilities. Making choices among competing proposals from different scientific fields will never be easy, the committee concluded, but the recommendations and detailed steps it describes can help NSF to excel in this critical part of its mission.

Committee chair William F. Brinkman and committee members Lee Magid and Marc Pelaez briefed Washington policymakers on the report. They met with the NSF Director's Office, members of the NSB, and staff from the House Science Committee, the Senate Commerce Subcommittee on Science, Technology, and Space, the House and Senate Appropriations Subcommittees, and officials from the White House's Office of Management and Budget and OSTP. The briefings were well received; many recognized the use of a roadmap as an effective tool to organize NSF's large-facility projects portfolio.

Since the public release of the report, press coverage has included write-ups in *Science*, *Science and Government Report*, *The Scientist*, *Washington Fax*, and *Chronicle of Higher Education*. Under the same law that helped originate the study, the NSF Authorization Act of 2002, NSF has about 3 months from the time of the release of the committee's report to prepare a written response to Congress about the report's findings and recommendation. The NSB has agreed to take up the report at its mid-February retreat.

The prepublication version of the committee's final report is available online at http://www.nationalacademies.org/nsf-priorities. ■

Burning Plasma: Bringing a Star to Earth

T.I. Meyer, BPA Program Officer

The U.S. fusion science research program has reached a critical opportunity in its long history. Significant advances have been made in the past several years in magnetic confinement fusion science, and many of the compelling questions are now answerable only with a burning plasma experiment. A burning plasma—a large-scale plasma physics experiment in which at least 50 percent of the energy to drive the fusion reaction is generated internally—is an essential step for advancing the underlying science and technology of fusion science. To assist in making the decision about whether to undertake a burning plasma experiment, in part because of the large investment required, the Department of Energy (DOE) asked the NRC to assess the importance of a burning plasma experimental program, the readiness to undertake such an experiment, and the U.S. plan for doing so. The NRC was also asked to recommend a program strategy aimed at maximizing scientific and technical understanding as the foundation for future fusion energy development. In December 2002, the NRC released an interim letter report recommending that the U.S. proceed with a burning plasma experiment and that it rejoin the International Thermonuclear Experimental Reactor (ITER) partnership.

The development of fusion as a source of power is a multidecade enterprise. It is subject to many unknowns—both technical and societal—that are beyond the scope of this committee's charge. Indeed, DOE has not yet established a clear program strategy for fusion (and hence did not

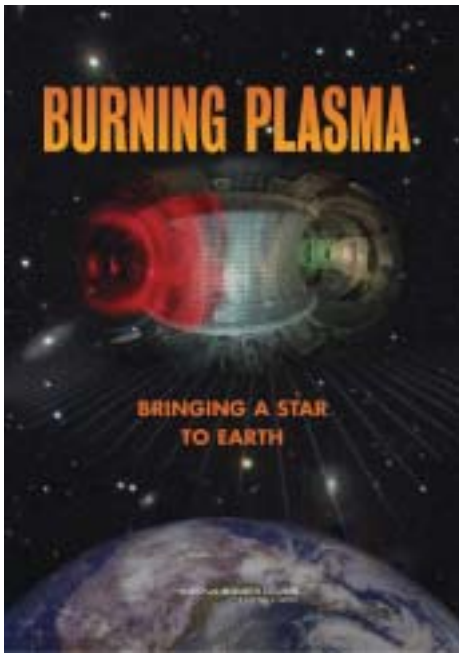
present one to the committee), in part because the plans for an international burning plasma experiment have been in flux for the past few years. The committee's goal was, nevertheless, to define a program approach that will optimize the near-term productivity of the U.S. fusion program and position it for development in the future at levels deemed appropriate at that time. To that end, the committee reached several conclusions:

• A burning plasma experiment is critically needed to advance fusion science. The committee is pleased that the U.S. government has rejoined the International Thermonuclear Experimental Reactor (ITER) negotiations, which the committee expects to be successful. If the negotiations are not successful, progress toward fusion energy will require moving ahead with some other kind of international burning plasma experiment.

• Undertaking a burning plasma experiment cannot be done on a flat budget. If the United States is interested in the long-term goal of fusion as a source of economical, sustainable energy and not only in the ITER effort, the nation needs a science program based on some of the existing facilities; a technology program; a computation, simulation, and theory program; and a university program. At a minimum, to capture the benefits of a burning plasma experiment, an augmentation of the U.S. program covering all of the U.S. ITER construction and operating costs would be required in the near term.

