



UNITED STATES GOVERNMENT
M E M O R A N D U M

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Date: March 28, 2006
From: Assistant Director, MPS
Subject: **Response to the Division of Physics Committee of Visitors Report**
To: MPS Advisory Committee

Please find attached the MPS response to the Committee of Visitors (COV) report from the 27-29 January 2006 COV review of the Division of Physics. The review was thorough and insightful, and the findings will be very helpful to MPS and to the Division of Physics in fulfilling our responsibilities to the scientific community and to the nation.

The Division of Physics drafted the attached response, and I concur with its content. I therefore adopt it as the official response of the MPS Directorate. I hope the full MPS Advisory Committee finds this COV review and the MPS response useful and acceptable.

A handwritten signature in black ink, appearing to read "M. S. Turner".

Michael S. Turner
Assistant Director

Attachment: Response to Division of Physics COV Report of 2006

Division of Physics Response to the Report of the 2006 Committee of Visitors

INTRODUCTION

The 2006 Committee of Visitors (COV¹) for the Division of Physics met on 27-29 January 2006 and submitted their report to the Chair of the Advisory Committee for the Directorate for Mathematical and Physical Sciences (MPSAC) on 17 February 2006. The COV reviewed the actions made by the division for the fiscal years 2003-2005, and they examined in depth all aspects of the operation of the division, including review procedures, decisions and decision process, portfolio balance, quality of outcomes, strategic vision, priorities, etc. The COV commended the Physics Division (PHY) for its performance in all areas identified in the charge and in the COV template, as documented in the full COV report, included here by reference only. The COV also identified and commented on a range of issues for consideration by MPSAC, MPS, and PHY in the interest of further improving the performance of the division. The present response focuses on those issues, provides some initial feedback, and indicates what actions are planned to address each issue. This format lends itself to tracking and assessment by PHY, MPS, MPSAC and the 2009 COV. In addition, this response will be sent to the 2006 COV to provide feedback and lay out proposed actions resulting from their report.

The thoroughness, integrity, and insight exhibited by this panel of 33 representatives of the physics community served by PHY were exemplary; and the findings and advice provided in their report will help strengthen PHY in the years ahead. The Division of Physics would like to express its deep gratitude to the COV members for this vital contribution to the physics enterprise. We wish to express special gratitude to Prof. Luis Orozco, COV Chair, for his masterful leadership of this complex, fast moving, yet crucial review.

ISSUE 1: High-Level Portfolio Balance

The PHY gauge for overall portfolio balance has been to maintain PI support at more than 50% of the total budget. Facilities and center activities account for the other major components. The reasoning is that the PI support (aka Great Discovery Machine, Advancing the Frontier, Core Program) is the origin of the new ideas and talent in physics and, therefore, is the highest priority in the portfolio. This principle has been strongly endorsed by all past COVs. The 2006 COV reexamined this high-level portfolio balance issue and recommended the following: “The COV recommends keeping the individual investigator awards above 55%, while the PFCs are kept at not more than 10%.”

PHY Response: PHY agrees with this advice and will use it as a target in its planning, with the 50% mark acting as an absolute lower limit. We note that the present and projected FY 2007 balance meets both standards recommended by the 2006 COV.

¹ List of acronyms given in Appendix.

