Oregon State University Department of Physics
Academic Program Review

Report of the Review Committee
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The OSU Physics Department has faced challenges over the past decade or more, reflected in their small faculty count, inadequate and deteriorating infrastructure, and challenges in recruiting and retaining the desired number of excellent students. The program has taken innovative steps to deal with these challenges and cope with the constraints, and the program remains a congenial and stable one, albeit ranked very low amongst PhD granting programs nationally. The review panel is encouraged by the program's expectations for a more promising future, based partly on some increase in faculty numbers in recent years, and its willingness to listen to recommendations and consider bold changes that can raise its profile.

The review committee benefited from the detailed self study prepared by the Department and from the well organized and informative full-day visit to the Department.

Mission of the program and its relation to the missions of the University and College.

The department does not have a formal mission statement, but the self study mentioned two broad goals:
  - producing graduates whose knowledge of physics distinguishes them as scientifically literate, critical thinkers who are adept at understanding, articulating, and solving problems in science.
  - undertaking nationally and internationally recognized research programs and collaborating with industries to apply basic science to technology.

The panel recommends that the program agree upon an official mission statement and post it prominently on its web site. Discussion of this topic may well provide some new viewpoints on its mission and how it is impacted by program size and level of activity.

The department's research program aligns with the Research Agenda articulated by the OSU Research Office, particularly with regard to the healthy spectrum of fundamental and applied research that is conducted collaboratively with external and internal partners. Within these broad goals the department fosters two special themes: (1) advancing the physics curriculum to improve student learning and experience, and (2) developing research, often in collaboration with other organizations inside and outside OSU, to impart to students how physicists approach problem solving by making precision measurements and building an understanding on fundamental principles.

The OSU mission promotes "economic, social, cultural and environmental progress, to be achieved by producing graduates competitive in the global economy, supporting a continuous search for new knowledge and solutions, and maintaining a rigorous focus on
academic excellence, particularly in the three Signature Areas: Advancing the Science of Sustainable Earth Ecosystems; Improving Human Health and Wellness; and Promoting Economic Growth and Social Progress.”

On the face of it these Signature Areas do not readily fit the program of a typical physics department. The department has however usefully focused its research and graduate teaching along two very relevant lines by strengthening its applied solid state and optics research programs to interface with materials science and computational modeling in other departments and regional industries, and by developing connections with the life sciences through biophysics research applying optics, nanotechnology and computational strengths. This review group agrees that these lines of research focus are appropriate and have much potential for strengthening the graduate program and enhancing faculty productivity. They are less convinced that it is appropriate in the current circumstances to devote significant faculty effort to physics education research, a topic we return to below.

The program’s long term and short term goals were presented in the self study. The long term goals, stated briefly, are to: (i) increase research visibility (“publications”), (ii) attend to student placement, (iii) increase extramural funding, (iv) attract excellent new faculty. These are well chosen goals that will strengthen the research effort and the program more broadly. The short term goals are (admirably) specific: (i) increase the number of RA positions, (ii) hire additional faculty, (iii) improve research-related infrastructure, (iv) attract a stronger graduate cohort. The panel has kept these goals in mind while preparing this report.

Admissions selectivity and quality of students

The number of graduate applicants is variable year to year, but appears to be trending lower; this trend is certainly true over a decade or more. This negative slope is due in large part to the decreased number of international applicants, and also likely connected to the reduction in scope of the curriculum as the number of faculty fell. Over the recent 2009-11 period, the average was roughly 90 total applicants. About 25-35% of total applicants are admitted each year, and 35-50% of these admitted students matriculate. Women comprise less than 30% of the applicant pool, and an even lower percentage of matriculants. This gender imbalance reflects a nationwide long term issue for physics programs and is a concern at the American Physical Society level.

