Assessment Findings and Curricular Improvements
Department of Physics

Graduate Programs:
Master of Science in Physics
Doctor of Philosophy in Physics

Assessment Measures

The Department of Physics uses the following measures to assess student learning outcomes:

Direct Measures

Pass rate on Comprehensive Examinations
Progress toward the degree

Indirect Measures

Grades and course evaluations for required courses
Job placement
Alumni surveys

Assessment Findings

Comprehensive Examinations

The number of students passing the Comprehensive Examinations between 2000 and 2008 is summarized on Attachment 1. The number per year passing the M.S. exam varied between 0 and 2, and the number passing the Ph.D. exam varied between 0 and 6. Nearly all students taking either the M.S. or the Ph.D. exam passed on the first attempt (two attempts are permitted).

The Ph.D. comprehensive examination consists of a two-day written examination with two problems each in the areas of classical mechanics, electricity and magnetism, statistical mechanics and quantum mechanics, followed by a two-hour oral examination administered by a committee of three faculty members. Each written problem is graded by two faculty members, and the full grade report is submitted to the entire physics faculty, who then vote to pass or fail. The discussion of examination results by the faculty provides a forum for assessing the effectiveness of the coursework and advising offered by the department.

The M.S. written exam is similar in format, but gives the student a choice of some problems at intermediate level of difficulty. There is no oral component for the M.S. exam. Many of the students taking the M.S. exam were enrolled in the Ph.D. program, but chose to take the M.S. exam either in order to get an intermediate degree or as practice for the Ph.D. comprehensives.

Attachment 2 gives the pass/fail statistics and a graphical description of the number of years taken from matriculation to passing the Ph.D. and M.S. comprehensive examinations. The reasons for some of the large variations are explained in the section on Student Progress below.

Student Progress

Attachment 3 shows the progress toward graduation of students admitted in each year between 2000 and 2007. During these years, the number of students entering the Ph.D. program varied between 2 and 8 with total of 36 and an average of 4.5, and the number entering the M.S. program varied between 1 and 4 (total = 15, average = 1.9). Attachment 4 shows graphs of the time taken from matriculation to completion of the M.S. or Ph.D. degree for students admitted since 1996.

The large variations in time taken to pass comprehensive exams and complete the degree are partly due to the very large variation in student careers. On the one hand, some students have entered CUA with previous graduate study or Master's degrees, and have been able to complete their Ph.D. degree in as little as four years. Also, several former undergraduate students at CUA have entered the graduate program directly after graduation, and have completed the M.S. degree within 2 or 3 semesters. On the other hand, some students have been admitted to the graduate program from liberal arts colleges with excellent undergraduate records but minimal preparation in physics, requiring them to take some undergraduate-level physics courses at CUA before entering the more advanced courses normally expected of entering graduate students. Some of the extreme cases on the graphs (more than 5 years to pass the comprehensive exam, more than 10 years to complete the Ph.D. degree) represent part-time students, fully employed off campus, who have succeeded in fitting graduate study into their evenings and weekends. For normal "full-time" students, arriving with a bachelor's degree and employed part-time as teaching or research assistants, the typical time to pass the Ph.D. comprehensive exam is 2 to 4 years, and the typical time to the Ph.D. degree is 5 to 8 years. As described in the Curricular Improvements section below, we are working on ways to reduce this time.

An important aspect of a successful Ph.D. program is retaining the students who enter it. Approximately half of the 30 students admitted to the Ph.D. program between 2000 and 2004 have left the program either with no degree or after obtaining only a Masters degree. Some of these students had proved themselves incapable of doctoral-level work, but a substantial number of excellent students passed the Ph.D. comprehensives and then left before completing their doctoral work in order to take well-paying jobs. Most of this latter group were being supported by research assistantships at the time they left. We do not think that the level of our assistantship stipends played an important role, since they are not very different from those at other universities. It would be wonderful to identify the qualities of students most likely to persevere through the graduate program at the time that we admit them and offer them support, but no easy solution to this problem is known.

Course Discussion

There is no single course that acts as a gateway for the graduate programs in physics. All graduate students must master the material presented in the following graduate-level courses:

611-612	Mathematical Methods of Theoretical Physics I and II
615	Advanced Mechanics I
621-622	Statistical Mechanics I and II
623-624	Advanced Electromagnetic Theory I and II
659-660	Advanced Quantum Theory I and II

Although students entering with a Master's degree from another institution may be able to transfer credit for some of these courses, the majority will take most or all of them in preparation for the Comprehensive Examination.