• If negotiations proceed successfully, the fusion science program will move ahead with the ITER endeavor. In doing so, the fusion community should focus on the opportunities that this development will present and accept limitations on the level of activity possible within reasonable budget constraints. It is necessary to recognize that some of today's facilities will have to be shut down over time and that not all alternate concepts are affordable. Priorities will be set. Although this committee was not tasked to set them, it does recommend that the community take part in a real prioritization process for the fusion program. The Office of Fusion Energy Sciences must take the lead and bring the community to consensus.

The ITER project, however, should not be the sole element of a balanced U.S. fusion program. Investigation of critical plasma physics and stability issues is also required. Many of the important scientific and technical issues are best addressed by non-burning-plasma research facilities of both the tokamak and non-tokamak variety in parallel with the ITER project. In addition, a robust theory and simulation program coupled with experimental verification is needed. All of these



elements of the U.S. fusion program are essential and coupled.

In preparation for ITER participation, some of the current pre-ITER R&D in the U.S. fusion science program should be coordinated with international partners and the ITER negotiation process. Furthermore, international partnerships should extend beyond ITER and other tokamaks to alternative fusion configurations.

Responding to personnel needs in the era of the burning plasma experiment should also be a focal point of the U.S. program. The recruitment, training, and retention of scientific and technical talent are crucial elements of that program. Those universities engaged in fusion science research will play a crucial role in this connection.

As the ITER project develops, an augmentation in fusion science funding will be required in addition to direct financial support of ITER construction. A balanced program for fusion energy research is not possible without a credible and achievable multiyear funding plan that fits within federal spending constraints. To avoid the risk of the United States becoming a follower rather than a leader in fusion energy development, a funding trajectory is required that both captures the benefits of joining ITER and retains a strong scientific focus on the long-range goal of the program.

The addition of the ITER project will require that the content, scope, and level of U.S. fusion activity be defined by program balancing through a priority-setting process initiated by the Office of Fusion Energy Science (OFES). Not every existing or envisioned research activity can or should be supported unconditionally by OFES. The OFES effort should be based on a rigorous evaluation of U.S. fusion program science priorities with broad input from the fusion community. A clear, ordered list of activities to be pursued should result from this process.

Identification of important scientific and technology questions that can be addressed in extended campaigns should be the goal of the fusion community. A prioritized list of these campaigns would be very helpful in generating support for their pursuit.

Whatever strategy the fusion community adopts to address this scientific challenge, it should be flexible, innovative, and inclusive in achieving the required balance for success.

Response and Followup

The final report of the committee was released on September 26, 2003. Committee co-chairs Raymond Fonck and John Ahearne were in Washington to brief government officials. At the October 2003 Division of Plasma Physics meeting of the American Physical Society in Albuquerque, New Mexico, Ray Fonck and several committee members

presented the committee's findings and recommendations to the fusion community. At the town meeting, appreciation for the difficulty of the committee's job was expressed, but concerns were rasied about the uncertain future. To what degree could the community trust that ITER efforts would not overwhelm other aspects of the DOE plasma program, some asked. The committee members reiterated the need for a science prioritization process to help build the case for ITER and outline the extent of other necessary activities. Reactions continued to be mixed, however. At the November 2003 meeting of DOE's Fusion Energy Sciences Advisory Committee (FESAC), John Ahearne presented a summary of the committee's report. The advisory board appreciated the committee's efforts and started drafting a letter in formal response. FESAC also discussed the new charge received from Ray Orbach, director of the Office of Science at DOE. He called upon FESAC to identify the major science and technology issues that need to be addressed, recommend how to organize campaigns to address those issues, and recommend the priority order for these campaigns under three different funding scenatios. In his charge letter, Dr. Orbach requested a response before the end of July 2004. A subpanel has been formed under FESAC to address this charge. At the same meeting of FESAC, a visiting OSTP official urged the panel to consider its task carefully and with due time and attention. Saying that OSTP's physical sciences group had spent an "extraordinary amount of time" on formulating U.S. policy regarding ITER, he was particularly supportive of the BPAC report as an excellent basis on which to move forward, saying "we are endorsing the NAS report and many of the conclusions it drew."

