

**DEPARTMENT OF
PHYSICS AND ASTRONOMY**

DARTMOUTH COLLEGE

**GRADUATE STUDENT
HANDBOOK**

2021-2022

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SECTION I PRACTICAL MATTERS

1. WELCOME AND OVERVIEW

The Department of Physics and Astronomy faculty and staff bid you a warm welcome to Dartmouth! We look forward to a rewarding collaboration as you make the transition from a student to a working research physicist or astronomer. Your primary source of information and guidance will be your faculty advisor. However, we hope you will take the opportunity to get to know each of us. (A brief introduction to the staff is given in the logistics subsection, with faculty research interests described in previous mailings.) In addition, this handbook provides a written source for the most important rules, guidelines, and other helpful information.

You should start your graduate career with an emphasis on course work, filling in your knowledge to the depth and breadth required of a versatile physicist or astronomer. Soon after your arrival, you will meet with faculty members to assess the strength of your undergraduate preparation (see Section II-2 (A) of this handbook). This will help us place you in the appropriate courses and ensure that graduate students with diverse undergraduate backgrounds progress expeditiously through the program. Some students will be advised to supplement weak areas in their background with undergraduate courses. The degree requirements for physics and astronomy students are given in Section II-1.

Another important component of your first couple of years here will be undergraduate laboratory teaching and grading, which gives you experience teaching and communicating physics and astronomy to others. Many of us find that our understanding of physics improves and our questioning of the principles of physics becomes deeper when we consider the best way to teach that material to a beginning student. This teaching experience is important enough that we have made it a degree requirement.

By the start of the spring term of your first year, you should take a close look at the research groups that interest you. It is expected that students will find a research advisor at this time and start preliminary research. Research activity generally flourishes in the summers while most of the undergraduates are away. You will want to take full advantage of this special time.

Students concentrating in physics are required to take six courses from a prescribed graduate physics curriculum. Five of these must be taken in the first year. Furthermore, students must demonstrate competency by earning a minimum grade of "Pass" in four specific core courses by the end of the second year. This is explained in more detail in Section II-2.

Students concentrating in Astronomy must complete and successfully present a research project under the guidance of an Astronomy faculty by the end of their first summer term.

After the second year of graduate school, the teaching and course load decreases and research will become your primary focus. For students entering with a Bachelors'

degree, before the end of the spring term of the third year in residence you must have presented a thesis proposal, which is an oral and written presentation that covers the proposed thesis project and related topics (see Section II-8). Advanced incoming students must have attempted the thesis proposal by the spring term of their second year in residence. Most Ph.D. students complete their research and write a thesis in their fifth year, though the best-prepared students sometimes finish in less time than that.

The calendar on the next page summarizes a typical graduate student's work. There is plenty of flexibility, but you should consult your advisor and the Graduate Curriculum and Policy Committee before planning deviations from this calendar. Note that the academic year at Dartmouth begins with the summer term, which commences about the third week of June. Graduate students occasionally take courses or fulfill teaching obligations then, but the summer is typically devoted to research, and students and faculty look forward to this period as the best opportunity to become deeply involved in research.

**TYPICAL GRADUATE STUDIES CALENDAR FOR
A STUDENT ENTERING WITH A BACHELORS' DEGREE †**

Abbreviations: RA = Research Assistant, DF = Dartmouth Fellowship

FIRST YEAR

Summer (pre-arrival)	Fall	Winter	Spring
REVIEW: It is strongly suggested that you spend several weeks reviewing your undergraduate physics in preparation for the graduate program. ASSESSMENT: Entering physics students take a "no-fault" written and oral exam at beginning of Fall term. Provides basis for course recommendations.	COURSES: 3 courses RESEARCH: Ask faculty and other graduate students about their work. COLLOQUIA: Attend departmental colloquia. ADVISOR: A faculty member will be assigned to you.	COURSES: 3 courses including TA teaching. RESEARCH: Ask faculty and other graduate students about their work. COLLOQUIA: Attend departmental colloquia. Astronomy Placement test in early December.	COURSES: 3 courses including TA teaching. RESEARCH: You should find a research advisor early in the spring term and choose an area of research. COLLOQUIA: Attend departmental colloquia.

TEACHING: 2 units as a DF, 1 unit as an RA. (See page 23).

COURSES: Incoming students are required to take at least 5 of prescribed graduate courses by the end of the first year.

The expectation is that most first-year students take 2 courses when teaching and 3 courses when not teaching, plus the TA course.

TA course: First-year Ph.D. students take Physics 256, an introduction for teaching assistants (Fall and Winter).

SECOND YEAR

Summer	Fall	Winter	Spring
RESEARCH: You should be active in a research group at this time. Course credit for research through Physics 137, 138 or 139. Astronomy students: Prepare presentation of your research for Astronomy faculty in early September.	COURSES: 1 to 3 courses. RESEARCH: You should maintain some activity in research throughout the year. Master's students should have a well-defined project at this point. QUALIFYING EXAM: Offered beginning of fall term. COLLOQUIA: Attend departmental colloquia. SEMINARS: Attend the seminar series appropriate to your research area.	COURSES: 1 to 3 courses. RESEARCH: Master's candidates should form their thesis or research committee. COLLOQUIA: Attend departmental colloquia. SEMINARS: Attend the seminar series appropriate to your research area.	COURSES: 1 to 3 courses. RESEARCH: Ph.D. students should form their research committee. Master's candidates should complete and present their thesis or research. (Ph.D. candidates need not complete a master's degree.) COLLOQUIA: Attend departmental colloquia and the seminar series appropriate to your research area. PROGRESS: The faculty reviews the progress of second-year students at this time.

TEACHING: 3 units as a DF, 0.5 units as an RA. (See page 23).

THIRD YEAR

TEACHING: 2.5 units as a DF, 0.5 units as an RA. (See page 23).

COURSES: Any remaining course work should be completed this year. You must have completed at least two research courses by the end of summer term. Your thesis proposal must be attempted by the 15th of May of the spring term.

RESEARCH: Your primary focus will be on your research.

FOURTH YEAR

TEACHING: 2.5 units as a DF, 0.5 units as an RA. (See page 23).

RESEARCH: Your primary focus will be on your research. Your thesis proposal must be passed before the end of fall term of the fourth year.

FIFTH YEAR

TEACHING: 2.5 units as a DF, 0.5 units as an RA. (See page 23).

RESEARCH: You should be completing your thesis research. You should have completed and defended your thesis by the end of the spring term.

† Students entering with a Master's Degree in physics or astronomy may be considered advanced by one year (see Section I-3 and Section II-2 for details).

2. LOGISTICS

General Departmental Information

Among your most valuable initial contacts at Dartmouth will be with the department's administrator, Megan Whitlock, and administrative assistant, Tressy Manning. They are located in room 105 of the physics building, Wilder Laboratory. Drop by and introduce yourself when you arrive. Your mailbox will be located just outside of room 102. They will show you your office space and give you an authorization to obtain a key that will let you into most rooms except faculty offices and the main office. Tressy can also help you with office supplies such as paper, red pens for grading and etc. There are PCs and Macs available in room 300. Students may use the photocopier in room 106. Personal copying should be kept to a minimum and must be paid for in the office.

You will also find your graduate student colleagues a particularly good source of general information. Feel free to introduce yourself to them; a list of their office locations will be distributed early fall term.

Academic and Financial Advice

First-year students will be assigned a faculty advisor during an Incoming Graduate Student Review scheduled for you prior to the start of fall term classes. Your faculty advisor is your primary source of information on course selection, academic matters, and your stipend. You should meet with them at least once a term thereafter. When you find a research advisor, that person also becomes your faculty advisor.