As a sampling of these courses, we include as Attachment 5 data on student grades and course evaluations for two of these: Physics 621 (Statistical Mechanics I) and 659 (Advanced Quantum Theory I). Until recently, CUA course evaluation forms were not distributed for graduate courses or for courses with small enrollments, so the course evaluation record for all our graduate courses is spotty. Since Fall 2006, the Physics Department has required course evaluations for all its courses, and carried out its own evaluation when needed. The fairly negative course evaluation results for Physics 659 in Fall 2007 were discussed thoroughly with the instructor, and resulted in suggestions for improvements.

Employment of Graduates

We list below the current employment of a selection of our graduates by year.

Ph.D. graduates
2008
Research Programmer Analyst, Institute for Defense Analyses, Alexandria, VA
Postdoctoral fellow, Army Research Lab, Aberdeen, MD
NPP Postdoctoral Fellow at NASA/Goddard Space Flight Center
2007
Industrial researcher in medical imaging
U.S. Patent Office
Postdoctoral Research Associate, Vitreous State Laboratory, CUA
2006
Contractor Science Analyst at NASA/Goddard Space Flight Center
2005
Partner in company developing solar cells
2004
Homeland security contractor
Physics teacher, Glenelg Country School, Glenelg, MD
2001
Assistant Professor of Physics, Creighton Univ., Omaha, NE
2000
Physicist, Naval Research Laboratory, Washington, DC
Assistant Staff member, Chinese Academy of Sciences
1999
Nuclear Regulatory Commission

M.S. graduates (non-continuing)
2007
Research scientist, Naval Surface Warfare Center
2006
Computer analyst and supervisor, SAIC, Washington
US Patent Office
2003
Physics teacher, community college
2002
Defense contractor llll
2001
Technical staff, Vitreous State Laboratory, CUA
Teacher, high school
1999
Optical engineer with Swales Corp. at Beltsville, MD and NASA/GSFC

Perceptions of Outcomes by Graduate Students

We intend to implement a system of surveys and questionnaires for outgoing and recent graduate students, asking for their opinions about the effectiveness of the graduate curriculum, teaching and advising in preparing them for the completion of the degree.

Curricular Improvements

The graduate curriculum of the Physics Department has been unchanged for many years, but is currently being re-evaluated by the faculty. Using data compiled by the American Institute of Physics, we find that, in comparison with most other comparable Ph.D.-granting departments, we have many more required courses and a much more rigorous and time-consuming Comprehensive Examination. While we are proud of our traditions, we are concerned that this difference is harming our ability to recruit capable graduate students, and that it is causing our students to take an unacceptably long time to complete the Ph.D. degree.

Suggestions have been made that we reduce the number of required semester courses in Statistical Mechanics, Electricity and Magnetism, and Quantum Mechanics from two each to one each, to allow more coursework in the student's field of specialization such as astrophysics, condensed matter or nuclear physics. Another issue is the large amount of material tested in the Comprehensive Examination, with the consequent long preparation time before most students feel they are ready. We have begun holding faculty-wide discussions, and hope to have a plan in place by the end of the 2008-2009 academic year.

Attachments:

1. Comprehensive exam statistics (from CPIT)
2. Comprehensive exam graphs and statistics
3. Student progress (from CPIT)
4. Graphs of time from matriculation to degree
5. Course summary data for Physics 623
6. Course summary data for Physics 659

Attachment 1

Graduate Student Comps Exam Data
Department of Physics (Cohort 2000-2007)

Master's Program

Comps

Cohort	Cohort Size	Passed Master's comps in 2000-01	Passed Master's comps in 2001-02	Passed Master's comps in 2002-03	Passed Master's comps in 2003-04	Passed Master's comps in 2004-05	Passed Master's comps in 2005-06	Passed Master's comps in 2006-07	Passed Master's comps in 2007-08
2000	3	2	0	1					
2001	4		0	0	1	1	0	0	0
2002	1			0	1				
2003	1				0	0	0	0	0
2004	2					0	1	0	0
2005	1						0	0	0
2006	2							1	0
2007	1								0