ISSUE 2: Physics Frontier Centers

The 2006 COV was charged to specifically examine the Physics Frontiers Centers Program for its value, appropriateness, and management. This topic was taken up by a special PFC sub panel, and the entire COV discussed it at length, including a review of current NSB policy on the topic of centers. The following statement summarizes the overall evaluation: “The COV is convinced that there is room in the program of the Division for collective activities such as the PFCs. These activities span the programs of the Division and have proven to be excellent. The proposals should be subject to competition for renewal at the appropriate time intervals.” And elsewhere, “The current structure for the operation and management of the PFCs is appropriate.” And elsewhere, “As a group, the PFCs represent a stellar collection of outstanding clusters of leading scientists, including multiple Nobel laureates (5). The impact of the work carried out in the PFCs is expected to be profound.” Various cautions and concerns are expressed in the COV report, i.e., that the PFC funding be kept at 10% or below of the total budget, that the synergy or value added be kept in the forefront of the evaluation process, and that PFCs shown by peer review to have fallen below the highest competitive level be phased out so competitively superior PFCs can be started. Another comment captures what PHY has observed regarding the ability of PFCs to attract young talent: “One of the original notions behind the PFC program was to foster the training of young physicists, first by attracting young people to the programs and then offering them the best training in the most exciting new areas of physics. Based upon the evidence of the site visits, the PFC program is succeeding in this area beyond even what had originally been imagined.” Regarding the issue of value added and synergy, the PFC sub panel noted, “In several instances research claims by a center were also claimed by grantees in other programs. If the purpose of the PFC is to stimulate cooperation and collaboration that would be viewed as a great success, but if the result is supposed to have happened only because of the PFC exists it might be viewed that the PFC is just supplementing existing grants. This is an issue that might be clarified by the NSF and might be asked of PFCs on site visits.”

PHY Response: PHY is gratified by the findings of the COV. This program is still in its infancy, but transformational research and resulting recognition for PFC investigators has been impressive by any measure. The final point in the above summary concerns claims of credit by both a PFC and individual grants to PFC participants. PHY does not prohibit acknowledgement of multiple sources of support, and, indeed, there are many other examples where NSF grantees have support from other sources that, together with the NSF support, enable the resulting research to be carried out. PHY is, however, very sensitive to the issue of synergy and value added by PFC awards; and each step of the review/competition process singles out this issue for explicit examination. Heretofore, visiting panels have addressed this issue and found the PFC support to be justified on the basis of either unique contributions or on the basis of cooperation and collaboration and risk taking enabled by the PFC support. PHY will continue its vigilance on this central criterion for PFC support. Regarding the admonition to phase out competitively weaker centers, PHY is committed to this principle; and successive COVs will examine the track record.

ISSUE 3: Proposed Mid-Scale Instrumentation Program

Arising from the COV report is a clarion call for a program to support the acquisition or development of mid-scale instrumentation. Increasingly, frontier research requires the tools to work at the cutting edge of technology; and the costs for this instrumentation falls in the range above the limit of the MRI program (\$2M) and below the threshold for the MREFC program (\$100M for MPS). This issue was mentioned in the COV overview and in the AMOP, EPP, NP, and PNA sub panel reports. It has also been addressed in recent NRC and NSB reports, so the need is widely recognized and well documented. PHY has created a nascent program, Accelerator Physics and Physics Instrumentation (APPI) Program, to address this need, but budget growth has not been sufficient to launch it. One concern was that APPI might start at the MRI ceiling, thus prohibiting proposals from, e.g., AMOP groups that often fall under that amount.

PHY Response: PHY has created a new account called APPI to address this compelling need of the physics community; and it is awaiting the opportunity to ramp it up to, eventually, \$30M or 10% of the PHY budget, where it would be expected to have a profound impact on the physics community. The pent-up need is palpable and is being constantly expressed. Regarding the concern by the AMOP sub panel, PHY will not set a lower limit as high as \$2M for APPI, but will consider proposals down to approximately \$80K, as recommended by the AMOP sub panel, a level at which pressure on the PI program becomes too high for routine consideration. PHY will use any flexibility in future years to begin ramping up APPI. In addition, PHY and many other divisions are putting mid-scale instrumentation forward annually as an investment opportunity for future budgets.

