Strategic Assessment of Graduate Program
Department of Physics and Astronomy
September 3, 2009

Mission Statement
Academic studies and research training in the Graduate Program of the Department of Physics and Astronomy prepare and empower our students to meet the challenges of professional careers in a variety of academic and industry environments, which serve Iowa, the nation, and the world. The program advances scholarly and scientific endeavor through student participation in nationally and internationally recognized leading-edge research in experimental and theoretical physics and astronomy. The program promotes diversity and enhances undergraduate and public education through student involvement in teaching and outreach.

Admission Processes and Criteria
Student Demand and Recruitment
Student demand for the graduate program is high, averaging 145 applicants/year over the period 2004-08. Our graduate program is highly selective. The criteria for selection are proficiency in physics (determined from undergraduate transcripts and GRE scores), and a strong motivation to excel at research indicated in letters of recommendation. Over the past 5 years the selectivity ratio (# acceptances/# applications) has been steady at ~18%. This ratio compares favorably with a comparison group of ten peer institutions. For example, in 2008 the UI selectivity factor was 17%, ranking UI 4th of the 11 graduate physics programs in the peer group. The high quality of our applicants is also indicated by the large number of Presidential Scholar awards approved each year in the Graduate College, with 17 approved nominations in the past 5 years.

Success in Enrolling the Highest Quality Students Admitted
The enrollment yield (# offers accepted/# offers made) has been more variable, ranging from 25–50% over the period 2004-08. The UI enrollment yield compares favorably with the peer group. For example, in 2008 the UI yield was 30%, close to the group average of 33%. It is also noteworthy that UI spends much less for student recruitment than the peer group average. In 2008 the average recruitment cost ($ spent/enrolled student) for UI was $365, which is less than half the group average of $789. Our success in enrolling the highest quality students is hampered by the fact that our students pay tuition which results in a net compensation that is low in comparison to other physics programs. In addition, the number of foreign students that we can accept is restricted due to uncertainty that foreign students will pass the ELP test. This, in turn, impacts our international visibility and diversity.

Our enrolled graduate students are of high quality. Based on data provided by UI, average GRE scores for Physics and Astronomy graduate students over the period 2003-07 are higher than the national average for physics departments, and substantially higher than the averages for other UI graduate departments in the physical sciences and across the broader university.

Success in Enrolling a Diverse Student Cohort
The Physics and Astronomy Department is committed to increasing the enrollment of women and minority students in our graduate program. These groups have traditionally been underrepresented in physics departments nationally and Iowa is no exception. However, UI has made notable gains in faculty diversity with 4 women and 1 African American professor currently on the faculty; over time this should enhance our ability to recruit a diverse graduate student body. Currently in the UI Physics and Astronomy Department 2 of our graduate students are from underrepresented minorities and 11 are women. The fraction of women graduate students at UI (15%) is close to the peer group average (17%).

Financial Aid Commitments
The Department supports nearly 100% of entering graduate students either with an RA or a TA. While there is no fixed rule, TAs are generally the primary means of support until successful completion of the qualifying examination, usually at the end of the second or third year. In assistantship offer letters the department commits to support incoming students for a minimum of 4 years (assuming satisfactory job performance and progress toward the degree). Graduate students in the department are generally supported during the summer months as well. After passing the qualifier, students work actively with faculty members in research. The Department supports ~30% of post-qualifier graduate students in RA positions funded by external grants and contracts obtained by individual faculty members or, in some cases, by the students themselves.
Program Outcomes

Degree Completion and Time to Degree

According to data supplied by UI, 47 students entered the program with the Ph.D. degree objective during the five year period 1996-2000. Of these, 38% successfully completed the degree, 36% left the program with an M.S. degree, and 26% left with no degree. This Ph.D. yield is well below the average for all UI Physical Science/ Mathematics/ Engineering (PSME) departments (53%), but is comparable to the rates in Computer Science. For students successfully completing the Ph.D., the time-to-degree (TTD) was 5.8 years, which is comparable to both the average for all UI PSME departments (5.8 years) and to the peer group of physics departments (5.9 years).

It is not entirely clear why the Ph.D. yield is relatively low. The UI data cover outcomes for students entering the program during 1996-2000. Over this period average GRE scores for our entering students were low compared to national averages for physics departments. However, in recent years (since ~2003) the quality of our entering students as measured by GRE scores has steadily increased. This should presage an improvement in our Ph.D. yield.

The “gateway” to the Ph.D. in our department is the qualifying exam, which covers the content of the core graduate courses. Students generally take the qualifier in August at the beginning of their 2nd or 3rd year. If a student fails the exam on the first attempt they may retake it once, although some students choose not to make a second attempt. Over the period 1997-2001, only 32% of our graduate students had passed the qualifier after the 2nd attempt. However, for students admitted in the period 2002-2006, 65% have passed the qualifier. It is too early to judge the final Ph.D. yield from this group but we are confident that the yield will be higher than in earlier years. (Of the 13 students who passed the qualifier from the entering class of 2002, 12 have completed or are nearing completion of the Ph.D.)

One way to both increase our Ph.D. yield and to decrease the TTD would be to increase the fraction of students who pass the qualifier on the first attempt. To implement this strategy we have requested and received SIF funds from the University. SIF funds, in conjunction with matching funds from the Department, are used to provide two months of summer support for students preparing to take the qualifier. One month of support covers a period for intensive study, enabling the student to focus their time and energy in preparation for the exam. The second month of support is used for a graduate assistantship to help integrate students into research projects that may lead to Ph.D. theses. Because the program is new we do not yet have any outcome measure of its impact on our Ph.D. yield or TTD.