The Guarini School of Graduate and Advanced Studies is located on the 4th floor at 37 Dewey Field Road. The Dean of School of Graduate and Advance Studies is Professor Jon Kull, the Registrar and Assistant Dean of Guarini School of Graduate and Advanced Studies is Gary Hutchins, (ext. 6-2107), and the Office Manager is Amy Gallagher (ext. 6-2106). Gallagher takes care of transcript requests. Dean Hutchins can help you with other general graduate school problems, including graduate student loan information.

Housing Information

The Dartmouth College Real Estate Office is located at 4 Currier Place. Links to Dartmouth-owned student housing as well as an extensive list of local privately-owned apartments, condos, rooms, and houses for rent can be found at realestate.dartmouth.edu.

You should use your home address (or a P.O. Box) for personal mail. Certainly, we understand that on occasion you will need a signature for package delivery. However, personal bills, letters, bank statements, packages, etc. should not come to the department.

Office Space Policy

Desk space in Wilder is scarce. When seeking new desk space, we ask that all graduate students respect the following policy: (1) Graduate students in need of a desk or wishing

to change desks will consult with their advisors to identify suitable possibilities; and (2) Advisors will then request approval of any changes in desk space from the Building Committee (Chair: Prof. Rimberg). Upon approval by the Committee, the proposed changes can then move forward.

Teaching and Computer Resources

David Enriquez and Alan Goldblatt coordinate the undergraduate laboratories. You will find both to be valuable resources when you are TA-ing the undergraduate labs. Alan's office 200A Wilder is located directly inside 200 Wilder. David is located in 214 Wilder.

Your contacts for computer resources are Terry Kovacs, located in 341 Wilder, and Alan Goldblatt. Terry is our Unix specialist and Alan is our Macintosh and PC specialist. They can tell you about the computers available, and how to get an account on the various workstations and mainframes. There are several department-owned Macintosh computers, Northstar UNIX workstations, PCs and various terminals located in room 300. Dartmouth's computer resources are extensively networked (the "Kiewit network"). Use of computers at Dartmouth for teaching and for limited research projects is presently free of charge.

Your primary contacts as a TA will be the professor teaching the course and Alan Goldblatt. However, you are encouraged to become acquainted with Ralph Gibson who manages the lecture demonstration workshop in 110/114 Wilder.

Shops and Stockrooms (wood, metal, electronic, chemical, cryogenics):

The College Apparatus Shop (metal shop), located in 1D Wilder, is run by Dwayne (Whitey) Adams, assisted by Chris Grant. A course in machine shop use is offered each term for those who wish to use the shop facilities. Access to those facilities can be obtained only by passing the course or by otherwise satisfying the person who teaches the course that you are qualified to operate the machines. The cost of the course can be charged to a College account.

Jeff Renk manages the Science Division Electronics Shop, located in 1A Wilder. You will need to get an account number from your research advisor before obtaining electronic parts and design assistance.

Other research laboratory supplies are available from the Chemistry Stockroom (17 Burke Laboratory, ext. 6-3520), and the Biomedical Scientific Stockroom (110 Remsen, ext. 650-1583). Electronic components are stocked in the Chemistry Stockroom.

Useful Resources

- (i) Dartmouth College Bulletin of Organization, Regulations, and Courses (The ORC): This is the official source on course offerings and degree requirements. (www.dartmouth.edu/reg - click on ORC/CATALOG tab).
- (ii) Guarini School of Graduate and Advanced Studies: This contains detailed general information for all graduate students at Dartmouth. (graduate.dartmouth.edu)

3. STIPENDS, OUTSIDE EMPLOYMENT, and VACATIONS

Stipends normally begin in September, with the first paycheck available on October 1, and at monthly intervals thereafter. Sources of financial support available through Dartmouth College include the following:

1. Dartmouth Teaching Fellowship (DF) - This fellowship provides a full tuition scholarship and a stipend, which in the academic year 2021-22 is \$2,630.00 per month for 12 months. It carries a maximum teaching obligation of 200 hours per term during two or three of the four academic terms. The number of terms of teaching required per year is reduced in the later years, as detailed later (Section II).
2. Research Assistantship (RA) - These awards are available through research grants to individual faculty members or groups, from governmental or private agencies. They provide a stipend equal to that of a Dartmouth Fellowship and may or may not provide a tuition scholarship. If they do not, Dartmouth may provide it. The teaching obligation for an RA is reduced as described later (Section II).
3. Gordon F. Hull Fellowship - This Fellowship may be awarded to an advanced graduate student who is deemed by the three most senior members of the Physics and Astronomy faculty to have outstanding qualifications. The tuition scholarship, stipend and teaching obligations are the same as for a Research Assistantship and there is a \$1000 allotment for professional expenses such as travel, research books, and special materials.
4. Tuition Scholarship - Dartmouth may provide these Scholarships to students who receive stipend support, but no tuition from an outside source, or who are otherwise unsupported.

Stipends from the above sources are subject to state and federal taxes to the extent required by law although tuition scholarships are generally not taxed. Awards are normally made on a 12-month basis. It is expected that graduate students move from internal department support (DF) to externally funded research support (either their own or their advisor's funded RA) by their second or at latest third year in the program except under unusual circumstances. Awards can be terminated any time the Departmental Graduate Committee determines that a student is not meeting their obligations. As long as a student remains in good standing, financial support will normally be renewed annually for a period of up to five years for the Ph.D. and two for the M.S. In exceptional cases when a longer period is required for the Ph.D., the student's thesis committee may wish to petition the Department Graduate Curriculum and Policy Committee for further extension of support if circumstances warrant. The Graduate Curriculum and Policy Committee should receive such petitions no later than the first day of winter term classes of the student's fifth year, in order that he or she is considered for support beyond July 1st of the fifth year. Support is thereafter on a term-by-term basis by petition from the student's Ph.D. committee to the Graduate Curriculum and Policy Committee each quarter. If an RA supports a student, extension beyond five years is at the discretion of their advisor.

Students entering with a Masters' degree in physics or astronomy, and who transfer three or more graduate courses may be considered advanced by one year, with respect to both teaching obligations (see Section II) and financial support. Accordingly, if DF financial support were desired beyond the fourth year in residence at Dartmouth, then a petition from the Ph.D. thesis committee would be required no later than the first day of winter term classes of that year.

We strongly encourage students to obtain support from additional sources outside Dartmouth. These may include NSF, NASA and DOD Graduate Fellowships, veterans' benefits, support through industrial employee programs (eg. IBM or CRREL), etc. Some outside sources provide more support than DFs or RAs. If the outside source provides less than the prevailing Dartmouth Fellowship rate, Dartmouth may make up the difference, provided the student would otherwise qualify for Dartmouth support. We consider graduate study to be a full-time occupation; outside employment should be considered only under exceptional circumstances and undertaken only with the advice and written permission of your advisor, the Departmental Graduate Curriculum and Policy Committee, and the Dean of Guarini School of Graduate and Advanced Studies.

Vacation time policies in graduate school are somewhat unusual. Many of us find that our most productive research occurs during those quiet periods of the undergraduate holidays, and we are less inclined to take vacations during this highly valued time. On the other hand, we realize that one occasionally needs a break from research. The official policy is that students receiving any of the above forms of support are entitled to a total of twenty days vacation (including Christmas and other regular college holidays). Please note in planning your vacations that teaching and grading responsibilities frequently extend into the undergraduate holidays; always check first with the faculty member with whom you are teaching and/or doing research before making plans.

