

**Directorate for Mathematical and Physical Sciences
Advisory Committee Meeting Minutes
April 7-8, 2005**

Thursday, April 7, 2005
Morning Session

Welcome and Introductions

Dr. W. Carl Lineberger, Chair, called the meeting of the Directorate for Mathematical and Physical Sciences Advisory Committee (MPSAC) to order at 8:00 AM. After those present had introduced themselves (Attendees are listed in Appendix I), he asked Dr. Michael S. Turner, Assistant Director of the Directorate for Mathematical and Physical Sciences (MPS) to speak to the current state of the MPS Directorate and to the goals of the meeting. .

State of the Directorate, Goals of the Meeting

Turner began his presentation by noting that the MPSAC would discuss and receive the reports from the meetings of the Committee of Visitors (COVs) for the Division of Astronomical Sciences (AST) and the Division of Materials Research (DMR). In addition, a major aspect of the meeting would be on broadening participation, with the focus on the status of women in the mathematical and physical sciences at academic institutions. There would be a discussion of the FY 2005 and FY 2006 budgets, and this was also the final opportunity for MPSAC input on the FY 2007 budget. He would also be looking for input from the MPSAC with respect to searches for Division Directors in the Division of Chemistry (CHE) and the Division of Mathematical Sciences (DMS).

Turner then provided an update on the status of the FY 2005 and FY 2006 budgets. The President had signed NSF's FY 2005 budget, and the budget was 3.2% less than that of FY 2004. Research and Related Activities was 1.7% below the amount that had been provided in FY 2004. This was only the fourth time in fifty years that NSF's budget had been decreased, but he noted that there had been many pressures on the Veterans Administration (VA), the Housing and Urban Development (HUD) Agency, and the Independent Agencies area of the budget.

NSF's FY 2006 budget request was 2.4% more than the FY 2005 appropriation, with Research and Related Activities increasing by 2.7% in comparison with FY 2004. This was relatively positive in comparison to the budget requests of other agencies. There was now a new appropriations subcommittee structure in the House, and NSF and the National Aeronautics and Space Administration (NASA) were now reviewed by the new Science, State, Justice and Commerce Committee. Most observers in Washington believed this move of NSF and NASA to this new committee was a positive move. He noted that this Committee had held hearings on the NSF budget a few weeks ago, and at these hearing there had been very positive words from both parties. There had not yet been a hearing before Senate's Commerce, Justice and Science subcommittee.

With respect to the budgetary outlook, Turner noted that NSF was now almost three billion dollars behind what had been the target when the budget of NSF was doubling. NSF could expect flat or small growth in the budget for the next four to five years. The President and Congress recognize NSF's important role in science but the current budget climate, the Federal deficit of about four hundred billion dollars, and priorities such as the war on terrorism, homeland security, and the economy meant that budget would be held relatively level. In spite of this MPS had to insure that the most compelling science was done and one had to manage within very tight budgets. MPS had to maintain the capability of responding to new opportunities that were put forward by the community. In addition, the MPS workforce had to reflect the diverse face of the United States.

In discussing MPS strategies under such budget constraints, MPS needed to have a strong flexible core (with fewer targeted solicitations), and it was likely that MPS would be supporting a decreasing numbers of centers. There would be increasing support of the Large Hadronic Collider (LHC) and the Gemini Telescopes, but there would be a ramping down of support for the Cornell Electron Storage Ring (CESR).

Highlights of the MPS budget request included maintaining and protecting the core with significant investments in the Physics of the Universe, the Math-Science Partnership, Nanoscale research, cyber infrastructure, theory, and the Molecular Basis of Life processes.

With respect to facilities, there were budget increases requested for the Large Hadronic Collider (LHC), the Gemini Telescopes, and the National Superconducting Cyclotron Laboratory (NSCL). The Atacama Large Millimeter Array (ALMA) and Ice Cube (at the South Pole) were under construction, and the Rare Symmetry Violating Processes (RSVP) project was a new start. Funds for the Advanced Laser Interferometric Gravitational-Wave Observatory (LIGO) was in the budget request with a new start projected for FY 2008. MPS was investing in the future with design and development funding for a number of potential projects.

Turner returned to a discussion of the FY 2005 budget and noted that funding for all of the Divisions except for Mathematical Sciences (which had been held level) had declined. The issue of support for facilities had been discussed at the MPS Senior Staff Retreat, as one had to balance the need against flat budgets, design and development costs, and operating costs. This affected all of the MPS divisions, including those that did not have facilities.

Turner then provided the MPSAC with an update with respect to the RSVP project. NSF investments were to be complementary to Department of Energy (DOE) investments, and NSF costs had been predicated on the concept that only small incremental costs were needed to modify the Alternating Gradient Synchrotron (AGS) at Brookhaven. Initial project costs had aimed at a design and development budget of \$14 million, a construction cost of \$145 million, and an operations budget for five years at approximately \$12 million per year. Congress had provided \$14.8 million in the FY 2005 budget for this project but a recent baseline review had revealed the possibility of very significant cost increases, approximately double what had previously been estimated for construction and operations. The National Science Board (NSB) had been informed of this situation in December 2004. The Office of Science and Technology Policy (OSTP), the Office of Management and Budgets (OMB), the Department of Energy, and Congressional Committees were also briefed. Turner commented that baseline activities were continuing, and he noted that if cost changes are significant then the entire project must be reevaluated for its scientific value. There were three possible outcomes: recosting, rescoping; or termination of the project. NSF would make a decision based on the results of the baseline review and the joint NSF/DOE High Energy Physics Advisory Panel (HEPAP) assessments. He expected that a recommendation on the project would be made to the NSB by September 2005. The recommendation would impact high energy physics, MPS credibility, and NSF.

Turner then provided an update on NSF activities related to the concept of a Deep Underground Science and Engineering Laboratory (DUSEL). Proposals had been received for site planning, and there would be a down-select to three or four planning grants of \$500,000 each that would be awarded in the Spring/Summer 2005. The final site selection was planned for 2006. A subcommittee of HEPAP and the Nuclear Science Advisory Committee (NSAC) would be looking at possible experiments that could be conducted in the proposed laboratory.

With respect to cyber, investments were growing and NSF was requesting \$509 million in FY 2006. The NSF Director is leading the development of a cyberinfrastructure vision and strategic plan. With respect to interactions between NSF's Education and Human Resources (EHR) Directorate and MPS, the Acting Assistant Director of EHR, Dr. Don Thompson, had met with Turner and both were committed to an enhanced collaboration between the two directorates. A joint senior staff meeting had been held and three joint working groups had been created: Evaluation and Education Research, Connecting Research-Embedded Experiences/curriculum and Informal Science Education, and Broadening Participation.

In the discussion that followed, Dr. Sol Gruner stated that he had the impressions that Congress was increasing its scrutiny of the NSF's management of large projects. Turner responded that NSF had responded to the Congress, to OMB, and to OSTP, and they had been favorably impressed with the response. NSF was working on a revised facilities plan. Dr. David Morrison asked if there had been progress in increasing the staff within MPS. Dr. Judith Sunley responded that in 2005 and additional 25 positions were requested and approved, and the FY 2006 budget request had a request for an additional 25 staff. Turner commented that MPS was making the case to NSF that it needed resources. In response to a question from Dr. Frances Hellmann concerning support for operations of

facilities, Turner presented the facility budget for 2004 –2006 and noted that in planning for facilities, MPS was now including consideration of operation costs out to 2020 and was also including the incremented research costs.

Report from the Theory Workshop of 10/27-10/28 2004

In introducing Dr. Thomas Appelquist of Yale University, Chair of the Theory Workshop and a former MPSAC member, Lineberger commented that the action before the MPSAC was to review and accept the report, and that he expected action and feedback by MPS on the report (Appendix VI).

Appelquist began by recognizing the hard work of the steering committee in planning the workshop and writing the report. The workshop had had many participants across all of the fields of MPS, and he proceeded to review the report and its recommendations.

With respect to science and its support, the report noted the importance of inquiry-driven research and the breadth of the research being conducted in theoretical areas in MPS fields. There had been much discussion and concern about the relative mix of modes of support. The workshop recommended that MPS should monitor and develop metrics to determine the appropriate balance between the various modes of support. The duration and magnitude of theory grants should be increased, and support for theory should be included within major or moderate programs and facilities. The workshop felt that MPS should continue to support activities started the Information Technology Research initiative. The report noted that program officers were overworked and that help was needed to deal with this problem.

With respect to education and training it was felt that the Division of Undergraduate Education (DUE) in EHR should expand its program of faculty workshops. The workshop felt that within CAREER there was too much emphasis on K-12, that more focused summer schools, that more data was needed for graduate students in theory, and that there should be support for summer programs for gifted high school students in science and mathematics.

Appelquist noted that in the area of broadening participation there were no particular issues for theory but there were many issues that touched theory. The workshop recommended that NSF should support childcare expenses for conference and travel grants, and provide incentives for the provision of childcare in universities and institutions. MPS should also monitor diversity in meetings, panels, and other activities for which it provides support.

