

Physics graduate group policies and procedures

1.1 The mission and objectives of the physics graduate program

The mission of the Physics graduate program at UC Merced is to train our next generation of scientific leaders. Our graduates will be well prepared to conduct and communicate independent research at the knowledge frontier, advancing fundamental understanding of the world around us and using physics to solve important problems in society.

Program Learning outcomes

Graduates of the Physics PhD program will:

- 1) **Possess a broad foundation** in the fundamentals of physics and a deep understanding of their chosen subfield, which will permit them to understand and critically evaluate current research.
- 2) **Have the experimental, theoretical, and/or computational skills** necessary to conduct and lead independent responsible research and contribute to knowledge in their chosen subfield.
- 3) **Identify new research opportunities**, which may cross traditional discipline boundaries, plan effective strategies for pursuing these opportunities and conduct research that makes a new contribution to knowledge in their chosen subfield of physics and solve important problems in society.
- 4) **Communicate** both fundamental concepts of physics and details of their own research effectively, in written and oral form, including in a classroom setting to expert and non-expert audiences. This includes the publication of original research results in peer reviewed scientific journals.

Graduates of the Physics Masters program will:

- 1) **Possess a broad foundation** in the fundamentals of physics and a deep understanding of their chosen subfield, which will permit them to understand and critically evaluate current research.
- 2) **Be proficient in professional skills** necessary to lead a productive career in physics or a related career.
- 3) **Communicate** both fundamental concepts of physics and details of their own research effectively, in written and oral form, to expert and non-expert audiences.

2.1 Admissions Procedures and Requirements

All persons seeking admission to graduate standing must make formal application for admission through the Graduate Division's on-line application system. Applications are reviewed by the Admissions Committee, which makes recommendations on admission to Graduate Studies; the Dean of Graduate Studies makes final decisions on admission. The deadline for receipt of applications is December 15 for enrollment in the Fall semester. Applicants are encouraged to contact individual faculty members about their areas of research and teaching interests prior to applying.

Materials to be submitted:

- The complete official application form;
- The application fee;
- All official university/college/junior college transcripts;
- An official Graduate Record Exam (GRE) score report. Only the general tests are required, but the subject test in physics is also recommended;
- Three letters of recommendation from instructors or supervisors who can comment on the applicant's scholarly ability and promise as a researcher;
- Official score reports from the Test of English as a Foreign Language (TOEFL) if the applicant's native language or language of instruction is other than English.

The minimum requirement for graduate admission to UCM is a bachelor's degree, or any other degree or certificate which the Graduate Council accepts as equivalent, and a grade point average no lower than 3.0 on a 4.0 scale. This minimum will be waived only under circumstances where the applicant has demonstrated strong academic skills subsequent to their undergraduate studies. Performance on the GRE, accomplishments in undergraduate research, and letters of recommendation will also be evaluated as important determinants of an applicant's potential for success in graduate education.

Foreign students from non-English speaking countries are required to attain a minimum score on the TOEFL exam as required by UC Merced policy for admission to graduate programs. Students from non-English speaking countries will normally be interviewed by telephone by a member of the Admissions Committee in order to evaluate English proficiency.

2.2 General Requirements for Advanced Degrees

2.2.1 Residency

In accordance with SR 682 and 686, the minimum residency requirement for any advanced degree is two semesters. The minimum residency requirement for the Ph.D. degree is four semesters. Before advancement to candidacy Ph.D. students must be registered in regular University courses as a full-time student for at least two semesters. M.S. students must be registered as a full-time student for at least one semester before advancement to candidacy. M.S. students must be in residency for at least one semester after advancement to candidacy before conferral of the degree. For the purposes of determining residency, only the Fall and Spring semester will be counted; however, the summer semester may be counted in evaluating students on academic probation. Residency is established by satisfactory completion of at least 12 units of graduate coursework (including research) per term. Ordinarily, a graduate student shall not receive credit for more than 12 units of graduate courses in any semester. The physics graduate group only accepts full time students. Exceptions will only be granted for students in the non-

thesis Masters Degree program (Section V.B.) with the permission of the graduate group Chair, in consultation with the Executive Committee.