4. MISCELLANEOUS

Health Insurance Option

Each student is responsible for and required to have their own health insurance and *is not automatically covered by any college-wide health plan* upon enrollment at Dartmouth. The College does offer an excellent Student Group Health Insurance Plan, but it is the student's responsibility to apply for this coverage, or to take out equivalent protection from some other insurer. Information about this plan is available at students.dartmouth.edu/health-service/fees-insurance/insurance/dsghp-information, or from the health service. For the year 2021-2022 the health plan will be paid in full by the college, equivalent to single person coverage.

Dartmouth's Child Accommodation Policy allows graduate students who are full-time, stipend-supported and primary care providers to take up to 12 weeks of accommodation following the birth or adoption of a child. During the accommodation period, graduate students remain enrolled and receive their full stipend support and health benefits. An automatic one-term extension will also be granted to complete their degree. For further information see: graduate.dartmouth.edu/policy/child-accommodation-policy.

Professional Travel

If you are presenting a paper at a professional meeting, travel expenses up to a maximum of \$1,000 may be available upon application to the Dean of Guarini School of Graduate and Advance Studies. Ordinarily, a student will receive support for only one such meeting while a graduate student at Dartmouth. Additional funds are often available from grant money in your research group.

Accident Reporting

By New Hampshire State law all work-related accidents must be reported and in a timely manner. If you are involved in any type of accident, including [but not limited to] a laceration, chemical spill, radiation, etc., you or your supervisor or both must notify Alan Goldblatt within 24 hours. It does not matter if you feel you do not need medical attention - report it. Notification to Alan can be made in person, by telephone, or e-mail. Notification should include how he can contact you. If you are working in a lab, be sure to notify your supervisor/PI as well. You are also requested to report any accident you may witness within Wilder Laboratory or at Shattuck Observatory, including if it involves someone not employed by the College, e.g. outside contractors, etc. There are several report forms that need to be completed in writing by you or your supervisor, and then forwarded to Alan, and then he will immediately forward the forms to the State. In the event that an accident is not reported appropriately and the State fines the College, the individual or PI may be liable for the cost of the fine. Failure to report in a timely manner may result in the accident not being covered by insurance.

Graduate Student Representation: Graduate Student Council

The goal of the Graduate Student Council (GSC) is to nurture and enhance the graduate student community across Dartmouth's graduate departments, schools, and programs.

The GSC consists of elected departmental representatives from all Graduate Arts and Sciences programs, including TDI and Thayer, and non-voting representatives from the Tuck School of Business, the Geisel School of Medicine, and the Undergraduate Student Assembly. (sites.dartmouth.edu/gsc)

Grievance Procedure

The committee-based process for guiding and evaluating graduate thesis research in the Physics and Astronomy Department, while primarily designed to ensure effective mentoring, is also intended to guard against biased treatment of any individual. In addition to this committee system, the department has established a grievance process to ensure that student grievances will be investigated fully and fairly, treated confidentially and decisions rendered in a timely manner. In general, these issues are best moderated internally. With an effective oversight/grievance committee structure, few grievances or disputes will reach the stage where they require formal resolution. The Guarini School of Graduate and Advanced Studies office is the place to turn only after departmental and informal resolution proves not feasible or successful.

Here are the procedure students should follow to resolve grievances.

1. When possible, speak directly to the person who bears responsibility for the complaint or who is the alleged cause of the complaint.
2. If that fails, speak to your graduate advisor and/or members of your thesis or advisory committee.
3. If the grievance is still not resolved, speak to the Chair of the Physics and Astronomy Department Graduate Curriculum and Policy Committee and/or the Chair of the Department.
4. If a satisfactory resolution cannot be reached within the department or program, the aggrieved student may request a meeting with the Dean of Guarini School of Graduate and Advanced Studies to discuss the issue.
5. If the Dean, working together with the aggrieved student and appropriate faculty member(s) or other representatives of the Physics and Astronomy Department, is unable to reach a satisfactory resolution, the student can request in writing a formal hearing and ruling by the Dean of Guarini School of Graduate and Advanced Studies and the Committee on Student Grievances. Formal hearings are conducted as described at the link below. (see sections titled “Committee on Student Grievances” and “Formal Hearing” under Academic and Conduct Regulations at graduate.dartmouth.edu/policy/honor-principal-and-code-conduct-violation-procedures)

Please note that allegations of scientific misconduct, violations of the academic honor principle, and certain issues of professional and personal conduct (sexual harassment, discrimination, and others described in the Department of Physics and Astronomy graduate handbook under code of conduct - non-academic regulations), must be reported to and handled by the Guarini School of Graduate and Advanced Studies office.

SECTION II ACADEMIC MATTERS

We begin this section by spelling out the formal degree requirements, much as they appear in the ORC. We then develop the various aspects (courses, teaching, research, etc.) in detail, placing things in rough chronological order and describing how they fit into your overall learning experience. The Graduate Curriculum and Policy Committee will monitor your progress in all areas to ensure that this is commensurate with the timetable set out earlier. If your progress is satisfactory, and your teaching obligations are met, then you will remain in good standing; your stipend (DF or RA) will normally be renewed through June 30 of your fifth year, and you will retain the privileges normally accorded to graduate students (use of the library and computer facilities, access to student loans, etc.). We will refer to more specific conditions relating to good standing in the following discussion. Students entering with a Masters' degree in Physics or Astronomy, and sometimes in other disciplines and who have transferred three or more courses may be considered advanced by one year with respect to our timetable for completion of the degree requirements, such as the research proposal, completion of course requirements (allowing for transfer credit), teaching obligations, and stipend renewal. At most two courses with the grade LP (low pass) are allowed for credit toward either the Masters' or Doctor's degrees. (Section II-3).

1. DEGREE REQUIREMENTS

The graduate program of the Department of Physics and Astronomy does not admit students to a terminal M.S. degree program: all admitted students are admitted to the Ph.D. program. Nevertheless, some students wish to formally obtain the M.S. degree en route to the Ph.D. Similarly, students who depart the graduate program without the Ph.D. may wish to obtain the M.S. degree. For these reasons we list the requirements for the M.S. degree.

Requirements for the Masters' Degree (M.S.)

The general requirements for the M.S. degree are given in the "Graduate Study" section of the ORC. These requirements, together with the specific requirements of the Department of Physics and Astronomy indicated below, normally allow completion of the degree in two years. It is expected that graduate students who have not completed the equivalent of the Dartmouth Physics major program will do so in their first year of graduate study.

Special requirements:

- 1) Degree credit for eight graduate courses, exclusive of teaching courses. Two of the eight courses may be Graduate Research. At least six of the eight courses should be in Physics and Astronomy.
- 2) Credit for at least one term of Supervised Undergraduate Teaching (Physics 257).
- 3) Completion of a culminating experience chosen from the following options:

- a) Completion of a satisfactory thesis, which must be defended before the M.S. Thesis Committee in a public forum.
- b) Significant co-authorship of a publication submitted to a refereed journal or refereed conference proceedings, defended publicly.
- c) For physics students, satisfy the core competency requirement. For astronomy students, pass the first- and second-year research exams.

Requirements for the Doctors' Degree (Ph.D.)

Entering Ph.D. students are expected to enroll in Physics 256 (Instruction in Teaching for Graduate Students) fall and winter term, which is taken in addition to three regular course credits.