There was a strong feeling within the workshop that NSF should do more to publicize theoretical research.

Appelquist then discussed the division-specific recommendations. He noted that these recommendations were very different from division to division, and not all of the recommendations received the same scrutiny.

With respect to the Division of Astronomical Sciences (AST), the divisional session was well organized and had a set of recommendations in place early. Many of these recommendation resonated with the general recommendations of the workshop discussed earlier. Turner asked if there had been a recommendation that AST create a separate theory program. Appelquist replied that the workshop had said “no” to such a concept. Within the Division of Chemistry (CHE) session there was considerable discussion of improving and increasing support for theory. Within the Division of Materials Research (DMR) session there were recommendations on outreach and changing the names of the theory program. In the Division of Mathematical Sciences (DMS) session there was the problem of finding support for the many researchers who were with support, and there was also a strong recommendation to review the VIGRE program. The Division of Physics (PHY) session was the least organized of all of the breakout sessions, and as a result, not many clear recommendations resulted.

In the discussion that followed Dr. Robert Kohn noted that the report was silent on the wisdom of postdoc programs. He asked whether they had been discussed. Appelquist responded that there had been considerable discussion about this during the workshop, but that no consensus had developed across MPS. It had been left up to the divisions. There was considerable discussion concerning the workshop recommendation concerning childcare support. Turner stated that the recommendation was an important one, and perhaps a workshop for provosts and deans to address this issue might be useful. There was support for the recommendations concerning summer schools, where it was felt that Europe was considerably ahead of the US. Lineberger then asked about what would

happen to the report. Appelquist said that he would like to see the report circulated widely, and Narayanamurti felt it should be input into the physics decadal survey. Turner stated that MPS would look at the report carefully, and was already acting on the recommendations concerning support for the core. Appelquist noted that there were feelings at the workshop that there are certain kinds of theory needed that don't get enough support. Huchra noted that some of the recommendations built on the astronomy decadal survey recommendation that theoretical input is important early on, in design and data reduction. The discussion concluded with the comment by Lineberger that MPSAC would monitor and ensure that appropriate responses got back to theory group.

Lineberger proposed that the MPSAC accept the report and there was unanimous consent.

Report of the Committee of Visitors for the Division of Astronomical Sciences (AST)

Dr. Craig Wheeler of the University of Texas, Chair of the Committee of Visitors (COV) presented the report (Appendix IV). He was unable to attend the meeting in person, but joined the meeting *via* phone.

Wheeler stated that the COV met February 22 – 24, 2005 at NSF. The COV consisted of 14 members, including Kohn from the MPSAC. They responded to a charge from the AD/MPS to review AST proposal and award actions for the years FY 2002 – FY 2004 and to consider the balance, priorities, and future directions of the Division. A sample of 12 % of the actions was reviewed. The COV was impressed with the COV process and convinced of its value to NSF and to the community.

The COV found that:

- The processes were done with the highest level of integrity;
- AST responds to community input and priorities; and
- The awards were commensurate with present programs and future goals.

The COV recommended:

- Additional scientific personnel for the Division;
- Continued leadership by AST of appropriate joint interagency initiatives;
- Strong support for the planned Senior Review;
- Endorsement of the Division's new strategic plan;
- Maintaining the AST grants program at or above its present level;
- Continued pursuit of the priorities of the most recent decadal survey with a flexible, balanced approach;
- Aggressive defense of radio spectrum allocations for scientific research;
- Expanded role for AST in fostering the next generation of scientists; and
- Continued outreach efforts across observatory enterprises.

The discussion that followed covered the seriousness and frequency of Senior Reviews (“as needed”) and the importance of dealing with the issue of operations for new facilities. The AST COV report was *accepted* with thanks to the committee members (Appendix IV).

The MPSAC requested a status report on the AST Senior Review for the November meeting.

Report of the Committee of Visitors for the Division of Materials Research (DMR)

Dr. Horst Stormer of Columbia University, Chair of the Committee of Visitors for the Division of Materials Research, presented the COV report (Appendix V).

The COV consisted of about 30 people, working in three subgroups. Each subgroup prepared a separate report, and a summary report for the entire Division was also prepared.

Overall, the COV found scientific excellence across the range from fundamental to applied research. DMR is admirably managed through a consensus process that is working well. They found that program directors are the

heart of the proposal and award process. The FY 2002 COV had recommended additional staff and that is still needed.

The COV asserted that the DMR budget had not kept up with the NSF or the MPS budget and was severely impacted by a 4 % cut in FY 2005. They stressed the importance of maintaining grant size at a viable level and of balancing facilities and grants programs. The balance among individual investigators, groups, centers, and facilities is a big issue. It looks “about right” but the issue is very hard to quantify. There are severe challenges ahead for DMR that the COV expects DMR to be able to handle.

After a brief discussion, the DMR COV report was unanimously accepted (Appendix V).

Report of the Committee of Visitors for the Information Technology Research (ITR) Priority Area

Dr. Shenda Baker, who served as the Co-Chair of the NSF-wide Committee of Visitors for the ITR initiative, reported on the results of that COV. This was an information item for the MPSAC.

Baker noted that ITR was a response to 1999 PITAC Report, and during the five-year period from 2000 – 2004, the focus of the priority changes. Specifically, ITR focused on the following areas:

FY2000 – Fundamental IT research and education;
FY2001 – Application of IT to science and engineering challenges;
FY2002 – Multidisciplinary IT challenges;
FY2003 – Relationship between acquisition and utilization of knowledge and IT tools; and
FY2004 – IT research for national priorities.

The review was held at NSF March 8-10, 2005, and covered Fiscal Years 2001, 2002, 2003. In each of these year there were 3 ITR competitions: small (up to \$500K total for 3 years), medium (up to \$1 million per year for 5 years); and large (up to \$3 million per year for 5 years). The solicitation and management plan were aligned to each year’s scientific opportunities and external demands

The COV examined the manner in which the reviews were conducted, and recognized the problem of assembling a strong, diverse, conflict-of-interest free pool of reviewers when almost the entire community was submitting ITR proposals. The COV noted that many “best of breed” ideas were enabled by ITR, that new interdisciplinary NSF areas were seeded and fueled by ITR, that the program encouraged community building (and reaching across institutional boundaries) by researchers *and* by NSF PD’s. Many tools were developed, and best practices were beginning to evolve. The COV was concerned with how the impacts of this research would be evaluated and how this research would be maintained after the priority area disappeared. It was critical to capture lessons learned and incorporate proven business practices to prevent future problems.

In addition, the COV stated that the ITR priority area had made significant research contributions to software design and quality, scalable information infrastructure, high-end computing, IT workforce, and socio-economic impacts of IT. The solicitations encouraged interdisciplinary research in all years. Management plans were always encouraged (and required in large proposals) and forced principal investigators to develop plans for collaboration, and reviewers and panels had to evaluate these plans. NSF should capture and transfer what PIs learned about managing and coordinating large, interdisciplinary, multi-institutional projects.

The MPSAC adjourned for lunch and met with the individual divisional breakout groups.

Thursday, April 7, 2005
Afternoon Session

The MPSAC reconvened in plenary session at 4:30

Observations by European Science Foundation Physical & Engineering Sciences (PESC) Chair

Dr. Michel Mareschal, Chair of the European Science Foundation's Physical and Engineering Sciences Standing Committee (PESC) described the functioning of the Committee and the European Science Foundation (ESF). PESC is one of 5 standing committees within the ESF. ESF has 78 members from in 30 countries. He noted that the ESF was not part of the European Commission – the European Research Council (ERC) had been created by the European Commission and was an institution that provides grants to individuals based on scientific merit. However, while the ERC has been created, a budget for it has not yet been set. He described the various activities that the ESF sponsors, such as exploratory workshops and research conferences and support for young investigators.

The European Young Investigator Awards (EURYI) are grants for young investigators who have received their Ph.D. within the last 10 years. They are meant to stimulate the best young researchers in any field, from all over the world, to pursue a science career in Europe. The selection criteria are scientific quality, originality, and the quality of the host institution. In the past years over 700 proposals were submitted, with only 25 grants being awarded. Approximately 25% of applications in 2005 were female; and about one-third of the reviewing panelists were female.

Dr. Mareschal provided statistics on a study done concerning the role of women within the CNRS (<http://www.cnrs.fr.mpdf.index2.htm>). This study found that for researches between the ages of 28-68, 31% were women, and that promotion for men to upper level positions is around 45% where it is about 25% for women; this data has not changed over the last 30 years. In physics, about 20% of the researchers are women.

Reports from Divisional Breakout Groups

Membership within each breakout group can be found in Appendix II and the written reports from each of the breakout sessions are found in Appendix III.

Division of Mathematical Sciences (DMS): Dr. Robert Kohn presented the DMS report. He stated that more than 50% of time in the breakout session had been spent on the topic of broader participation with regards to women. The major conclusion was that women were leaking out of system at multiple stages in the pipeline. Some were easy to pinpoint, others were not. He noted that DMS has a fellowship program but only 12% of the fellowships have gone to women, and the conclusion is that many women not even applying for post doc. There was a need for better mentoring and for more networking opportunities for women. The success rate for proposals for women was a little less than men, and this was consistently the case.

