

# GRADUATE STUDENT HANDBOOK

Department of Physics & Astronomy, University of Delaware  
2020

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## I. 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 (TAs). Valuable information about being a TA can be found in the [Handbook for Graduate Teaching Assistants](#), issued by the Center for Teaching and Assessment of Learning. This handbook also provides a convenient [summary of University policies](#) that apply for the appointment of Graduate Teaching Assistants.

## II. Admission requirements

Admission is selective and competitive, based on the number of well-qualified applicants and the limits of available faculty, facilities, and financial resources. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission if they offer other appropriate strengths. Applicants should have an undergraduate grade point average of at least 3.2. In addition, scores for the Graduate Record Exam (GRE), Verbal, Quantitative and Analytic is required, and the GRE Physics Subject Test is recommended. All complete official transcripts or equivalent certified written records of academic work to date beyond secondary education are required. At least three letters of reference should be sent independently by persons familiar with the applicant's academic work. Students whose first language is not English must provide a score for the Test of English as a Foreign Language (TOEFL) or the IELTS. For financial support, a TOEFL score exceeding 100 or IELTS score exceeding 7.0 is required.

## III. Degree requirements

### M.S. Degree

Students may choose to obtain an M.S. degree with or without thesis:

The **M.S. with thesis** degree requires **24 credits hours** of graded PHYS courses, including at most 3 credits of research (PHYS 868). Graded courses are those receiving a letter grade (A through F). Among 24 required credits, at least 6 credits 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 **M.S. without thesis** degree requires **30 credit hours** graded PHYS courses, including at most 3 credits of research (PHYS 868). Graded courses are those receiving a letter grade (A through F). Among 30 required credits, at least 6 credits 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 Master's degree that is equivalent to a U.S. Master of Science degree 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 for regular track students**

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 *graded classroom course work* within the first five semesters after entering graduate school. Graded courses are those receiving a letter grade (A through F). As part of the 30 required credits, students *must* take the following 4 core courses (12 credits total):

PHYS 809: Electrodynamics I  
PHYS 811: Quantum Mechanics I  
PHYS 813: Quantum Statistical Mechanics  
PHYS 820: Advanced Classical Mechanics

and pass each of them with a grade of B- or higher. If a student fails to obtain a B- or

higher grade for a core course, the particular course in question must be repeated once again and the student must acquire a passing grade of B- or higher.

In addition, as part of the 30 required credits, students should select one “practical skills” course (3 credits total) from:

PHYS 646: Instrumentation for Scientists

PHYS 660: Computational Methods of Physics

Finally, as part of the 30 required credits, students should take one 600-level and one 800-level specialized course of relevance to their intended field of research (6 credits total) selected from the following two sets of courses.

*Students intending to pursue a Ph.D. in Astronomy & Astrophysics; Particle Physics; Space Physics; or any crossover area between these areas should take one 600-level and one 800-level course selected from:*

PHYS 633: Introduction to Stellar Astrophysics

PHYS 635: Space Physics

PHYS 644: Elementary Particles & Big Bang Cosmology

PHYS 815: General Relativity

PHYS 822: Quantum Field Theory

PHYS 834: High Energy and Particle Astrophysics

PHYS 835: Laboratory, Space and Astrophysical Plasmas

*Students intending to pursue a Ph.D. in Atomic, Molecular and Optical Physics; Condensed Matter & Materials Physics; or any interdisciplinary area involving research at the Departments other than Physics & Astronomy should take one 600-level and one 800-level course selected from:*

PHYS 624: Introduction to Condensed Matter Physics

PHYS 626: Introduction to Atomic, Molecular and Optical Physics

PHYS 655: Statistical Biophysics

PHYS 806: Atomic, Molecular and Optical Physics

PHYS 814: Advanced Quantum Mechanics

PHYS 824: Nanophysics and Nanotechnology

*Students who decide to change their field of research must satisfy the above course requirements for their new field of research.*

Course credit earned at the University of Delaware to obtain an M.S. 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.

### **Course requirements for fast track students**

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

In consultation with and with approval from the Director of the Graduate Program, the student will identify four 3-credit 800-level classroom courses (12 credits total) 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.

### **Other course requirements**

All Ph. D. students (regular track or fast track) must satisfy the following course requirements:

PHYS 600: Research and Presentation Skills  
PHYS 601: Introduction to Teaching Physics and Astronomy  
PHYS 699: Physics and Astronomy Colloquium  
PHYS 861: Introduction to Graduate Research  
PHYS 862: Graduate Research  
PHYS 969: Doctoral Dissertation

**All** first year Ph. D. students are required to take the one-credit courses PHYS 600, PHYS 601, and PHYS 861.

**All** second year Ph. D. students are required to take the one credit course PHYS 699: Physics and Astronomy Colloquium (in both the Fall and the Spring semesters).

