

MIT Department of Physics

Graduate Program

GUIDELINES FOR PHYSICS DOCTORAL CANDIDATES

August, 2009

INTRODUCTION

This document describes the doctoral program in the Physics Department. It supplements the Graduate Students Office Policies and Procedures which outline the general Institute requirements and are available on the web at <http://web.mit.edu/gso/gpp/index.html>.

The primary goals of the graduate program in physics at MIT are to solidify and broaden your knowledge of physics, to teach you how to do research, how to identify important problems and how to communicate scientific information effectively. In short: how to become a professional physicist and a productive member of the scientific community.

The steps involved in accomplishing this are described here. Please forgive the somewhat bureaucratic tone of the material, but experience has shown that it is helpful to have every aspect of the graduate program spelled out clearly in one document.

THE PHYSICS GRADUATE PROGRAM

The physics graduate program is under the direction of the Physics Education Committee, which includes members with the following graduate responsibilities:

Professor Thomas Greytak, Graduate Student Coordinator, Graduate Officer
Professor David Litster, Graduate Career Counselor
Professor John Negele, General Examination and Requirements Coordinator
Professor Christoph Paus, Graduate Appointments Coordinator
Professor Krishna Rajagopal, Associate Department Head for Education
Dr. Sean Robinson, Academic Administrator
Professor Vladan Vuletic, Graduate Admissions Officer

The staff in Academic Programs, Room 4-315, can direct you to committee members most appropriate to your specific questions or concerns. All graduate students and faculty are assigned to one of the Department's four research divisions. Each division is headed by a faculty member with responsibilities in aspects of the graduate program relevant to the division's students. The current Division Heads are:

Professor Deepto Chakrabarty, Astrophysics
Professor Patrick Lee, Atomic, Bio-, Condensed Matter, and Plasma Physics
Professor Edward Farhi, Theoretical Nuclear and Particle Physics
Professor Peter Fisher, Experimental Nuclear and Particle Physics

All of the forms referenced in this document are available in 4-315 or on the Physics web page at <http://web.mit.edu/physics/graduate/current/curdocguide.html>. Professor Krishna Rajagopal serves as the advisor for student concerns about scientific misconduct issues including interactions with research supervisors, data integrity, and authorship. In addition, [Physics REFS](#) can provide mediation services between student peers and/or faculty members and Dr. Sean Robinson, Academic Administrator, can be helpful in dealing with sensitive issues.

Upon entering the Department, every student is assigned an academic advisor. Under most circumstances this faculty member will continue to advise the student until graduation. Later, when the student joins a research group, another faculty member will become his or her research supervisor. Thus, for most of their time in the Department, students have two separate faculty members to whom they can turn for help and advice. Throughout this document, “advisor” refers to the academic advisor. The term “supervisor” is associated with the research or thesis supervisor, even though this person is often colloquially known as the “thesis advisor”.

TYPES OF FINANCIAL SUPPORT

Students with a Research Assistantship (RA) or Teaching Assistantship (TA) are expected to spend full time on education and assigned duties and may not engage in any other activity for compensation without the specific approval of the Department Head. Graduate assistants are required to register for an academic load of 36-48 units (which may include Special Problems, Thesis Research or Physics Teaching) during any term (including summer) in which they have any form of MIT or Departmental support. In addition to course work, students doing research should always register for Special Problems (8.391 in the fall and 8.392 in the spring or summer) or, after turning in a thesis proposal, Thesis Research (8.THG). The number of units will vary between 12 and 48 according to the approximate number of hours per week spent on research. This gives students academic credit for their research work. Teaching assistants may register for 12-48 units of Physics Teaching (8.399). In this way, TAs also receive credit for teaching. Under most circumstances, the normal course load for graduate students with a full-time RA or TA is two academic subjects.

The current stipend rates for RAs and TAs are available in Academic Programs. For both RAs and TAs, full tuition and health insurance is paid over and above the stipend. If a student loses RA support due to termination of a research contract, the Department will provide support for one additional term (in the form of a TA) and will make every effort to provide an alternative form of continuing support.

The periods for RA appointments are as follows: Fall: September 1 to January 15; Spring: January 16 to May 31; Summer: June 1 to August 31.

RESEARCH ASSISTANTSHIP

These appointments are generally for the academic year, plus the summer. The amount of time a student spends on RA duties depends on the amount of course work he or she needs and on the requirements of the group in which he or she works. For new graduate students taking classes and preparing for the general examination, research duties normally require 20 hours per week or less. After two to three years, research usually becomes full-time.