He noted that DMS has a large institute portfolio and that these institutes are a broadening mechanism – people can benefit from NSF funding even if don't have NSF funding directly. With respect to other issues, the group and conducted a follow-up on issues raised by COV a year ago and was impressed with how DMS has addressed issues raised by the COV. The group commented that DMS was very dependent on rotators, and while it important to continually draw in new people, it is also important to hire permanent staff.

With respect to future tight budgets, trimming would have to be done within disciplinary programs, based on quality rather than based on scientific topics chosen in advance.

Division of Physics (PHY): Dr. Janet Conrad presented the PHY report. She noted that physics covers a wide range of subfields and commented on the approach of PHY in setting priorities. At least 50% of funding goes to fund core research and the group felt that physics has a good set of funding priorities in times of significant budget constraint. PHY is currently supporting 10 centers, and will be freezing this number, which appears to be appropriate. It was important to fund mid-sized projects. The group noted that panels reviewing theory proposals should include an experimentalist, and that there were small things that could be done to bring more women into the field of physics.

The group felt that a one-term course release for principal investigators would be a good idea. PHY should help faculty to learn how to better apply for small individual grants, and that PHY should reward those who mentor well. In conclusion the group was impressed with the ideas coming from the Physics Division.

Division of Chemistry (CHE): Dr. Jean Futrell presented the CHE report. He noted that activities sponsored by the chemical professional societies have good programs for women and that CHE should encourage these societies. Role models are very important, and the best role models are those in the local institutions. There is a need to change the culture of institutions. It will be slow but it is required. Industry and government do better at recognizing diversity than academic institutions, and perhaps they can be used as role models to implement programs at universities. Department chairs and departmental search committees are critical in changing diversity.

The group suggested organizing a workshop dealing with diversity and one should invite institutions with the best practices as well as those with the worst practices. The composition of chemistry faculty has been unchanged for some time – only 12% female with only 8% at full professor rank. He noted that within CHE, women's involvement in reviews and panels significantly higher than that of men

Division of Astronomical Sciences (AST): Dr. John Huchra presented the AST report. He presented statistics compiled by the Committee on the Status of Women in astronomy, and noted that there had been some improvement in the number of women in faculties in the period 1989 –2003, but it was still low, especially at the full professor level. The success rate for females and minority males was still increasing, and the group felt that the manner in which proposals from these groups was treated was not gender biased. Women receive about 20% of the awards in AST. A large fraction of recipients of awards in the post doc program were women. The professional societies associated with astronomy have been very active in sponsoring activities to broaden participation of women and they provide childcare at meetings

The group felt that NSF could help by limiting post-doc terms, improving reentry grants, meeting with departmental chairs and Deans, providing graduate student support in block grants with criteria related to training and diversity, asking for department plans/statistics as part of major proposal process, enforcing Title IX, sponsoring longitudinal studies, and providing visiting professorships for women, and increasing the number of women as reviewers, panelists, program officers and COV members. There was strong support by the group for childcare policies.

The group felt that the core had to be maintained, and there was very strong support for cyber-related activities. The group was looking forward to the results of the Senior Review.

Division of Materials Research (DMR): Dr. Sol Gruner presented the DMR report. The group had discussed mechanisms that would help increase the number of women in the field of materials research. These included dual career programs, consultant networks, parental leave programs, child care subsidy programs, adoption assistance programs, and keeping departmental chairs informed of what exits at their institution and training them to be aware of subtle discrimination.

The group felt that NSF had relatively limited ways of encouraging participation. It could pressure universities to provide diversity plans for larger proposals. He noted that there had been a slow but progressive increase in the number of principal investigators who were women, but NSF had to be sensitive to over use of women on panels, as reviewers, etc.

It was important that NSF preserve the core, and the group felt that they would rather have a larger grant size with a resultant cut in the number of supported principal investigators. However, one had to be extremely sensitive to including support for younger principal investigators. Cyber infrastructure should be a priority.

Adjournment

The meeting was adjourned at 6:30 P.M.

Friday, April 8, 2005

Morning Session

Lineberger convened the meeting of the MPSAC at 8:00 am. He congratulated Morrison on being named a Guggenheim fellow. He noted that the morning session would be devoted to an overview of issues on diversity. The goal was the development of strategy in broadening participation.

The Status of Women in MPS Disciplines in Academia and Possible MPS Actions to Enhance Their Levels of Participation.

Dr. Lucy Fortson introduced the discussion by describing the activities that had led up to this meeting. A steering committee had been formed in November 2004 with the goal of trying to understand if holding an MPSAC workshop on broadening diversity was appropriate. The steering committee decided to split the discussions for the MPSAC meetings into two: a discussion on the participation of women in the academic environment for the Spring 2005 MPSAC meeting, and a similar discussion on underrepresented minorities at the Fall 2005 MPSAC meeting.

She then presented an overview of what the steering committee perceived to be the current status of women in the academic environment. There has been progress, but it has been slow. To date there has been a rough doubling of the number of women in the academic community every 15 years. She noted that there were pipeline issues. For example, in chemistry, 47% of B.S. students are women, but only 12% of faculty in chemistry departments are women. In physics, 21% of B.S. students are women, but only 6% of the faculty are women. With respect to the number of women receiving doctorates, the trend is positive but there are significant disparities between the number of women holding academic positions in the different disciplines in MPS. If one looks at the top 50 institutions, given the number of doctorates now being awarded to women, it was her assessment that departments were not staffing academic positions with women commensurate with the numbers receiving doctorates.

In commenting on reports in this area, Fortson noted that it was hard to compare information, and that the data was not always reliable. Data is not always reliable, but there are many anecdotal comments that the atmosphere in academia is often poisonous to the advancement of women. Fortson concluded her discussion by noting that it was necessary to maximize the talent pool, that different fields are progressing at different rates, that cross communication between directorates/disciplines on practices is important, and the percent of women faculty is "the single most important indicator for academic success of women undergraduates."

Common Themes from MPS Divisional Breakout Sessions

Huchra summarized the common themes arising from the breakout discussions the previous day. The common recommendations could be broken into three areas: policies, actions, and programs.

With respect to policies, common themes were the need to encourage mentoring, networking, and confidence building among women. There was the need for daycare and family support. NSF should enforce diversity in meetings and workshops (some language to this effect already exists in current solicitations), and NSF should make department diversity and action plans a review criterion for larger grant proposals.

With respect to actions that MPS could be done now, it could conduct a workshop consisting of university administrators (chairs, deans, etc.) with a focus on diversity, it should improve the visibility of science done by women and minorities, and it should develop databases of women and minorities by field. In particular, this could eliminate the excuse that departments would hire women and minorities, but can't find them. MPS should remain sensitive to young/new investigators and support surveys/data collection for longitudinal studies - where and why is the pipeline leaking? MPS should monitor non-traditional career paths and support them. For example, 40% of active astronomers work in academia, with the remainder work in industry, etc. MPS should also consider workshops for women and minorities.

With respect to programs, NSF and MPS should consider department level ADVANCE awards, and bring back the POWRE program. There should also be re-entry and bridge support to get more women and minorities into the faculty ranks and there should be graduate student support grants.

Finally NSF/MPS could improve postdoctoral fellowship policies, conduct site visits to inform and collect data, provide supplements to graduate student mentors, use diversity as a criterion for awards at the fund/no-fund line, and encourage finding innovative means to deal with the two-body problems. Finally, care had to be taken not to over commit women and minorities. He concluded his presentation by emphasizing that change at the departmental level was critical.

In the discussion that followed his presentation, it was noted that ideas and possible improvements are quickly thought of, but there is no way to evaluate them. Ways to evaluate success or failure are needed. Time lag studies to determine losses that occur within the pipeline need to be done with reference to discipline, as the time to degree and postdoctoral periods are different in different disciplines. Change at the department level is important, but the Chair of a department cannot do it alone. The power structure needs to be in favor of changes as well. Re-entry to graduate school should be considered as well. Age discrimination is an issue for older graduate students.

The discussion then turned to how should Title IX be applied and how can the compliance of agencies be evaluated? Hogan commented that NSF is about to do an evaluation and is in the planning stages in coordination with the Office of Equal Opportunity. A national discussion is needed on indicators of improvement, *e.g.*, hiring, time to Ph.D., *etc.* With regard to the ADVANCE program, re-entry is a challenge and the program needs to be integrated in a larger community. More flexible career paths need to be accepted.

The NSF Context

Dr. Henry Blount described current NSF programs and the MPS strategy in this area. NSF programs include the VPW and ROW (including Research Planning Grants, which bought time to put together a competitive grant proposal, and Career Advancement Awards, which bought extra research capability) awards, the Faculty Awards to Women (he noted that all recipients of this grant have made it to the full professor level.), the POWRE program, and the ADVANCE program. The MPS strategy is to maintain an MPS presence in Foundation-wide activities. MPS activities need to be research-based, and gender equity must be embedded in all activities. Plans must resonate with the disciplinary communities. In addition, capacity must be built, meaning that the work environments must be non-toxic for women and minorities. MPS encouraged partnerships with EHR, other directorates, professional societies, the NSF Office of Equal Opportunity Programs (considering Title IX and Title VI) and the MPS community.

