Department of Physics

Guidelines for Physics Doctoral Candidates

[*Last updated September, 2025*]

The "Department of Physics Doctoral Guidelines" serves as the handbook of graduate policies and procedures. It contains academic information such as breadth and specialty requirements, General Exam information, timelines of satisfactory progress and thesis information. It also contains research information regarding funding, switching groups and other policies/procedures.

Department of Physics Doctoral Guidelines:

1. Introduction
2. The Physics Graduate Program
3. Types of Financial Support
4. Satisfactory Progress
5. Academic Issues
6. General Doctoral Examination
7. Specialty Subject Requirements
8. Breadth Subject Requirements
9. Research
10. Thesis
11. Career Counseling

1. INTRODUCTION

This document describes the doctoral program in the Physics Department. It supplements the Graduate Policies and Procedures, which outlines the general Institute requirements and is available on the web at https://oge.mit.edu/gpp/.

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

The major steps involved in your graduate career are described in the various sections here.

2. 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:

Prof. Scott Hughes, Associate Department Head

Prof. Mehran Kardar, General Examination and Requirements Coordinator

Prof. Christoph Paus, Graduate Appointments Coordinator

Prof. William Detmold, Graduate Student Coordinator, Graduate Officer

Ms. Shannon Larkin, Assistant Director, Academic Programs

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

Prof. Raymond Ashoori, Atomic, Bio-, Condensed Matter, and Plasma Physics
Prof. Anna Frebel, Astrophysics
Prof. Gunther Roland Experimental Nuclear and Particle Physics
Prof. Tracy Slatyer, Theoretical Nuclear and Particle Physics

Professor Scott Hughes 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 Shannon Larkin, Assistant Director, Academic Programs, can be helpful in dealing with sensitive issues.

Every incoming 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 these guidelines, "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."

3. 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 Pre-Thesis Research, Thesis Research and/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 Pre-Thesis Research (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. Under most circumstances, the normal course load for graduate students with a full-time RA or TA who have not yet completed their qualifying exams is two academic subjects.

The current stipend rates for RAs and TAs are established by the Collective Bargaining Agreement between the Graduate Student Union and the Institute. 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 Assistant (RA) Appointments:

Graduate study is a full-time commitment, with a RA/TA/IG role constituting 20 hours per week of that full-time commitment. Graduate students are expected to dedicate additional time to academic progress. To ensure you have time to dedicate to your academic work, “No graduate student RA/TA/IG shall be compelled, coerced, or obligated to work more than an average of twenty (20) hours per week throughout their employment appointment period.” Read detailed policies for student academic and employment accounting.

Teaching Assistant (TA) Appointments:

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.

Very occasionally, 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 internship 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, the 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 through Academic Programs and the Office of the Dean for Graduate Education, 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 as soon as possible.

4. SATISFACTORY PROGRESS

Satisfactory progress involves both academic and research benchmarks. These include passing both the Written and Oral portions of the General Exam on time (see the timetable under Academic Issues), completing the subject requirements in the specialty area, and satisfying the breadth requirement. The Department and/or the Vice Chancellor of MIT 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.

In addition, a student must join the research group of a supervisor who will oversee the student's doctoral thesis research. It is expected that a student will join a group by the end of the first year in the program. Any student who anticipates a possible delay in this schedule should confer with his or her academic advisor; Associate Head Scott Hughes; or Assistant Director, Academic Programs Shannon Larkin before the end of the first spring term.

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 and complete their thesis in the new group. 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 the 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 in the form of 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 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 the Assistant Director, Academic Programs.

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, the Division Head, or the Graduate Committee. Committee members are available 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 the Guidelines.

5. ACADEMIC ISSUES

Degree Programs

The normal degree program in the Department leads to a Ph.D. in Physics. Direct admission to a Master's degree program in Physics is available only in special cases (e.g., US military officers). On occasion, a student admitted for a Ph.D may decide not to follow the Ph.D. program through to completion, or may fail the General Exam. In th ese cases the student may be able to satisfy the requirements for the Masters degree.

Advising and Registration

Each fall and spring term students must meet with their academic advisor to complete their registration. Meetings are not required for summer registration, but each student must still take responsibility for registering on line for an appropriate number of units, either in 8.392 (Pre-Thesis Research) or 8.THG (Thesis).

To make a subject change after registration day, students should use the Institute's electronic add/drop process, available through WebSIS. After a student has electronically requested a change, the advisor must approve it and the student must then submit the approved change. To avoid late charges and the need to petition a change through the Dean for Graduate Education, students should be sure to register 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.

Requirements for the Ph.D.