TEACHING ASSISTANTSHIP

Some TA appointments are available during the fall and spring terms. These appointments involve teaching sections in a course or lab, tutoring, or grading homework and exams. This work requires up to about 20 hours per week in addition to any research or class work the student is doing.

Some first year graduate students are supported by a nine-month (fall and spring) TA appointment. Although the Department cannot guarantee employment during the subsequent summer for these students, in the past virtually all have been able to find summer RA appointments in a Physics Department research group or obtain a summer externship in industry or in a national laboratory. Students who have a TA in their first year normally join a research group and are supported by an RA in subsequent years.

TA appointments are typically made after the first year. These appointments are used to encourage students who wish to hone their teaching skills, to help alleviate funding pressures on the faculty, to facilitate a student's transition to a different research group, or to support departmental teaching needs. Each of the four divisions in the department has been assigned a guaranteed number of TA positions. In the Spring, each division compiles a list of students to be funded by TA appointments in the subsequent academic year. This list is submitted to the department for approval. Thus, students who desire TA support after the first year must inform their research supervisor, who will forward this information to the Division Head. If, after the divisions have submitted their TA lists to the Department, additional TAs are needed, the Department will solicit applications from the physics graduate student population as a whole.

FELLOWSHIPS

Fellowships are full time positions, unless specifically exempted by the Department Head. A student entering the Department with a fellowship has a great deal of flexibility in planning his or her graduate program and in seeking out a research group. However, fellowship recipient is responsible for finding a research group that will provide funding upon expiration of the fellowship support. Some information on fellowships for graduate students in physics is available in Academic Programs, 4-315 and the Graduate Students Office, Room 3-134.

SWITCHING GROUPS

Many students continue through from their first RA to a thesis in the same group. Others, however, elect to change research groups. An RA who does not wish to continue research in his or her group, or who simply wishes to investigate other possibilities, should not hesitate to talk to other professors about different opportunities. However, students are responsible for notifying their current supervisor of their intention to leave a group. Students are expected to work in the research group as long as it is providing funding. In order to facilitate the transition from one research group to another, each student is guaranteed one semester of transitional funding in the form of a TA. Once the decision has been made and approved to switch groups, the student should complete a [Research Supervision Form](#) or [Research Co-Supervision Form](#) and submit it to Academic Programs, 4-315, as soon as possible.

SATISFACTORY PROGRESS

Satisfactory academic progress involves passing the three parts of the General Exam on time (see the timetable on Page 5), completing the subject requirements in the specialty area, and satisfying the breadth requirement. The Dean for Graduate Students, in conjunction with the Department, may issue academic warnings to graduate students who maintain a cumulative grade point average of 3.5 or lower or whose unit load for any given term is below 36 units.

Satisfactory progress in research is more difficult to define since Ph.D. research does not follow a rigid time schedule and each professor has his or her own approach. Certainly satisfactory progress includes completing assigned RA or TA duties competently and on time. More importantly, a student is expected to take responsibility for a specific project, both solving the day-to-day problems and mustering the vision,

ingenuity and skills necessary to bring the project to completion. By meeting regularly, the student and research supervisor can agree on the scope of the thesis project and establish a reasonable schedule for milestones along the way. Students should maintain close contact with their research supervisor and make known as early as possible any dissatisfaction with their projects, or any desire to leave the group. Students having difficulty communicating with their research advisor or having concerns about their position should meet with their academic advisor or Dr. Sean Robinson, Academic Administrator, to discuss the situation.

Many of our graduate students continue through to a Ph.D. in the group they first enter. Others change to another group that is a better match to their interests and abilities before completing their thesis. Only a very few students have difficulty finding the correct match. Several policies have been established to protect the interests of these students, and to help them make appropriate career decisions.

A student's first period of work with any given faculty member is considered to be a "trial period" with no obligation by either party to continue the arrangement for a subsequent term. Of course the student may decide to change groups, or request a transitional TA, at the end of any term. If so, he or she must give four weeks notice to the group leader and Division Head. Before deciding to discontinue funding after a trial period the faculty member must discuss any issues of concern with the student. The faculty member must notify the student of his or her intention to discontinue funding at least six weeks before the term ends. In special cases where a research area has made a prior written commitment to provide a full academic year of research support for an incoming student, the area will offer an alternative second semester RA to a student whose first semester RA has been terminated.