Also in November 2003, DOE's Office of Science released its 20-year science facility plan, a roadmap for future scientific facilities to support the department's basic science and research missions. The plan prioritizes 28 projects, including both new, major scientific facilities and upgrades to existing facilities. Topping the list as the highest priority within near-term commitments was U.S. participation in ITER. The administration's policies are optimistic about fusion energy.

The 2005 presidential budget request to Congress for OFES is modest. According to the documents released on Feburary 2, 2004, the "fusion energy sciences program continues to implement the recommendations of the reports by the National Research Council, the Secretary of Energy Advisory Board, and recommendations of the Fusion Energy [Sciences] Advisory Committee." The budget request includes $38.0 million for the department to prepare for participation in ITER, although the overall level of support for the program is $264 million, comparable to estimates of the 2004 appropriations levels.

Status of ITER

ITER negotiations have continued to develop since the committee released its interim report in December 2002, endorsing U.S. involvement in the international project. The total number of international partners now numbers six (China, European Union, Japan, Russian Federation, South Korea, and the United States), after the formal withdrawal of Canada in late December 2003. On November 26, 2003, the European Council of Research Ministers agreed to propose the Cadarache site in France as the EU candidate site for ITER. The administrative headquarters of the EU team would be located in Spain. This decision was long overdue according to some pundits, but it indicated the EU's continued commitment to ITER. The remaining site contender is Rokkasho-mura in Japan, about 600 miles north of Tokyo.

At a December 4 and 5 meeting at the Vienna headquarters of the International Atomic Energy Agency, another milestone was achieved. Cost-sharing and procurement allocation arrangements were agreed upon by all ITER parties. At a December 20 meeting hosted by Secretary Abraham in Washington, D.C., ministers of the participating countries were slated to select the final ITER site. However, consensus was not reached: the United States and Korea backed the Japanese site at Rokkasho, and China and Russia supported the European Union's site at Cadarache in France. Negotiators asked France and Japan to answer questions about the technical merits of each site, and to consider making the experimental reactor into part of a larger, international fusion-research package. The broader program would examine, for example, how the reactor walls of a future fusion power plant would stand up to radiation damage or the development of critical superconducting magnet technologies. The estimated cost of such a program would be about $800 million, and might serve as compensation for the country that doesn't host the tokamak istelf. The ministers agreed to reconvene in late February 2004 in the hope of selecting the ITER site.

In early January, the United States publicly supported the Japanese site with statements by the Secretary of Energy. Soon afterward, France and the EU announced that if Japan won the site selection contest, it might withdraw from negotiations and undertake its own separate burning plasma experiment. Since then, Russia and South Korea have declined to publicly support Japan, while China has opted to support the French bid. Meanwhile, partners in ITER have cancelled the meeting scheduled for late February at which the siting decision was to have been made. The delay has been caused by continued deadlock over the choice between France and Japan as host for the project. Holding another ministerial-level meeting that concluded without a site decision was deemed by some to be too risky. Recent discussion has been overshadowed by the perception that the United States is supporting Japan out of a desire to punish France for its lack of support for U.S. Iraq policy. Meanwhile, the European Union and Japan are engaged in talks aimed at finding common ground. One possibility might involve the European Union offering South Korea and Japan support for projects ranging from genomics to neutron science, if they (in turn) will support the French bid to host ITER.

The back room doors have been swinging in both directions as the parties brace themselves for what may be the final opportunity to select a site for ITER and, ultimately, the last chance to keep the project moving forward. ■

Spectrum Policy (continued from page 1)

safety, federal transportation infrastructure, and science.

To cover this broad charge, the task force includes participants from the Departments of State, Treasury, Defense, Justice, Interior, Agriculture, Commerce, Transportation, Energy, and Homeland Security, as well as the National Aeronautics and Space Administration, the Office of Management and Budget, and the Office of Science and Technology Policy. Its report is due this coming June, and the public comment period closes on March 18, 2004. The progress of the task force can be followed at its Web site, http://spectrumreform.ntia.doc.gov/. The National Telecommunications and Information Administration (NTIA), the division of the Department of Commerce responsible for the task force, has stated that the task force's report will be the beginning of a 10-year effort to wholly revamp the spectrum management process. ■

CORF's Changing Role

Brian D. Dewhurst, BPA Program Associate

The Committee on Radio Frequencies (CORF) is a unique activity within the NRC. It performs a vital service for those scientific fields that depend on access to the radio portion of the electromagnetic spectrum. Portions of the radio spectrum are allocated for various uses through a labyrinthine process at both the international and federal levels. CORF monitors and participates in this process at a number of points and believes it is necessary to expand its activities further in the coming years.