A student will be admitted to Ph.D. candidacy upon:

Physics students:

1. Receiving credit for six out of the following nine prescribed core physics courses: Physics 76, 90, 100, 101, 103, 104, 105, 106, 109.
2. Satisfy the core competency requirement. (See Section II-2(C).)
3. Presenting a thesis proposal and successfully defending it before an appointed Ph.D. thesis committee, for certification.
4. Passing a departmental review of the student's course record and preliminary research progress.
5. Receiving credit for at least two terms of Supervised Undergraduate Teaching (Physics 257) and Physics 256.

The core competency requirement is satisfied by earning a grade of HP or P in the following courses: P90 Intermediate Quantum Mechanics; P101 Classical Mechanics; P104 Statistical Mechanics; and P105 Electromagnetic Theory I.

Students must achieve thesis proposal certification by the end of the fall term of their fourth year, in order to remain in good standing. The Department will admit students who successfully complete these requirements to Ph.D. candidacy.

Astronomy students:

1. Receiving credit for Astronomy 115, Astronomy 116, Astronomy 117, Astronomy 118, Astronomy 74 (tentatively renumbered Astronomy 174), and any one Physics course numbered 61 or above, and any other courses required by the student's advisory committee. Receiving credit for at least six terms of graduate research.
2. Passing a research exam at the end of their first and second years.
3. Presenting a thesis proposal and successfully defending it before an appointed Ph.D. thesis committee, for certification.
4. Passing a departmental review of the student's course record and preliminary research progress.
5. Receiving credit for at least two terms of Supervised Undergraduate Teaching (Physics 257) and Physics 256.

Students must achieve thesis proposal certification by the end of the fall term of their fourth year, in order to remain in good standing. The Department will admit students who successfully complete these requirements to Ph.D. candidacy.

The candidate will receive the Ph.D. degree upon:

1. Receiving degree credit for at least twelve graduate courses, exclusive of teaching courses. Physics students: Two of the twelve courses may be Graduate Research, and at least two terms of Graduate Research must be completed no later than the second summer in residence. Astronomy students: Six of the twelve courses may be Graduate Research, and at least six terms of Graduate Research must be completed no later than the second summer in residence.
2. Receiving credit for at least two terms of Supervised Undergraduate Teaching (Physics) 257 and Physics 256.
3. Completing a dissertation of substantial significance and publishable quality.
4. Successfully defending the dissertation before the Ph.D. Thesis Committee in a public forum.

It is expected that most students will receive the Ph.D. degree by the end of the fifth year of graduate study.

2. STARTING THE PATH TO THE Ph.D.

(A) INCOMING GRADUATE STUDENT ASSESSMENTS

All incoming students will meet with faculty to discuss their background in various areas of Physics and Astronomy. The outcome of this meeting will be the assignment of first-year advisors and a recommendation about which courses to take.

For physics students, this process consists of a diagnostic assessment exam, to help identify gaps in preparation, and determine the best plan of coursework. This is a take home, open book, no-fault exam consisting of a small number of problems (4-6) drawn from the Dartmouth undergraduate core curriculum. The exam is distributed during orientation week, and students are given three days to complete. Students may consult any books and notes, though the use of the internet or consulting with another person is not permitted. Each student will then meet in person with a three-person faculty committee for discussion of solutions and oral evaluation. For example, students may be asked to explain their solution-method or discuss the interpretation of a problem. The committee will recommend a plan for coursework based on the results of the evaluation. (For example, a student with a weak preparation in statistical mechanics or quantum mechanics may be advised to take an undergraduate course in that subject.) Incoming students are required to take, or otherwise satisfy, at least 5 of the prescribed graduate core courses by the end of the first year. However, if the faculty committee recommends the student take two or more undergraduate courses (which do not carry graduate credit) then this requirement is waived.

For astronomy students, in December of their first year, students take a placement test to determine the student's knowledge of undergraduate astronomy and physics. The

results of the test will be used by the student's advisory committee to determine any supplementary courses, which the student will be required to take.

All students will be notified of their appointment with assigned faculty advisors, which will be scheduled for the week before the beginning of fall term.

(B) TRANSFER AND ADVANCED INCOMING STUDENTS

Students entering the Ph.D. program with a MS degree in Physics or Astronomy who transfer at least 3 courses may be considered advanced by one year with regards to the thesis proposal, teaching obligations, and financial support. Students entering with a MS degree in other disciplines will be advanced one year at the discretion of the department.

- 1) Graduate credits may be recommended by the Graduate Curriculum and Policy Committee for courses passed elsewhere, provided that the courses are comparable in level and content to Dartmouth courses for which we grant graduate credits. No graduate credits may be awarded, however, for courses taken in partial fulfillment of the requirements for an undergraduate degree. Note that the ORC allows at most three transfer credits toward the M.S. and at most six toward the Ph.D. degree requirements. In order to receive transfer credit for a course, a student must pass either an oral or a written exam administered by the faculty member in charge of the corresponding course at Dartmouth College. An important exception is that if the credit is for one of the four core competency courses, then the examination is made by the graduate evaluation committee. The deadline to request a transfer is the middle of the first winter term. On the recommendation of the faculty member the Graduate Curriculum and Policy Committee will approve the transfer credit by the end of the first winter term. An "Application for Transfer of Graduate Credit" is required to complete the transfer process.
- 2) You may receive an exemption from required graduate courses if comparable courses have already been passed (whether or not such courses are eligible for credit).
- 3) The Graduate Curriculum and Policy Committee must approve requests for transfer credit or exemption before the end of the first winter term.

At most a total of three reading courses, Physics 85 and Physics 127, may be counted toward the Ph.D. course requirement. This restriction is almost superfluous except possibly for students who have taken a large number of graduate courses elsewhere. Even in such cases, one can probably fulfill the course requirement by taking Special Topics courses, Physics 122, with essentially no redundancy.

The "Arts and Sciences Graduate Student Academic Standing Policies," a copy of which is given in the next section, ultimately determine grading policies.

(C) REQUIRED EVALUATIONS

1) Physics:

Assessment Exam: During Orientation, first-year physics students take an assessment exam, as described above in Section II-2(A).

Core Competency: The core competency requirement is satisfied by earning a grade of HP or P in the following courses: P90 Intermediate Quantum Mechanics; P101 Classical Mechanics; P104 Statistical Mechanics; and P105 Electromagnetic Theory I.

Students who do not achieve a P or better in any of the above courses have an alternate opportunity to demonstrate competency, consisting of a self-study reading course and subsequent examination by a faculty committee.

- a) The self-study reading course is held in either the summer- or winter-term, and is intended to enable intensive, focused study of the course material.
- b) Evaluation is made in the last week of the term or during examination week, by a three-person faculty committee, including at least one faculty member who has recently taught the relevant course. The committee is appointed by the chair and will be the same for all students.
- c) Evaluation is based on a written and orally defended exam consisting of 4-6 problems at the level of recent core undergraduate and graduate course exams. Faculty who have recently taught the relevant courses are responsible for providing exam problems.
- d) Students have three days to work the problems and turn in their completed solutions. Students may use their own notes, textbooks, and course materials, but may not consult the internet or any other person. Students may consult with the faculty committee for clarification on any problems. The faculty committee will evaluate the written solutions and then meet with the individual students. They will be asked to explain the solution-method (e.g. on a whiteboard). Demonstration of competency will be based upon both the written solutions and oral defense, by a majority vote of the faculty committee.
- e) Students have one attempt per core topic. The grade for the reading course (C/NC) is determined by the chair or designated faculty member and is separate from the evaluation made by the faculty committee.
- f) All attempts must be completed by the end of the second summer (first term of the third year), at which time a determination is made whether the student advances or departs the program.