**All** Ph. D. students must take the two-credit course PHYS 862: Graduate Research, and pass the Research Readiness Exam associated with this course to continue in Ph. D. study. Students on regular track must take it no later than their fifth semester. Students on fast track must take it no later than their third semester.

Note that PHYS600, PHYS601, PHYS699, PHYS 861, and PHYS 862 are evaluated as Pass/Fail, and therefore are not considered as graded courses and do not count for the 30 credits of graded course work.

**All** students in the Ph. D. program are required to complete 9 credits of doctoral dissertation (PHYS 969).

## **Ph. D. Candidacy Exams**

### **The Research Readiness Exam**

Students will prepare a written report and oral presentation on their research before the end of their fifth semester for regular track students or their third semester for fast track students. The research must contain a clearly identified original component. The written and oral components will be evaluated by a committee with 4 faculty members, 2 from Quantum Science and 2 from Physics of the Universe. The research advisor is not allowed to speak during the oral presentation or vote on the decision but may participate in the closed-door question-and-answer. The committee will vote on whether the candidate proceeds on the Ph. D. track, or conditionally proceeds on the Ph. D. track, or can transfer to the M. S. program. The conditions need to be fulfilled by the student in writing without retaking the exam. Students will register for a 2-credit course, PHYS 862, which they pass based on the committee's evaluation. This exam is a rigorous test of research readiness. If the exam and PHYS 862 has to be postponed to a later semester because of factors beyond the student's control, a written request from the student and a support letter from the advisor has to be submitted to the graduate review committee for approval no later than two weeks prior to the start of the fifth (regular track) or the third (fast track) semester.

### **Dissertation Proposal**

By the end of the third year for regular-track students, or the second year for fast track-students, each student must present an oral proposal for their planned Ph. D. research to their Ph. D. committee. The committee will vote on whether to fully advance the student to candidacy (pass), conditionally advance the student and require remediation (conditional pass), or fail the student. A student who fails the Dissertation Proposal must leave the Ph. D. program. If an extension is given for the Research Readiness Exam, the student must complete the Dissertation Proposal by the end of the semester following the Research Readiness Exam. The purposes of the Dissertation Proposal and the Research Readiness Exam are different. While the Research Readiness Exam assesses past research to judge the research ability of a student, the Dissertation Proposal is about the future research plan. This may be in the same research area as the Research Readiness Exam, but can also be on

a new topic, and occasionally even with a different adviser. Presentation of preliminary results is not required for this exam.

### Standard Schedule of Courses and Candidacy Exams

Standard schedule for Ph.D. students on regular track in the first six semesters of studies:

	Fall	Spring
<b>Year 1</b>	<p><b>Graded courses:</b> PHYS607, PHYS616, PHYS620</p> <p><b>One credit courses:</b> PHYS601</p>	<p><b>Graded courses:</b> PHYS603, PHYS811, PHYS660 or PHYS646</p> <p><b>One credit courses:</b> PHYS600, PHYS861</p>
<b>Year 2</b>	<p>Symposium: all 2nd year students present posters (part of future PHYS862)</p> <p><b>Graded courses:</b> PHYS809, PHYS800 level, PHYS600-level specialized courses</p> <p><b>One credit courses:</b> PHYS699</p>	<p><b>Graded courses:</b> PHYS820, PHYS813</p> <p><b>One credit courses:</b> PHYS699</p>
<b>Year 3</b>	<p>Research Readiness Exam (part of PHYS862)</p> <p><b>Research courses:</b> PHYS862, PHYS868</p>	<p>Dissertation Proposal</p> <p><b>Research courses:</b> PHYS868</p>

Standard schedule for Ph.D. students on fast track in the first four semesters of studies:

	Fall	Spring
<b>Year 1</b>	<p><b>Graded courses:</b> Two PHYS800-level courses</p> <p><b>One credit courses:</b> PHYS601</p>	<p><b>Graded courses:</b> Two PHYS800-level courses</p> <p><b>One credit courses:</b> PHYS600, PHYS861</p>
<b>Year 2</b>	<p>Symposium: all 2nd year students present posters (part of Phys862)</p> <p>Research Readiness Exam (part of PHYS862)</p> <p><b>Research and one credit courses</b></p>	<p>Dissertation Proposal</p> <p><b>Research and one credit courses</b> PHYS868, PHYS699</p>



	PHYS862, PHYS868, PHYS699	
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**Regulations for students who change adviser**

If a student plans to change dissertation advisor, we recommend that such transition be made after the Research Readiness Exam and before the Dissertation Proposal.

**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**

*Immediately after passing the Research Readiness Exam*, the candidate, together with his/her advisor, should decide upon the composition of the dissertation committee.

After passing the Dissertation Proposal, the student will meet with their Ph.D. committee once per year to evaluate progress toward degree. The meeting will take place before the end of September. The student will submit a short (~2 pages) report in advance of the meeting and give a 20-minute oral presentation at the beginning of the meeting.