CORF works at the intersection of a number of fields. The committee's primary constituencies are the radio astronomy and Earth remote sensing fields, but they also include oceanography, wildlife telemetry and tracking, and other disciplines. These scientific endeavors all require that certain frequencies be set aside for passive or active sensing and remain free of interference. Freedom from interference is especially important for the fields where passive sensing is utilized. A subcommittee of CORF (CORF-Strategy) recently held a 2-day meeting at the University of California at Berkeley to identify the needs of the scientific community and the ways in which CORF could best serve its constituency.

CORF's primary function is to monitor the regulation and management of the radio spectrum and provide input to the regulatory process when necessary. In the recent past, this activity has absorbed most of the committee's time and energy. However, the growth of wireless technologies has led to a variety of new threats to the scientific uses of the spectrum. The committee believes that to perform its mission it needs to become increasingly active in a variety of new ways, and to change the current reactive stance to a more proactive posture.

CORF-Strategy's first conclusion was confirmation of the importance of the committee's input to the FCC's regulatory process. CORF is often the lone voice raising scientific concerns but is recognized by the FCC as the consensus view of the scientific community, and as such its comments are given considerable weight in the regulatory process. This activity is the bedrock on which any other activities must be based.

The current set of spectrum allocations has grown organically since the Radio Act of 1912. As new spectrum uses and techniques have been invented, they have been granted licenses to operate at certain frequencies. Scientific uses have been recognized for decades, but their current allocations are based on the historical techniques and interests of separated constituencies. Today's researchers use the spectrum in different ways, and at different frequencies, than their predecessors. CORF-Strategy believes that it is time to conduct a comprehensive study that will survey the current spread of scientific activity and bring attention to the needs and benefits of such research. The NRC's Governing Board approved such a project in 2003, and the BPA is approaching several sponsors to support this effort.

During the CORF-Strategy meeting, Mike Davis of the SETI Institute, a consultant to the committee and former CORF chair, relayed his concerns about the manner in which the U.S. position at the last World Radio Conference (WRC) was developed. In the idealized process, each community with a stake in spectrum issues develops a position statement. These statements are presented to the U.S. delegation to the WRC, which uses them to develop the final position of the United States. A group called Working Party 7D (WP 7D) is assigned to develop a position for radio astronomy—though participation in the working party is open to anyone. In recent years, representatives of industrial concerns and other competitors have attended WP 7D meetings in increasing numbers, to the point that actual radioastronomers are in the minority at these meetings—effectively stifling the voice of radio astronomers in developing the national position. Working Party 7C—the corresponding group for Earth remote sensing community—has also seen a rise in "outside" participation, though it has yet to reach the same level as for WP 7D.

This situation is affecting the interests of radio astronomers worldwide. At the WRC, a proposal to study the potential for new radio quiet zones elsewhere in the world was defeated by the strong opposition of the U.S. delegation that did not have sufficient input from the domestic radio astronomy community. A new radio quiet zone may be necessary for the operation of the next generation of radio observatories, such as the Square Kilometer Array (SKA) or the Low Frequency Array (LOFAR), neither of which is likely to be sited in the United States. The position taken by the United States at the WRC was not helpful to the international reputation of the U.S. radio astronomy community.

In response to these concerns, CORF-Strategy concluded that members of CORF should discuss the Working Party 7D issue with the diplomats at the State Department who represent the United States at the WRC. No solution has yet been identified, but by opening a dialogue the concerns in the community will be voiced. In addition,

See "CORF Strategy" on page 11

Smaller Multiuser Facilities in Materials Research

The Committee on Smaller Facilities (COSF) was established by the National Research Council (NRC) with support from the National Science Foundation and the Department of Energy to review the current state of small and mid-sized multiuser facilities for materials research within the United States, to make recommendations about methods for optimizing the operation and use of existing resources, and to consider strategies and actions needed to ensure efficient and successful facility operation in future years. Although they play a major and widely recognized role in materials research in this country, it is generally thought that small and mid-sized materials research multiuser facilities (called simply smaller facilities herein) are not being optimally developed or utilized. The NRC's 1999 report *Condensed Matter and Materials Physics: Basic Research for Tomorrow's Technology* found that a greater burden now falls on small research centers in universities and government laboratories and that it is appropriate to strengthen this part of the nation's research infrastructure. Smaller facilities appear to face many issues in common, yet a study has never focused specifically on them.