Students must demonstrate competency (through coursework or evaluation by the above-described examination) in all four core courses. Successful students must find an advisor within two terms of passing the core or by the fall of their third year, whichever is sooner. Students who do not demonstrate competency in all four topics, or students who do not find a research advisor within two terms, must leave the program.

Students who demonstrate competency in all four topics will have satisfied option 3c of the requirements for the M.S. degree. Students who do not demonstrate competency may still earn a M.S. degree if the other requirements are satisfied.

Summary of Deadlines for Evaluations and Thesis Proposal for Physics Students

PHYSICS ENTERING QUALIFICATIONS	NORMAL	ADVANCED BY ONE YEAR
CORE COMPETENCY	Completed no later than end of second summer (third year).	Completed no later than end of first summer (second year).
THESIS PROPOSAL:	Attempted no later than the end of spring term of the third year in residence and must be passed by the end of fall term of the fourth year in residence.	Attempted no later than the end of spring term of the second year in residence and must be passed by the end of fall term of the third year in residence.

2) Astronomy:

Placement Test: In December of their first year, students will take a placement test to determine the student's knowledge of undergraduate astronomy and physics. The results of the test will be used by the student's advisory committee to determine any supplementary courses, which the student will be required to take.

Research Exam 1: At the end of their first year, students will present a written report and make a short oral presentation to their advisory committee on a research project they undertook at Dartmouth. The oral presentation will be followed by questions about the project. Upon completion of this exam, a student will be awarded a pass, low pass, or fail. The student's participation in journal club will be considered by the committee when determining the grade. The advisory committee may place additional requirements on a student who receives a low pass. A fail means that the student must leave the program by the end of the fall term.

Research Exam 2: At the end of their second year, students will present a written report and make an oral presentation to their advisory committee on their research at Dartmouth. In lieu of a written report, a student may submit a paper they wrote, which has been submitted, or published by a peer reviewed journal. Students who submit a published or accepted paper will automatically pass this exam and will present their research work as an astronomy seminar. The oral presentation will be followed by questions about the research, and its broader context, including the motivations for the research, the history, and the current status of the field. Upon completion of this exam, a student will be awarded a pass, or a fail. A fail means that the student must leave the program by the end of the fall term. Students who fail their research exam may be awarded an M.S. degree if they satisfy the requirements for an M.S. degree by the end of the fall term of their third year.

Summary of Deadlines for Evaluations and Thesis Proposal for Astronomy Students

ASTRONOMY ENTERING QUALIFICATIONS	NORMAL	ADVANCED BY ONE YEAR
RESEARCH EXAMS:	Must be passed at the end of first and second years.	N/A
THESIS PROPOSAL:	Attempted no later than the end of spring term of the third year in residence and must be passed by the end of fall term of the fourth year in residence.	Attempted no later than the end of spring term of the second year in residence and must be passed by the end of fall term of the third year in residence.

D. COURSES AND CREDITS

Physics and Astronomy courses offered for graduate credit are those numbered 61 or higher. The Department of Physics and Astronomy allows graduate credit for any course offered by the Departments of Biochemistry, Biological Sciences, Chemistry, Earth Sciences, Engineering Sciences, Computer Sciences or Mathematics, which receives graduate credit from that department.

You should discuss course selections each term with your advisor, but useful general guidelines for your first year are: concentrate on the core graduate courses in order to satisfy the core competency requirement; take the appropriate undergraduate course(s) if the need is indicated by your Incoming Graduate Student Review; and take one or more of the courses relating to the principal areas of research in the department, Introductory Condensed Matter Physics (Physics 73, offered in the fall), Astrophysics (Astronomy 74, tentatively renumbered Astronomy 174, offered in the fall) or Introductory Plasma Physics (Physics 68, offered in the fall). *You need to register for the equivalent of three credits. When teaching, one credit will be Physics 257, which is graded HP/P/LP/NC. The grade does not count towards the degree credits needed in 12 graduate courses.*

3. GUARINI SCHOOL OF GRADUATE AND ADVANCED STUDIES ACADEMIC STANDING POLICIES (graduate.dartmouth.edu/policies)

Full-Time Student

(graduate.dartmouth.edu/policy/requirements-meet-full-time-student-status)

For financial aid purposes, a graduate student enrolled in two or more courses or in a graduate research course is considered to be a full-time student. However, for IRS purposes under certain circumstances, a three-course load may be required for full-time status. Therefore, we advise all students to enroll in three courses each term. A full-time student in the Guarini School of Graduate and Advanced Studies who is in good academic standing is considered to be making satisfactory progress unless the student's graduate committee or the Dean of the Guarini School of Graduate and Advanced Studies has placed the student in unsatisfactory academic standing or taken action to separate the student from the college.

Financial Aid

graduate.dartmouth.edu/admissions-financial-aid/funding)

The Guarini School of Graduate and Advanced Studies offers a financial aid package consisting of scholarships, fellowships, research assistantships and loans. It is intended to attract well-qualified students and, depending on the degree program, considers ability and financial need as independent factors in determining awards. **All awards are contingent upon the availability of funds, continued satisfactory performance and satisfactory academic progress.**

Satisfactory Progress

graduate.dartmouth.edu/policy/satisfactory-progress)

Grade Standards:

Course work and grades are only one component of graduate education, and the grading system is designed to reflect this fact. The following grades will be used in courses acceptable for credit toward a graduate degree and as one criterion for determining satisfactory progress.

HP: High Pass, indicating work of quality which is distinctly superior. Denotes high standing and satisfactory progress.

P: Pass, indicating work of good quality, worthy of graduate credit. This would be the most common grade denoting satisfactory progress.

LP: Low Pass, indicating work which is acceptable for graduate credit, but in which the student exhibited one or more serious deficiencies. Only two LP grades are acceptable for degree credit. A student receiving two LP grades will automatically be placed on probation.

CT: Credit, indicating satisfactory work in certain courses, such as research courses, in which assignment of a grade of HP, P, or LP is considered inappropriate. The grade CT is the only passing grade in a course in which it is used.

INC: Incomplete, indicating work still in progress. A grade must be assigned to replace the INC by the end of the following term, except with special permission from the Dean of Guarini School of Graduate and Advanced Studies. If the work is not completed the grade will automatically be recorded as NC.

NC: No Credit, indicating work, which is not acceptable for graduate credit and automatically places the student on probation.

A graduate student who has received more than one LP grade or has received one NC grade will automatically be placed on probation for one term. (Individual programs may set a standard for course work that is more rigorous than this minimum standard.) The

department graduate committee must review the student's progress at the end of the probationary term. The committee will then inform the Dean of Guarini School of Graduate and Advanced Studies, in writing, if the student has produced course work and/or research at a satisfactory level.

If such is the case, the student will be removed from probationary status.

If, however, the student has not met the departmental standards for satisfactory progress, the student will remain on probation until satisfactory progress is achieved according to the written requirements of the student's graduate committee. A graduate student may also be placed in '*unsatisfactory standing*' if the student receives more than two LP's or more than one NC, and may be suspended or permanently dismissed from the program by the department faculty or the Dean of the Guarini School of Graduate and Advanced Studies. **A student in '*unsatisfactory standing*' is not eligible for federal loans or Dartmouth scholarships or fellowships.**

In addition to the grade and probation standards set above, the student is also expected to meet quantitative standards by successfully completing coursework in a timely manner. Since there are *full-time* graduate students (those enrolled for *two or more* courses per term) and *half-time* students (those enrolled for only *one course* per term), the quantitative definition is based upon how many courses the student registers for and completes satisfactorily. Full-time graduate students must complete **eight of each consecutive 12 courses** for which they register; Doctoral students are further expected to meet all program requirements for graduation within a *maximum* of seven years and Master's program students are required to complete all requirements within a *maximum* of six years.