If, in any term beyond the first with a given group, a faculty member believes a student's performance as an RA is unsatisfactory, he or she must write a warning letter to the student explaining clearly why the performance has been unsatisfactory and stating the conditions that must be met to avoid termination of support at the end of the term. The letter should be approved in advance by the Division Head and sent to both the student and the academic advisor. In order to give the student time to make the changes justifying continued support the following dates will apply.

	Warning delivered by	Decision made by
Fall term	October 1	Last day of Fall classes
Spring term	February 15	Last day of Spring classes
Summer term	June 1	August 15

In the event that a student whose funding has been terminated is not able to secure another research position prior to the start of the next semester, the Department will guarantee one term of support as a transitional TA. If the termination of an RA occurs at the end of the spring semester and the student is unable to find other support for the summer, the Department will make an effort to find some form of summer support for the student. The one semester transitional TA would then be available in the fall, if needed. Students have a responsibility to continue working in their research group as instructed by their research advisor as long as they are being supported. Questions about this process should be directed to Dr. Sean Robinson, Academic Administrator.

If differences arise between the research supervisor and the student concerning the interpretation of "unsatisfactory performance", the problem should be brought to the attention of the student's academic advisor, Division Head, or the Graduate Committee. Committee members are willing to discuss, in private, problems encountered by either the student or the research supervisor before formal action takes place. Additional resources are listed on the front page of this document.

ACADEMIC ISSUES

DEGREE PROGRAMS

The normal degree program in the Department leads to a Ph.D. in Physics. Only in special cases (e.g., US military officers) are students admitted to pursue a Masters degree in Physics. Sometimes a student admitted for a Ph.D. may desire a non-terminal Masters degree en route to the Ph.D., or decide not to follow the Ph.D. program through to completion, or may fail the General Exam. In these cases the student may be able to satisfy the requirements for the Masters degree.

REQUIREMENTS FOR THE MASTERS DEGREE

Masters candidates must complete 66 units, 42 of which must be “H” level subjects. A thesis is required; however, an oral thesis defense is not required. The thesis will be assigned a grade by the research supervisor in consultation with the thesis committee.

REQUIREMENTS FOR THE PH.D.

The specific requirements for the Ph.D. are:

- Passing the General Doctoral Examination
- Specialty Requirements
- Breadth Requirements
- Written Thesis and Oral Defense

ADVISING AND REGISTRATION

Each fall and spring term students must meet with their academic advisor to complete their registration. Summer registration is processed by the Academic Administrator. To make a subject change after registration day, students should use the Institute Add/Drop Form, available in the Student Services Center (11-120) or in Academic Programs (4-315). The subject’s instructor must sign the form if a subject is being added and, in all cases, the form requires an academic advisor’s signature. To avoid late charges and the need to petition a change through the Dean of Graduate Students, students should be sure to change their registration before the Registrar’s deadlines. The Add date is about five weeks into the term and the Drop date is about three weeks before the last day of classes. Pre-registration for all terms is done on-line via [WebSIS](#).

TIMETABLE OF PROGRESS TOWARD A PH.D. +		
YEAR	TERM	DEADLINE**
1 st	Fall*	Part I General Exam: First Attempt
	Spring*	
2 nd	Fall	Part I General Exam: Final Attempt
	Spring	Part II General Exam: Deadline for First Attempt
3 rd	Fall	Part II General Exam: Final Attempt
	Spring	Part III General Exam: Deadline for First Attempt
4 th	Fall	Part III General Exam: Final Attempt Thesis Proposal Due: must be registered for 8.THG this term
	Spring	
5 th		
6 th		Mean time to Ph.D. is 5.8 years.

+This timetable is effective for students entering in June, 2001 and later. Students entering before this date should consult the Doctoral Guidelines dated August 2000.

*Students who enter in February should invert the fall and spring terms in this table (i.e., Part I first attempt is in the spring term of the 1st year).

**If delays or postponements are needed, contact the General Exams Coordinator for the General Exams or the Graduate Student Coordinator for the Thesis Proposal. See applicable sections in these Guidelines for detailed procedures.