The relatively small number of applicants also means the pool of highly qualified applicants is small, thus selectivity is limited. This limited pool may become a significant hurdle in recruiting and retaining research-active new faculty, as well as in growing the graduate program enrollment. A recruiting plan to increase the number of highly qualified applicants, including international applicants, is not in place but should be formulated. Some components of this plan might include: forming a standing recruiting committee with chair serving for several consecutive years; seeking resources and assistance from the graduate school and international office; developing pipelines domestically and internationally; sending research-active and new faculty on recruiting seminars or interview trips; sending top grad students to revisit their alma maters. The program should formulate a plan for assessing which of these (or other) choices are the most effective.

The department supports admitted students for a recruiting weekend, and the percentage of students that accept offers is quite good. To get a handle on the effectiveness of the
recruiting weekend, it will be useful to track the percentage of accepted offers from the students who take advantage of this visit. We note, however, that highly successful programs offer similar visits to the students they make offers to, and it may simply be non-competitive not do so.

Incoming student metrics, such as GPA and test scores, have remained constant or trended upwards recently. There was one faculty comment about relatively low capabilities of graduate students, but overall faculty views of student quality are good. This conforms to graduate students’ views in general of faculty; relationships and perceptions are very positive in both directions. The numbers of students leaving without a PhD degree is high, in the range of 35-50%. This fraction is large, but probably not out of line with many other physics programs. This attrition leaves the perception of a problem, but may simply reflect the complexities of achieving a PhD degree in the midst of many other life decisions.

Level of financial support

The department restricts the number of graduate student offers to ensure that sufficient TA positions are available for incoming and continuing students. Students are supported, at a minimum, by the department on TA or RA appointments for 9 months. Compared to peer institutions, monthly stipends are at least average, possibly somewhat higher. However, some students (a small number, we believe) are not supported fully through the summer as is done at most programs at major universities. Students understand the economics but emphasized that this is a problem, and faculty feel it is a problem not only for the impacted students but also for recruiting. We recommend making it a program priority to find a mechanism to provide 12 months of support for students.

On a separate issue, some students as well as some faculty thought a tiered support system, with higher stipends based on benchmarks (viz. more teaching experience, higher research productivity) would be more equitable than uniform pay, and help to provide incentives. A tiered salary system appears difficult to implement and regulate. However, we heard that some units already do this at OSU so, with input from those units, the idea may be worth exploring.

Curriculum Strength and Areas of Specialization

Teaching in the department is done by the 13 faculty, buttressed by 4-5 fixed-term instructors to enable the delivery of several large foundational (introductory) courses that are required by other departments. The undergraduate program is not being reviewed by this panel, hence undergraduate students were not interviewed for their impressions. However, the undergraduate program affects both the faculty and the TAs, and requires comment.

Undergraduate: lower division. In a large and expanding university, a faculty of 13 that also provides a PhD program in physics requires instructors to handle most lower division courses. With a little experience, instructors can and do become excellent educators, as seems to have occurred at OSU. The fixed term nature of the appointments (often one year, it seemed), with the uncertainty it carries, presents an extra, and unnecessary, challenge to the delivery of the undergraduate curriculum and therefore of the graduate curriculum. Longer term appointments are needed to ensure the stability of these courses, and they will serve the entire department – faculty, students, and instructors – well.
**Undergraduate: upper division.** The small faculty pool for teaching has posed challenges in providing the depth and breadth of courses that are provided by most PhD granting institutions (which have many more faculty). Physics is an essential foundational discipline for quantitative sciences and engineering, and teaching it with physicists (including instructors) must be protected. The department has addressed this challenge of a restricted teaching pool by providing (1) research area-specific courses only in the areas of graduate research at OSU, and (2) by providing, instead of a large number of specific courses, an innovative curriculum comprising \(~10\) “Paradigms in Physics,” nine of which are required of each physics major. The ‘Paradigms’ material and their delivery method appear to have been well received. If the faculty can increase by several members, as is their plan and as is supported by this panel (see below), they will have some latitude to begin to fill out their upper division course list. The justification of additional faculty is clear from the large number of students (~2000) that are taught annually.