2.2.2. Scholarship

Graduate students must maintain at least a 3.0 grade-point average to be considered in good academic standing or to be awarded an academic graduate degree. A student whose cumulative graduate grade-point average falls below 3.0, or who is judged not to be making satisfactory progress toward the degree by his or her graduate advisor or faculty committee, will be placed on academic probation. The student will then be allowed a maximum of two semesters to make up the deficiencies and be returned to good academic standing. Otherwise, the student will be dismissed from the graduate program.

Specific scholarship requirements are as follows:

- 1 Only courses in the 100 and 200 series in which the student receives grades of “B” or above, or “S” may be counted in satisfaction of the requirements for advanced degrees. A course in which a student receives a “C” or “D” or lower cannot be used to satisfy the unit requirement for the degree but will count in determining the grade point average.
- 2 Candidates must maintain an average of at least three grade points per unit in all upper division and graduate courses elected during their residence as graduate students at the University of California. Students must maintain an average grade point of 3.0 for advancement to candidacy and conferral of the degree.
- 3 Courses graded “S/U” will not be counted in determining grade point averages.
- 4 Students must make satisfactory progress on their programs of study as determined by their graduate research advisor.

2.2.3. Faculty Committees For Advanced Degrees

The graduate advisor, normally in consultation with the student and other program faculty, recommends appointment of faculty members to advise on and supervise the student’s dissertation research as part of their examination committees. Final approval of the membership on these committees rests with the Dean of Graduate Studies.

Advanced degree committees in the Physics group shall consist of at least three members. One must be the student’s graduate research advisor, one other must be a UC Merced faculty member in the group who is not an advisor of the student (who is also appointed as Chair), and one other may be from outside the group. This outside member may be a regular or adjunct faculty member from any UC campus or an individual from outside the University of California who has special expertise and qualifications. In this case, the graduate advisor should submit a brief statement indicating the appointee’s affiliation and title and how the prospective appointee has special expertise or qualifications that are not represented on the campus. In addition to the justification letter from the graduate advisor, a curriculum vitae and a letter from the proposed appointee indicating a willingness to serve must be submitted to the Dean of Graduate Studies for review and approval.

A student may opt to choose a graduate advisor from outside of the physics group faculty (for example in applied math or chemistry). In such a case a nominal additional advisor from the physics group will be assigned in addition to the regular committee membership.

All members of the committee must be in attendance for Ph.D. qualifying and final examinations or Master's comprehensive oral examination (Plan II). All members of the committee must approve the Master's thesis (Plan I) or Ph.D. dissertation. If a committee member's absence from campus for an extended period of time makes scheduling of examinations unreasonably difficult, the student may request that the committee be reconstituted. Reconstitution of the committee may also be justified by a substantial change in the student's thesis topic or may be required by the departure of a committee member from the university. When membership changes must be made, the graduate advisor in consultation with the student should recommend a new committee member, giving the reason for the change. The reason must be acceptable to the Dean of Graduate Studies.

2.3 Programs Of Study

2.3.1 Masters Degree

Students may be admitted to the graduate program in Physics to work towards a Masters Degree (M.S.). Additionally, a Ph.D. student who has been in residence for at least two semesters, is in good academic standing, and has completed at least four of the core courses may petition the Admissions Committee to pursue a terminal M.S. degree. The recipient of a M.S. degree is understood to possess knowledge of a broad field of learning that extends well beyond that attained at the undergraduate level, but is not necessarily expected to have made a significant original contribution to knowledge in that field.

Students are normally admitted to the graduate program in Physics to work toward the Ph.D. degree. The Physics group has established the following requirements for the M.S. degree. Each M.S. student has a committee with at least three members.

- Complete at least two semesters of full-time academic residence (12 units minimum) at UC Merced;
- Pass the preliminary examination
- Complete at least 24 semester hours of upper-division and graduate course work with a cumulative grade-point average of at least 3.0. At least 16 semester hours must be from regular, letter-graded lecture or discussion courses, while the remaining 8 hours may be research or similar courses;
- Pass a comprehensive oral examination administered by the faculty committee. This examination will test the student's understanding of the main concepts in the field at the graduate level.