The specific requirements for the Ph.D. are:

- Joining the group of a research advisor who will supervise the doctoral thesis
- Passing the General Doctoral Examination
- Specialty Requirements: two subjects (three for NUPAT students)
- Breadth Requirements: two subjects
- Written Thesis and Oral Defense

TIMETABLE OF PROGRESS TOWARD A PhD

YEAR	TERM	DEADLINE
1st	Fall*	Written General Exam: required first attempt
	Spring*	Written General Exam: required attempt of all sections not already passed
2nd	Fall	Written General Exam: required attempt of all sections not already passed
	Spring	Written General Exam: final attempt
3rd	Fall	Oral General Exam: deadline for first attempt
	Spring	Oral General Exam: final attempt Students who passed Oral Exam in fall term: Thesis Proposal due; student registers for 8.THG
4th	Fall	For students who passed Oral Exam in spring term: Thesis Proposal Due, and student registers for 8.THG

	Spring	Research
5th		Research
6th		Mean time to Ph.D. is 5.8 years.

* Students who enter in February begin their timetable as if they entered in the following fall term (i.e., first attempt at Written Exam is in the second (fall) term.

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

Choosing First Year Subjects

The Department does not require PhD 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). Not only have these subjects been proven to give students a broad view of basic physics, but each of them (with the exception of 8.322) may be used to satisfy the related part of the Written General Exam. As of fall 2016, 8.309, will be offered and can be used to satisfy the Classical Mechanics portion of the Written Exam.

First-year students concerned with the level of their undergraduate preparation are encouraged to consider taking 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 subject load for those with full time RAs is two academic subjects, or about 24 units. A student with an RA will also register for Pre- Thesis Research (8.391 in the fall; 8.392 in the spring and summer terms), for 12 or more units, depending on the rest of the course load.

Requirements for the Masters Degree

Masters candidates must complete 66 units, 42 of which must be graduate-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.

6. GENERAL DOCTORAL EXAM

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 one written part and one oral part.

Structure and Scheduling of the Examination

The general examination consists of two parts. a Written Examination that consists of four areas – quantum mechanics (QM), statistical mechanics (SM), electricity and magnetism (EM), and classical mechanics (CM), and the Oral Exam.

The Written Exam is given prior to the first week of each term. All entering graduate students are required to sit the exam in their first semester. 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.

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.

The Written Exam

The Written Exam consists of two problems in each of four areas – quantum mechanics, statistical mechanics, electricity and magnetism and classical mechanics. Demonstration of core competence in all areas may be achieved in one of two ways. A student may pass each area either by passing one of the two problems on the Written Exam, or by completing the corresponding graduate-level course (for classical mechanics, 8.309; for quantum mechanics, 8.321; for statistical mechanics, 8.333; for electricity and magnetism, 8.311) with a grade of B+ or higher.

Overall, in each term after the first fall, any student with parts of the exam still to satisfy must take the next opportunity available to satisfy any remaining sections, whether the next opportunity is an exam or classes.The one exception to this rule concerns the EM portion of the exam: a student who takes the Written Exam for the first time *in the first January* and does not pass EM is not required to immediately enroll in 8.311 in the spring term (although doing so is highly recommended). Such a student who declines to take 8.311 in the first spring after failing the EM portion of the exam in January must then take EM again in the second August. However, a student who takes the Written Exam in the first August, fails EM, and then fails EM again in January, must enroll in 8.311 in the first spring.

Following are guidelines for the first three semesters:

- **Incoming students** must take the Written Exam in August of their first year. If they do not pass CM, QM, or SM, they may choose to take the corresponding subjects (8.309, 8.321, or 8.333) in the fall term.
- **First-year students** must take the exam in January if they still have any parts of the exam to complete.
- **Students entering the second year** who have sections not yet satisfied must take each of these sections in the August exam just before the start of the student's second year. If either CM, QM, or SM still remain to be completed at the beginning of the student's second fall term, the student must enroll in each corresponding course that fall.

All students must satisfy all four components of the Written Exam requirement by the end of the January of their second year.

In the event a student has not passed all parts of the Written Exam by the end of the January of their second year, an ad hoc committee consisting of the student's academic and research advisors, the Associate Department Head, the General Exam Coordinator, and the Chair of the Written Exam Committee will review the student's progress and decide how to proceed. This committee *will not* give a special oral exam. In most cases, it will confirm that the student must switch to a Masters degree status. In unusual cases, this committee could instead recommend to the Associate Department Head that the student be allowed to continue in the Ph.D. program until the following August, do prescribed further study, and attempt 8.311 in the Spring or attempt the needed component(s) of the Written Exam in August. This decision would be made by the Associate Department Head.

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 his or her 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.)