Doctoral Program

Comps

Cohort	Cohort Size	Pass Doctoral comps in 2000-01	Pass Doctoral comps in 2001-02	Pass Doctoral comps in 2002-03	Pass Doctoral comps in 2003-04	Pass Doctoral comps in 2004-05	Pass Doctoral comps in 2005-06	Pass Doctoral comps in 2006-07	Pass Doctoral comps in 2007-08
2000	3	0	1	0	1	1			
2001	5		0	1	1	1	0	1	0
2002	8			0	3	2	2	0	0
2003	6				0	2	0	0	0
2004	4					0	3	0	1
2005	4						0	0	1
2006	3							1	0
2007	2								0

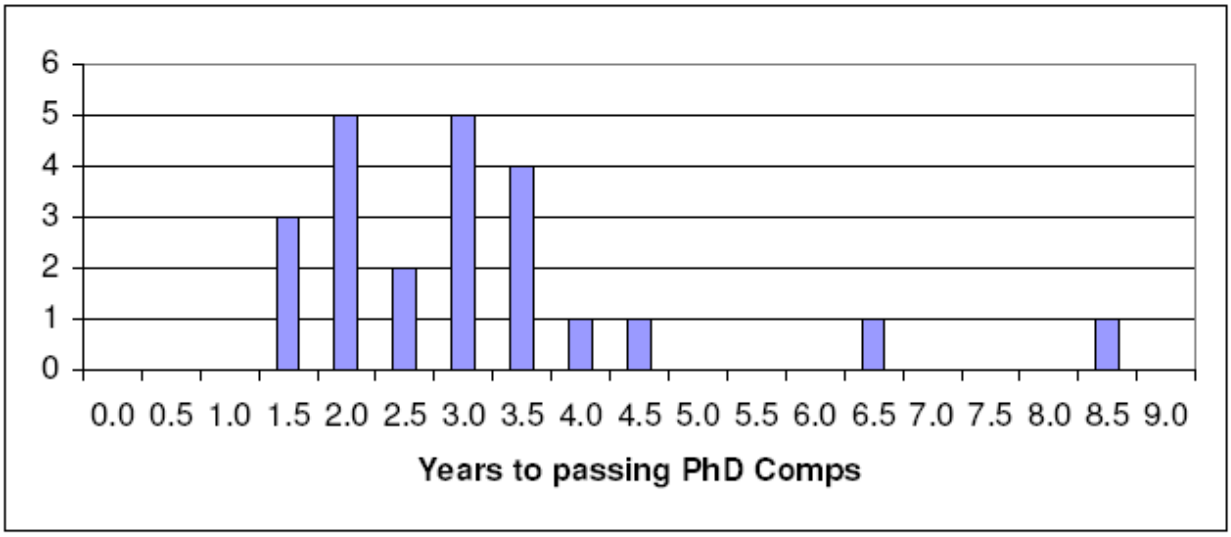
Note: A particular cohort is defined as the combination of the students first enrolled in consecutive sessions of one year: the summer session, the fall semester, or the spring semester the following year.
For example, Cohort 2000 consists of the students first enrolled in Summer 2000, Fall 2000, or Spring 2001.

Attachment 2

Time from matriculation to passing Comprehensive Exam (Exam dates 2000-2008)

