



UNIVERSITY OF
WISCONSIN
M A D I S O N

May 1, 1998

To: Alex Nagel
301 South Hall

From: Lee Pondrom *Lee Pondrom*

Subject: Assessments

I am transmitting to you the results of the assessment of the graduate program in physics carried out last year, and the plans for implementation of the undergraduate program assessment, to be done next year.

LP:cl

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**Assessment Report
Department of Physics**

ABSTRACT

The Graduate Program in Physics was assessed in the 97-98 academic year by reviewing the admissions criteria, the curriculum, the advising, the qualifying and preliminary examinations, the research program, the time required to obtain a PhD degree after entering graduate school, and professional placement. Evaluations by current graduate students and recent alumni were obtained through surveys.

The Graduate Program has been under some stress in the last few years. The total number of graduate students has dropped from 205 in 1990-91 to 134 in 1996-97. The present graduate student class is too small to cover the TA requirements of the introductory undergraduate courses, to supply the needed enrollments in the graduate courses, or to meet the demands of the research groups for RA's. A vigorous recruiting program which has been in place for the past two years has succeeded in increasing the size of the entering graduate student classes, and will over time restore the population to around 150. A terminal masters program has been implemented to meet the needs of students who plan to enter the work force at that stage. The time required to complete a PhD has been shortened. The UW has waived tuition for both TA's and RA's, which has improved our competitive position in recruiting. The overseas component of the graduate classes is stable at about 30%. Total women/minorities are about 15%.

The graduate student and alumni surveys yielded generally positive results regarding experiences at UW. Some of the concerns, like the tuition, have already been addressed. Others are part of the ongoing effort to tune the graduate program to meet the requirements of its customers.

The undergraduate program will be assessed in the 98-99 academic year according to the outline prepared in 1997.

ASSESSMENT TOOLS USED:

Direct indicators

Graduate program

National Exams GRE's

Local Exams qualifier/prelim

Review theses yes

Pre/post testing not formally

Indirect indicators

Student surveys yes

Alumni surveys yes

NARRATIVE

The review of the graduate program was conducted by the Physics Graduate Program Committee, which compiled and analyzed data for the past ten years on applications and enrollments, the quality of incoming students as measured by GRE scores and subsequent performance on the Qualifying Examination in Physics, the makeup of the applicant pool, the composition of the graduate student body, and the time necessary to complete the Ph.D. It conducted surveys of the present graduate students and of Ph.D. graduates since 1990 to get student and graduate assessments of their graduate experience in all areas, including courses and research, experience as TAs and RAs, and, for the graduates, the relevance of their preparation to their professional activities. The committee invited suggestions for possible improvements in the program, and followed up the suggestions with discussions with current graduate students. Some changes in the program have already been made as a result of the discussions. Other possible changes are being considered.

The Ph.D. program in Physics is quite selective, and heavily oriented toward research. The only course requirements are in core areas. Students are admitted only if there is a high likelihood of their finishing the Ph.D. Successful candidates are well trained in the core areas of physics, have mastered the research techniques of a subfield of physics, and have demonstrated the ability to pursue independent research.

The graduates from this program have been notably successful in obtaining employment and continuing to pursue basic or applied research in universities and in industrial and government research laboratories.

The M.S. and M.A. programs:

New two-year terminal Master's programs were started in 1996-97 in response to demand from prospective graduate students, and the recognition that many of the employment opportunities in applied physics require advanced training, but do not require the full Ph.D. research degree. Graduate students may now be admitted directly to one of two Master's programs:

Master of Science Program:

This is a two-year professional program which gives the student a significant introduction to research. It requires the completion of a Master's thesis based on a short directed research project, and has flexible course requirements to allow the program to be tailored to the professional needs of the student.

Master of Arts Program:

This is an academic program based on enhanced course requirements without a research component. It is suitable as background for students who wish to move into non-traditional areas with a strong physics background, or for students in physics education.

Both degrees require that the student pass the comprehensive Qualifying Examination.

The new MS programs have begun to attract entering graduate students. There are only a few programs of this type in major physics departments in the U.S., and those have been very successful in preparing students for work in technical areas.

DATA AND COMMENTARY ON THE GRADUATE PROGRAM:

Size of the graduate program:

The total graduate enrollment in Physics has declined in the last decade from 205 students to about 134. This decline in entering graduate students is a nationwide phenomenon, caused partly by the robust economy, and partly by a perception that the job market in physics research is shrinking, both in industry and academia. UW's competitive position for attracting qualified students from a diminished pool of applicants has been improved by the TA and RA tuition remissions. The Department has implemented an aggressive recruiting drive, has increased stipends with Foundation funds, has made the graduate program more flexible to meet the needs of today's market, and has streamlined the path to the PhD degree. The quality of those admitted, as measured by the Graduate Record Exam scores, has not declined.