**Graduate curriculum.** Some time ago, to accommodate to the low faculty count, the program resolved to focus on teaching graduate courses related to their research expertise (condensed matter experiment, optics, computational physics) at the loss of courses in particle physics and astrophysics. Physics education is also emphasized, due to the interest of several faculty and that science education specifically is not attractive to education colleges. This selection of research areas necessitates that recruiting focus on only those students who have, or are likely to have, interest in these areas. This approach can be said to be working; students definitely aimed at other specialties will not apply. However, by limiting the type of applicants who apply, some excellent applicants will be excluded. Elsewhere in this report the applicant pool is discussed at more length.

The graduate curriculum is definitely constrained by the number of faculty available to teach, even considering the restriction to their own research areas. Group theory; many body theory; exotic phases (viz. superconductors and topological insulators); these are areas of current great importance that can only receive attention if there is growth in the number of faculty.

**PSM (Professional Science Masters) program.** The department has been encouraged to participate in this PSM program that has been implemented by a few graduate programs at OSU, very successfully in some cases. The PSM program was mentioned several times during the panel visit, and the panel met with the faculty administrator. The program has graduated 4 students total over several years, however only one of them came from outside specifically to take the program. For a program that is intended to attract additional students of a different kind, the level of activity is extremely low. While it is not a huge drain on time (the courses are already in the curriculum), it does require time of the faculty administrator even when inactive (making brochures, filing reports). It seems that this science + business + communication offering is only rarely successful in physics departments, and probably then only in much stronger departments. There is no discernible benefit to the department from this low level of activity. The panel recommends discontinuing the PSM offering, “focus on strengths” is usually the best plan.

**Ecampus.** OSU has in place its Ecampus model for online teaching that provides strong support and entrepreneurial opportunities for departments. Physics, despite its strength in education and curriculum development as well as expertise in computational physics that might provide benefit for online teaching, has thus far only one faculty member (emeritus)
involved in the Ecampus program. Students are increasingly at home in cyberspace, there is a need for more scheduling flexibility and distance teaching, and there are enough examples in universities elsewhere, that the panel sees this lack as a missed opportunity. In the OSU model of Ecampus there are also financial benefits to participating departments, which could be used to support the graduate program. The department should find a faculty champion and, assuming good faculty support, invest resources in getting an Ecampus program underway,

Quality and Adequacy of Personnel

Chair. This discussion can begin with the lead position, the Chair. The current chair took the position 14 years ago, before the modern practice of targeting the chair position at 3-5 year tenures. The panel addressed this issue of the chair's acceptance and effectiveness, both indirectly and directly. In their interview, the students – while mentioning some issues that are addressed elsewhere in this report – praised the chair for his accessibility: he is felt to be approachable and eager to make the time to talk with students. In the panel's interview with the faculty, the length of service and effectiveness of the chair was brought up. The response, without going into details, was overwhelmingly favorable. The chair consults with the faculty on department issues; he decides on pressing issues when or if discussions bog down (stated positively by the faculty). He does course scheduling, and is recognized for being willing to teach the orphan course that has no other instructor. He teaches a full load, unlike most chairs who get some teaching relief. This full load may be necessitated by the small number of faculty; possibly it may also be enabled to some extent by the small size of the department. The panel encountered no significant negative comment about the chair; the overriding impression is that he goes above and beyond the normal chair's duties to ensure the survival of the department and the success of the students. That said, it seems common knowledge that the chair does not intend to remain in the position for more than two more years. The deans indicated that an outside search is plausible if no obvious candidate arises from within. The panel recommends that the department and deans indeed keep open the option of an open search. An outside person brings in an additional excellent and experienced physicist, and there are numerous examples where an outside person provided a stimulus that would not be possible with an inside, entrenched person.

Office Coordinator. The person identified in this position was praised especially by students but also greatly appreciated by faculty. There is little to add: no problem in this area, quite the opposite: the primary department staff person is admired by all.

Other Departmental Staff. Due to the shortness of the one-day visit, other staff positions were not addressed specifically.