CHOOSING FIRST YEAR SUBJECTS

The Department does not require students to take any subjects other than those needed to satisfy the specialty and breadth requirements described below. However, many students begin by taking some combination of graduate Quantum Mechanics (8.321 and 8.322), graduate Electricity and Magnetism (8.311), and graduate Statistical Mechanics (8.333). These subjects are proven to give students a broad view of basic physics as well as a foundation for preparing for Part II of the General Exam. First-year students concerned with the level of their undergraduate preparation (in this regard Part I of the General Exam is a useful diagnostic tool) are encouraged to take senior level undergraduate subjects such as Electricity and Magnetism (8.07), Statistical Mechanics (8.08) and Classical Mechanics (8.09). Some first-year students may wish to sample basic graduate subjects in specialty areas: Atomic and Optical Physics (8.421 or 8.422), Solid State Physics (8.511), Systems Biology (8.591J), Plasma Physics (8.613J), Introduction to Nuclear and Particle Physics (8.701), and Astrophysics (8.901 or 8.902). These subjects may later be counted towards one's specialty or breadth requirements. While planning their first year program, students should keep in mind that the normal load for those with full time RAs and TAs is two academic subjects, or about 24 units.

GENERAL DOCTORAL EXAMINATION

During the first three years of graduate study students must demonstrate a mature grasp of the whole field of physics and detailed knowledge of their chosen area of physics. Students should discuss their plans for preparing for the examination with their research supervisor and academic advisor.

The purpose of the general examination is to assure the Department that its graduates have a broad background in physics and a firm understanding of a particular branch of physics. The format is based on the premise that it is valuable for each student to review his or her general knowledge of physics in a systematic fashion and to measure it against a set of “community” standards. The examination is given in the Fall and Spring terms and consists of two written parts and one oral part.

STRUCTURE AND SCHEDULING OF THE EXAMINATION

The general examination consists of three parts. Part I and Part II are five-hour, written examinations. Part III is an oral exam. It is approximately two hours long.

Parts I and II are given prior to the first week of each term. Students may take Part I and Part II in the same term. Applications for Part I and Part II must be submitted to Academic Programs one week prior to taking the exam. The questions for each part of the exam are prepared by committees of physics faculty members. The questions are subsequently screened by faculty who are assigned to grade each part of the exam. Copies of at least three Part I and II exams are available at <http://web.mit.edu/physics/graduate/current/samplegen.html>. In addition, copies of Parts I and II from a number of previous years, and their solutions, are available for reference in the Physics Reading Room, 4-332.

A committee of three faculty members administers the oral portion of the general examination during the second half of each term. The oral is in the student’s general field of research, and only a minor portion of the exam concerns the student’s specific research topic. By the middle of the term, the General Examination and Requirements Coordinator identifies oral exam committees in each research area. The Academic Programs office subsequently notifies the student of his/her committee members. The student is responsible for scheduling the exam with the committee and notifying Academic Programs of the exam day, time, and place.

*Please note that all timelines noted below are effective for students entering on or after June, 2001. Students entering prior to that date should consult the Doctoral Guidelines dated August 2000.

PART I

Part I attempts to measure a student’s general level of understanding, physical insight, ability to get to the essence of a question, intuitive grasp of orders of magnitude and proper approximations, and knowledge of basic facts. Part I typically consists of 20 short questions covering a broad range of physics. The questions are at the level of those encountered in undergraduate physics subjects at MIT. This is a five-hour written examination. The first attempt at Part I must take place at the beginning of the student’s first term at MIT. One faculty member, with a working knowledge of the Part I exam and of our undergraduate offerings, will meet with students who fail to pass or who marginally pass the Part I exam. This faculty member will advise the students on which undergraduate subjects to take in order to strengthen their preparation for our graduate subjects. If at this point a student agrees to take two or more of the undergraduate subjects 8.05, 8.06, 8.07, 8.08, and 8.09 during the first year, the department will stretch out his or her satisfactory progress calendar by one term. This advice will be communicated to the student's academic advisor with the understanding that it is the Department's strong recommendation. Part I must be passed by the first term of the second year with a maximum of three attempts. Failure to take Part I on schedule without prior

approval from the Requirements Coordinator counts as a failure. Passing of Part I is decided by the Graduate Committee. If a student does not pass Part I by the beginning of the second year, a committee consisting of three faculty members gives the student a special oral exam. The student's research supervisor may attend but will not participate. The special oral is generally scheduled within a few weeks after notification of failure.

