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Introduction

The Department of Physics and Astronomy (DPA) offers a graduate program leading to the M.S. or Ph.D. degrees in Physics. This handbook provides an outline of the requirements for these degrees. Many aspects of graduate work at the University of Delaware are covered by University regulations and can be found in the Academic Regulations for Graduate Students which is part of the Graduate Catalog.

Nearly all graduate students in the program are at some point or another supported as Teaching Assistants. Valuable information about being a Teaching Assistant can be found in the TA Handbook, issued by the Center for Teaching and Assessment of Learning. This handbook also provides a convenient summary of University policies that apply to the appointment of graduate teaching assistants.

Degree requirements

M.S. Degree

Students may choose to obtain an MS degree with or without thesis:

The MS with thesis degree requires 24 credits hours in PHYS courses, including at most 3 credits of research (PHYS 868). At least 6 credits of classroom courses must be at the PHYS 800 level. In addition 6 credits of thesis work (PHYS 869) are required. The purpose of the M.S. thesis is to demonstrate that the student can conduct research under supervision and communicate the results clearly in English. The thesis is defended in an oral examination administered by a committee of three members of the Department.

The MS without thesis degree requires 30 credit hours in PHYS courses, including at most 3 credits of research (PHYS 868). At least 6 credits of classroom courses must be at the PHYS 800 level. In addition, the degree candidate will survey the literature on a current topic in physics or astronomy, write a report on this topic and make a public presentation to the department, represented by three members of its faculty (appointed by the Director of the Graduate Program with approval of the Chair of the Department).

Approval of the graduate review committee is required if more than 6 credits are from departments other than Physics and Astronomy or if any are in a discipline unrelated to physics.
Ph.D. Degree

Students may enter the Ph.D. program after successfully completing an M.S. degree program, at the University of Delaware or elsewhere, or may be admitted directly to the Ph.D. program directly after a Bachelor’s degree. To obtain a Ph.D., students will normally follow the course intensive regular track.

Students entering the program with at least a U.S. Master of Science degree, or its equivalent, in Physics or a closely related field may be eligible to follow the less coursework intensive fast track. Eligibility for the fast track will be determined by the DPA Graduate Admissions Committee.

Course requirements

Students on the regular track must satisfy the following course requirements:

Taking and passing, with an average grade of 3.0 or better, 30 credits of course work within the first five semesters after entering graduate school. At least 18 credits must be from among 800-level PHYS courses (excluding PHYS868). Of these 18 credits at the 800 level, 12 credits (i.e. 4 courses) must come from the following group of 6 courses, which have to be passed with a grade of B or better.

PHYS 809, PHYS 810
PHYS 811, PHYS 812
PHYS 813, PHYS 815

Students following the fast track must meet the following minimum requirements:

1. In consultation with and with approval from the Graduate Program Director, the student will identify 4 3-credit 800-level classroom PHYS courses to be taken in their first year in the graduate program. Each of these courses must be passed with a grade of B or better (not B-). Students may take additional courses.

2. Students must take the Written Candidacy Exam on entering and pass it then, or by the beginning of the second semester in the graduate program, to remain on the fast track.
All students in the Ph.D. program are required to complete 9 credits of doctoral dissertation (PHYS 969).

Course credit earned at the University of Delaware to obtain an MS in Physics may be applied toward the doctoral degree. Students on the regular track may, with approval of the Graduate Review Committee, apply graduate course credits earned elsewhere, but not used to obtain a previous degree, toward the doctoral degree to a maximum of 9 credits.

Ph.D. Candidacy Exam

The Written Candidacy Exam (WCE)

All students in the Ph.D. program must pass the WCE at the latest at the next offering of the exam after the end of their third semester in the graduate program. If a student on the fast track has not passed the WCE before beginning their second semester in the program, they will move to the regular track.