In the discussion it was noted that there were really two issues: retaining women and minorities and bringing them along path that would lead to academic appointments. There was a question about how can the impact of the grants be evaluated, what they enabled, and did they help. Or was it simply to allow resources to flow to women?

Dr. Luis Echegoyen gave a presentation on the NSF Committee for Equal Opportunity in Science and Engineering (CEOSE). CEOSE was established by congressional mandate in 1980. While it reviews and provides advice to NSF, it does not set policy. It provides reports to Congress, and in a recent study concerning progress made with respect to broadening participation, it found that while there had been an overall increase in the numbers of women and underrepresented minorities in science and engineering, the gains have been modest, and that the barriers to progress remain unchanged.

Dr. Alice Hogan described the NSF's ADVANCE program. The goal of ADVANCE is to increase the participation and advancement of women in science and engineering. There are more women majoring in sciences, and more women are earning doctorates. There are few women or minority role models, and it appears that there is a chilly climate for women and minorities in academia. Women have little influence on institutional/departmental decisions. In addition, fewer women are pursuing science and engineering careers. The problems appear to be persistent, pervasive, and complex, and there is need to define creative solutions. Hogan concluded her presentation by describing the types of awards made within the ADVANCE program.

Sunley described the “Research on Gender in Science and Engineering” program within the Engineering and Human Resources (EHR) program.

The Institutional Context

Dr. Susan Coppersmith gave an overview of how she viewed the effects of the ADVANCE program. Dr. Steve Koonan gave a summary of how advancement of women is viewed from an industrial setting. Basically, many companies now see this as simply a sound business policy that helps them understand their markets and customers. Dr. David Oxtoby pointed out his experience with the "one woman" problem, especially in small departments. Hiring one woman is not diversity or a reason to stop recruitment efforts.

During the discussion, a contrast was drawn between “slot” restricted hiring in academia versus the more flexible hiring approaches in industrial labs. There was some feeling that academic hiring suffers from a zero-sum effect, while industry avoids this because they are more driven by market and technical developments. There was also considerable discussion on how the hiring of women is influenced by the age distribution of the faculty members doing the hiring. There was also concern that academia is going through a hiring “pulse” that will, in the next five years, lock down the diversity at US universities for several decades to come. Several NSF actions were suggested in this area: there should be more NSF graduate fellowships, grant guidelines should be more strongly tied to diversity reporting, and there should be more postdoc programs.

General Discussion

The discussion focused on what recommendation the MPSAC could suggest with respect to increasing the participation of women and minority in MPS disciplines in academia and other professions. Suggestions that were made were:

- There should be more graduate fellowships.
- Grant/award letters should clearly state diversity guidelines and requirements at workplace. Reporting requirements should be initiated and enforced. At present NSF Engineering Centers have very strong requirements. Diversity at work place could be enforced with the help of the community, and MPS by itself with its limited funding resources could not be very effective in this area.
- MPS should start a Postdoctoral program for women, minorities and handicapped.
- NSF should encourage family friendly policies at work place.
- Title IX should be applied.
- MPS should provide funding opportunities and activities related to broader participation.
- MPS should provide awards for mentoring to increase diversity at work place.
- MPS should assemble 'best practices' and disseminate this information.
- MPS should set up workshops on diversity and best practices to achieve them with participation by department chairs and deans in these workshops.
- Diversity at work place is a continuing issue and MPSAC members should continue to come up with additional recommendations and suggestions.
- If NSF has data on diversity, it should be put to use to effect institutional changes.

Meeting of the MPSAC with NSF Director Arden Bement

Dr. Bement joined the meeting and thanked MPSAC members for the hard work that it does noting “As a materials scientist, MPS is my ‘home department.’” He noted that broadening participation (BP) has many dimensions: [Experimental Program to Stimulate Competitive Research \(EPSCoR\)](#), women, underrepresented minorities (URM), etc. He noted that broadening participation was protected in the FY 2006 budget and stressed this with the House Science Committee recently.

Bement told the MPSAC that he and senior NSF staff were about to conduct a retreat to consider FY 2007 budget priorities. He and the National Science Board are committed to a “Vision for the 21st Century” as expressed in Article 33 of his recent report to Congress. In his words, “doubling is not enough.” The challenge is to convince

policy makers that support of science is important. Given the outlook for the next 2-3 budget cycles, NSF must stick to its core, eschewing new initiatives while paying attention to facilities and cyberinfrastructure. Bement reiterated his support for extensible terascale computing facilities, noting the potential for data mining.

Bement remarked that the new appropriations committee structure should sharpen their focus on science. The new members need to be educated about NSF. He remarked that MPSAC members could help with this by talking to congressional staff members. The leaders of the sub-committees are passionate and want to be helpful. For these reasons, he is cautiously optimistic.

A question and answer period followed these introductory remarks. Lineberger noted that the BP discussion was intense and committed. Bement posed the rhetorical question “Are we overproducing scientists?” He remarked that the rate of new jobs may not keep pace with production of new scientists so, while we need to fill the pipeline and broaden participation, we also need to broaden the perspective for career opportunities.

Fortson and Huchra summarized the BP exercise, noting that there were lots of positive suggestions as to how to move forward. Turner noted that not all of them would cost more money. Lineberger added that an example would be allowing the reimbursement of childcare during professional travel.

The discussion then turned to cyberinfrastructure. Baker stressed (1) the need to maintain large collaborative networks, (2) the need to ensure community input to planning, and (3) the distinction between cyberinfrastructure and science-driven cyber-science. Bement commented that the Extreme Terascale Facility (ETF) is an experiment. Middleware, standards, etc. are still in development and much work remains to prove the concept. So we must maintain existing supercomputers. Growth will surely come and a national infrastructure may result but capacity will always be oversubscribed by demand. In this formative phase, the most difficult challenge is matching the vision to the community needs. Baker asked if smaller efforts would be precluded. Bement replied in the negative and went on to stress that we need to grow the workforce and keep in mind that every facility that has a cyberinfrastructure component must design it in from the beginning.

Huchra asked about the status of the Advanced Technology Solar Telescope (ATST) project. Bement responded that NSF has a mandate from the Brinkman Report and the appropriators to address the procedural as well as the prioritization and certification processes in the development of new facilities. He reported that the NSB has been through one prioritization exercise and that the new procedures are being well received on the Hill. The next steps would be the approval of the ‘opportunities’ and ‘facility plan’ documents. He expects that the NSB will consider them at the May meeting.

Lineberger turned the discussion to the reports of the AST and DMR COVs. Kohn, a member of the AST COV, described it as a tremendous educational experience and was very impressed by the quality of the staff but distressed by the typical workload of program officers. Bement commented that he was well aware that NSF has a shortfall of staff and pointed out that it is difficult to get Congress to consider putting more resources into the “staff and expenses” category versus research funding. As a result, NSF was investing in internal information technology and productivity tools to make the program officers more efficient. Kohn noted the AST COV’s support for the Division’s management and endorsed plans for the upcoming Senior Review of the AST portfolio.

Hellman provided a summary of the DMR COV’s report noting that it had been very positive. The COV was concerned about the budget but was impressed by the Division’s support of high-risk proposals. The discussion turned to Review Criterion 2. Both COV reports noted that Criterion 2 is not universally understood or applied by reviewers. Is this an NSF-wide problem? Bement replied that it is imperative for NSF to normalize the dealing with Criterion 2 and more work remains to be done in this area.

Bement thanked the MPSAC again for its hard work, and commented that NSF was a bottom-up organization and so groups such as the MPSAC are critical for establishing priorities.

Other Topics

Futrell reported on a review being conducted by a Blue Ribbon Panel appointed by DMR to consider the future of the National High Magnetic Field Laboratory (NHMFL). NHMFL is a multi-site laboratory with activities at Florida State University (FSU), at Los Alamos, and at the University of Florida-Gainesville. NHMFL was granted a two-year extension for FY 2006 and FY 2007 in 2004. There is a draft National Research Council (NRC) report by COHMAG to look at the prospects for high magnetic field research. It is finding that the field is thriving and that the U.S. is a leader. The Blue Ribbon panel is to consider options concerning possible recompetition for the NHMFL for the renewal of the present activity or for other arrangements. They have been favorably impressed with their reviews so far. Their report is due at the end of June. NSF will have to make a decision in the fall of 2005.

Turner outlined his plans to search for replacements for Dr. Arthur Ellis, the Director of the Division of Chemistry who is leaving in June 2006 and Dr. William Rundell, the Director of Division of Mathematical Sciences. Dr. Rundell will be leaving in September 2006. In both cases the two individual's 4-year Intergovernmental Personnel Act (IPA) appointments come to an end. Turner wanted to make a selection of their replacements in January 2006 in order to allow for some overlap. The vacancies will be announced in late summer. He invited the MPSAC members of the divisional breakout groups plus other volunteers to identify candidates and to define the characteristics of the person for the job.