**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.

## IV. General rules of the program

### Enrollment

In order to remain in good standing in the 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 satisfied course requirements, 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 are not fast track Ph.D. students in good standing are required to take for credit in their first year at least 5 classroom PHYS courses at the 600- or 800-level.

### 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 the end of the first semester to be eligible for financial support during winter. They are encouraged to participate in research as early as possible and assisted by one credit Pass/Fail courses PHYS 600

and PHYS 861 during their second semester. 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 M.S. or 4 to 6 years when entering with a Bachelor's degree. 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 Research Readiness Exam within 2½ years may request transfer to the M.S. program, as may those who fail to pass the Dissertation Proposal. Students may appeal to the termination by writing to the Graduate College in accord with the [University's Dismissal Policies](#).*

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 average.*

### **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.

## **V. 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 3.00.* There are also Departmental rules and guidelines for eligibility for financial support, which are given below in the section **V**.

### **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 as TAs or Research Assistants (RAs), or ii) 9 credits if they have a fellowship or are on sustaining status (see section **Sustaining status**).

### **TA training**

First-time recipients of Teaching Assistantships in the DPA are required to attend the annual Teaching Assistants Learning Sessions offered by the Center for Teaching and Assessment of Learning. 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 PHYS 601 Introduction to Teaching Physics and Astronomy, at the earliest opportunity.

### **TA duties**

Students who are supported by the DPA as Teaching Assistants are expected to prioritize their teaching responsibilities and performance, and to carry out duties assigned specifically to them. Other activities (including research) should be scheduled around TA responsibilities. In addition, TAs are expected to remain on campus through the end of the final exam period.

### **Instructorships**

Some students may be offered positions as lecturers in summer or winter sessions. In order to lecture, a student must have passed the Research Readiness Exam and Dissertation Proposal, 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 Research Readiness Exam and Dissertation Proposal, 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 Graduate College approves the degree candidacy recommendation form, they will change the PHYS 964 Pre-Candidacy course to PHYS 969, which is the final course required prior to transitioning to sustaining status.

## **VI. Departmental regulations and guidelines for graduate student financial support**

### **Regulations**

1. Departmental TA support is not guaranteed to students who have not achieved ELI ITA category of I, II or III before the start of their second semester.
2. TA support during summer sessions is guaranteed only to first year students in good academic standing.<sup>1</sup>
3. Consistent with Graduate College regulations, students on academic probation are not guaranteed support. A student in their second term on probation is not eligible for any

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<sup>1</sup> To be in good academic standing, a student must have 1) a GPA greater than 3.00, 2) fulfilled ELI requirements in item 1 above, and 3), if applicable, met deadlines for forming their Ph.D. dissertation committee and passing the Research Readiness Exam and the Dissertation Proposal.

Department support.<sup>2</sup>

4. Students who have not passed the Research Readiness Exam and the Dissertation Proposal 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 M.S. program will not be supported as TAs after the end of their 5th semester in the graduate program. However, an additional semester of TA support can be granted to students transitioning from the Ph.D. to the M.S. program after the Research Readiness Exam or Dissertation Proposal.

*NOTE the following as a general implementation principle:* During the aforementioned approved periods for Departmental support, faculty requests for TA graduate student salary support will only be approved in such a way that one additional TA support is provided by the Department for each student supported by the faculty as an RA. For faculty with no sponsored research funding, only one student supported as TA is allowed.

## **VII. 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 one or more months in the summer are eligible to

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<sup>2</sup> 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.

receive support from the Departmental supplemental graduate support fund. Priority will be given to students who have not been offered TA support or whose advisors do not have funds to support them as RAs. The monthly amount of support is determined by dividing the fund by the total number of unfunded, summer student months but it will not exceed the equivalent monthly TA/RA stipend rate.

## **VIII. Time limits for the completion of degree requirements**

### **Degree time limits**

Time limits for the completion of degree requirements begin with the date of matriculation and are specifically expressed in the student's letter of admission:

1. *M.S. degree program*: The University time limit is **ten consecutive semesters (5 years)** to complete the degree requirements. Students completing the requirements for the M.S. degree who are subsequently granted permission to continue toward the doctoral degree are given an additional ten consecutive semesters.
2. *Ph.D. program for students entering with a M.S. degree*: The University time limit is **ten consecutive semesters (5 years)** to complete the degree requirements.
3. *Ph.D. program for students entering without a M.S. degree*: The University time limit is **fourteen consecutive semesters (7 years)** to complete the degree requirements.

### **Degree time limit extension**

If extenuating circumstances exist that are beyond a student's control, a request for an extension of time limit for *an additional year* would have to be made by the student, *in writing*, to the departmental Graduate Review Committee. The request would have to be approved by the departmental Graduate Review Committee and the student's advisor. The department will forward this request to the Graduate College, who will in turn determine the student's eligibility for a time extension and will notify the student in writing of its decision to grant an extension of time.