PART II

Part II is also a five-hour written examination. The General Examination Committee for Part II prepares a set of eight questions, more detailed and advanced than those of Part I. They cover the general areas of Classical Mechanics, Quantum Mechanics, Electromagnetic Theory, and Thermodynamics/Statistical Mechanics. The student is required to do only one of the two questions in each of the four general areas. The material covered is at the level of our first year graduate subjects and the textbooks they use. However, the student should not expect a one-to-one correspondence between the content of those subjects and the material tested on the exams. Some topics are so well treated in standard textbooks that it would be wasteful to cover the same topics in a classroom setting. On the other hand, lecturers are free to cover special topics of high current interest or topics for which they have a unique insight. Such material, while enriching the students' understanding, would not be appropriate on a Part II exam.

Two attempts of Part II are permitted. Part II of the general examination must be attempted no later than the second term of the second year. If the first attempt of Part II is earlier than the middle of the second year, the second attempt, if necessary, must be made within one year. If the first attempt is in the second term of the second year, the second attempt, if necessary, must be made in the subsequent term. Therefore, in effect, Part II must be passed by the first term of the third year, with a maximum of two attempts. Passing of Part II is decided by the Graduate Committee. Passing of the exam will be based on the student's performance on the exam as a whole. The student will not be passed on one area and failed in another. A student who does very well in three problems, but very poorly on the fourth will fail. However, in this case the student will be given the option on the next exam of doing both problems in the weak area, and no others, in half of the normal time. Students who fail an exam will be informed if they are eligible for this option. Students wishing to exercise this option must inform the department when they apply to take the next exam. Failure to take Part II on schedule without prior approval from the Requirements Coordinator counts as a failure. If a student fails a second time, a committee consisting of three faculty members gives the student a special oral exam on the material of Part II. The student's research supervisor may attend but will not participate. This special oral is given during the same semester and is generally scheduled within a few weeks after notification of failure.

ORAL EXAMINATION

The purpose of the oral portion of the general exam is to test students' broad general knowledge within their field. The student's field is determined by that of their research supervisor. (Students with supervisors outside of the department will be examined in the research field of the co-supervisor. For the purpose of the Oral Exam, the co-Supervisor will be considered the "research supervisor" in the committee structure outlined below.) Study guides in the various fields of physics are available in Academic Programs. They contain information outlining what to expect on the oral examination. The designated Committee Chair for each field will host a meeting of examinees at the start of each term to review exam expectations. The first question will be in the student's specific area. The student's committee chair will provide this question at least one week prior to the examination. Under normal circumstances, the chair will ask the research supervisor to suggest a question to be used for this purpose. The oral examination will continue in the student's general field. Discussion of a student's research, when applicable, will comprise no more than the final quarter of the examination.

The oral exam committee consists of the chairperson and two other faculty members. Each research field (there may be several within a given division) will appoint one committee each year to examine all students within that field. If a student's research supervisor is a member of the standing committee, he or she will be replaced by an alternate faculty member for that exam only. The research supervisor may observe the exam and provide input if solicited by committee members. The supervisor and student will be asked to leave the examination room when the final decision is discussed. The oral is to be taken after the first attempt at Part II, but no later than the second term of the third year. Two attempts are permitted with the second attempt, if necessary, scheduled in the subsequent term. (If the subsequent term precedes the third year, a student may postpone the second attempt until the beginning of the third year.)

Currently, oral exam committees are formed in each of the following fields:

Astrophysics	Nuclear and Particle Experiment
Atomic and Optical Physics	Nuclear and Particle Theory
Biophysics	Quantum Information
Condensed Matter Experiment	Plasma Physics
Condensed Matter Theory	

POSTPONEMENTS

Postponements for taking any part of the general examination are granted only under unusual circumstances. Requests for postponement of Part I or Part II must be submitted one month prior to the exam. Requests for postponement of the Oral portion must be submitted by September 30th for the fall term and by February 28th for the spring term. A request to postpone any portion of the general examination must be made in writing (e-mail is acceptable) to the research supervisor. The request must include a clear justification. The research supervisor will add comments and forward the request to the General Examination and Requirements Coordinator. A student with no research supervisor should submit the request through his or her academic advisor. Appeals should be addressed to the Associate Department Head for Education, who will consult with appropriate faculty members when reviewing the case.