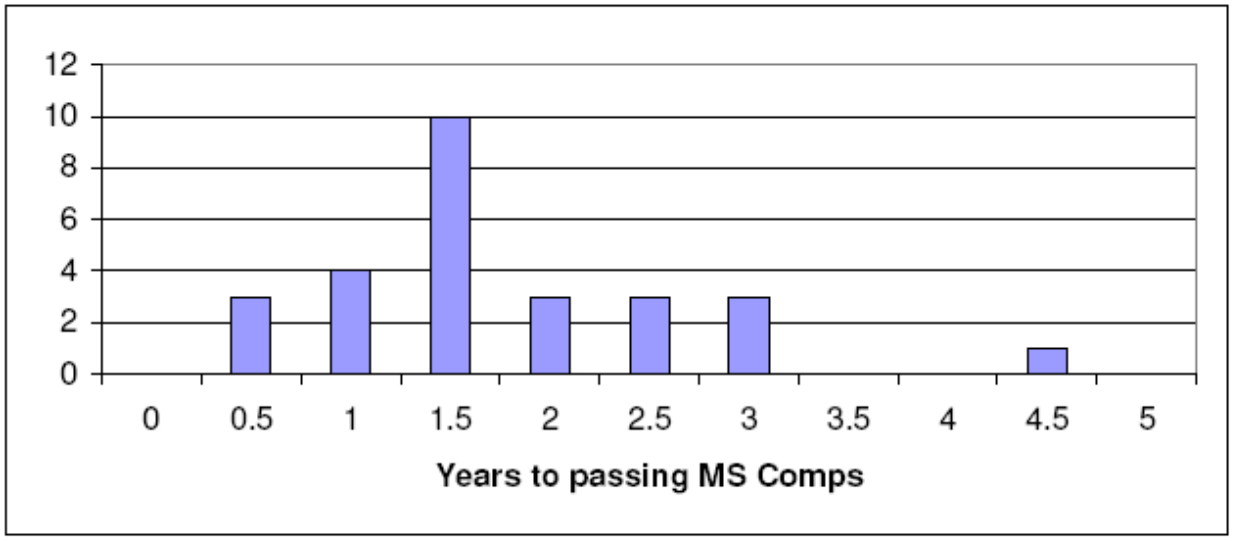
PhD Comprehensive Exam

Number passed =	23	Passed first try	19
Mean =	3.13 years	Failed first try	8
Std. dev.=	1.63 years	Passed second try	4
		Failed second try	0



MS Comprehensive Exam

Number passed=	27	Passed first try	26
Mean =	1.76 years	Failed first try	3
Std. dev.=	0.91 years	Passed second try	1
		Failed second try	1



Graduate Student Retention & Graduation Data Summary
Department of Physics (Cohort 2000-2007)

Master's Program

Cohort	Number of entering master's students	Number of students who have not received a degree and did not maintain continuous enrollment	Number of students who enrolled in PhD program after receiving a master's degree	Number of students who passed comps	Graduated in 1st year	Graduated in 2nd year	Graduated in 3rd year	Graduated in 4th year	Graduated in 5th year	Graduated in 6th year	Graduated in 7th year	Graduated in 8th year
2000	3	0	1	3	2	0	1					
2001	4	1	1	2	0	0	1	1	0	0	0	
2002	1	0	1	1	0	1						
2003	1	1	0	0	0	0	0	0				
2004	2	0	1	1	0	1	0	0				
2005	1	1	0	0	0	0	0					
2006	2	0	0	1	1	0						
2007	1											

PhD Program

Cohort	Number of entering doctoral students	Number of students who have not received a degree and did not maintain continuous enrollment	Number of students who left the program after receiving a master's degree	Number of students who passed comps	Graduated in less than 2 years	Graduated in 3rd year	Graduated in 4th year	Graduated in 5th year	Graduated in 6th year	Graduated in 7th year	Graduated in 8th year
2000	3	1	1	3	0	0	0	0	0	1	1
2001	5	1	2	4	0	0	0	0	0	0	
2002	8	1	2	7	0	0	0	0	1		
2003	6	3	2	2	0	0	0	0			
2004	4	0	1	4	0	0	1				
2005	4	1	0	1	0	0					
2006	3	0	0	1	0	0					
2007	2										

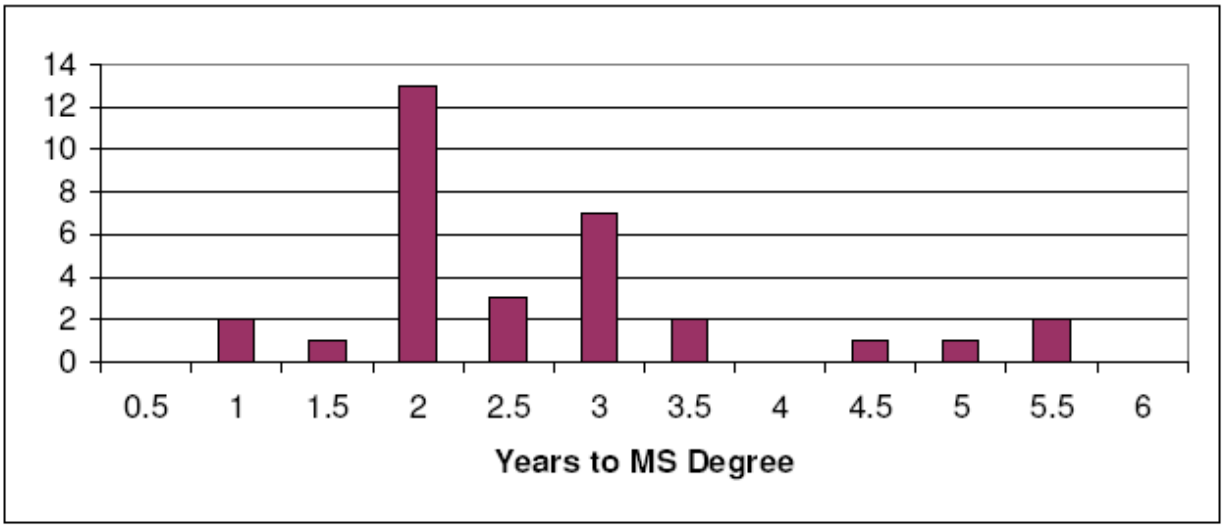
Note: A particular cohort is defined as the combination of the students first enrolled in consecutive sessions of one year: the summer session, the fall semester, or the spring semester the following year. For example, Cohort 2000 consists of the students first enrolled in Summer 2000, Fall 2000, or Spring 2001.