ISSUE 4: Planning Budgets for Large Facilities

Another clarion call arose in multiple places in the COV report, namely, that better life-cycle budget planning and agency oversight be carried out for MREFC scale facilities. This request entails several sub themes, e.g., (1) budget for R&RA costs in a way that doesn't damage the PI support level of 55% of the PHY budget; (2) invest in early R&D and design work to obtain a viable design and budget; (3) provide a transparent plan for future facilities to demonstrate adherence to these admonitions; and (4) include entire life-cycle costs and sources of funds for all aspects of projects, from concept development R&D to decommissioning and decontamination. The recent cancellation of the RSVP project was used to emphasize the corrective actions that are needed. Quoting from the COV overview on p. 5, "The Division should continue its commitment to many exciting facilities, which are defining new programs in their fields. The operations of these large facilities should be funded without compromising the base programs in the Division....The 2003 COV recommended that the Division works out a concrete public plan for operation of large facilities; the 2006 COV concurs with the recommendation of the previous committee and is worried that this has not happened." A more detailed analysis was given in the EPP sub panel report: "The cancellation of RSVP was a tragedy – the loss amounted to millions of dollars, hundreds of person-years, credibility with foreign partners, and credibility of MPS with the NSB. Although RSVP was an MREFC and therefore outside of EPP, it originated in EPP and was reviewed here.

However, the lessons learned from the cancellation of RSVP go well beyond EPP and are relevant for NSF as an agency.

NSF must learn to think big if it wants to do big projects well and prevent such tragedies in the future. Some of the lessons we have extracted from this regrettable experience include the following.

- The initial PI cost estimates were optimistic because they were not based on well-engineered designs. A mechanism to fund preliminary engineering studies and do a proper baseline review before submitting an MRE proposal to the NSB must be identified and become a required part of the process.
- Closer cooperation with other agencies providing facilities or infrastructure is needed from the very beginning. Even though RSVP was to be hosted at a DOE facility, the first DOE Lehman review of the project came in 2004 (four years into the project). Some of the cost overruns were related to the need to refurbish the AGS extraction line, and earlier involvement by DOE experts would have caught this problem much sooner.
- Both of the above problems would have been identified sooner had an independent project management office been provided to support the PI-led scientific management from the beginning. The pattern of significant cost increases over the initial PI estimate has been observed in numerous MRE projects, but in other cases project management was on board before the projects were brought to the NSB
- Operations and other “life cycle” costs must be included in the budgeting and planning, and care must be taken that such large ticket items do not adversely impact the divisional core PI support.
- A delay of several years between MRE approval and the start of funding is very unhealthy and efforts should be made to reduce this lag.

We suggest that an NSF office for large projects be established in order to provide sufficient support and oversight, and to ensure that this history is never allowed to repeat.”

PHY Response: The DD/PHY discussed this issue openly and extensively with the COV; and the points raised above are valid, except for the last point on establishing an NSF office for large projects, which has been done, although this office does not provide any form of direct funding. The early investment and life cycle budgeting for MREFC scale projects is generally understood to need further improvement; and this is being carefully scrutinized in projects going through the system now. The general policy concerning how R&RA funds planning and operating facilities is still under discussion. However the practice is for such costs to devolve to the requesting program or division, with intermittent but no generally practiced budgeting for such costs at the NSF or directorate level. This creates the tension with the core programs that is of great concern to this and previous COVs. One consequence of this tension is that fewer facilities will be advanced, owing to the magnitude of the required R&D and operations and the consequent pressure on the PI program. The other consequence in the recent past is that projects are not proceeding in a robust, success-oriented fashion, prior to MREFC

funding. This is an intrinsic challenge in planning and executing major investments in facilities; and PHY joins with MPS and NSF in the desire to find an efficacious and fair algorithm for managing this natural conflict.