EVALUATION PROCEDURE

The Part I and Part II examinations are graded by physics faculty. The Graduate Committee meets to review the results and determine who passes and who fails. There is no fixed percentage of students who pass, nor is there a fixed passing score. The difficulty of the examinations varies somewhat from year to year, and this is taken into account. For a given exam there is a range of grades that clearly indicates a passing performance. Similarly, there is a range of grades that clearly indicates failure. The exams of students with grades between these limits are reviewed in detail by members of the Committee. If a student is repeating an exam, the earlier performance is taken into account.

A student who ultimately fails any part of the general examination will be asked to withdraw from the Ph.D. program, with the option to pursue a Master's thesis. Appeals should be addressed to the Associate Department Head for Education, who will consult with appropriate faculty members when reviewing the case. To reenter the Ph.D. program the student must submit a Master's thesis, then apply for readmission.

SUBJECT REQUIREMENTS

SPECIALTY SUBJECTS

Students are required to take two basic one-semester subjects in their research specialty (three in Nuclear and Particle Theory). These subjects are central to the research area and it is advantageous to complete

them as early as possible. The specialty subjects in the various fields are listed below and each must be passed with a “B-” or better. Substituting for any of the following subjects requires a request in writing (or e-mail) to the appropriate Division Head. After commenting, the Division Head will forward the request to the General Examination and Requirements Coordinator who will send notification of the decision.

Astrophysics

8.901, 8.902 Astrophysics I, II

Atomic and Optical Physics

8.421, 8.422 Atomic and Optical Physics I, II

Biophysics

8.591 Systems Biology

and one of the following:

8.592 Statistical Physics in Biology

8.593 Biological Physics

Condensed Matter Physics

8.511, 8.512 Theory of Solids I, II

Experimental Nuclear Physics

8.701 Intro to Nuclear and Particle Physics

8.711 Nuclear Physics

Experimental Particle Physics

8.701 Intro to Nuclear and Particle Physics

8.811 Particle Physics

Nuclear and Particle Theory

8.325 Relativistic Quantum Field Theory III
and, as appropriate, two of the following

8.334 Statistical Mechanics II

8.962 General Relativity

8.952 Particle Physics of the Early Universe

8.821 String Theory

8.831J Supersymmetric Qntm Field Theories

8.841 Electroweak Interactions

8.851 Strong Interactions

8.701 Intro to Nuclear and Particle Physics

Plasma Physics

8.613J, 8.614J Introduction to Plasma Physics I, II

Quantum Information

Consult Prof. E. Farhi

BREADTH SUBJECT REQUIREMENTS

To enrich knowledge about physics outside of one's own research field, students must complete two breadth requirement subjects. At least one of these must be from the list below. Both must be passed with a grade of "B-" or better.

	BREADTH REQUIREMENT	Atomic	Biological	Condensed Matter	Plasma	Astrophysics	Nuclear Exp.	Particle Exp.	Nuclear Theory	Particle Theory
SUBJECT NUMBER	SUBJECT TITLE									
8.251	String Theory for Undergraduates								2	x
8.323	Relativistic Quantum Field Theory I						2	2	x	x
8.421 or 8.422	Atomic and Optical Physics I & II	x		2						
8.511	Theory of Solids I	2		x						
8.591	Systems Biology		x							
8.592	Statistical Physics in Biology		x							
8.613J	Introduction to Plasma Physics				x					
8.701	Introduction to Nuclear and Particle Physics						x	x	x	x
8.711	Introduction to Nuclear Physics						x	2	x	2
8.811	Particle Physics						2	x	2	x
8.901 or 8.902	Astrophysics I & II					x				
8.962	General Relativity					x				x

X indicates the subject is not allowed as a breadth requirement for students in this area

2 indicates the subject may be used as the second breadth requirement for students in this area as long as they also take one of the unmarked subjects

If only one breadth requirement is taken from this list, students may request approval of a second course that is not on the list if it genuinely satisfies the two stated objectives of the breadth requirement: 1) learning about physics and 2) being outside the student's research field.

To request approval for a course, a student should write a short but clear email or letter explaining why the course satisfies these two objectives. If the course is in another department, the message should tersely explain on the basis of the course description or curriculum, why it should be considered learning about physics. The student should also succinctly state his or her research specialty and thesis topic, and explain why the course should be considered as being outside this research area. A short paragraph is sufficient to convey the necessary information.

The student should send the request to his or her academic advisor and, if necessary, discuss and modify the content to obtain the advisor's approval. The advisor should then forward the request, with his or her approval, to the General Examination and Requirements Coordinator who will send notification of the decision.