The decrease in the size of the graduate program has caused some difficulties in running graduate courses because of under-enrollments. The Department has responded by changing the frequency with which some courses are offered. Enrollment in some high level specialty courses remains a problem. The scheduling difficulties should disappear longer term if the incoming graduate classes of 25-30 can be maintained. This will require continued aggressive recruiting in a very competitive environment.

Quality of the students:

The Graduate Admissions Committee routinely monitors the quality of the students admitted to the graduate program through GPAs, recommendations, and GRE test scores. The admissions process is checked by the performance of the students on the comprehensive Qualifying Examination which covers undergraduate physics at a sophisticated level. The success of the students on the exam is a measure both of the quality of their undergraduate education, and of their ability to carry what they have learned to a higher level and recognize new applications. There has been no measurable change in the quality of the students admitted despite a decrease in the size of the pool of applicants in recent years.

The department has not been notably successful in attracting the very top fellowship students in competition with more prestigious programs elsewhere, but competes very effectively for good students with other large state universities.

Makeup of the graduate student body:

The makeup of the graduate student body has been remarkably stable, with 2/3 domestic students and 1/3 foreign. The enrollment of females has been stable at about 11%, while the enrollments of underutilized minorities have varied from 10% to 5% of the domestic enrollment, with an average of about 8%.

An average of 15% of the applicants have been female, while about 9% of domestic applicants have been in minority categories. These percentages define the pool from which

the Physics Department recruits. Females have averaged 16% of students offered admission over the last few years, while minorities constituted roughly 19% of domestic admissions. The percentage of women actually enrolling at Wisconsin is systematically 1/3 smaller than the percentage admitted, indicating a problem in attracting females to Wisconsin. The problem in attracting minorities is much more severe.

Student support:

Most incoming graduate students are admitted and enroll as TAs, teach for 1-2 years, and then go onto RA support with research groups. A smaller number are admitted as fellows of various kinds. There continues to be adequate support for RAs. The staffing of TA positions has become a problem with the decreased overall enrollment and good RA support.

Survey of present graduate students:

The Graduate Program Committee surveyed the present graduate students in 1997 to determine their reaction to the graduate experience and identify areas of particular strength or concern. We conclude from the survey and follow-up discussions that our graduate students are generally satisfied with the education they are receiving, and find their research activities particularly exciting. Their main concerns were with advising and placement. These are addressed below.

Survey of recent Ph.D.s:

In order to obtain feedback on the graduate program from the perspective of the professional physicist, the Graduate Program Committee conducted a mail survey of 170 graduates from 1990 on, and received 54 responses. These graduates are in a variety of positions. They completed the program recently enough that their commentary is relevant to the program as it now exists, and most have had several years of experience to test their training and its suitability for their career objectives.

The comments of this group indicate that they are generally satisfied with the course and research training they received. The suggestions for improvements emphasize better advising with respect to job opportunities and placement, and point out particular skills that are especially useful, but generally agree with the suggestions made by current graduate students. Some of the points are addressed in the discussion below.

CONCLUSIONS ON THE GRADUATE PROGRAM

Strong points in the program:

We conclude from the data we have acquired in our review of the graduate program in Physics that it is generally successful in attaining its objectives. We note in particular the following:

The quality of the students admitted to the program is good as measured by GPAs, GRE scores, recommendations, and internal standards, and has not been affected measurably by the nationwide decrease in the applicant pool. The success of Ph.D. and Master's graduates in obtaining positions that offer suitable career opportunities confirms the quality of the

program.

The research experience provided in the program is highly valued by graduates as well as current students. The depth and breadth of knowledge provided by the core graduate courses is regarded as useful and is appreciated by the graduates and current students.

The program is successful in preparing students for their subsequent careers in traditional and non-traditional positions as determined by the survey of recent graduates, but more breadth in the graduate training in physics would be useful.

The new Master's programs are likely to provide an attractive alternative for students who want advanced training, but do not need the full Ph.D. research degree for their intended careers.

New initiatives in the graduate program:

1. The institution in 1996-97 of the professional Master of Science and strengthened academic Master of Arts programs described above.
2. The institution in 1995-96 of a new Option B Internal Minor in Physics to give students greater breadth in physics and its applications without increasing the time to the Ph.D.
3. Changes in 1995-96 in the procedures for testing out of the core physics courses, or having the requirements waived on the basis of equivalent graduate-level work taken elsewhere, to encourage students who have already had equivalent work to move directly to courses in other areas, thus speeding up their progress.

Areas for future change:

1. Although the length of time necessary to complete the Ph.D. is decreasing as a result of recent changes in the Qualifier and Prelim and tightened requirements for obtaining a major professor and starting research, a further decrease would be desirable. Future data and progress on this will be monitored by the Graduate Program Committee.
2. The advising of incoming students should be improved, especially with respect to department and university requirements, the necessity to plan a coherent major and minor program early in the graduate career, and the desirability for later employment of using the Minor to build breadth into the program.
3. The advising of students on job opportunities in industry and other non-academic situations should be improved, and more help should be provided in placement. The department should investigate the possibility of coordinating its efforts with Engineering which has a highly successful placement program.
4. The coordination of the graduate courses could be improved. There may be possibilities for changing existing courses or adding new courses to better prepare students for the new breadth of employment opportunities. The Graduate Program Committee will continue to work on these questions. It will also continue to monitor enrollments and will further adjust the course schedule to ensure that the advanced specialty courses can be taught regularly.