Academic progress (both qualitative and quantitative) is reviewed at the end of the academic year (completion of the spring term) for both full and half-time students and is reported to the Financial Aid Office. Students who fail to meet the requirements for "satisfactory progress," **will not receive federal loans or Dartmouth scholarships or fellowships.**

Students who have not met satisfactory progress may be able to regain this status for *federal financial aid purposes* by completing missing coursework in the next term. As an example, consider a full-time student, enrolled for 12 courses in four terms, who had completed only seven courses prior to spring term. During spring term the student requested an incomplete grade for three courses. During the next term of enrollment (summer), the student completed the coursework, which changed the INC grades to P, thereby satisfying the eight-course requirement. Although ineligible for aid during the summer term, the student would regain eligibility for the remainder of the academic year.

Since there are various scenarios as to how a student might regain academic progress for financial aid purposes, each student who is interested should make an appointment with the Graduate Financial Aid Officer who will provide advice according to the individual student's record.

Students who have special circumstances which may have affected their ability to maintain satisfactory progress and who wish to appeal their non-eligible status may do

so by providing written details and documentation to the Graduate Financial Aid Officer, HB 6024.

Applicants who are interested in finding out if their situation can be re-assessed should make an appointment to see the Graduate Financial Aid Officer by calling 646-2451. (Note: this appeal is for financial aid purposes *only*. Academic status questions should be addressed to the student's department or the Dean of Guarini School of Graduate and Advanced Studies.)

Other Standards:

graduate.dartmouth.edu/policy/other-standards-pertaining-satisfactory-progress)

Each graduate program within the Guarini School of Graduate and Advanced Studies provides in writing to their students a standard of progress the student is expected to make toward the degree in that particular discipline. These standards of satisfactory progress are concerned mainly with timely completion of specific degree requirements such as the qualifying exam(s), project research and thesis proposal.

Failure to complete departmental requirements within the specified time periods will result in a letter of warning to the student with a copy to the Dean of the Guarini School of Graduate and Advanced Studies.

An extension of time for completion of the requirement may be specified in the letter. If the work is not completed within the specified time, the student will be placed in '*unsatisfactory standing*' and may be suspended or permanently dismissed from the program by the department faculty or the dean. **A student in '*unsatisfactory standing*' is not eligible for federal loans or Dartmouth scholarships or fellowships.**

Transferring Programs

graduate.dartmouth.edu/policy/transferring-programs)

Occasionally, a student may transfer from one graduate program to another at Dartmouth for the completion of his/her Ph.D. Although the process of acceptance and transfer lies with the individual graduate programs, the Office of the Dean of Guarini School of Graduate and Advanced Studies must give final approval for transfer of the candidate from one program to another.

If the Dean of the Guarini School determines that the candidate's credentials and qualifications are not adequate, then acceptance and transfer into the program will be denied. (see also Dismissal below).

Withdrawal and Suspension

graduate.dartmouth.edu/policy/withdrawal-and-suspension)

If a student has withdrawn in good academic standing, the student will be eligible for fellowship funds, tuition scholarships and, if qualified, for loan funds upon readmission. A timely application (set by the student's department) is necessary, however, in order to ensure that funds are available.

Students who are suspended for academic reasons, who withdraw in questionable academic standing, or who withdraw while on academic probation must present positive evidence of the ability to resume satisfactory progress when applying for readmission.

Dismissal

graduate.dartmouth.edu/policy/dismissal

Both the department faculty and the Dean of the Guarini School of Graduate and Advanced Studies have the right to dismiss a student from a program if their academic work is not up to the generally accepted standards of a graduate scholar.

Students who were previously dismissed and wish to apply to another graduate program at Dartmouth must submit a written petition to the Dean of the Guarini School of Graduate and Advanced Studies.

4. THE ACADEMIC HONOR PRINCIPLE

students.dartmouth.edu/judicial-affairs/policy/academic-honor-principle

On February 13, 1962, the Dartmouth College Faculty passed unanimously the following resolution; the text was updated by faculty vote on May 17, 1999: Whereas, on February 1, 1962, a majority vote of the student body adopted the principle that 'all academic activities will be based on student honor' and thereby accepted the responsibility, individually and collectively, to maintain and perpetuate the principle of academic honor. Therefore, be it resolved that,

I. The Faculty of Dartmouth College, in recognizing the responsibility of students for their own education, assumes intellectual honesty and integrity in the performance of academic assignments, both in the classroom and outside. Each student upon enrollment at Dartmouth College accepts this responsibility with the understanding that any student who submits work which is not their own violates the purpose of the College and is subject to disciplinary actions, up to and including suspension and separation.

II. The faculty recognizes its obligation: (a) to provide continuing guidance as to what constitutes academic honesty; (b) to promote procedures and circumstances which will reinforce the principle of academic honor; (c) to review constantly the effective operation of this principle.

III. The practice of proctoring examinations is hereby discontinued, though a teacher may be present at appropriate times for the purpose of administration or to answer questions.

IV. The Committee on Standards shall undertake to:

- (a) Publish and interpret the Resolution on Academic Honor to the student body each year
- (b) Adjudicate reported violations according to established procedures
- (c) Review constantly the effective operation of this principle and, if necessary, make recommendations to the Faculty for maintaining the spirit of this Resolution.

The faculty, administration and students of Dartmouth College recognize the Academic Honor Principle as fundamental to the education process. Any instance of academic dishonesty is considered a violation of the Academic Honor Principle.

Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in and out of the classroom. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Any student who submits work which is not their own, or commits other acts of academic dishonesty, violates the purposes of the college and is subject to disciplinary actions, up to and including suspension or separation.

The Academic Honor Principle depends on the willingness of students, individually and collectively, to maintain and perpetuate standards of academic honesty. Each Dartmouth student accepts the responsibility to be honorable in the student's own academic affairs, as well as to support the Principle as it applies to others.

Any student who becomes aware of a violation of the Academic Honor Principle is bound by honor to take some action. The student may report the violation, speak personally to the student observed in violation of the Principle, exercise some form of social sanction, or do whatever the student feels is appropriate under the circumstances. If Dartmouth students stand by and do nothing, both the spirit and operation of the Academic Honor Principle are severely threatened.

A number of actions are specifically prohibited by the Academic Honor Principle. These focus on plagiarism and on academic dishonesty in the taking of examinations, the writing of papers, the use of the same work in more than one course, and unauthorized collaboration.

This list of examples covers the more common violations but is not intended to be exhaustive.

1. Examinations. Any student giving or receiving assistance during an examination or quiz violates the Academic Honor Principle.

2. Plagiarism. Any form of plagiarism violates the Academic Honor Principle. Plagiarism is defined as the submission or presentation of work, in any form, that is not a student's own, without acknowledgment of the source. With specific regard to papers, a simple rule dictates when it is necessary to acknowledge sources. If a student obtains information or ideas from an outside source, that source must be acknowledged. Another rule to follow is that any direct quotation must be placed in quotation marks, and the source immediately cited. Students are responsible for the information concerning plagiarism found in "Sources: Their Use and Acknowledgment," available in the Deans' Offices and online at

3. Use of the same work in more than one course. Submission of the same work in more than one course without the prior approval of all professors responsible for the courses violates the Academic Honor Principle. The intent of this rule is that a student should not receive academic credit more than once for the same work product without permission. The rule is not intended to regulate repeated use of an idea or a body of

learning developed by the student, but rather the identical formulation and presentation of that idea. Thus the same paper, computer program, research project or results, or other academic work product should not be submitted in more than one course (whether in identical or rewritten form) without first obtaining the permission of all professors responsible for the courses involved. Students with questions about the application of this rule in a specific case should seek faculty advice.