The exam will be given twice a year, in late August and in late January/early February. The exam will be graded as a whole and will consist of 4 sections, each with 4 problems. The sections of the exam and the textbook and associated material from which that section will be based are:

- Classical mechanics - covering all the material except chapters 4 and 14 in S.T. Thornton and J.B. Marion, "Classical Dynamics of Particles and Systems", 5th edition;
- Electricity and Magnetism - covering all material in D.J. Griffiths, "Introduction to Electrodynamics", 3rd edition;
- Statistical Mechanics and Thermodynamics - covering chapters 1 - 9 in F. Reif, "Fundamentals of Statistical and Thermal Physics";

Special relativity problems, if any, will only appear on the Electricity and Magnetism section of the exam.

The Oral Candidacy Examination (OCE)

The purpose of the OCE is to show that the student has a clear research plan with a path to its completion, has a general understanding of the research topic and can put it in context in the broader field of research.

Before the later of a) 1 year after passing the written part of the candidacy exam
and b) 2 years after being admitted to the program, a Ph.D. candidate must make an oral presentation to a committee consisting of the local members of the Ph.D. dissertation committee and two additional members appointed by the director of the graduate program. A member of the OCE committee other than the dissertation adviser of the Ph.D. candidate will be appointed committee chair by the graduate program director. A student who fails the OCE has one opportunity to retake the exam. This has to take place within 6 month of the original examination.

**Regulations for students who change adviser after passing the OCE**

Students who change dissertation adviser after having passed the OCE are required to give, within 6 months of changing adviser, a written progress report and an oral presentation to the Graduate Review Committee, who will make a funding recommendation based on their evaluation of the progress report and oral presentation.

**Ph.D. Dissertation**

Upon successful completion of a research program, the Ph.D. candidate will write a dissertation showing originality of thought and scholarship, properly expressed in English. The dissertation is defended in an oral examination administered by the student's dissertation (doctoral) committee (see below). The committee may require that changes or revisions be made to the dissertation. The final oral examination is not considered to have been passed until the dissertation revisions have satisfied the committee. In general, doctoral committees should strive to achieve consensus concerning the student's performance and quality of work. In the case of dissenting votes, the majority opinion rules and a majority vote in favor is needed for a successful defense.

**Role of the Ph.D. committee**

Within six months of passing the written part of the Ph.D. Candidacy Examination, the candidate, together with his/her advisor, should decide upon the composition of the dissertation committee.

The Ph.D. candidate should provide the members of the Ph.D. committee with an annual report (due May 15) outlining the progress made and plans for the following year. At least six months prior to the anticipated defense of the dissertation, the candidate will make a careful written and oral presentation to the dissertation committee, which may advise upon the final stages.

**Composition of the Ph.D. committee**

It is the policy of the University's Graduate Program that each dissertation committee will consist of between four and six members.
• At least one committee member will be drawn from an academic unit other than the department of the advisor, or from an institution or organization external to the University.

• The chair of the committee is the faculty member in charge of the candidate's research and dissertation.

• At least one member of the committee will be a member of the DPA faculty from a research area distinct from that of the candidate. For this purpose, the distinct research areas are: 1) Astronomy & Astrophysics, 2) Atomic, Molecular and Optical Physics, 3) Condensed Matter & Material Physics, 4) Particle Physics, and 5) Space Physics.

• At least one member of the committee will be from the DPA faculty.

• The members who satisfy the various requirements need not be distinct.

General rules of the program

Enrolment

In order to remain in good standing in the DPA graduate program, each full-time Master's candidate must take at least six credit hours of 600 or 800 level PHYS courses during each semester, maintaining in these PHYS credit hours a cumulative GPA of 3.0 or better, until he/she has fulfilled the course requirements for the Master's degree. Ph.D. candidates must continue taking six or more credit hours of 600 or 800 level PHYS course work in each semester until they have passed the written part of the Ph. D. Candidacy Exam, maintaining in these PHYS credit hours a GPA of 3.0 or better. Courses designated as pass/fail and courses in research or in thesis/dissertation do not satisfy the six PHYS credit hour per semester course requirement and are not considered in computing the required grade point average.