FY 2005, 2006 Budgets and FY 2007 Planning

Turner introduced the budget discussion by noting that all NSF priority areas, including the Mathematical Sciences Priority Area (MSPA), are winding down. DMS has doubled since 1999. The Math-Sciences Priority Area (MSPA) and Nano were funded out of MPS with no extra funds. The Physics of the Universe (POU) is an internal MPS priority.

For FY 2007, planning is underway. The goals are:

- 1) The most compelling science gets done;
- 2) New opportunities are pursued; and
- 3) Broadening participation.

MPS will adopt the following strategies:

- 1) Maintaining a strong, flexible core by reducing solicitations and decreasing centers;
- 2) facility stewardship [The large Hadronic Collider (LHC), Gemini, *etc.*]; and
- 3) Broadening participation by integrating activities with research. He outlined the steps taken so far and noted the science themes of POU, MBLP, CS/CI, MSPA, and Nano.

Lineberger requested that the record reflect that both he and Dr. Lars Bildsten did not participate in the discussion concerning reducing the number of centers and funding to these centers in MPS.

Turner noted that Baker, Dr. Peter Green, Futrell, Morrison, Dr. Claudia Neuhaser, and Dr. Gary Sanders were leaving the MPSAC at the end of September. He thanked them for their service. He invited MPSAC members to send nominations for new members to him by July 1.

Adjournment

The meeting adjourned at 2:45 p.m.

Appendices

APPENDIX I

ATTENDEES

MPSAC Members

Shenda Baker, Harvey Mudd College
Lars Bildsten, University of California, Santa Barbara
Janet Conrad, Columbia University
Susan Coppersmith, University of Wisconsin
Luis Echegoyen, Clemson University
Mostafa El-Sayed, Georgia Institute of Technology
Lucy Fortson, Adler Planetarium and University of Chicago
Jean Futrell, Pacific Northwest National Laboratory
Sol Gruner, Cornell University
Frances Hellman, University of California, San Diego
John Huchra, Harvard-Smithsonian Center for Astrophysics
Jon R. Kettenring, Telcordia Technologies
Robert Kohn, New York University
Steve Koonin, British Petroleum, Inc.
W. Carl Lineberger, University of Colorado
David Morrison, Duke University
Venkatesh Narayanamurti, Harvard University
Claudia Neuhauser, University of Minnesota
Eve Ostriker, University of Maryland
Marcia Rieke, University of Arizona
Elizabeth Simmons, Michigan State University

MPSAC Members Absent

Peter Green, University of Texas-Austin
Raymond Johnson, University of Maryland
Gary Sanders, California Institute of Technology

MPS Staff

Morris Aizenman, Senior Science Associate, MPS
Adriaan de Graaf, Senior Advisor, MPS
Laura Bautz, Acting Executive Officer, Division of Physics
Henry Blount III, Head, Office of Multidisciplinary Activities
Joseph Dehmer, Director Division of Physics
Arthur Ellis, Director, Division of Chemistry
Eileen Friel, Executive Officer, Division of Astronomical Sciences
Adriaan de Graaf, Executive Officer, MPS
Lance Haworth, Executive Officer, Division of Materials Research
Deborah Lockhart, Acting Executive Officer, Division of Mathematical Sciences
Lee Magid, Acting Executive Officer, Division of Chemistry
William Rundell, Director, Division of Mathematical Sciences
Judith Sunley, Executive Officer, MPS
Michael Turner, Assistant Director, MPS
Thomas Weber, Director, Division of Materials Research

Visitors

Arden Bement, Acting Director, NSF
Craig Foltz, Program Manager, National Optical Astronomy Observatories, AST
Alice Hogan, Program Director, NSF ADVANCE Program

Michel Mareschal, Chair, European Science Foundation's Physical and Engineering Sciences Standing Committee
Horst Stormer, Columbia University
Mitchell Waldrop, Office of Legislative Affairs, NSF

APPENDIX II
MPS Advisory Committee Meeting
April 7 - 8, 2005
Divisional Breakout Group Assignments

| | | | AST | PHY | CHE | DMR | DMS |
|---------------------------|---------------|--|-------------|-------------|-------------|-------------|-------------|
| | | | Room | Room | Room | Room | Room |
| | | | 365 | 320 | 370 | 375 | 530 |
| Term Ends 09/30/05 | | | | | | | |
| | BAKER | | | | X | | |
| Absent | GREEN | | | | | | |
| | FUTRELL | | | | R | | |
| | MORRISON | | | | | | X |
| | NEUHAUSER | | | | | | X |
| Absent | SANDERS | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Term Ends 09/30/06 | | | | | | | |
| | CONRAD | | | R | | | |
| | ECHEGOYAN | | | | X | | |
| | EL-SAYED | | | | | X | |
| | FORTSON | | X | | | | |
| | HELLMAN | | | | | X | |
| | HUCHRA | | R | | | | |
| Absent | JOHNSON | | | | | | X |
| | KETTENRING | | | | | | X |
| | LINEBERGER | | | | X | | |
| | NARAYANAMURTI | | | | | X | |
| | | | | | | | |
| | | | | | | | |
| Term Ends 09/30/07 | | | | | | | |
| | BILDSTEN | | | X | | | |
| | COPPERSMITH | | | | | X | |
| | GRUNER | | | | | R | |
| | KOHN | | | | | | R |
| | KOONIN | | | | | | |
| | OSTRIKER | | X | | | | |
| | OXTOBY | | | | X | | |
| | RIEKE | | X | | | | |
| | SIMMONS | | | X | | | |

APPENDIX III
MPSAC DIVISIONAL BREAKOUT SESSION REPORTS

**Report on MPSAC Breakout Session with
Division of Astronomical Sciences (AST)
April 7, 2005**

The MPSAC astronomers (Fortson, Huchra, Ostriker & Rieke) met with the NSF AST Division staff. Lars Bildsten was also present for the discussion over lunch. The breakout discussion centered on the posed topic of women in astronomy (with the topic of minorities to be taken up in the Fall 2005 meeting). We also discussed the general health of the Division's programs and the upcoming Senior Review.

The astronomical community has very active programs to support women and minorities in the field that are run by the American Astronomical Society. The CSWA (Committee on the Status of Women in Astronomy) has monitored the demographics of women in astronomy at different career levels for 20 years. Table 1 shows both the problem and the progress:

Table 1. The fraction of Women in Astronomy at Different Career Stages

| | <u>1992</u> | <u>1999</u> | <u>2003</u> |
|----------------------|-------------|-------------|-------------|
| Graduate Students | 22% | 26% | 30% |
| Postdocs | 16% | 19% | 22% |
| Assistant Professors | 18% | 21% | 19% |
| Associate Professors | 12% | 17% | 22% |
| Full Professors | 5.6% | 6.7% | 9.4% |

In eleven years, the fraction of female full professors went from 5.6% to 9.4%. On the other hand, in a group where one might expect greater change over eleven years, the assistant faculty percentage has stayed much the same. These numbers show very mixed progress and if gender balance is the agreed upon goal, these numbers imply that we might achieve gender balance in 120 years!

The AST Division staff reported that the success rate for women proposers was higher(!) than for men. For minorities it was higher still, but small number statistics dominate. At present, women PI's are getting approximately 20% of the grants in astronomy, and men ~80%. However, there is some field dependence to these numbers. Reports from the Theory Workshop indicate that women represent 8% of PI's currently holding AST AAR grants. The AST Postdoctoral Fellowship program is running well, and a large fraction of the AST postdocs are women. We also discussed the American Institute of Physics demographic study of women in physics and astronomy, which concluded that when the time delay effects are taken into account for a pool of potential candidates moving through the pipeline, there is not a major issue in the hiring of women in astronomy and physics. Nonetheless, there were still significant pipeline issues exemplified by the approximately 50% drop in women taking physics in high school versus those receiving undergraduate degrees in physics. We strongly believe that the AIP Study can be dangerously misinterpreted, giving a sense that all we have to do is wait for the current population of high school students to work their way through the pipeline. In fact, constant vigilance is still required not to lose ground. The gains in astronomy have come because efforts are constantly made to recruit women. Even so, as said above, at the current rate of improvement at the most senior ranks, we have a very long way to go.

Our responses to the discussion questions and topics are as follows:

- **1. What activities are sponsored by the discipline's professional societies (AAS, APS, AGU) with respect to broadening the participation of women?**

The AAS is very active in this area with the CSWA, meetings at the AAS, other activities like the Space Telescope Science Institute sponsored meeting which produced the Baltimore Charter (and now the Pasadena Recommendation). The AAS facilitates childcare at meetings, and the IAU (International Astronomical Union) has organized meetings on women in astronomy as well.