4. Unauthorized Collaboration. Whether or not collaboration in course work (labs, reports, papers, homework assignments, take-home tests, or other academic work for credit) is permitted depends on expectations established in individual courses. Students are sometimes encouraged to collaborate on laboratory work, for example, but told to write their laboratory reports independently. Students should presume that collaboration on academic work is not permitted, and that submission of collaborative work would constitute a violation of the academic honor principle, unless an instructor specifically authorizes collaboration. Students should not presume that authorization in one class applies to any other class, even classes in the same subject area. Students should discuss with instructors in advance any questions or uncertainty regarding permitted collaboration.

We cannot emphasize enough the importance of adhering to the Honor Principle. Always ask the professor what his/her expectations are about working together with other students.

5. COLLOQUIA AND SEMINARS

The departmental colloquium is normally held each Friday afternoon during fall, winter, and spring terms. Here you will have the opportunity to listen and respond to well-known physicists and astronomers from other institutions, as they present their research work. The talks are aimed at the non-expert graduate student level. Exposure to the wide range of topics presented is an essential part of your graduate education, and *all graduate students are expected to attend every week*. Although no formal course credit is given, attending the colloquia is just as important as attending your courses. The incoming graduate students are responsible for setting up refreshments before each colloquium and cleaning up afterward. Tressy will provide students with a schedule of duties. The department provides and pays for the refreshments.

In addition to the departmental colloquia, there are research seminars in each of the three major areas of research at Dartmouth: Astronomy/Cosmology, Quantum Nanophysics, and Plasma Physics, which include Space Physics and Fluid/MHD Theory. These talks are at a more technical level than the colloquia. Graduate students, faculty and outside visitors present them. You are not expected to attend all of these, although some may be helpful in selecting a research area. Once you have begun research, of course you are expected to attend the appropriate seminar series. You are encouraged to also attend any other seminars of interest in this department and in other departments. A bulletin board near the physics office has a posting of announcements for many of the scientific seminars on campus.

6. TEACHING

Degree Requirement

As indicated in the ORC, an essential element of graduate education at Dartmouth is the experience gained in teaching other students, especially for the many graduate students who are pursuing academic careers. Therefore, at least one term of undergraduate teaching is required of all graduate students. Each student's program is arranged, according to his/her individual needs and interests, in consultation with the faculty advisor and the department. The requirement may be satisfied with one term of Physics 257 (Supervised Undergraduate Teaching) for the M.S. degree, or two terms for the Ph.D. Physics 256 (Instruction in Teaching for Graduate Students) is required for the Ph.D. Credit for the completion of both terms of Physics 256 is awarded upon completion of the second term.

Teaching Obligations

The academic year at Dartmouth starts with the summer term (in June). Advanced incoming students with three course transfers may be considered advanced by one year, with respect to both teaching obligations and financial support. Students with a teaching or grading assignment in any given term must register for Physics 257, even if the course requirement has been met. This course is graded HP/P/LP/NC. As with other graded classes, if you receive a grade of NC you will be put on academic probation.

The teaching load is defined in terms of a unit corresponding to a maximum of 200 hours per term. A one-term laboratory or recitation teaching assignment will normally rate one unit, a grading assignment for a small class one-half unit.

Teaching duties will be made in accordance with the department's instructional needs. During the spring term, students will be asked about teaching/grading preferences for the coming year. This is your opportunity to request specific courses. It cannot be guaranteed that all wishes will be met, but an effort will be made. When a student is assigned to a course, it is that student's responsibility to seek out the professor in charge and to find out from him or her what the specific duties are. General questions regarding teaching obligations should be addressed to the Graduate Advisor of the department (or someone designated by the Chair). Assignments are made on a term-by-term basis, rather than the full year. This process allows us to better know needs based upon actual course enrollments. Concerns on the part of the professor or TA should be discussed with each other as soon as a problem arises. If a reasonable resolution is not achieved, the Graduate Advisor is available to mediate.

Teaching Fellows who receive a regular stipend plus a tuition scholarship will normally teach two units in their first year, three in their second year, and two and a half each year thereafter.

Research Assistants, and other students who receive only a Tuition Scholarship from Dartmouth funds, with either no stipend or a stipend from other sources, will normally teach one unit in their first year, and one half each year thereafter. Graduate Students whose full support (stipend plus tuition) comes from outside sources (e.g., NSF

Fellowship, employment, private funds) will have no teaching obligation once the degree requirement has been met (as indicated above).

7. RESEARCH ADVISORS AND RESEARCH COMMITTEE

Research Advisor

You should find a research advisor (at least provisionally) by the spring term of your first year so you can make plans to be engaged in research during the summer term. This means that you must think about the choice of a research area well before then. Most students are uncertain about this choice when they arrive in the fall. However, you will develop a feeling for the research areas by attending colloquia and seminars, attending student presentations such as research proposals and theses defenses, talking with graduate students and faculty about their research, taking one or more of the introductory "specialty" courses such as High Energy Astrophysics (Astronomy 74, tentatively renumbered Astronomy 174), Introductory Plasma Physics (Physics 68), and Introductory Condensed Matter Physics (Physics 73). As you develop a preference for a research area, you should talk with individual faculty members in that area before reaching a final decision and asking someone to serve as your research advisor. If you reach a decision early, you are certainly welcome to acquire a research advisor and even to begin research prior to the spring term, if you so desire. Students entering with Masters' degrees are particularly encouraged to accelerate this process.

Second-year Review

In early spring of your second year, the departmental faculty will review your progress in all areas, including preliminary research progress. If your progress appears commensurate with the Ph.D. degree requirements, you will be directed to form a Ph.D. research committee. If your progress is insufficient, you may be directed to work toward the completion of a Masters' degree by the end of your second summer.

M.S. Research Committee

Students who fulfill the M.S. culminating experience with significant co-authorship of a publication submitted to a refereed journal or refereed conference proceedings, must form a research committee. The role of the committee is to assess your work, oversee the public defense of your research, and to make recommendations to the Graduate Curriculum and Policy Committee regarding the fulfillment of requirements and awarding of the M.S. degree. The committee consists of three full-time faculty members. An external member is not required.

Ph.D. Research Committee

Your Ph.D. Research Committee consists of two full-time faculty members in addition to your department advisor, at least one of whom must belong to this department. You should select these two additional members in consultation with your advisor, who then recommends them to the Dean of Guarini School of Graduate and Advanced Studies, from whom the official appointment must come. Your research proposal (next subsection) will be presented to this committee. The role of your committee is to

monitor your research progress and to provide advice directly to you. Its more formal obligations are to make recommendations to the Graduate Curriculum and Policy Committee regarding the acceptance of your research proposal, your advancement to Ph.D. candidacy, and eventually on the acceptance of your Ph.D. thesis itself. Students are required to meet with their committee at least once per year between the time of their thesis proposal and their defense. The yearly progress report meeting can take whatever form the advisor deems appropriate (short presentation, informal discussion), but requires that the student, the advisor and the in-house members of the committee all be in attendance. It is the responsibility of the student to arrange each meeting and deliver a completed confirmation sheet within one week of the meeting. Confirmation sheets are available on the department's website or from the department office. This review should be scheduled during the first half of the spring term; a student may, at the discretion of the Graduate Curriculum and Policy Committee, be put on probation for not scheduling these reviews in a timely fashion.