In addition the following rules apply:

• Approval of the Graduate Review Committee is required if more than six classroom credit hours are from departments other than Physics and Astronomy, or for any credit hours in a discipline unrelated to Physics.

• First year students will register for PHYS 600/800 courses only.

• All full-time first-year graduate students who have not yet passed the written part of the candidacy exam are required to take for credit in their first year at least 5 classroom PHYS courses at the 600- or 800-level.

• First year students are required to take the one credit courses PHYS699 Physics
and Astronomy Colloquium (in both the fall and the spring semesters), PHYS600 Physics Research Talks, and PHYS601 Introduction to Teaching Physics and Astronomy.

Advisement

The Director of the Graduate Program functions as the initial advisor for the first year students. Students are encouraged to select a research advisor early, and must formally identify one (subject to possible change later) by May 15 to be eligible for financial support during summer. They are assisted in their choice of research area and research advisor by a one credit pass/fail course, PHYS 600, in which members of the faculty presents brief, informal descriptions of their research programs. Students are also encouraged to broaden their awareness of current research by attending the DPA colloquia, seminars and graduate student research talks.

Progress towards a graduate degree

A reasonable goal for a well-prepared graduate student is the completion of an M.S. degree within 2 years from the time of first entering graduate school, and the completion of a Ph.D. degree within 2 to 4 years if the student enters with an MS or 4 to 6 years when entering with a BS. In order to extend support beyond these time limits, the Graduate Student Review Committee must take positive action. It is in the student's interest to complete a degree as soon as possible insofar as is consistent with work of good quality. Thus every effort is made to encourage a student and his or her advisor to design a degree program which can be completed within these time limits. In the event that extensions of support are needed, a student and his or her advisor should submit a written request to the Graduate Review Committee as soon as the need for extra time becomes clear.

Students who fail to pass the WCE within 1½ years may request transfer to the MS program, as may those who fail to pass the OCE.

The Graduate Review Committee meets immediately after the end of Spring semester to examine the time table for all students. The committee reviews their status regarding progress and financial support, and thereupon provides written reports to the students, their research advisers and to the Director of the Graduate Program.

Good academic standing

To be considered in good academic standing, a student must maintain a minimum cumulative graduate grade point average (GPA) of 3.00 on a 4.00 scale each semester. To be eligible for an advanced degree, a student’s cumulative grade point average shall be at least a 3.00. A grade below a C- will not be counted toward the course requirements for a degree but is calculated in the student’s cumulative grade point
Arbitration
In those instances in which difficulties arise in communications between a student, the advisor, and/or the Graduate Review Committee, informal consultation with the Director of the Graduate Program may be helpful. Should this avenue fail to restore healthy communication, the matter may be considered by the entire Graduate Studies Committee.

Graduate student teaching and financial support
Students who are awarded fellowships or assistantships assume a contract with the University. The University agrees to provide a scholarship for the student’s tuition and pay a stipend. As with any professional appointment, the amount of service may vary but the average is usually expected to be 20 hours per week. Continuation of the appointment is contingent upon satisfactory performance of assigned duties, continued academic eligibility and compliance with the University’s Code of Conduct.

Eligibility for financial support
The University will not permit support of a student who has not obtained a 3.00 (B) grade-point average in graduate-level courses. The department may request a one-semester temporary continuation of support for a student whose grade-point average has fallen slightly below 3.0.

There are also Departmental rules and guidelines for eligibility for financial support, which are given below in the section ‘Departmental regulations and guidelines for graduate student financial support’.

Tuition scholarship
A student receives a 100% tuition scholarship for fall or spring semesters if they are "on contract" i.e. they are paid at least 50% of the UD minimum stipend and are matriculated as a full-time student. Students maintain full-time status by being registered for i) 6 credits if they are supported by a TA or RA, or ii) 9 credits if they have a fellowship or are on sustaining (see section ‘Sustaining status’).