ISSUE 5: DUSEL

The attention to developing future MREFC-class projects naturally focused on the major facility presently under consideration, namely, the Deep Underground Science and Engineering Laboratory (DUSEL). The following statement from the PNA sub panel gives the context: “We note that within the Particle & Nuclear Astrophysics program a significant portion of the present and expected future experiments require locations underground in order to control backgrounds. The experiments are on topics considered among the most important in particle, nuclear, astrophysics and cosmology; to cite a few: dark matter, double beta decay, geo- and solar neutrinos. The NSF's has begun a cross-Divisional initiative to create a DUSEL, which would greatly benefit the present and growing PN&A program. We strongly commend this initiative and encourage careful planning for its creation and operation so that its successful passage through the long review process is assured.”

PHY Response: DUSEL is, indeed, an indicator of efficacy of the present process of developing MREFC projects by PHY. Plans for the R&D, design, and project management needed for a reliable cost estimate have been estimated by the program officer in charge of the DUSEL project, a person with extensive project management experience. The two candidate sites are developing conceptual designs, and NSF has formed a working group including representatives from other interested agencies. While these actions are encouraging, DUSEL remains a possible prospect for development in PHY, without firm knowledge that the needed funds can be provided by PHY without impacting the PI programs of PNA, NP, and EPP and the high-level portfolio balance, discussed earlier. This issue will require continuing careful attention to successfully adhere to COV advice to more definitively advance large construction projects in a way that ensures the best chances of success, while not damaging the core PI support required for the physics community.

ISSUE 6: PHY Staffing

The 2006 COV reiterated the theme cited in all past COV reports, that the staff is increasingly overburdened and that this is a serious problem for the continued success of PHY. Contributing to this are factors such as the complexity of larger activities, increase in NSF-wide program responsibilities, static staff numbers, creation of several new programs, increased reporting requirements, etc. Particularly acute are the need for a new Program Director for AMOP and a full time PD for Education and Interdisciplinary Programs. In the former case, the existing PD has taken on much NSF-wide work and responsibility for the new Physics Frontiers Centers and Biological Physics Programs and is now clearly overburdened. In the latter case, the staffing for EIR has gone from 1 PD to ½ PD to 0 PD over the last few years; and this situation is significantly afflicting PHY efforts in education, diversity, outreach, and new interdisciplinary programs. Additional staffing comments are made in the report, e.g., need to have more permanent staff to

retain institutional memory (EPP), same comment for NP and PNA, and the overarching recommendation to maintain 50:50 mix of IPA and permanent appointments.

PHY Response: All of the staffing needs, accurately identified by the COV, are in the recently updated PHY 5-yr staffing plan; and recruitment or appointment actions are pending on the most critical needs.

ISSUE 7: Broadening Participation

Quoting from the COV General Conclusions, “The statistics on the number of women PIs and Co-PIs show a trend of growth that this COV welcomes. It has crossed the 15% mark and shows evidence of increasing. The numbers for other underrepresented groups do not show significant change during the last ten years. The COV encourages the Division to continue its efforts to reach, mentor, and encourage women and underrepresented groups to involve them in the scientific enterprise of the Division.”

PHY Response: PHY was pleased to show growth in the fraction of grants held by women PIs and/or co-PIs; and the lack of statistically significant increases in minority groups was noted. PHY is committed to continuing the positive trend for women and to establishing a similar trend for minorities. PHY has established a reserve for the purposes of annually investing new funds in activities, mainly research grants, that broaden participation, usually in the form of co-funding with the regular programs. This mechanism will not affect the type of grant received, thus avoiding any perceived stigma. The program started modestly (\$500K/yr) but PHY is committed to increasing it 10%/yr until the participation in the PHY portfolio substantively improved.

ISSUE 8: Improvements for Future COVs

The COV made the following recommendation for improvements for future COVs.

“This COV has a few suggestions to make the next COV process more effective while keeping it informative and educational:

- Keep the statistics over 10-year period, not just for the Division, but also for the programs.
- Make sure that the general materials are available several weeks before the meeting. (For COV 2006 the web page opened ten days prior to the meeting.)
- We would like the next COV to have uniform accessibility to the electronic files.
- We recommend that the next COV try to get started on reviewing jackets earlier, and leave the program overview for later, maybe on the morning of the second day.
- Many members of the COV felt that conference calls first with subcommittee chairs, and then within subcommittees to explain the web site, the process, and the charge would be good.
- The Chair benefited from having participated in a previous COV.
- We hope that NSF can implement the use of Fastlane interactive panel system (submit comment feature) to create the sub panel reports.”