Attachment 4

Time from matriculation to degree for students admitted since 1996

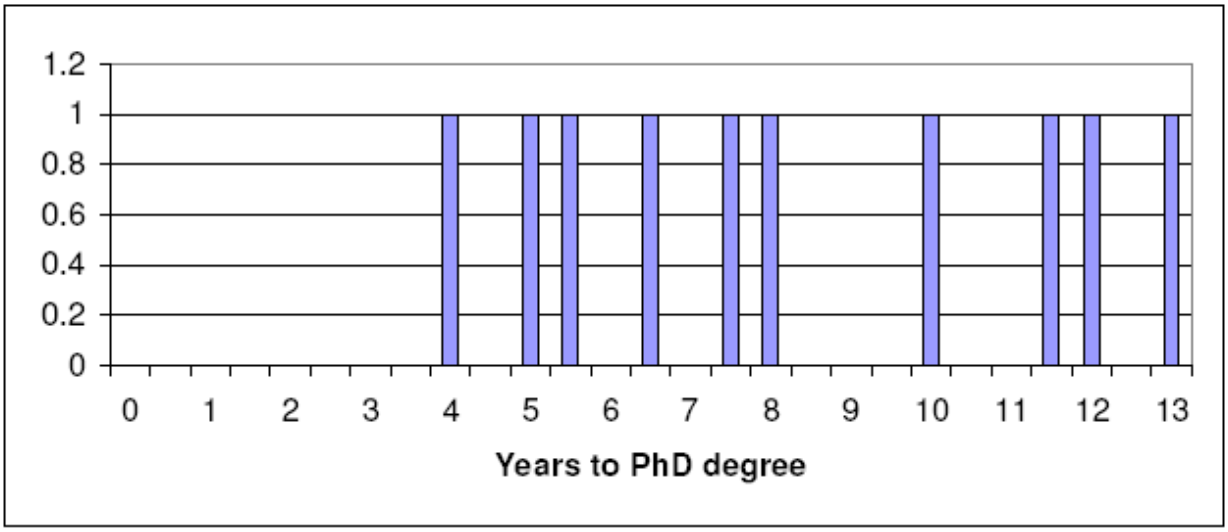
Years to MS Degree

Number =	32
Mean =	2.67
Std. dev. =	1.13



Years to PhD Degree

Number =	10
Mean =	8.30
Std. dev. =	3.16



Attachment 5

Grade and Course Evaluation Statistics -- Physics 621 (Statistical Mechanics I)

Grades

Semester			Number of students	Mean grade
Fall	2000		8	3.89
Fall	2002		16	3.92
Fall	2004		4	3.83
Fall	2005		5	3.80
Fall	2006		3	3.90

Course evaluations

Semester			Number of evaluations	Teacher average (of 10)	Course average (of 10)	
Fall	2000					
Fall	2002					
Fall	2004					
Fall	2005		4	10.0	10.0	(CUA evaluation)
Fall	2006		4	8.8	8.2	(Physics Dept evaluation)

Attachment 6

Grade and Course Evaluation Statistics -- Physics 659 (Advanced Quantum Theory

Grades

Semester			Number of students	Mean grade
Fall	2001		6	2.90
Fall	2003		11	3.53
Fall	2004		4	3.68
Fall	2006		5	3.68
Fall	2007		8	3.80

Course evaluations

Semester			Number of evaluations	Teacher average (of 10)	Course average (of 10)	
Fall	2001					
Fall	2003					
Fall	2004					
Fall	2006					
Fall	2007		8	7.5	6.6	(Physics Dept. evaluation)