- **2. In our departments/institutions how is women's under representation being addressed? What are the barriers to progress?**

Barriers: There are many including Lifestyle --- "Women opt out of academic positions because they're smarter!" Compensation/ Reward Structures, Required Skills, the Career pipeline timeline, Mentoring (lack thereof), and poor Family Support Policies. Perhaps one of the most important Other Barriers is Department Atmospheres. An important question to ask is "Where in the institution are the problems?" We had a general "gut" feeling based on much anecdotal evidence that a lot of the problems for women occurred at the department level.

- **3. What levers/incentives might MPS use to address the under representation of women as faculty? Consider specific suggestions that are relevant to the types of awards MPS makes (e.g. individual investigator, group, center, facility, fellowships, conference support, etc.) or to the balance of investments in undergraduates, grad students & postdocs?**

Our group came up with several suggestions. The first was to limit postdoc terms, so people did not find themselves in low paid positions without long term benefits (e.g. full family health and retirement). Another was to improve re-entry grants. Third, and perhaps the easiest to implement, was to have the AST staff meet with Department Chairs/Deans on a regular (annual or semi-annual) basis to emphasize the importance of diversity (to keep the issue on the burner and to disseminate some of the best practices in hiring and retaining women faculty). Another was to use the "carrot" of graduate student support in block grants to departments with such grants including criteria related to training and diversity. We thought that the NSF should ask for department diversity plans and statistics as part of any major proposal process (centers, large grants, block grants, etc). Use of Title IX was discussed with no clear resolution.

We also thought that the NSF should support longitudinal studies to better understand the losses along the career path. In particular, there is a need to conduct exit interviews at the undergraduate and graduate levels for women and men who had an interest in astronomy or physics and decided not to pursue a career in that field. Reinstating visiting professorships for women should be considered after carefully weighing the positive aspects against the possible negative outcomes: providing a way of inserting role models into departments that need them versus allowing a department to have a token female with no commitment). Childcare policies are viewed to be an important issue, and anything the NSF can do to encourage family friendly policies, such as support for child care at meetings or in certain job-related aspects like traveling to observe or take shifts, would be useful. Finally, we suggest site visits by the NSF/CSWA/CSWP. There was a general feeling among our group that industry and government labs seem to do better on lifestyle issues.

- **4. How can MPS improve its recruitment of women & minorities as reviewers, panelists, program officers, COV members, AC members, Division Directors & Assistants?**

Timeliness – get to people to serve on committees early! Many of the folks we want are heavily committed. In particular, women are often over-recruited for committee and other service work. Because women are underrepresented in ranks of working scientists, efforts to include them on committees ends up leading to an inequitable burden in terms of service effort. Therefore, NSF needs to be very judicious in its recruitment of women for any of its service needs.

The AST group then discussed general issues in the Division:

For FY2005 --- the loss of the AODP (Adaptive Optics Development Program) funding was felt strongly. This program is key for progress on the number one priority large NSF project in the Astronomy and Astrophysics decadal Survey, the GSMT (Giant Segmented Mirror Telescope). While funding for the construction phase of the

GSMT may not be available until the next decade, funding the AODP is essential to decide what the project should be, where it should be sited and even if it should go forward on schedule. However, given the perspective that the NSF may choose one of the two current GSMT development projects as a primary partner in 2008, it may be advisable, in an era of tight resources, to direct funds towards the readiness of those projects rather than reestablishing a broader AODP program.

For FY2006 we had no comments other than to hope for the best from the appropriation process. We expect proposal pressure for individual investigators to increase as less NASA funding is available for science.

For FY 2007 and beyond we continue to emphasize the development of facilities as outlined in the Decadal Surveys and the need to incorporate operating costs properly. We believe that, despite the long list of new facilities that has been presented, it is absolutely necessary to maintain funding for the CORE individual investigator programs in astronomy. That's where the research gets done. We also believe that the Division should continue to support the goals of Broadening Participation and of making proper links to the Cyber Infrastructure/ Cyber Science programs, for example, through the NVO (National Virtual Observatory) and through a follow-on program to ITR to support infrastructure development (community codes, tools, and resources) in computational astrophysics.

We strongly support the Senior Review and believe that the NSF should get the results of that review into the planning process for astronomy as soon as it can. In a separate letter to the Division, the MPSAC astronomers emphasized the need to proceed with this review at the highest levels and with proper deliberation. This review needs to include broad community involvement, site visits to major facilities, a blue ribbon Senior Review panel, and must not keep programs or projects off the table (except, of course, the core AARG).

The current status of the ATST (Advanced Technology Solar Telescope) was unclear to us. We endorsed it at the last meeting of the MPSAC and would like to see progress in moving it to the NSB. What is needed? Can we help?

The Dark Energy Task Force getting underway is also a good idea, and the Cosmic Background Task Force report is expected soon.

We also recommended that the MPS and the AST Division try to maintain Divisional/Directorate control of key programs and priorities such as cyber infrastructure, cyber science, and ITR. Programs generally should be managed at the level where the work is done. Lastly, we noted that Supercomputer resources are important, agency wide, and that the Division and Directorate should continue to support their operations and development.

Report on MPSAC Breakout Session with Division of Chemistry (CHE) April 7, 2005

After a brief discussion of our collective sense of priorities we elected to discuss several issues of primary concern to our group and to CHE before proceeding to a discussion of the assigned topics for our breakout sessions. In particular we discussed the challenge of sustaining momentum in addressing chemistry frontiers while sustaining the core program focusing primarily on individual investigator research grants.

CHE Director Art Ellis and CHE staff described several workshops and associated follow-ons that have been conducted, are in advanced planning stages or have been reviewed since our last meeting. These included chemical imaging, THz spectroscopy, cyber-enabled chemistry, development of new analytical tools for molecular level investigation of chemical phenomena, and molecular basis of life processes (MBLP). The theme of sustainability in relation to water and energy supply, the roles of anions in surface science, aerosol chemistry, nanoclusters and so forth is of significant interest as a new MPS-wide science opportunity. Each of these topics stimulated considerable discussion. It is evident that they represent fundamental research challenges that are motivated by the understanding of nature, discovery and important applications of the molecular sciences. Chemical science sits squarely at the center of this panoply of challenges that invite many of the best and brightest students and beginning investigators. The MPSAC members present endorsed the idea of a series of workshops to explore the MPS-related science drivers in the broad area of sustainability.

We noted that a search for a new Director of CHE will be initiated in the near future because Art Ellis will complete his fourth and final year as Division Director in June, 2006. This is of obvious concern to the MPSAC, and our committee should be engaged in soliciting highly qualified applicants to lead the Division in a financially constrained period. It was generally agreed that creative leadership is even more important when budgets are stagnant or declining, as forecasted for the next several years. This led us to consider and discuss the funding profile and recent history of CHE relative to other divisions within CHE. We obtained and discussed the statistics summarized in the table that follows:

Comparison of Funding Levels in FY99 and FY05

| | FY99 (Actual) (Millions \$) | FY05 Current Plan (Millions \$) | % Increase |
|-----------------------|--|--|-------------------|
| NSF Total | 3,690.00 | 5,652.01 | 53.2% |
| Research and Related | 2,821.60 | 4,293.34 | 52.2% |
| MPS | 733.65 | 1,069.86 | 45.8% |
| Research Directorates | | | |
| DMS | 100.75 | 200.38 | 98.9% |
| AST | 118.54 | 195.10 | 64.6% |
| PHY | 162.74 | 224.94 | 38.2% |
| DMR | 186.37 | 240.50 | 29.0% |
| CHE | 135.34 | 179.45 | 32.6% |

Without speculating as to the rationale for budget decisions, it is apparent that the MPS Directorate has not enjoyed the same percentage increase in funding that other Directorates have enjoyed over the past six years. Within MPS, CHE and DMR have experienced the lowest percentage growth. Since chemists are supported by both of these divisions it is evident that the molecular and material sciences communities are at a competitive disadvantage with regard to funding of our disciplines. It is our speculation that the emphasis on major instrumentation and facility of operations associated with those facilities are at least partially responsible for this disparity.

We noted that facilities are very important to advances in our discipline independent of the fact that most chemists are focused on research by small groups with most of the necessary instrumentation available at their institution, if not within their individual laboratories. As research frontiers demand ever more sophisticated instrumental approaches and sophisticated theoretical and modeling treatment, it is likely that this balance will evolve over time to more emphasis on regional, centralized facilities. This is already evident in MRSECs and in increasing use of major facilities by chemists and materials scientists. In this connection an upcoming "town meeting" at the Fall ACS meeting will bring together experts on large shared-use facilities of interest to the chemical sciences community. We also note that future chemical science depends critically on cyber infrastructure developments and visualization of complex phenomena.

We also discussed the challenges to both individual investigators and to reviewers of the mandated consideration of Criterion II in making NSF grant awards. We think that improved communication to the community, both as researchers and reviewers, will lead to improved understanding of Criterion II requirements and improve the quality of the proposal review process. To that end MPSAC member Luis Echegoyen is responsible for organizing a poster session at the upcoming ACS meeting identifying 53 examples of research "nuggets" that address Criterion II. These finalists were juried and selected by chemist members of MPSAC.