In addition, the M.S. program requires attendance at physics seminars and M.S. students are recommended to take research units (PHYS 295), attend journal clubs and group meetings to help fulfill their unit requirements. Many of the mandatory Physics courses are "letter grade only". Graduate students should be aware that grades obtained of B- may land them in a state of unsatisfactory degree progress, as they must maintain an overall GPA of 3.0, and their semester GPA must not remain below 3.0 for two consecutive semesters. Graduate students should also be advised that S/U grades do not count towards GPA calculation by the registrar.

2.3.2 Doctor of Philosophy Degree

The Doctor of Philosophy degree is not granted by the University of California merely for the fulfillment of technical requirements, such as residence or the completion of fundamental courses. The recipient of a Ph.D. degree is understood to possess thorough knowledge of a broad field of learning and to have given evidence of distinguished accomplishment in that field; the degree is a warrant of critical ability and powers of imaginative synthesis. The degree also signifies that the recipient has presented a doctoral dissertation containing an original contribution to knowledge in his or her chosen field of study.

The Physics group has established the following requirements for the Ph.D. degree:

- Complete at least four semesters of full-time academic residence (12 units minimum) at UC Merced;
- Complete the required courses with a letter grade of at least "B" in each course ("S" in seminar courses graded S/U);
- Serve as a teaching assistant for at least one semester;
- Pass a preliminary examination;
- Pass the oral Ph.D. qualifying examination;
- Present and successfully defend a doctoral dissertation containing an original contribution to knowledge in the field.

2.3.3. Selection of A Graduate Research Advisor

The heart of the Physics Ph.D. program is the completion of a piece of original scientific research leading to the preparation and defense of a Ph.D. thesis. To this end, each student should discuss research interests and possible Ph.D. projects with faculty in the group as early as possible, and select a graduate research advisor early during the first year of study. Selection of a graduate research advisor must be approved by the graduate group and must occur before the student's faculty committee can be constituted. The student and the graduate research advisor together will develop a research topic, and research will normally occupy a majority of the student's time after the first year of residence. Interdisciplinary projects are encouraged, as are research collaborations with faculty or senior scientists outside UC Merced. Students will be assigned an initial advisor when they first enroll, unless the student has already chosen an advisor. This initial advisor will guide the student in their final choice of advisor.

2.3.4. Coursework Requirements

All Ph.D. students in the Physics group are required to take:

A. Core Course Requirements:

To be completed within the first four semesters.

- 1) PHYS 237 - Quantum Mechanics I
- 2) PHYS 210 - Electrodynamics
- 3) PHYS 212 - Statistical Mechanics
- 4) PHYS 205 - Classical Mechanics

B. Electives:

To be completed at any time during the PhD

- 1) An elective from the physics courses
- 2) A second elective which may be chosen from any graduate level courses in the school of Natural Sciences of Engineering

Physics electives include advanced physics courses such as Quantum Mechanics II, Condensed Matter Physics, Biophysics and any other PHYS 2XX courses available. They can also include graduate courses from the applied math, BEST or chemistry groups as long as they are 3 units and taken as a graded class. Any elective must be at least 3 units and we require at least one elective be a course outside the student's primary research area, which can be selected by discussion with the student's thesis advisor or the graduate group advisor for Physics.

C. In addition, students must take 1 unit of BEST/QSB294 Responsible Conduct of Research, 4 semesters of Physics seminar.

Other courses may be added to these lists as fulfilling the requirements at any time, as designated by the physics faculty. If a student would like to attain a waiver for any of the courses above, the rules are:

1. No waiver will be granted unless the student has passed the preliminary exam.
2. For waivers regarding elective courses, a student can only ask for a waiver on one elective course. All core courses can be waived if competency is demonstrated.
3. For a waiver on any of the courses, the student will need to attain the waiver from the faculty member who taught the course most recently. The faculty member granting the waiver will only do so if the student can successfully complete an exam in the course. This exam can be given at any time at the faculty and student's convenience, any time of the year. The final decision to grant the waiver will be taken by the Graduate Division.

Course electives must be regular graduate courses (not research or independent study). Courses offered by other graduate programs may be taken as electives but require approval of the major professor. Requirements for formal course work beyond the minimum are flexible and are determined by the individual student's background and research topic in consultation with the major professor.

All Physics graduate students must successfully complete their core course requirements with a grade of S or B or better. A student may petition the graduate chair for a single B- grade to be accepted. Graduate students should be aware that grades obtained of B- may land them in a state of unsatisfactory degree progress, as they must maintain an overall GPA of 3.0, and their semester GPA must not remain below 3.0 for two consecutive semesters. Graduate students should also be advised that S/U grades do not count towards GPA calculation by the registrar.