There was a recognized need, therefore, for a study to be carried out to collect data on these facilities and to recommend methods for using existing resources more effectively and more efficiently. Of concern are the scientific opportunities in a broad cross section of disciplines that might be missed because of these issues and perceived problems. Furthermore, the developments in instrumentation that take place in smaller facilities underpin critical tools for industry, and these facilities have an important educational role for future industrial scientists and engineers.

As a consequence of the great diversity of smaller facilities for materials research in the United States, COSF has a broad membership that includes expert individuals with university, national laboratory, and industrial backgrounds. It also includes facility users, managers, and directors. The collective expertise encompasses a wide range of condensed matter and materials physics.

The full committee first met in May 2003. At this meeting, presentations were made by senior personnel with experience in operating user facilities in both university and government laboratory settings. The committee also heard from various agencies currently providing extensive support for instrument acquisition and facility operation. The major outcomes of this meeting were the formulation of a preliminary definition of smaller facilities, the establishment of the general areas of investigation, and the identification of a plan of action to gather information about a broad range of facilities by a series of site visits to be carried out during the summer of 2003.

During summer 2003, subgroups of the committee, generally consisting of 2-3 committee members plus an NRC staff officer, visited various user facilities around the country. The purpose of these visits was primarily to gather some first-hand experience relating to planning, operation, and maintenance of typical smaller facilities. In order to minimize the time commitment involved, and to ensure maximum effectiveness, it was decided to target geographical areas that had clusters of similar facilities. Five separate site visit trips were carried out, concentrating on the approximate geographical areas of Boston, upstate New York, Illinois, the San Francisco Bay Area, and the Pacific Northwest. A total of 47 facilities were visited. In order to ensure that broadly similar information was obtained from each facility, a site visit protocol was established.

The full committee convened again in October 2003. At this meeting, the experiences and impressions gained by the various subgroups were shared. Several presentations were made relating to the operation and organization of smaller facilities and the need for staff training. Extensive discussions followed relating to the development of a vision statement, a working definition of a smaller facility, the characteristics of successful facilities and best practices, current and future issues relating to facility operation, and future committee activities. The committee decided that it should develop, and distribute as widely as possible, a questionnaire that would survey operation of existing user facilities within the materials community.

In addition to dissemination of an interim report in early 2004 and widespread distribution of a questionnaire to facilities around the country, the committee will be conducting a series of town hall meetings during the spring, coinciding with annual meetings of the major related scientific societies (e.g., the American Physical Society meeting in March and the Materials Research Society meeting in April). The purpose of these open meetings will be to provide opportunities for discussion of the various issues identified in this report and to gather feedback from the community. The committee will then reconvene as a whole in late May 2004 to prepare the draft of its final report. ■

BPA Meeting (continued from page 3)

best leverage the technological contributions of condensed matter physics while still paying tribute to its nature as fundamental physics with profound basic science at its heart. Finally, the committee discussed the role of the peer review process in the trend toward increasingly conservative research directions and began to ask whether procedures and practices could be found that encourage support of innovative research within that process.

Lee Magid, as chair of the Solid State Sciences Committee (SSSC) and member of the Board, presented a status report. She first congratulated SSSC member Anthony Leggett on his receipt of the 2003 Nobel Prize in Physics. The SSSC is developing several new project ideas including a study on biomolecular materials and processes that will be carried out jointly with the Board on Life Sciences; she also discussed the committee's thoughts on the upcoming condensed matter and materials physics volume of the *Physics 2010* survey. She then described the progress of the Committee on Opportunities in High Magnetic Field Science. Robert Sinclair of Stanford University, chair of the Committee on Smaller Facilities, presented a short progress report on his committee. Finally, Dr. Magid described developments at the recent SSSC meeting where the need for a study of advanced materials synthesis was identified. In the ensuing discussion, the Board wondered if the SSSC's name adequately reflects the breadth of its concerns and activities.