This was followed by a brief discussion of rapid developments in research and higher education in China. The contrast between budgets increasing at 35% per year in China and declining at several percent per year in the U.S. will have inevitable and easily predictable consequences

We then proceeded to discuss the assigned topics of Divisional and community engagement in diversifying the chemical sciences work force, particularly in academia. The general statistics on composition of the professoriate

vs. student populations demonstrate that we are not doing well. Although one-third of Ph.D.'s in chemistry are awarded to women, they represent only 21% of the assistant professor ranks at research universities. In particular the drop between faculty on probation and full professors is a leaking junction in the pipeline. The severity is debatable in that the aging faculty represents staffing practices spanning many decades. However, without the advantage of a detailed analysis it is clear that important opportunities are being missed. It is our opinion, based on the collective experience of MPSAC and CHE staff that industry, government laboratories and GOCO's have achieved better diversity track records. This experience should be helpful to university administrators as we go forward. This generalization includes CHE staff, who demonstrate significant diversity, and CHE practices that actively promote diversity in panels, workshops and advisory groups.

We discussed active programs of professional societies that promote diversity. The principal professional group for chemists is the American Chemical Society (ACS) and a comprehensive description with relevant links is on their web site: <http://www.chemistry.org/portal/a/c/s/1/acdisplay.html?DOC=minorityaffairs/index.html> (provided by Robert Lichter). The Women Chemists Committee of the ACS provides a wealth of resources--an active networking opportunity, an awards program and visiting lecture program to promote the professional advancement of women. The Council for Chemical Research (CCR), a professional society comprised of departmental chairs of chemistry and chemical engineering departments, and chemical research directors in industrial and government laboratories provides numerous workshop and networking opportunities.

Our discussion of institutional practices identified several suggestions - improving communication on best practices; highlighting the achievements of women colleagues in teaching and research; recognizing women leaders in our profession, specifically identifying women department chairs, deans, provosts, and university presidents - that send critically important messages. The role models effect in mentoring is demonstrably effective. Local is best, of course, but showcasing the effectiveness of women leaders at other institutions was also considered to be of significant value.

The most important individual for appointing, mentoring and advancing women scientists at universities is without question the departmental chair. The makeup of search committees and promotion committees is critical and the responsibility for appointing these committees resides in the department chair. Department chairs strongly influence seminar and colloquium programs as well. The opportunity for showcasing successful role models and actively mentoring junior faculty through to tenure and promotion is a shared responsibility for all faculty but the departmental chair sets the tone. The MPSAC members endorsed the idea of a workshop that CHE would help organize to bring together department chairs, department opinion-makers, and perhaps senior campus administrators to discuss strategies for increasing the participation of women on the chemistry faculties of research universities.

Report on MPSAC Breakout Session with Division of Materials Research (DMR) April 7, 2005

Attendees: *MPSAC*: Peter Green, Frances Hellman and Venkatesh Narayanamurti

Gruner reported on the DMR breakout session. The budget situation is difficult. Because of continuing grants, the actual budget cuts are larger than one might expect. This has also affected the success rate for new grants, which in many cases is around 10%, and has slowed the introduction of anticipated programs, (e.g., mid-scale facilities funding).

In response, DMR is exercising damage control for FY2005. Given a very limited budget, one can either decrease the amounts funded per grant or decrease the number of grants funded. DMR chooses to do the latter. The advisory breakout committee members agree with this strategy. Other programs have been deferred for a year. There was discussion about the balance between allocation to the core (e.g., individual investigator grants), centers, and facilities. DMR feels that the overall balance between different program types is about right. Centers within MPS have grown rapidly, relative to the rest of the NSF, and if any program type needs to be trimmed to accommodate

further belt tightening, it will probably be centers. Some centers (e.g., STCs have sunset clauses and can be trimmed back by simply not recompeting them when a given STC hits its 10 year sunset.

A perennial problem is that the number of proposals has grown much more rapidly than the DMR staff. One way DMR expects to deal with this is mainline special solicitations, because special solicitations require lots of special staff attention. For example, in FY2006 DMR has historically had a large number of nano proposals in its portfolio. Nano solicitations can be absorbed into other calls for proposals and reviewed within that context, yet still be identified as nano proposals for reporting purposes. Another way DMR expects to reduce the workload is to accept proposals only within a specified window once per year for many proposal categories. The motivation is to reduce the tendency for investigators to do some minor tweak on an unfunded proposal and then to immediately resubmit essentially the same proposal. Advisory committee members were somewhat uncomfortable with this strategy. DMR responded that this is effectively what happens anyway, because by July most of the budget year has already been committed. Cyber infrastructure will be a priority for FY2006.

For FY2007, DMR hopes to introduce a biomaterials program and to carefully consider DMR synchrotron facilities.

Report on MPSAC Breakout Session with Division of Mathematical Sciences (DMS) April 7, 2005

MPSAC Participants: Jon Kettenring, Robert Kohn (reporter), David Morrison, Claudia Neuhauser

STATUS OF WOMEN

Deborah Lockhart summarized the available data on the proportion of women in the mathematical sciences educational pipeline at various stages. She also presented statistics on the proportion of women faculty in college and university mathematics departments, segregated by rank and institutional type. Finally she discussed the participation of women in programs funded by NSF, and in NSF's own activities.

Briefly, the evidence indicates that

- a) Women are fairly well-represented among undergraduate math majors at US institutions. At the top 50 (Group I) institutions, about 35% of math majors are women; nationwide about 45% of math majors are women.
- b) Women are underrepresented in PhD programs. At the top 50 (Group I) institutions, about 22% of mathematics PhD's are women; nationwide about 30% of mathematics PhD's are women.
- c) Women are even more underrepresented among college and university mathematics faculty. At the top 50 (Group I) institutions, women account for about 5% of tenured mathematics faculty, 8% of the tenure-track cohort, and 20% of the non-tenure-track cohort.
- d) DMS is pushing the community to improve this situation through its traineeship programs (formerly VIGRE, now EMSW21), which emphasize diversity and the importance of mentoring.

Clearly women are leaking from the pipeline at various stages. The most striking figure we heard was that of the 153 Mathematical Sciences Postdoctoral Fellowships awarded in 1999-2003, only 19 (about 12%) went to women. The percentage of women in the applicant pool was not available, but it is believed to be similar. Apparently, a substantial proportion of the women PhD's are "opting out," i.e. they are not striving for the highest benchmarks of success.

This leakage of female talent is a well-known problem. The EMSW21 program's emphasis on mentoring and its "Mentoring through Critical Transitions" subprogram were designed in part to address this problem. In addition, a

variety of programs have been established to create networking and mentoring opportunities for women mathematicians at early stages in their careers. These include:

- i) Workshops at NSF-sponsored institutes (recent example: IMA's Workshop on Career Options for Women in the Mathematical Sciences, Feb. 4-5, 2005, <http://www.ima.umn.edu/cwims/>)
- ii) The annual summer school organized by the Institute for Advanced Study's program for Women in Mathematics (<http://www.math.ias.edu/womensprogram/>)
- iii) Workshops organized by the Association for Women in Mathematics at each annual SIAM meeting, each annual AMS/MAA meeting, and major international meetings such as ICIAM (<http://www.awm-math.org/workshops.html>).

Many of these activities are sponsored by NSF.

The participating MPSAC members discussed their departments' policies and experiences with regard to increasing the number of women graduate students and faculty. There was general agreement that active participation of the department leadership is crucial. Beyond this, some universities have special policies that seem to help -- for example considering spousal hires, maintaining a generous family leave policy, and being willing to adjust the tenure clock.

The breakout group asked DMS staff members to discuss the relative success rates of male and female grant applicants, and the degree to which gender plays a role in the evaluation process. The group was pleased with DMS's handling of these issues.

FOLLOWUP ON RECOMMENDATIONS OF THE 2004 COV

The 2004 Mathematical Sciences Committee of Visitors report noted that the number of Institutes funded by DMS has increased in recent years, and asked DMS to review the Institute portfolio as a whole, to analyze how well its strategic goals are being met. The staff of DMS have devoted a great deal of energy to this review over the past year. They found that the Institutes need to coordinate their activities better, and mechanisms have been put in place for this to happen. They also found that the Institutes can be a powerful, cost-effective tool for broadening participation, and mechanisms are being put in place to measure this effect. Finally, they found that the Institute portfolio provides the community with valuable platforms for scientific leadership.

The 2004 COV also asked DMS to develop a framework for evaluating the effectiveness of its human resource programs, particularly VIGRE and EMSW21. This is not an easy matter, since these programs' goals are not just to train young mathematicians but also to change the educational programs and cultures of top mathematics departments. DMS is quite appropriately proceeding deliberately, striving to define a framework that captures all the programs' goals.

THE MATHEMATICAL SCIENCES PRIORITY AREA

The Mathematical Sciences Priority Area activity is currently in progress and will continue through 2007. Unfortunately, due to the prospect of flat budgets, no funding increments associated with this activity are expected for FY06 or FY07.

THE SEARCH FOR A NEW DIVISION DIRECTOR

Bill Rundell's four-year term as Director of DMS will expire in summer, 2006. The mathematicians on MPSAC expect to play an active role in the search for his successor.