The preliminary exam

All students in the group are required to pass a written preliminary examination that tests undergraduate-level understanding of the fundamental concepts in the field. This exam is administered twice each year, at the beginning of Fall and Spring semesters. The exam consists of three papers – Classical Mechanics, Quantum Mechanics and Electromagnetism. Students may elect to take the exam for the first time at the start of either the first or second semester in residence. The exam may be taken once each time it is offered, but must be passed no later than the start of the fourth semester. Students need to pass each paper individually but not necessarily

at the same time. A student may, however, be deemed to have passed the exam outright if, at any one attempt, their overall performance in all three papers is good enough. Students who have not passed the exam by the start of their fourth semester may be subject to dismissal.

2.3.5. Research Proposal

Before the qualifying exam, the student will provide to the degree committee a written document that describes his or her research topic, summarizes progress to date, and outlines what he or she proposes to do, why it is relevant, and what will be learned. The format of the research proposal will be determined by the student in consultation with their advisor and committee; however the proposal must follow the format of a research proposal to a major funding agency in the student's area of research. The committee will review this document with the student and determine if the student has outlined a project that is appropriate for a Ph.D. If not, the student is given a month to rewrite the research plan. Once the research plan is approved the student may take the oral portion of the Qualifying Examination.

2.4. Ph.D. Qualifying Examination

All students in the Physics Ph.D. program are required to pass an oral qualifying examination before advancement to candidacy for the Ph.D. degree. Students are expected to take and pass the qualifying examination before the end of their third year of graduate study unless they successfully petition the Graduate Group Chair to take it at a specific later date. The qualifying examination may not be scheduled until the preliminary examination has been passed and the three core courses have been completed. The intent of this examination is to ascertain the breadth of a student's comprehension of fundamental facts and principles that apply in his or her major field of study. It will also determine the student's ability to think critically about the theoretical and practical aspects of the field. Accordingly, the examination should be focused on the student's field of research but may and should venture into other areas of scholarship that underlie or impinge on the thesis topic. **The scope of this examination should be communicated to student by the committee chair at least two months in advance of the exam date.**

The examination committee is the same as the student's faculty committee. The graduate advisor is a voting member of the committee, but will normally not participate in the examination except to provide technical clarifications as requested by the other members of the committee.

The date of the examination is arranged between the student and the committee chairperson. At least two weeks prior to the examination date, the student will provide to the committee a research proposal (typically about ten pages) that describes his or her research topic, summarizes progress to date, and outlines what he or she proposes to do, why it is relevant, and what will be learned. The committee conducts the examination, and immediately thereafter submits the results of the examination to Graduate Division.

The committee members should include in their deliberations such factors as relevant portions of the previous academic record, performance on the examination, and an overall evaluation of the student's performance and potential for scholarly research as indicated during the examination. A unanimous decision is required for a "Pass". If not all members of the committee vote to pass, they must write a report explaining their decision and must inform the student of the reasons for the decision. A student who has not passed the examination may repeat the qualifying examination after a preparation time of at least three months. The examination must be held by the same committee except that members may be replaced, with the approval of the graduate

advisor, for cause such as extended absence from the campus. Failure to pass the examination on the second attempt means that the student is subject to disqualification from further study for the doctoral degree.

2.5. Advancement To Candidacy

Upon successful completion of the examination, the student is given an application for advancement to candidacy by the examining committee chair. When it is filled out and signed by the graduate advisor and major professor, the student pays a candidacy fee and submits the form to Graduate Studies. Upon advancement to candidacy for the degree, the faculty committee is then charged to guide the student in research and in the preparation of the dissertation.

2.6. Publication Expectations

The final confirmation of the quality of a PhD dissertation is the ability to publish the research results in a peer-reviewed journal. The research field may influence the timing and work required to publish research results, making it difficult to define the number of publications required for each dissertation. For this reason, whether a student has made sufficient progress for the PhD will ultimately be determined by the student's advisor and thesis committee. The process of writing journal articles will be undertaken with the assistance and guidance of the student's research adviser. Published work should be presented to the graduate committee at the time of the student's thesis defense.