Level and Quality of Infrastructure

The program self study identified infrastructure as one of the difficulties faced by the department. Space per se is not the issue; after all, more faculty members were accommodated in earlier years in the same space. However, in what is often referred to as "vintage 1960s laboratory space," modern researchers usually find the space that is available to be unacceptable for precision equipment and measurements that are required for modern experiments. One serious issue for several faculty is vibration level, for which many modern experiments have strict requirements. There are other areas of inadequate
physical infrastructure: sufficient cooling and heating at the appropriate times, and availability of water, gas, and power. On the staffing side, there has been little formal training of students in the machine and electrical shops. On this topic of shop training, the department can consider partnering with other physical science or engineering departments.

Computational infrastructure. Computational physics has a comparatively long history at OSU; its educational presence in this area has national visibility (including a textbook by a faculty member), and there are several researchers with successful programs in computational physics. The infrastructure in this research and teaching area is woefully inadequate. This deficiency highlights what can be characterized as a lack of fair treatment of computational scientists, a feature of many (but not all) campuses. It has long been accepted, and rightfully so, that laboratory scientists and engineers are entitled to the space and infrastructure facilities that will enable modern, competitive research opportunities. With modern accounting methods, it is space that is the expensive item, followed by the related infrastructure that enables modern, precision experiments. With computational science growing alongside experimental science and now surpassing purely theoretical science as one of the three pillars of science -- experimental, computational, theoretical -- their infrastructure needs should be recognized and addressed.

Computational physicists require comparatively little space, actually very minor compared to laboratory scientists. The necessities of electrical power and cooling are not inconsequential, but are not great compared to the laboratory scientist. The Physics Department has a useful but comparatively (to peer programs) small room for its computer clusters that is woefully limited in infrastructure: cooling certainly, and almost surely an upgrade in power is necessary. It seems a comparatively minor issue to provide the computational research group with the infrastructure that is necessary to house their computational hardware. The panel was made aware that some faculty have the capability of purchasing more computational hardware, but the infrastructure currently is unsuitable. The panel strongly recommends that the infrastructure be developed to enable the computational physicists to expand their programs and pursue leading-edge research.

Laboratory infrastructure. The available laboratory space in the Weniger Building is widely acknowledged to be unacceptable for most modern laboratories for the condensed matter experimentalists that form part of the core of the departmental plan for hiring. To the University’s credit, recent hires have been accommodated with renovations that enable their research at a modern, competitive level. Although the panel hears of plans of a new building in the future (“Pauling II”) this addition to infrastructure appears to be years in the future. The panel encourages all involved persons at OSU to support, and facilitate, improvements in the infrastructure for the experimental faculty in Physics. Such improvement, or definite scheduled plans for it, will be necessary to succeed in hiring new faculty who can excel in their research.

Quality of Institutional Support

The panel was not apprised of enough of the history of the physics program at OSU to understand the many issues that have resulted in the low number of faculty in recent years. However, it became clear that the faculty level (FTE) fell from the level of 19 about 2 decades ago, to 9 a decade ago and then to only 8, and then to recover to the 13+1 (one new hire) in 2012. During at least the latter part of this time, the student body at OSU has
grown considerably, and the teaching of physics to physical science, engineering, and bioscience majors has increased greatly. The physics department continues to teach fundamental physics (typically called service courses) to the students in other science areas who must be able to incorporate the fundamental physical laws into their research thinking. With the low number of physics FTE, this teaching has been accomplished by the hiring of fixed-term instructors. This policy has allowed the physics program at OSU to survive.

The panel believes that it is crucial for a major university that the Physics Department is facilitated in a way that it cannot only survive but can thrive and carry out forefront research and train excellent PhD students, in addition to one of its primary educational roles: to educate young scientists in the understanding of, and the disciplinary tenets of, modern physics. The principles of physics underlie the physical sciences and engineering, as has long been recognized, but the precise, quantitative measurements and the problem-solving aspects long associated with physics increasingly underpin leading edge research in the biological sciences. In addition, small programs are increasingly under fire from state and national figures who are attacking higher education. Physics is one of the fundamental disciplines that should be brought up to, and maintained, at critical mass.