TA training
First-time recipients of Teaching Assistantships in the DPA are required to attend the Annual Conference for Graduate Teaching Assistants offered by the Center for Teaching Effectiveness. International TAs must also attend the ELI/ITA training program and meet the SPEAK/UDIA score requirements to be eligible for a TA appointment. First year students, irrespective of their source of support, are required to take and pass the 1
credit hour course PHYS601 Introduction to Teaching Physics and Astronomy, at the earliest opportunity.

Instructorships
Some students may be offered positions as lecturers in summer or winter sessions. In order to lecture, a student must have passed the WCE and OCE, or have shown other convincing evidence of competence. In addition, lecturers will be expected to have shown high teaching ability, using student evaluations and/or classroom visits by DPA faculty members as evidence.

Sustaining status
Once a student has satisfactorily completed all course work required for their degree, including either six credits of Master's Thesis (PHYS 869) or nine credits of Doctoral Dissertation (PHYS 969), and has passed both the written and oral candidacy exams, they must maintain matriculation in the degree program during fall and spring semesters by registering for either Master's Sustaining (UNIV 899) or Ph.D. Sustaining (UNIV 999). All students must be registered and pay tuition in the semester in which their degree is awarded. Sustaining registration is required for summer or winter session only if the degree is awarded during summer or winter session. A student in sustaining status is considered a full time student.

Students can register for Doctoral Dissertation (PHYS 969) only if they have filed the Doctoral Degree Candidacy Recommendation Form. If this form has not been filed but all other requirements for sustaining status have been completed, Ph. D. students should register for 9 credits of PHYS964 Pre-Candidacy Study. Once the Office of Graduate and Professional Education approves the degree candidacy recommendation form, they will change the PHYS964 Pre-Candidacy course to PHYS969, which is the final course required prior to transitioning to sustaining status.
Departmental regulations and guidelines for graduate student financial support

Regulations

1. Support as a GA (Graduate Assistant, or grader) will be available for ONLY the first 6 months after a student enters the program.

2. TA (Teaching Assistant) support during summer sessions is guaranteed only to first year students in good academic standing.

3. Consistent with OGPE regulations, students on academic probation are not guaranteed support. A student in their second term on probation is not eligible for any Department support.

4. Students who have not formed a PhD Dissertation Committee within 1 year after passing the Written Candidacy Exam will receive no Department support.

5. Students who have not passed the Oral Candidacy Exam before their deadline are ineligible for funding of any kind.

Guidelines

1. Regular track students who remain in the program for more than 6 years cannot be supported with Department funds.

2. Fast track students who have been in the PhD program more than 4 years cannot be supported on Departmental funds.

3. Students in the MS program will not be supported as TAs after the end of their 5th semester in the graduate program.

NOTE the following as a general implementation principle:
During the aforementioned approved periods for Department support, faculty

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1 To be in good academic standing, a student must have 1) a GPA greater than 3.000, 2) fulfilled any ELI requirements, and 3) if applicable, met deadlines for forming their Ph.D. dissertation committee and passing the written and oral candidacy exams.

2 Department support includes Teaching Assistantships and support from the supplemental graduate support fund. It does not include Research Assistantships, fellowships, and support from PI overhead return.
requests for TA graduate student salary support will be approved on a l(TA): l(RA) basis only. (For faculty with no sponsored research funding, only one student is allowed.)

Guidelines for winter and summer support

1. First year students in good academic standing and in residence are guaranteed full support for the winter and summer sessions. This support will involve TAs.

2. For students beyond their first year TA support is not guaranteed. Normally students will not be assigned more than two TA sections in winter and summer session combined. The two TA sections can be in the winter session. A student supported as an RA in winter session may also receive a single TA section in winter, if their adviser anticipates a shortfall in summer support. Past teaching effectiveness will be used in prioritization of TA assignments.

3. Students who do not have support for August are eligible to receive support from the departmental supplemental graduate support fund. Priority will be given to students who have not been offered TA support or whose advisers do not have funds to support them as RAs. The support amount is determined by dividing the fund equally between students in need but will not exceed the equivalent of 1 month of TA support.