Ph.D. Thesis Committee

Prior to the presentation and public defense of your Ph.D. thesis, you must augment your research committee by the addition of one full-time faculty member, thus forming your thesis committee. The Ph.D. examination committee consists of a minimum of three full-time Dartmouth Faculty members of which a minimum of two must be from the student's graduate program (including the dissertation advisor) as well as an external member with a faculty-equivalent research appointment outside of Dartmouth. The external member may participate in meetings in person or via videoconference. The responsibility of this committee is to judge your written thesis and your oral defense (see part 8 of this section). Your research advisor must recommend this committee to the Dean of Guarini School of Graduate and Advanced Studies, who makes the official appointment. The appointment form is available on the department's website or in the department office.

M.S. Thesis Committee

Some students write a terminal M.S. thesis at Dartmouth, and some write a Masters' thesis en route to the Ph.D., although it is more typical to skip this step and proceed directly to Ph.D. candidacy. Prior to the presentation of your M.S. thesis, you must have a thesis committee consisting of three faculty members including two from this department (one of whom is your research advisor), and one member from outside. Your research advisor must recommend this committee to the Dean of Guarini School of Graduate and Advanced Studies, who makes the official appointment. The appointment form is available on the department's website or in the department office.

8. RESEARCH PROPOSAL AND STUDENT SEMINARS

Research Proposal Presentation

The student must, with the help of his/her advisor, formulate a research proposal plan and assemble an examination committee. The committee, which should eventually comprise the Ph.D. Thesis Committee, must consist of three faculty members including

the research advisor. The external Ph.D. examiner need not be present for the research proposal.

Prior to the presentation, the student must complete and submit a Ph.D. Thesis Proposal Application (available on the department's website or in the department office). Submission of this form officially notifies the Department of Physics and Astronomy of the student's intent to attempt the Ph.D. Thesis Research Proposal. This form is to be completed and submitted to the Physics and Astronomy Department office no later than the last working day before April 15 in the spring quarter of the student's third year (second year for advanced incoming students). The application must include a one-page description or abstract of the intended research. The student must then deliver the thesis proposal paper to his/her committee at least five working days prior to the thesis presentation date. The thesis proposal paper is typically 10-15 pages in length, double-spaced, and must include a cover sheet. The faculty will also be notified of the thesis presentation at least five working days prior to the thesis presentation date.

The examination must consist of a seminar-style technical presentation (~45 minutes in length) that is open to all faculty and research associates, as well as a list of graduate students invited by the advisor. Following open questions, the audience apart from the committee will be excused and the examination will continue. The thesis committee will examine the student to determine his/her preparation and planning for research, knowledge of the field, as well as general physics or astronomy knowledge. The committee can recommend pass, fail, or provisional pass with recommendations.

If the student passes, he/she must then submit a copy of the thesis proposal with the committee's signed cover sheet **to the department office within two weeks of the thesis presentation.**

If the student provisionally passes with recommendations, and the committee determines the proposal requires some revisions, then the thesis advisor must notify the student in writing of these deficiencies and the necessary revisions. This letter must be sent to the student within one week of the thesis presentation and must include a firm deadline for completion of these revisions. A copy of the letter must be sent to the Graduate Curriculum and Policy Committee and the department office.

If the student fails, then the student may make up to one further attempt at the thesis proposal.

The Ph.D. Thesis Proposal must be attempted by May 15th of the spring term of the third year in residence (second year for advanced incoming students) and must be passed by the end of the fall of the fourth year in residence (third year for advanced incoming students). Any request to delay the thesis proposal must be made in writing to the Graduate Curriculum and Policy Committee no later than the last working day before April 15 of the third year in residence (second year for advanced incoming students).

If any deadlines are missed, the student must petition the Graduate Curriculum and Policy Committee in order to remain in good standing.

If you have any questions, please speak with your advisor or the Graduate Chair.

Ph.D. Candidacy

Receipt of your signed proposal notifies the Graduate Curriculum and Policy Committee that your Thesis Proposal has been successfully completed. If by this time you have also passed the Ph.D. Qualifying Exam, and your graduate course work has advanced satisfactorily, then you will be eligible for Ph.D. candidacy. In this event, the Graduate Curriculum and Policy Committee will make a formal recommendation to this effect, which will be voted upon by the full department faculty.

Student Seminars

Once you have been admitted to Ph.D. candidacy, you have passed all major hurdles except for the completion of your research and the preparation and presentation of a thesis. During the ensuing period of research, most students find it useful to present seminars on their research. Although such presentations are not compulsory, there are several benefits. The main benefit to you is the feedback you get from your student and faculty colleagues, which accelerates your progress and makes the research experience more meaningful. Other benefits include the experience of presenting difficult material in public and helping to introduce beginning students to the research life of the department.

In addition to public seminars it may prove useful to give an occasional oral progress report to your research committee. Your committee may request such a report at any time. You are expected to meet with your committee in some format at least once per year between proposal and defense (page 24).

9. THE THESIS

You should try to develop independence as a researcher during the course of your thesis research. This goal is not inconsistent with continually seeking appropriate forms of advice from your research committee and other colleagues in the department. The advice of your committee can be especially important in helping you draw conclusions from your research and in planning the writing of a thesis. The thesis should be more than a description of what you did and what results you got. It is a scholarly work, and as such it should present your contribution in the context of the developing knowledge of your field. You should discuss thoroughly the significance of your results, which is frequently deeper than it appears at first sight, and usually not fully appreciated until after considerable discussion with others, especially with your thesis committee.

Preparation and Presentation (These remarks apply to both Masters' and Doctoral theses)

As soon as you have confirmed a defense time and date with all of your committee members, see Tressy about your preferred room. Sooner is better than later. Your first choice of room may not be available so the earlier you contact her about reserving, the better chance you have of getting your first choice.

Instructions are available from the Guarini School of Graduate and Advanced Studies office for the preparation of the thesis manuscript, as well as online at

graduate.dartmouth.edu/support/academic-support/writing-support - scroll to the bottom and click on thesis guidelines.

Be sure to review these guidelines carefully before finalizing your document. The Department does not pay for thesis preparation, but copies for distribution to thesis committee members can be made on the departmental copier at no charge. Copies should be distributed to your thesis committee **at least a week prior to your public presentation**. Tressy circulates an announcement of your defense at least one week prior to the presentation, so be sure to see her at least 10 working days prior to your presentation with your title and abstract. The public presentation should last about 45-50 minutes and should be appropriate for a general scientific audience. Immediately following this presentation, you will meet privately with your thesis committee for questioning. Invariably, even if you successfully defend your thesis, the committee will make suggestions for improving the manuscript. After you attend to these corrections and suggestions, the revised thesis must be approved by the committee and the cover sheet signed. A copy of your signed cover sheet is required to complete the certification. *Please bring the cover sheet to the Department Office two full working days prior to your planned thesis submission date. Finally, you are responsible for submitting the thesis to the Graduate Office.* Online submission instructions are located here: (graduate.dartmouth.edu/academics/graduate-school-forms/thesis-and-dissertation-forms).

Well, there you have it. The thesis presentation is the culmination of a challenging, intense, and rewarding learning experience. We wish you the best of luck as you embark upon this journey.