Level and quality of student performance

About 10-12 students per year are admitted, a number limited mainly by the availability of TA positions, as there are relatively few RA positions available. About 25-35% of entering students leave the program without a degree, a fraction that is typical of physics programs nationwide. Two or three in recent years leave after receiving an MS degree, and typically 4-5 students progress to doctoral candidacy each year. Time to completion of a PhD is 5-6 years in most cases, comparable to the national norm in physics. Students are expected to be involved in a research program in their second year, with the expectation that some will be taken on as RAs after spending ~2 years as TAs. Talking to the students, the panel got the impression that some felt very integrated into active research groups, had clearly defined research programs and had opportunities to attend conferences etc., whereas others had more difficulty identifying research topics to pursue.

The students were generally satisfied with the level and quality of graduate teaching but mentioned one or two classes that they strongly felt needed oversight by experienced educators: one clear issue was far too much homework in one class. Several students would have liked more formal computational physics classes, and stated that the computer facilities were out of date. Other students mentioned a lack of machine shop technical support. There seemed to be little or no interest among the students in developing an internship program with industry or government laboratories. Given the local possibilities, this seems to be an area faculty might revisit and look for opportunities. All students commented very favorably on the willingness of the faculty to provide advice and encouragement. At the risk of repeating ourselves, we again emphasize that the panel was heartened by the camaraderie displayed between all levels within the department.

Level and quality of faculty performance

The faculty members are strained to cover their undergraduate and graduate teaching responsibilities, which they take very seriously. There is impressive enthusiasm facultywide for the innovative teaching approaches for which the department has
established a reputation in recent years. With the exception of a few low scores recently, student evaluations of graduate teaching are good to very good.

The faculty as a whole publish about ten refereed articles per year – a low output for 13 faculty, but undoubtedly influenced by the heavy teaching load, small number of RAs, and the limitations of infrastructure. Average research grant income per faculty member is well toward the low side, but this average hides the success of a few individual research programs. It is particularly encouraging to see the successful programs of several relatively new faculty, including three NSF Career grants. Research grants also clearly show the very effective collaborations that several faculty have developed with researchers in other OSU departments and elsewhere. The panel notes a good range of non-traditional agencies providing funding, particularly the ONAMI program and the Office of Naval Research.

**Viability of the scholarly community**

Although the students commented on the openness and activity of the faculty, a few faculty do not seem to be active in research. This difference adds to the load of the active faculty who need to serve as major professors to well over the average number of students. The program also creates an additional advising burden by requiring all senior undergraduates to complete a research project, a commendable practice both for attracting good students and for giving them useful experience for future careers but also a drain on faculty time. The recent influx of several new young faculty has shown the benefits that new energy and enthusiasm can bring. If similarly impressive hires can be made over the next few years the department will be re-invigorated. Without such an expansion it is hard to see how the research performance can improve significantly. The faculty who are so inclined will not have the time available for additional grant writing, and without grants there will not be enough RA support to grow the graduate program.

**Professional viability of graduates**

According to the self study, out of 32 students graduated from the PhD program since 2006, 26 found employment at the time of degree in physics-related jobs. This is a commendable record in these economic times. Out of the 26, nine went into the private sector, three to the National Labs, thirteen to colleges and universities (these include teaching positions at community colleges and post-doctoral research positions at universities), and one became a high-school teacher. This is an example of success that should be kept handy for those who need, or want, to know and use such information.

As for their earlier graduates, the department (and, apparently, the college) does not keep up-to-date information on career progress of its graduates, and with some contact has been lost. While such a database may be difficult to maintain at the department level, it is very important to follow students in their careers. They can share their career path and life experiences with current students and contact with alumni is important to the development effort. The panel makes two recommendations in this area: (1) regularly invite alumni but also physicists from industry and from national labs such as PNNL, LBNL, and LLNL to share with students and faculty their job seeking and working experiences, and (2) engage the college, the university, and alumni organizations to help keep alumni contact information up to date, as it is needed for development purposes.
One of the drawbacks of the small size of the department is the inability to offer a broad curriculum. As mentioned above, the current curriculum is limited to foundational courses (quantum mechanics, electromagnetism, optics, solid-state physics, and computational physics), and a few courses in the areas of research interests of the faculty. Modern technological megatrends, such as mobile devices, green energy, and sustainability, require physical knowledge beyond the traditional set of courses that interface with other fields: chemistry (e.g. batteries), engineering, biology and others. With a large graduate fraction going to industry, it is important that students receive proper training that will make them competitive in today’s labor market. One of the benefits of growing the physics program at OSU could be extending the curriculum to include other modern topics, e.g. multiphysics modeling and physics-related courses in engineering departments. The panel recommends that the department consider such extensions as part of its long-term development plan. It might be appropriate to develop some modules in collaboration with other departments.