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 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 first attempt at the oral exam must be made by the first 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 the Written Exam 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 Procedures

The Written General Exam is graded by physics faculty. A General Exam 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

7. 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	**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 Quantum Field Theories 8.851 Effective Field Theory 8.701 Intro to Nuclear and Particle Physics
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	**Plasma Physics** 8.613J, 8.614J Introduction to Plasma Physics I, II

Experimental Nuclear and Particle Physics 8.701 Intro to Nuclear and Particle Physics 8.711 Nuclear Physics 8.811 Particle Physics	**Quantum Information** 8.371 Quantum Information Science and one of the following: 8.322 Quantum Theory II 8.323 Relativistic Quantum Field Theory I 8.421 Atomic and Optical Physics I 8.422 Atomic and Optical Physics II 8.511 Theory of Solids I 8.512 Theory of Solids II

8. BREADTH SUBJECTS

This applies to students entering in Fall 2023. Students who started before Fall 2023 may follow this requirement or the old requirement, below..

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.

There are two types of breadth courses: primary breadths and secondary breadths. A student may satisfy the graduate breadth requirement by taking either: two primary breadth courses or one primary breadth course and one secondary breadth course. If two primary breadth courses are used to satisfy the requirement those must be from two different areas. A course cannot satisfy both the breadth and specialty requirement, so breadth courses cannot be from the student's own area. A student's area is determined by the Oral Exam they plan to take.

Primary Breadth Courses	**Secondary Breadth Courses**
8.370 - Quantum Computation	8.316 - Data Science in Physics
8.421 – Atomic and Optical Physics I	8.321 - Relativistic Quantum Field Theory I
8.422 – Atomic and Optical Physics II	8.322 - Relativistic Quantum Field Theory II
8.511 - Theory of Solids I	8.323 - Relativistic Quantum Field Theory III
8.512 - Theory of Solids II	8.962 - General Relativity
8.591 – Systems Biology	Graduate Courses cross-listed with physics.
8.592 - Statistical Physics in Biology	
8.613J – Introduction to Plasma Physics I	
8.701 - Introduction to Nuclear and Particle Physics	
8.711 - Nuclear Physics	
8.811 - Particle Physics	
8.821 - String Theory	
8.901 - Astrophysics I	
8.902 - Astrophysics II	
8.942 - Cosmology	

The detailed table by area is here: https://drive.google.com/file/d/1Wjyt2B2D8i6FXwD1TIvLOdokKjf3IuMW/view?usp=share_link

Internships

An internship can be used as a secondary breadth. Internships need to be arranged ~6 months in advance in coordination with the department and the research advisor. Internships may be scheduled during either summer or academic terms and the student will need to register for the correct units.

Harvard Courses

The Harvard equivalent of the above courses can be substituted. QFT is the most common case of this. Please confirm with the department that the Harvard course has the correct curriculum to substitute for the MIT course.

Substitutions

The current breadth requirement was crafted with care. If you believe a course should be part of the breadth requirement, the instructor will need to go through the procedure for the course to be cross-listed with physics.

Subject #	**Subject name**	**Atomic**	**Bio**	**CMX**	**CMT**	**Plasma**	**Astro**	**Nuclear-ParticleX**	**Nuclear-ParticleT**	**QI**
8.323		1	1	1	X	1	1	1	X	2
8.324/8.325 or Harvard equivalent	Relativistic QFT	2	2	2	X	2	2	2	X	2
8.370 **8.371/8.372**	Quantum Computation	2 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	X X
8.421/8.422	AMO	X	2	2	2	2	1	1	1	X*
8.511 **8.512/8.513/8.514**	Theory of Solids	2 2	2 2	X X	X X	2 2	1 2	1 2	1 2	1 2

8.591	Quantitative Biology	1	X	1	1	1	1	1	1	1
8.592	Stat Phys in Biology	1	X	1	1	1	1	1	1	1
8.613J **8.614**	Plasma Physics	1 2	1 2	1 2	1 2	X X	1 2	1 2	1 2	1 2
8.701/8.711/8.11	Nuclear & Particle Physics	1	1	1	1	1	1	X	2	1
8.712		2	2	2	2	2	2	X	2	2
8.821	String Theory	1	1	1	1	1	1	1	X	1
8.901 **8.902**	Astrophysics	1 2	1 2	1 2	1 2	1 2	X X	1 2	1 2	1 2
8.942	Cosmology	1	1	1	1	1	X	1	1	1
8.962	General Relativity	2	2	2	2	2	X*	2	X	2
8.316	Data Science	2	2	2	2	2	2	2	2	2

Breadth Subject Requirement prior to Fall 2023

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.

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.