The first day of the BPA meeting ended with a science presentation from Walter Munk of the Scripps Institute of Oceanography about ocean water levels, deep water mixing of temperature and composition, and the tidal effects of the moon. An expert and pioneer on these topics for many years, he discussed the latest debates over different ocean water mixing models, including transference of angular momentum from the Earth to the Moon, wave-scattering off ocean floor topographies that gives rise to turbulence, and thermal and density changes due to global warming.

The second day of the BPA meeting was convened by Anneila Sargent, vice chair of the Board. The morning began with a science presentation by Donald Backer of the University of California at Berkeley's astronomy department. He presented some highlights of recent observations about massive black holes and analyses of pulsar timing, the highlight of which was a digital movie of observed stellar orbits around a massive black hole at the center of our galaxy. Dr. Backer is also chair of the Committee on Radio Frequencies (CORF); he presented an update on these activities as well. CORF has filed public comments on recent spectrum management issues ranging from broadband internet transmissions over powerlines to vehicular radar systems. With a new era of spectrum policy management dawning, CORF will be examining its modus operandi in the coming year, he concluded. In discussion, the Board agreed that CORF activities were essential and that the impending workforce crisis was very troubling; ideas were suggested for help in "the fight to preserve the spectrum for scientific use."

The connections between the physical and life sciences were then discussed in a panel format with the purpose of better understanding the issues of increasing communication and collaboration between these fields. Board member William Eaton launched the session with a description of the similarities and differences between the cultures of the physics and life sciences, a key ingredient in getting to know one another, he said. Jose Onuchic of the University of California at San Diego discussed the physics of complex systems in his work with protein folding. He emphasized that "every page of a standard biology textbook contains exciting challenges for the physics community," and urged physicists to get involved in the new frontier of biological physics. Steven Block of Stanford University discussed the challenges of 21st century biophysics. He compared the National Institutes of Health (NIH) and the NSF as funding agencies and described a new Institute of Physics journal, *Physical Biology,* that may bridge the communications gap between the fields. Corey Goodman, chair of the Board on Life Sciences, then made some remarks via telephone. Although the actual practices of physicists and biologists are quite different, he said, it might be appropriate to consider working together from the education side. The final panel member, John Whitmarsh of NIH, described efforts to enhance quantitative biology through a biological physics initiative at NIH; he suggested a workshop as one way to get started.

In the ensuing discussion, it was suggested that some of the problems of communication between the two disciplines have their origins in the nature of the disciplinary education that biologists and physical scientists receive. Board member Carl Wieman proposed a study to define the graduate training of the future that would be appropriate for those wishing to work at the intersection of the physical and life sciences. One of the objectives of such a program would be to equip biologists and physicists with the conceptual tools to exchange ideas effectively as well as to perform forefront research. Some were skeptical about the potential for success of trying to define a curriculum but it was agreed that a small group would pursue these ideas further.

In the final session of the meeting, Pierre Meystre of the University of Arizona, as chair of the Committee on Atomic, Molecular, and Optical Sciences, presented a status report on the new *AMO 2010* project . The proposal for this volume of *Physics 2010* has been submitted and is under consideration by the agencies. The Board again addressed the challenge of setting priorities in the decadal assessment and outlook studies. Although AMO science does not rely heavily on large facilities, grand challenges or compelling questions could be identified. It was agreed that extreme prioritization of science topics could remove the opportunity for innovation and discovery. Cary Forest of the University of Wisconsin at Madison and chair of the Plasma Science Committee presented a similar status report on the *Plasma 2010* project. Initial conversations with agencies have been positive, and the proposal will be submitted shortly.

The meeting wrapped up with a summary from vice chair Anneila Sargent. The Board adjourned at 12:30 p.m. for a luncheon on the sunny outdoor patio of the Beckman Center. ■

CORF Strategy (continued from page 8)

CORF-Strategy directed the staff officers to forward the filings and other CORF statements to a broad group of interested parties outside the United States. This effort is designed to communicate the issues that CORF (and by extension the radioastronomy community in the United States) is facing and their positions on these issues.