PHY Response: Many of these build upon improvements suggested by the 2003 COV and implemented for the 2006 COV. For example, the request for 10-year statistics was addressed this year. The COV has pointed out additional breakdowns that would make their work more efficient and effective. We hope the next COV will have total electronic

access to the years under review. This is only limited by the implementation of eJacket for awards by NSF, a process that is not complete as of this writing. It is worth noting that PHY will participate in the electronic awards pilot and plans to conduct the 2009 COV fully electronically, consistent with NSF IT security procedures. For the 2006 COV, we moved up the reviewing of jackets to the middle of the first day; but we will continue to move it earlier in response to this recommendation. We will experiment with the notion of diving right in and giving overviews on the second day. This is an interesting and novel suggestion. We will arrange for a conference call before the meeting to review the charge and answer questions. We will continue to appoint Chairs with COV experience. And we will implement the use of Fastlane interactive panel system to create sub panel reports, assuming no unforeseen prohibitions on the use of the interactive panel system in this way. We appreciate these comments and will follow-up on them to try to improve the COV process.

ISSUE 9: Suggestions for Improved Proposal Processing

There were four recommendations regarding the proposal processing practices of PHY that are treated together here. First, “this COV has seen a significant improvement in the use of the use of Merit Criterion 2 “broader impact of the proposal” compared to previous COVs. This is in great measure the result of an effort to educate both the proposers and the reviewers on Merit Criterion 2 by the program directors. The results are clear, but we encourage the effort to continue.” Second, “while reading the jackets, many of the COV members found that the most informative part was the review analysis written by the program director. The COV would like to ask the Division that if possible they provide the PI with a suitably redacted version of the review analysis.” Third, there were several mentions of the need of interdisciplinary participation in review panels and discussions with other divisions for proposals with multidisciplinary content. Examples are Biological Physics (BIO, NIH), PNA (NASA, GEO, ENG, BIO, DOE), and emerging interdisciplinary proposals in EIR. Fourth, some comments were made about the review process in particular cases, e.g., the possible need for site visits for large theoretical groups and the spotty record of review for certain interdisciplinary proposals, partly due to the lack of a PD for EIR.

PHY Response: PHY appreciates these comments very much. The second point, providing redacted review analyses to PIs, has a potential upside (better communication) and a significant downside (significant work to redact analyses that are good precisely because they are confidential, an attribute that is subject to redacting). We will seriously discuss this internally (to see if it is possible and worth the effort involved) for further discussion with others at NSF and the 2009 COV. On interdisciplinary proposals, we are definitely sensitive to the need for special care when working at and across boundaries of different programs and disciplines. We have some excellent examples of spanning such gaps, e.g., in review panels for the DUSEL activity, which involved mining engineers, geologists, environmentalists, physicist, etc. However, this remains a challenge. We will reinforce the need for care in these cases and hope to have an even better record in subsequent COV reviews. Also, a permanent PD for EIR is being recruited; and this will go a long way to providing more attention to this issue in the near future. We are also in the process of recruiting a PD for theoretical particle physics; and the subject of site visits will be proposed to that person for large group grants.