In conversations with the panel, students mentioned that writing research papers, preparing grant applications, and giving conference presentations are distributed unevenly among the research groups. Many active programs provide such opportunities for development of these and other professional skills. While such a disparity is not unexpected, some students may not receive the training needed later in professional life. The panel recommends finding ways to provide minimal training to everybody. For example, a class or seminar on writing grant proposals may be useful. Again, collaboration with other departments should be considered. There is for example a thriving graduate class on this topic offered in CEOAS.

Satisfaction of students and graduates

The panel found overall satisfaction among graduate students to be high, inspite of the challenges that are mentioned in this report. The students complimented the chair, faculty, and staff for accessibility, openness and dedication. The students feel engaged, most of them enjoy the research they conduct, and the majority consider physics to be their future profession. However, areas for improvement do exist. Several of these items may be addressed in the near term, others are consequences of underfunding that can be improved only on a longer time scale.

- Students are consulted about many aspects of the departmental life. For example, they meet with all new hire candidates and then are asked to provide their impressions. However, it is not clear how students’ opinions affect the final decisions.
- Similarly, students do not know what effect their evaluation forms have. The complaint mechanism is not clear to them. The University has support structures but most students are unaware of them.
- There is an employment gap for some students during summer months, which creates financial uncertainty.
- Some students expressed an opinion that lack of differentiation in salary reduces incentives to work harder.
- Machine shop skills are seen by many as beneficial for the future but obtaining training is problematic. Broken equipment takes a long time to have fixed.
The students would welcome more opportunities to interact, such as what a larger graduate common room would promote. (The panel learned during the tour that attention to this item is already under way.)

Rankings/rating

The National Research Council Assessment of Physics Doctorate programs released in 2010 places OSU in the 140-150 category among 162 programs surveyed. This is acknowledged in the self study to be “quite low”. The panel does recognize that this ranking was based on the data collected in 2005-2006, when the OSU department was small and just began hiring young faculty members. The available ranking is not necessarily representative of the current state of the Department. (The panel is aware that there are gross inaccuracies in the NRC database. It lists in relation to OSU physics: “Total Faculty in 2006” of 30, and “Number of Core and New Faculty in 2006” of 25, which is total fiction. Although those numbers were not used in ranking according to the database, this raises a question about the accuracy of the information on which the ranking was based.)

We note that the previous ranking, released in 1995, placed the OSU graduate physics program at #75, and it can expect to have fallen as the program’s size and activity level decreased since that time. There is, not surprisingly, a very strong correlation between a physics program size and its ranking in the various lists. A benefit of increasing the program size is that it will provide more opportunity to rise in the rankings.

Recommendations to the Deans

The Department of Physics has weathered a difficult era in which faculty numbers dwindled while students, and student credit hours taught, have increased very substantially. This accommodation was accomplished by (i) general tightening of belts, (ii) employing instructors to help with lower division teaching, (iii) by revising their upper division curriculum to deliver several elements of the fundamental physics curriculum while offering ten paradigms in focused form, and (iv) focusing graduate offerings to the research areas of the faculty. The delivery of the undergraduate curriculum has survived, and the education and training of PhD students has been maintained, but the ranking of the graduate program has decreased to the lowest levels of PhD granting institutions.

Physics is the discipline that provides the fundamental physical principles that underlie the physical sciences, all engineering disciplines, and more recently the biological sciences. It is unthinkable that a major PhD granting university can move to the next level in visibility and impact without a thriving Physics Department. It is noteworthy that the OSU Physics Department has begun a recovery, increasing its numbers to 14 faculty in 2012-13. But at this size, it remains a very small program, albeit one on the upturn. The stated goal of the program is to hire four new faculty in the near term (~5 years), as well as replacing two likely retirements.