In addition to international communication, CORF-Strategy concluded that the committee and staff should pursue a wide range of new communication and dissemination efforts. Electrical engineers working in industry (especially those below the management level) have been quite friendly to scientific concerns when informed about them. Many engineers used scientific instruments during their undergraduate training and remember the experience. In the coming months CORF intends to produce a number of products that will inform the engineering community about scientific uses, and it will provide references to more detailed information for use in their designs.

To disseminate these documents, CORF-Strategy identified a number of scientific and engineering professional societies that it believes are vital to contact. This list includes the American Astronomical Society, the American Geophysical Union, the American Meteorological Society, the Institute of Electrical and Electronics Engineers, the Geoscience and Remote Sensing Society, and the International Union of Radio Science (URSI). These societies could be valuable partners, helping educate their memberships about spectrum management and the needs of the scientific community and providing additional feedback to the FCC in support of scientific uses of the spectrum.

Through these and other new outreach activities, CORF-Strategy hopes that the full committee will be able to educate and inform other spectrum users about the needs of passive users early in their planning processes. By working with other users, CORF may be able to reduce the need for contentious decisions in the FCC regulatory process. ■

Physics 2010 Gets Under Way

T.I. Meyer, BPA Program Officer

The Board on Physics and Astronomy periodically conducts a comprehensive assessment and outlook activity for all of physics. The most recent survey was completed in 2001 with the publication of the overview volume, *Physics in a New Era.* It is important to realize, however, that the physics survey activity (including assessments of the various branches of physics conducted serially) spans almost a decade itself. Regular surveys of physics and astronomy have been conducted for more then four decades. They serve not as only important exercises in assessment and planning, but also as detailed snapshots that capture the spontaneous growth of each subfield.

To examine each discipline, a committee is convened under the Board and, with the guidance of the appropriate standing committee, it considers the progress of the field and identifies new and emerging opportunities. After the disciplinary committees have finished their work, an overview committee synthesizes the reports into a coherent whole that provides a vision for all of physics. In this cycle of the decadal survey, the BPA is proposing the production of popular booklets to capture the promise and excitement of each field's future for the general public. The Board has discussed general guidelines for *Physics 2010*, including emphases on identifying science drivers, highlighting connections with other fields and and agencies, and framing an outlook for the future of each field.

The standing Committee on Atomic, Molecular, and Optical Sciences (CAMOS) and the Plasma Science Commitee (PLSC) have prepared proposals for their respective science assessment and outlook projects, AMO 2010 and Plasma 2010. The Solid State Sciences Committee (SSSC) is developing a plan for the condensed matter and materials physics volume. A related workshop at the upcoming American Physical Society's March meeting in Montreal will help inform the discussions. As the first decade of the millennium unfolds, stay tuned—with such a large effort under way, you may be involved before you know it! ■

BPA Calendar: Upcoming Meetings in 2004

March	
3/25	COSF presentation at APS meeting, Montreal, Canada
3/27-28	COHMAG meeting, Washington, D.C.
April	
4/2-3	PLSC meeting, Washington, D.C.
4/8-9	SSSC meeting, Washington, D.C.
4/8-9	CORF meeting, Washington, D.C.
4/13	COSF presentation at MRS meeting, San Francisco, Calif.
4/16-17	BPA meeting, Washington, D.C.
May	
5/14-15	CAMOS meeting, Washington, D.C.
5/17-18	CAA meeting, Washington, D.C.
5/22-23	COSF meeting, Washington, D.C.
October	
10/2-3	PLSC meeting, Irvine, Calif.
10/21-22	SSSC meeting, Irvine, Calif.
November	
11/6-7	BPA meeting, Irvine, Calif.
11/15-16	CAMOS meeting, Irvine, Calif.
11/30-12/1	CAA meeting, Irvine, Calif.

THE BPA Web site at **www.national-academies.org/bpa** provides news on recently released reports and other developments as well as a link to this newsletter in PDF format. Reports may be ordered at **www.nap.edu.**

Recent Reports:

Report of the Committee on Setting Priorities for NSF-Sponsored Large Research Facility Projects

Burning Plasma: Bringing a Star to Earth

Coming Soon:

Letter Report of the Committee on Opportunities in High Magnetic Field Science

Interim Report of the Committee on Smaller Facilities

Board on Physics and Astronomy
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