ISSUE 10: Program Specific and Other Issues

There were a number of program-specific and other general issues that were identified during the COV activity. They were all valid points that have been known by PHY and, to some extent, taken into account during annual budget allocations. Nevertheless, PHY takes very seriously such comments and welcomes them. Continued efforts will be made to address these important points. A general observation was that outstanding proposals, many rated must fund by review panels, were being declined due to lack of funds. This is true across PHY and other divisions, and it is balanced with the need to give adequate funding for awards that are made. A general growth in funding levels would enable funding extremely important work that does not make the cut at the present time; and PHY, MPS, and NSF are keenly aware of this situation and are working diligently to improve the budget. Six specific comments are paraphrased here as examples: (1) Plasma Physics is under greatly increased proposal pressure since ONR stopped funding in this area. (2) Stewarding the Cornell particle physics group after the CLEO collider experiment closes down in 2008-2009 is important owing to the importance of Cornell to the national particle physics, accelerator physics, and synchrotron radiation activities. This is problematic because the operating funds from CESR-CLEO are being used to ramp up operations support for the LHC and are not available to support the redirection of the Cornell activities. (3) NSF is the primary steward for gravitational physics in the U.S.; and LIGO is now operating at its design sensitivity. Nevertheless, the need for support for numerical relativity to simulate the waveforms from gravitational wave sources has not met the need, as defined by a national workshop. (4) Theory, generally, is beset by very low grant funding levels, and the growth being realized in theoretical physics is not being accommodated by funding growths. PHY has recognized this and has pledged to increase theory support by 5%/yr for several years. The COV commended this action, but is concerned about the larger scale of the problem. (5) The RET program for teachers that has been built on the REU infrastructure has proven very successful but has experienced no budget growth. (6) Initiation of new streams of interdisciplinary research in EIR has not continued at the pace of the past, which is associated with a lack of a PD for EIR, flat budgets, and failure to communicate opportunities for funding such work in EIR. There were also three general comments summarized here: (1) The EIR sub panel recommended a formal liaison agreement with EHR on PER proposals. (2) The Gravitational Physics sub panel recommended an advisory mechanism for GP. (3) It was recommended that the number of graduate students on grants was low, in particular on theory grants.

PHY Response: PHY is sympathetic with all of these points and will work to mitigate the identified problems as well as others known to exist across the PHY portfolio. Review by the 2009 COV will constitute the assessment of success in these matters. Regarding the formal liaison with EHR on PER proposals, PHY notes that the informal PD-PD liaison is working well, resulting in PER proposals being reviewed in collaboration with DUE.

APPENDIX: Acronyms

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| AMOP | Atomic, Molecular, Optical, and Plasma Physics Program |
| APPI | Accelerator Physics and Physics Instrumentation Program |

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| APS | American Physical Society |
| CAREER | Faculty Early Career Development |
| COV | Committee of Visitors |
| DOE | Department of Energy |
| DUSEL | Deep Underground Science and Engineering Laboratory |
| EHR | Directorate for Education and Human Resources |
| EIR | Education and Interdisciplinary Research |
| EPP | Elementary Particle Physics Program |
| HEPAP | High Energy Physics Advisory Panel |
| IPA | Intergovernmental Personnel Act |
| LHC | Large Hadron Collider |
| LIGO | Laser Interferometer Gravitational Wave Observatory |
| MPS | Directorate for Mathematical and Physical Sciences |
| MPSAC | MPS Advisory Committee |
| MREFC | Major Research Equipment and Facility Construction |
| MRI | Major Research Instrumentation |
| NP | Nuclear Physics Program |
| NRC | National Research Council |
| NSAC | Nuclear Science Advisory Committee |
| NSB | National Science Board |
| NSCL | National Superconducting Cyclotron Laboratory |
| OMA | Office of Multidisciplinary Activities |
| OMB | Office of Management and Budget |
| ONR | Office of Naval Research |
| OSTP | Office of Science and Technology Policy |
| PER | Physics Education Research |
| PFCs | Physics Frontiers Centers |
| PHY | Division of Physics |
| PI | Principal Investigator |
| PNA | Particle and Nuclear Astrophysics Program |
| R&D | Research and Development |
| R&RA | Research and Related Activities Account |
| REU | Research Experiences |
| RSVP | Rare Symmetry Violating Processes |