RESEARCH

Most graduate students are supported by Research Assistantships. RAs become involved in a research project as soon as they begin their assistantship, and this often leads to a thesis topic. TAs, Fellows, and self-supporting students who are not involved in research should look for a research group during the first year. Prior to thesis research, students get academic credit for their research by registering for Special Problems (8.391 or 8.392), which is generally taken every semester that research is conducted until thesis research formally commences. Starting with the semester in which the thesis proposal is submitted (see section titled "Thesis"), registration changes from Special Problems to Thesis (8.THG). While many students stay with their first research group, some register for Special Problems in two or more research areas before finding a research topic suitable for a thesis. The Special Problem is graded on a Pass/Fail basis.

All graduate students conduct research that eventually leads to a thesis, but there are many different paths to gaining a research project. Students are expected to register for thesis and be assigned a thesis committee by the first term of their fourth year of graduate school (see section titled "Thesis").

RESEARCH SUPERVISION

Any person who holds a Faculty or Senior Research Scientist appointment in the Physics Department may serve as a research supervisor. Under special circumstances, a faculty member outside the Department may supervise a student (this includes other MIT departments or Physics Departments at other institutions). Prior to embarking on a research project with an outside supervisor, the student must obtain a Departmental co-supervisor. In consultation with the research supervisor, the student should find a Faculty member in the Physics Department who agrees to be the co-supervisor. The co-supervisor will maintain close contact with the research as it progresses and must ultimately co-sign the thesis. The student should submit a [*Research Co-Supervision Form*](#), which requires the signatures of the research supervisor and co-supervisor. This form must be completed and returned to Academic Programs. Any funding (i.e. RA) will not be administered by the Department of Physics until this form is submitted.

RESEARCH EXTERNSHIPS

To broaden the graduate experience, the Graduate Committee encourages physics graduate students to arrange an externship in an industrial or national laboratory at some time during their graduate career. Such externships may be scheduled during either summer or academic terms and can be used, with approval of the student's academic advisor, to satisfy one of the Departmental breadth requirements. Even if the externship is in the student's research field, it may be used to satisfy the breadth requirement. Externships may not be used to satisfy the specialty requirement. The Department recognizes that demands of MIT research may make it difficult for students to consider this opportunity, but it also believes that the benefits outweigh the possible conflict. Students seeking externships should discuss the issue with their research supervisor and schedule the externship to minimize disruption of research. Interested students should contact the Career Counselor and provide him with a curriculum vitae.

THESIS

PH.D. THESIS

Students must register for thesis and be assigned a thesis committee no later than the first term of their fourth year of graduate school. It is strongly recommended that students register for thesis in a term earlier than this final deadline. The first step is for the student and research supervisor to agree on a thesis topic. An initial [Graduate Thesis Proposal Cover Sheet](#) (available in Academic Programs or via the web) must be submitted to Academic Programs by the second week of the term. The form requires an initial thesis title, the name and signature of the research supervisor and the name of one reader for the thesis committee agreed upon by the student and supervisor. The student should register for 8.THG (reminder: the minimum number of combined units for all subjects in any particular semester should equal 36) beginning this term. A third reader from the physics faculty, who is not in the same research area, but whose interests, background, or special knowledge make him or her an appropriate member of the committee, will be assigned by the Graduate Student Coordinator. If there is a co-supervisor (see above), the thesis committee will consist of four people: research supervisor, co-supervisor, selected reader, and assigned reader. After notification of the final reader, the student will need to convene an initial thesis committee meeting no later than four weeks before the last day of classes.

At that meeting the student will make an oral presentation to the thesis committee of a detailed proposal for a research program that would subsequently become the Ph.D. thesis. The student should demonstrate a thorough knowledge of relevant literature, explain the significance of the research to progress in the field, and present a well thought out program of research including contingency plans, if appropriate. After that meeting, and based on the discussion, the student will develop a written proposal. The written proposal will consist of a one or two page description of the body of work that is to comprise the thesis. It will be due in Academic Programs near the end of the semester (a formal date will be determined each semester, but it will be approximately two weeks before the end of the term).

Subsequent changes in title, scope, supervisor(s), or readers may be made with the written approval of the Graduate Student Coordinator.

In some cases, the thesis research may be in a borderline field between physics and some other field of science or engineering. In these cases, a joint committee, including members of another department may be formed. This requires approval by the [Dean of the Graduate School](#).