Physics graduate students may wish to arrange an internship in an industrial or national laboratory at some time during their graduate career. Internships 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 internship is in the student's research field; internships may not be used to satisfy the specialty requirement. The Department recognizes that the demands of MIT research may make it difficult for students to consider this opportunity, but it also believes that the benefits can outweigh the possible conflicts. Students seeking internships should discuss the issue with their research supervisor and schedule the internship to minimize disruption of research.

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.

Subject #	BREADTH REQUIREMENTS Subject Title	Atomic	Biological	Condensed Matter	Plasma	Astronomy	Nuclear Exp.	Particle Exp.	Nuclear Theory	Particle Theory	QI
8.251	String Theory for Undergraduates								2	X	
8.323	Relativistic Quantum Field Theory I						2	2	X	X	
8.370	Quantum Computation										X
8.421 or 8.422	Atomic and Optical Physics I & II (only one may be used as a breadth requirement)	X		2							X
8.511	Theory of Solids I	2		X							
8.591	Quantitative Biology		X								
8.592	Statistical Physics in Biology		X								
8.613J	Introduction to Plasma Physics				X						
8.701	Introduction to Nuclear & Particle Physics						X	X	X	X	
8.711	Introduction to Nuclear Physics						X	X	X	2	
8.811	Particle Physics						X	X	2	X	
8.901 or 8.902	Astrophysics I & II (only one may be used as a breadth requirement)					X					
8.942	Cosmology					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.

9. 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 and Fellows should look for a research group during the first year, and have a supervisor secured by March 1. Prior to thesis research, students get academic credit for their research by registering for Pre-Thesis Research (8.391 or 8.392), which is generally taken every semester that research is conducted until thesis research formally commences. Starting with the semester **after a student passes the oral exam**, registration changes from Pre-Thesis

Research to Thesis (8.THG). While many students stay with their first research group, some register for Pre-Thesis Research in two or more research areas before finding a research topic suitable for a thesis. Pre-Thesis Research 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 Thesis section).

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 submitted to Academic Programs. No funding will be administered by the Department of Physics until this form is submitted.

Research Internships

To broaden the graduate experience, the Graduate Committee encourages physics graduate students to arrange an internship in an industrial or national laboratory at some time during their graduate career. Internships 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 internship is in the student's research field; internships may not be used to satisfy the specialty requirement. The Department recognizes that the demands of MIT research may make it difficult for students to consider this opportunity, but it also believes that the benefits can outweigh the possible conflicts. Students seeking internships should discuss the issue with their research supervisor and schedule the internship to minimize disruption of research. Interested students should contact the Assistant Director, Academic Programs and provide her with a curriculum vitae.

10. 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 Form 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 with the term the Proposal Form is submitted. 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. Thus, in general, a thesis committee has three members (supervisor, selected reader, assigned reader). If there is also a co-supervisor (see above), the thesis committee will consist of four people. When the departmentally-assigned reader has been selected, it is the student's responsibility to convene an initial thesis committee meeting no later than four weeks before the last day of classes.

At that meeting the student makes 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. After that meeting, and based on the discussion, the student will develop a written proposal consisting of a one- or two-page description of the body of work that is to comprise the thesis. This proposal is submitted to Academic Programs, approximately two weeks before the end of the term (a specific date will be determined each semester).

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 for Graduate Education.

Students who have not registered for thesis research or submitted a thesis proposal by the first term of their fourth year must provide the Graduate Student Coordinator a written explanation of the circumstances leading to the delay. This procedure must be followed in any subsequent term the student is still 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 communication.

After 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 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.

MIT Degree List

A student may be recommended for his or her 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 in residence 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 date posted by the Institute for approval of degrees by academic departments. This oral presentation is based on an acceptable written 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. The student is responsible for scheduling the thesis defense and arranging for the room in which it is to be held. The student should then notify the Graduate Assistant in Academic Programs of the day, time, and place of the defense; the Graduate Assistant will send notice to the Physics community, including to all faculty members. The defense is public and all members of the MIT community may

attend. 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.

Details of the required thesis, abstract, and title page formats are provided in *Specifications for Thesis Preparation* http://libraries.mit.edu/archives/thesis-specs/. Care should be taken to follow the presented format. The student should determine whether or not the supervisor, fellowship sponsor, etc. require additional copies. 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 Deepto Chakrabarty, Associate Department Head. This signature is obtained by the Academic Programs Office after the student submits the thesis.

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.

11. CAREER COUNSELING

Although the MIT Physics graduate program is primarily focused on training students for careers in physics research, 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 and professional plans. 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 Career Advising and Professional Development (capd.mit.edu) has a variety of resources for graduate students.