AMS COMMITTEE ON SCIENCE POLICY

The American Mathematical Society's Committee on Science Policy took place the same day as this MPSAC meeting. A major topic of discussion was the proper balance between single investigator grants, group grants, and centers. It will be natural to revisit this question at the mathematics breakout session associated with the Fall 2005 MPSAC meeting.

APPENDIX IV

MPSAC ACCEPTANCE OF THE DIVISION OF ASTRONOMICAL SCIENCES COV REPORT



University of Colorado at Boulder

W. Carl Lineberger
Department of Chemistry and Biochemistry
JILA

440 UCB

Boulder, CO 80309-0440
(303) 492-7834
FAX: (303) 492-8994
Internet: WCL@JILA.Colorado.edu

April 22, 2005

Dr. Michael S. Turner, Assistant Director
Directorate for Mathematical and Physical Sciences
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Dear Dr. Turner,

I am very pleased to inform you officially of the formal acceptance by the Mathematical and Physical Sciences Advisory Committee (MPSAC) of the report of the Committee of Visitors (COV) for the Division of Astronomical Sciences (AST). This report was considered by the Mathematical and Physical Sciences Advisory Committee during its April 7-8, 2005 meeting. The report was presented by telephone by the Chair of the COV, Dr. Craig Wheeler of the University of Texas, assisted by Professor Robert Kohn, a member of both MPSAC and the COV. The report strongly endorsed the programs and work of the Division of Astronomical Sciences, especially noting the fashion in which the Division has assembled an outstanding portfolio of world-class research programs and facilities. The COV was extremely pleased with the management of the division, the mechanisms by which decisions were made and the thoroughness with which those decisions were documented.

The report articulates several challenges facing AST, raising issues that MPSAC also believes should receive attention. AST faces particular challenges associated with new facilities, as documented in the report. The COV noted the importance of the new facilities and the careful mechanisms by which facility priorities are determined. The COV endorsed the Division's new strategic plan to build a sustainable program using a community-based process that considers the scientific merits of extant facilities and programs, as well as the advances that can be realized with new instruments and other initiatives. The COV strongly recommended that the AST grants program should be maintained at or above its current funding level, despite the severe budget

pressure presented by proposed large facilities. The MPSAC strongly endorses the planned Senior Review as an important planning step to address these stresses.

The COV noted that AST will face severe challenges in the coming years to maintain its excellent research portfolio in the face of a difficult funding environment. The COV expressed confidence that the AST staff has the expertise and perspective to optimally manage its program within these severe constraints. The COV noted the key role of AST in fostering the next generation of scientists poised to take full advantage of new facilities. The COV further noted the uneven fashion with which Criterion 2 is treated by proposers, reviewers and review panels, and urged AST leadership to continue efforts to enlighten the community with respect to this important component. The MPSAC unequivocally endorsed all of these recommendations.

The MPS Advisory Committee members had read the report carefully prior to our meeting, and Dr. Wheeler's presentation provided an opportunity for the Advisory Committee to ask further questions about the challenges described above, as well as questions arising from the other COV recommendations. At the end of this exchange, the MPS Advisory Committee members were firmly convinced that the COV report provided a fair and balanced perspective on the operation of the Division of Astronomical Sciences, and that it had properly posed the important issues facing AST. We are very grateful to the COV and its Chair for this excellent, in-depth review of the Division of Astronomical Sciences, and we are grateful to the AST staff for their thorough preparations for this review and for their commendable performance.

Sincerely,



W. Carl Lineberger, Chair
MPS Advisory Committee

cc: Dr. Craig Wheeler
Dr. Robert Kohn
Dr. Wayne Van Citters
Dr. Morris Aizenman



AST 2005 COV
Report

APPENDIX V
MPSAC ACCEPTANCE OF THE DIVISION OF MATERIALS RESEARCH COV REPORT



University of Colorado at Boulder

W. Carl Lineberger
Department of Chemistry and Biochemistry
JILA

440 UCB

Boulder, CO 80309-0440
(303) 492-7834
FAX: (303) 492-8994
Internet: WCL@JILA.Colorado.edu

April 24, 2005

Dr. Michael S. Turner, Assistant Director
Directorate for Mathematical and Physical Sciences
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Dear Dr. Turner,

I am very pleased to inform you officially of the formal acceptance by the Mathematical and Physical Sciences Advisory Committee (MPSAC) of the report of the Committee of Visitors (COV) for the Division of Materials Research (DMR). This report was considered by the Mathematical and Physical Sciences Advisory Committee during its April 7-8, 2005 meeting. The report was presented by the Chair of the COV, Dr. Horst Stormer of Columbia University. The report strongly endorsed the programs and work of the Division of Materials Research, especially noting the fashion in which the Division has assembled an outstanding portfolio of world-class, materials-inspired research programs. The COV found that the program directors of the DMR have been especially mindful of the People, Ideas and Tools multiple foci of NSF, and that they have managed their programs very effectively to optimize productivity within the substantial financial constraints that the Division faces. The COV was extremely pleased with the management of the division, the mechanisms by which decisions were made and the thoroughness with which those decisions were documented.

The COV noted the budget challenges faced by DMR in the near future, especially the significant cut in the current fiscal year. The COV supports strongly the intent of the Division Director to maintain funding for each DMR grant at a viable level, and the COV reiterated the cautionary note of previous COVs to pay very careful attention to the balance between center and individual investigator funding. The COV urged the DMR leadership to do everything possible to maintain or increase the fraction of individual investigator grants in DMR's funding

spectrum. The COV noted that DMR will face severe challenges in the coming years to maintain its excellent research portfolio in the face of a difficult funding environment. The COV expressed confidence that the DMR staff has the expertise and perspective to optimally manage its program within these severe constraints. In all of these areas, the MPSAC fully endorsed the COV recommendations.

The MPS Advisory Committee members had read the report carefully prior to our meeting, and Dr. Stormer's presentation provided an opportunity for the Advisory Committee to ask further questions about various topics in the report. At the end of this exchange, the MPS Advisory Committee members were firmly convinced that the COV Report provided a fair and balanced perspective on the operation of the Division of Materials Research, and had articulated the important issues facing DMR in the near future. We are very grateful to the COV and its Chair for this excellent, in-depth review of the Division of Materials Research, and we are grateful to the DMR staff for their thorough preparations for this review and for their commendable performance.

Sincerely,



W. Carl Lineberger, Chair
MPS Advisory Committee

cc: Dr. Horst Stormer
Dr. Thomas Weber
Dr. Morris Aizenman



DMR FY2005 COV
Report

APPENDIX VI
FINAL REPORT OF THE WORKSHOP OF OCTOBER 28-29, 2004

THEORETICAL SCIENCE IN THE MATHEMATICAL AND PHYSICAL SCIENCES
DIRECTORATE WORKSHOP

Date: Sat, 02 Apr 2005 12:18:53 -0500
To: wcl@jila.colorado.edu, mturner@nsf.gov
From: Thomas Appelquist <thomas.appelquist@yale.edu>
Subject: Report of the Theory Workshop[
Cc: maizenman@nsf.gov, abrahams@physics.rutgers.edu,
rdb3@stanford.edu, eac@chem.ucla.edu, snc@physics.wisc.edu,
fhellman@ucsd.edu, steven.girvin@yale.edu, huchra@cfa.harvard.edu,
cmckee@astron.Berkeley.EDU, drm@math.duke.edu, venky@harvard.edu,
pembertn@u.arizona.edu, bberger@nsf.gov, vpankoni@nsf.gov,
crohlfm@nsf.gov, cstark@nsf.gov, gtaggart@nsf.gov

Dear Carl and Michael,

I enclose the Report of the Workshop on Theoretical Science in the Mathematical and Physical Sciences Directorate. I look forward to presenting the report to the MPS Advisory Committee on Thursday, April 7.

I want to take this opportunity to thank all the members of the Steering Committee for their wisdom and hard work in organizing the Workshop and developing the report over the past several months. The leadership of this group was the key to bringing the broad MPS theory community together so successfully, and to creating the consensus leading to this report.

Sincerely,

Tom

Thomas Appelquist



Theory Workshop
Report

APPENDIX VII



University of Colorado at Boulder

W. Carl Lineberger
Department of Chemistry and Biochemistry
JILA

440 UCB
Boulder, CO 80309-0440
(303) 492-7834
FAX: (303) 492-8994
email: WCL@JILA.Colorado.edu

July 26, 2005

Dr. Michael S. Turner, Assistant Director
Directorate for Mathematical and Physical Sciences
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Michael:

I have reviewed the final version of the minutes of the Directorate for Mathematical and Physical Sciences Advisory Committee meeting that was held on April 7-8, 2005 (attached), and am pleased to certify the accuracy of these minutes. I especially appreciate the efforts of Morris Aizenman, both in preparing this record, and in incorporating those changes suggested after my review of the draft minutes.

With best wishes,

A handwritten signature in cursive script that reads "W. Carl Lineberger".

W. Carl Lineberger
Chair, MPS Advisory Committee