Students who have not registered for thesis research or submitted a thesis proposal by the first term of their fourth year (see deadline dates listed above) must write a letter to the Graduate Student Coordinator explaining the circumstances leading to the delay. Similar letters must be submitted in each subsequent term the student is not registered for thesis. Graduate appointments will be renewed only for students who meet the thesis registration and proposal requirements unless the Graduate Student Coordinator approves an extension based on the circumstances described in the student's letter.

Subsequent to the initial oral presentation to the thesis committee, each student must make at least one substantial oral presentation of progress to the thesis committee every 12 months. The scheduling of this presentation is to be arranged by the student.

MASTER'S THESIS

Students pursuing a Master's degree are required to submit a written thesis. No oral defense is necessary. When work on the thesis commences, each student must submit a [Master's Thesis Proposal Form](#) with the proposed title of the thesis and the signature of the research supervisor to Academic Programs, 4-315. The student should begin registering for 8.THG immediately. A second reader will be assigned by the Graduate Student Coordinator and the student will be subsequently notified. Upon completion of the thesis, the research supervisor will submit a letter grade for the work to Academic Programs.

DEGREE LIST

Students may be recommended for their degree in any term. A student must submit an [Application for Advanced Degree](#) at the beginning of the term in which he or she plans to graduate, and **must be registered during that term**. Only the names on the degree list will be considered for degrees for that term. Those on the September and February degree lists may participate in commencement the following June. Reminder: as an advanced degree candidate, a student should register for thesis as long as he or she is doing thesis research, **including the summer terms**. No specified number of research units is required, although the combined number of registered units each term should not be fewer than 36.

THESIS ORAL DEFENSE

The thesis defense is primarily an oral presentation of the thesis research. In order that suggestions for revision from the thesis committee can be incorporated into the final version of your thesis, the defense should take place at least three weeks before the due date posted by the Institute. This oral is based on an acceptable draft of the thesis, which is provided to the thesis committee at least two weeks prior to the defense. What constitutes an acceptable draft should be discussed carefully with the thesis committee. At this time, the student should notify the Graduate Assistant in Academic Programs of the day, time, and place of the defense. The student is responsible for arranging the thesis defense. The defense is public and all members of the MIT community may attend. Notices are sent to all physics faculty. Immediately following the public presentation there will be a mandatory private session involving only the student and the thesis committee.

THESIS COPIES

After passing the thesis defense and incorporating the suggested changes, students must submit to Academic Programs: 1. two original copies on thesis archival paper with original signatures and 2. the completed form from the [Specifications for Thesis Preparation](#), with an abstract and title page attached. The student should determine whether or not the supervisor, fellowship sponsor, etc. require additional copies. Students should also be aware that a thesis archival fee will be charged to their student account. The Institute requires that this, and all outstanding charges, be paid before the final degree is approved. Details of the required thesis, abstract, and title page formats are provided in *Specifications for Thesis Preparation* <http://libraries.mit.edu/archives/thesis-specs/>, or at <http://web.mit.edu/gso/gem/ad/theses.html>. Care should be taken to follow the presented format. For advanced degrees submitted to the Physics Department, copyright is usually granted to MIT instead of retained by the student. The "Chairman" signature line on the thesis cover page should be that of Professor Krishna Rajagopal, Associate Department Head for Education. This signature is obtained by the Academic Programs Office after the student submits the thesis.

CAREER COUNSELING

Although the MIT Physics graduate program is primarily focused on training students for careers in physics research, you should be aware that the pursuit of an advanced degree in physics is an excellent preparation for a variety of careers, both in physics and in other fields. If you have questions, or if you need someone to talk to about your career, there are many people available and willing to help. Every incoming student is assigned an academic advisor with whom they can discuss their course schedule. Students in research groups have excellent resources in their research supervisor and other graduate students, and teaching assistants can talk to the professors for whom they are teaching. Students can also get advice from their course instructors. The Graduate Career Counselor is also an excellent resource for discussing career paths and options. The MIT Career Development Center (12-170) has a variety of resources for graduate students. Finally, the Physics Department maintains the mailman list 8careers@mit.edu to which employment opportunities of interest to physics graduate students are posted on a regular basis. Subscription to the list is controlled by visiting <http://mailman.mit.edu/mailman/listinfo/8careers/>.