Graduate Student Fellowships, Awards, Honors, and/or Publications

Since 2003, 3 Physics and Astronomy students have received UI Presidential Graduate Fellowships and 6 have received graduate fellowships from outside UI, including 4 prestigious NASA Graduate Student Research Fellowships, one AGEP NSF Fellowship, and one Fermilab Fellowship. In addition, in the past 3 years Physics and Astronomy graduate students have received a D.C. Spriestersbach Award for outstanding doctoral thesis work and a Leslie Sims Award for outstanding masters thesis work. Over the 3 year period 2006-08 Physics and Astronomy graduate students have co-authored 60 publications in refereed scientific journals.

Graduate Student Placement

Our Ph.D. recipients are placed in appropriate positions. It is common in physics and astronomy for students to serve one or two stints as a Post-Doctoral Fellow (typically in 2 year appointments) following their Ph.D.. This period enables students to further refine their research skills and broaden their experience. This preference is reflected in the placement statistics provided for this study by UI; initial placements are heavily weighted toward post-doctoral appointments, as expected. For the period 1996-2008, 43% of Ph.D. graduates were initially placed in academic, industrial, or government post-doc positions, 24% directly in industry, and 15% in college or university teaching positions. Most of the remainder was split among academic research or administrative positions, or government service. For long-term employment, Ph.D. physicists have a wide range of desirable employment opportunities in teaching, research, and industry, as reflected in placement statistics. Current placements for Ph.D. graduates from the period 1996-2003 (> 5 years post degree) include 36% in college or university teaching positions, 18% in academic research or administrative positions, and 39% employed in industry. The remainder (7%) was split in “other” areas. None from this group report being “out of the field” or “unemployed”.

Our Masters degree recipients either transfer to other Physics or Astronomy Ph.D. programs, enter industry, or teach at the community college or secondary school level. Many of our students
choose to leave the program with an M.S. because of the excellent job opportunities available with advanced training in physics and astronomy.

**Program Characteristics**

*Comment on Appropriate Size for Graduate Program*

Our graduate program is small. The number of graduate students with an astronomy specialization is particularly low, in large part because we do not offer an Astronomy Ph.D. The current size (~60 graduate students for ~30 faculty) corresponds to a student/faculty ratio of ~2, which is the lowest among the peer group for this study.\(^1\)\(^2\) The average graduate student to faculty ratio for the 11 physics departments in the peer group is 2.7. The number of graduate students in our department is limited, in part, by the number of available graduate assistantships. In this regard we note that in 2008 the number of TAs funded by the university was 0.87 TAs per faculty member, which was well below the average of 1.2 for the peer group.\(^1\)\(^2\) In recent years the number of TAs awarded by the College has decreased, which directly impacts the size of our entering graduate class since most first year students receive TAs. This, in turn, impacts our teaching mission. Enrollment in the Department’s general education courses with lab such as 29:50: Stars, Galaxies, and the Universe, is severely restricted by number of available lab TAs. During some semesters the Department has curtailed graduate student staffing hours for the Tutorial Room, a free tutorial service offered to undergraduate students enrolled in physics and astronomy classes, in order to add TAs for the lab sections. Furthermore, the small number of graduate students coupled with minimum enrollment restrictions for graduate classes make it difficult to offer advanced graduate courses in specialty areas.

*Comparison to Peer Programs*

The UI Physics and Astronomy Department was ranked 56\(^{th}\) in the 2008 US News and World Report ranking of Physics graduate programs. However, there is a well-documented size bias in this measure and our ranking is commensurate with our faculty size. At this rank we are tied with other prominent programs of a similar size: Case Western Reserve, Notre Dame, Rensselaer Polytechnic, Oregon, Utah, and Vanderbilt. It is also noteworthy that the UI ranking is on an upward trajectory, having dramatically improved over the past ten years, both in absolute ranking and in ranking relative to other programs of a similar size. (For example, in the 1995 NRC survey Notre Dame, Oregon, Utah, and Vanderbilt were all ranked in the range 56-60 while UI was ranked 73\(^{rd}\); all are now tied at 56\(^{th}\) in the 2008 US News survey.) In the specialty area of plasma physics the UI was ranked 8\(^{th}\) in the nation in the 2008 US News and World Report survey.

*Strengths and Weaknesses of Graduate Program*

The department has an internationally recognized program of growing stature, with strong external funding in a variety of disciplines including: space physics, condensed matter, particle, nuclear, and plasma physics, and astronomy. In 2008 funding through external grants and contracts for UI Physics and Astronomy faculty exceeded $400K/ year per faculty member, ranking UI 3\(^{rd}\) of the group of 11 peer physics departments, and well above the average of $256K/year.\(^4\) This affords students high quality graduate training which typically results in employment in a challenging professional career.

However, the relatively small size of the department impacts our national ranking and impedes our ability to attract the best students. This, in turn, impacts the Ph.D. yield. As noted the department is striving to increase the Ph.D. yield and decrease TTD through the “Qualifier Study Program” noted above. Other improvements to the program would result from increasing the faculty size and, through additional TA lines, the number of graduate students. Additional improvements could come through increasing the budget for graduate student recruitment, working toward full tuition reimbursement, and creating a means for foreign students to meet the ELP requirement in their home country before acceptance. The low number of students in Astronomy could be addressed by adding an Astronomy Ph.D. program, which would significantly increase the applicant pool.

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1. The peer comparison group for this assessment is comprised of the Big Ten Universities (excluding Penn State, which did not participate in the surveys) + Iowa State University.
2. Statistics provided by the Midwest Physics Chairs Meeting Group for 2008.
4. Data from the *2009 Graduate Programs* Guide for Physics published by the American Institute of Physics.