5. The department's effectiveness in the recruiting of outstanding students, women, and minorities can be improved. The enrollment of women is consistently about 1/3 below their availability in either the applicant pool or in the set of students offered admission. Greater emphasis should be placed by the Admissions Committee and the Department as a whole on actively recruiting women and providing a supportive atmosphere for them.
6. The number of minority graduate students has remained very small despite continuing efforts at recruitment at traditionally black institutions and a high acceptance rate as a fraction of all domestic admissions. The failure to recruit any minorities in the past three years led to a sharp drop in their representation in the graduate student body. The present recruitment efforts should be continued, but more extensive options should also be considered, including active recruitment of Hispanic and Asian-American students.

ASSESSMENT PLAN FOR THE UNDERGRADUATE PHYSICS MAJOR PROGRAM

The goal of the assessment is to understand how to serve our undergraduate majors better. The study, which we aim to make as quantitative as possible, should identify potentially useful changes in the program. Some of the major courses also have a service role, especially in relation to the AMEP major. We also aim to improve this aspect of our teaching program. The assessment will include the present status and future role of enrichment options having to do with the honors program and undergraduate research. It will address the career goals of our students, both those preparing for graduate school and those intending to pursue other jobs after graduation.

The assessment report is scheduled for completion and submission to the College of Letters and Science on May 1, 1999.

The schedule and method for the information-gathering part of the process is as follows.

At the beginning of the 1998-99 academic year, the committees on intermediate and advanced courses will be informed as to the scope and nature of the review to be carried out. By November 1, 1998 they will provide a summary of the current status of their areas. The committees will be invited to recommend changes in and additions to the curriculum. Faculty members will be invited to submit comments on areas of concern which they have identified.

By November 1, 1998 the instructional program manager will collect information on enrollment trends that affect the major program. She will also collect any relevant information on staffing and scheduling of courses. Connected with this will be a survey of physics major enrollments at institutions comparable to UW.

In May, 1998 an exit poll of graduating seniors will be conducted by the coordinator of undergraduate programs. This will be done by e-mail and by regular mail. A questionnaire for this purpose already exists. Topics to be covered in these surveys are: (i) the department environment: mentor program, physics club interactions, departmental advising; (ii) enrichment experiences: undergraduate seminars, getting and holding undergraduate research appointments; (iii) professional and employment preparation: to what job or academic program will they proceed next and how the major program meshes with that; (iv) review of the academic program: courses that met and did not meet expectations.

In September, 1998 a survey of alumni will be carried out in order to assess longer-term effects. This survey will stress the role of the major in preparing students for careers.

There are five major components of the assessment.

1. Classroom Curriculum.

Much of the most basic classroom curriculum is dictated by generally recognized standards of the field, and is addressed by excellent texts. Apart from an ongoing vigilance to ensure that the courses continue to cover this subject matter in a coordinated fashion, there is no great need to review it in the short term. The two greatest concerns are how to incorporate progress at the frontiers of physics and newly available computational tools into the

curriculum. These are issues to be discussed among the faculty and in the appropriate committees.

The faculty together have considerable experience of a variety of methods of training physicists. They are made aware of experiments elsewhere through professional contacts. The assessment will not attempt to catalogue new classroom approaches. It will attempt to track and evaluate the success of experiments already underway in the department.

2. Undergraduate Research Experience.

The department has maintained a long tradition of hands-on experience as part of the major. There are specific required laboratory courses and students are urged to join the activities of the research groups. We do not expect the assessment to change this tradition. We hope that the assessment will serve to reveal any differences between this ideal picture and reality. It should also explore ways to encourage more theoretically-inclined students who are deterred by the frustration and effort of the laboratory experience.

Faculty supervision of undergraduate research has grown to be a major feature of the undergraduate program. There are hourly jobs, sophomore honors support for summer research, the junior-senior Hilldale program, and the senior honors thesis. We will assess particularly the organization and recording of these activities, and the possibility of other initiatives in this area. The exit poll will be helpful for this.

3. Departmental Guidance for Majors.

Currently there are:

(i) an annual meeting to find potential majors; (ii) a handbook to provide them with useful and important information; (iii) semiannual meetings concerning career advising; (iv) the instructional program manager as a day-to-day contact for problem assistance; (v) faculty advisors; (vi) faculty mentors; (vii) departmental honors program; (viii) departmental support of the physics club. At present there is no systematic review of this multi-faceted portion of the department's interactions with its majors. The assessment will address whether reorganization or other improvements should be made in this structure.

Instructor evaluation is already in place and will not be part of the assessment.