Based on the dedication of the faculty and the needs of a vigorous physics program at a major university, this panel supports this ambitious but laudable goal, and we recommend that the deans who are involved find the means to achieve this goal. The Physics program must revisit its curriculum and research plans together with its hiring plans, and provide a lucid justification for the direction of the program; additional comments are provided below. The hiring plan written in 2009 is near its end timewise, even if its (understandably
ambitious) goals have yet to be reached. Now is the time to develop a current department plan, including the hiring plan but extending into curricular areas as well. It is necessary for the program to serve its constituency, including projecting that constituency.

I. Our first recommendation to the deans is: support a well prepared and strongly justified department plan from the Physics faculty, including the growth of the tenured faculty by up to four new faculty in the next five years. We provide below our recommendations to the faculty of what is likely to be required of the justification for this expansion.

II. We further recommend to the deans that the pressing infrastructure needs of the Physics Department be addressed in the near term, based on prioritized needs provided by the department.

Recommendations to the Physics Program

The review panel applauds the faculty for its dedication and tenaciousness throughout recent tough times. Their decision and commitment, to survive and to educate their students in spite of small numbers, is inspiring. The program has demonstrated a resiliency that bodes well for the challenging task of moving the program to a more vigorous, more visible, and clearly viable program to serve the State in coming years. The challenges are several, but a concerted effort by administration, faculty, staff, and students can forge the path to a strong Physics program. The way forward will require concerted effort, and this review panel intends their recommendations to be constructive in this effort. The statement of recommendation will be kept very short when the explanation given within this report (above) requires no elaboration.

A. The hiring plan will be central in progressing toward a thriving and improving Physics program. The program has strength in condensed matter physics, in optics, and in computational physics which overlaps other areas (condensed matter, biological, potentially other areas). The program has also accumulated an admirable nucleus in physics education, an area that we want to pinpoint. The national (and state) need for more and better science education and teachers is very real. This area is also receiving focus from federal agencies, up to and including OSTP (Office of Science and Technology Policy, at the White House level). It would be a notable service to the state and country to devote effort and resources to this worthy aim. It is, on the other hand, a somewhat risky strategy upon which to base the recovery of a struggling Physics program. While it is true that federal funding is becoming available in this area, there are possible downsides. One is that the level of funding in the education of physics majors dedicated to secondary school teaching is substantially less than available for the other areas of focus in the program. Fewer students would be supported, likely less visibility will accrue to the program. Secondly, graduate physics programs overwhelmingly attract students interested in physics research versus education research, as laudable as the latter may be. While the review panel does not provide an answer to these choices, it does recommend that the Physics program obtain funding profiles and other evidence that will allow them to make projections of research funding (thus student support) that can inform their new department plan.

B. Create an informative and inspiring official mission statement.

C. Discontinue PSM offering, focus on strengths.

D. Find a method to ensure full summer support for students.
E. Identify faculty/staff leaders and resources to develop an Ecampus program in Physics.
F. Initiate systematic tracking of the success and career paths of graduates. College or university staff may be available to handle the recordkeeping.
G. Consider developing a seminar class, possibly shared between undergraduate and graduate students, of visitors and alumni to discuss their careers after obtaining a Physics degree. Studies indicate that most graduate students enter Physics programs thinking of an academic or research career, while there are relatively few positions in those areas. A seminar course, possibly shared between undergraduate and graduate students, of visitors to discuss their careers after obtaining a physics degree can be very informative. This format can also serve other purposes; inviting alumni back to present can help in development.
H. Formalize communication lines with students.
I. Consider seriously an open search for the next chair.
J. Prioritize needs involving improvement of infrastructure; prepare and circulate a document on this issue.
K. Extend, or institute where necessary, student training: machine shops; writing of publications and grant preparation.
L. Expand collaboration with other departments, in both teaching and research.
M. Develop a vigorous but sustainable recruiting plan.