2.7 Dissertation And Final Examination

The Ph.D. dissertation must be creative and independent work that can stand the test of peer review. The expectation is that the material will serve as the basis for publication(s) in a peer reviewed journal. The work must be the student's, and it must be original and defensible. The student is encouraged to discuss with members of the faculty committee both the substance and the preparation of the dissertation well in advance of the planned defense date. Detailed instructions on the form of the dissertation and abstract may be obtained from the Graduate Studies office.

The student must provide a copy of the dissertation to each member of the faculty committee and allow each committee member at least four weeks to read and comment on it. If one or more committee members believe that there are significant errors or shortcomings in the dissertation or that the scope or nature of the work is not adequate, the student must address these shortcomings before scheduling a defense. Once the committee members are in agreement that the dissertation is ready to be defended (although minor errors or matters of controversy may still exist), the final examination date may be scheduled by the student in consultation with the committee. The date must be reported to the Dean of Graduate Studies, and one copy of the dissertation filed, no later than three weeks before the proposed date of the final examination.

The Ph.D. final examination consists of an open seminar on the dissertation work followed by a closed examination by the faculty committee. During the examination, the student is expected to explain the significance of the dissertation research, justify the methods employed, and defend the conclusions reached. At the conclusion of the examination, the committee shall vote on whether both the written dissertation and the student's performance on the exam are of satisfactory quality to earn a University of California Ph.D. degree. A majority is required for a pass. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the dissertation. In this case, the committee will select one member, normally the major professor,

who will be responsible for approving the final version of the dissertation that is submitted to Graduate Studies.

Time to degree and annual evaluation

The Physics group places no strict limits on the length of time a graduate student may remain in residence. However, it is normally expected that successful completion of the Ph.D. will require no more than six years. In order to ensure satisfactory progress toward the degree, each student must meet with his or her faculty committee for an annual review of progress at a mutually agreeable time prior to the first day of each Fall semester. At least three members of the committee, including the major professor, must be present. The committee will review the student's progress toward the degree during the past year and develop a time table, mutually agreeable among student, major professor, and faculty committee, for completion of the remaining requirements. The annual report of the committee will become part of the student's record. Should the committee conclude that the student is not making satisfactory progress toward the degree, the student may be placed on academic probation.

2.9 Sample PhD Program

Table 7 - A sample timeline for the first 4 semesters of courses for a PhD student is shown below. A full description of the courses can be found in Section 5.

Fall 2013	Spring 2014	Fall 2014	Spring 2015
PHYS210 C (4)	PHYS237 C (4)	PHYS 238 (4)	PHYS248 (4)
PHYS205 C (4)	PHYS 212 C (4)		
PHYS 2XX (2)(writing)	PHYS 295 (3)	PHYS 295 (7)	PHYS 295 (7)
PHYS293 (1)	PHYS293 (1)	PHYS293 (1)	PHYS293 (1)

C = core class, brackets indicate units.

Table 8 - The physics group has developed the following sample guidelines for students to make good progress in the PhD program.

Year/semester	Activities
Year 1 (Semesters 1,2)	Learn about all research groups Take classes Pass preliminary exam (if applicable) Pick PhD advisor by end of second semester
Summer 1	Begin full time research with PhD advisor
Year 2 (Semesters 3,4)	Continue full time research with PhD advisor Take one class per semester if necessary Assemble faculty committee (beginning of third semester) Prepare for qualifying exam Schedule qualifying exam (during fourth semester) – defend PhD research proposal Apply for candidacy after passing qualifying exam (end of fourth semester)
Years 3	Conduct research Prepare manuscripts for publication Present work at a scientific conference; network for career

Years 4	Conduct research Continue publishing manuscripts Present work at a scientific conference; network for career.
Year 5 (Semesters 9,10)	Conduct research Present work at a scientific conference; network for career Declare candidacy for graduation (ninth semester) Defend and publish dissertation (tenth semester)

TEACHING AND RESEARCH ASSISTANTSHIPS AND STIPENDS

1. Newly admitted students will normally be supported as graduate TAs during their first two semesters in residence. After that, students will be supported as either TAs or GSRs depending on availability of TAs and the research advisor's funding situation.
2. New students who cannot be appointed as TAs because of limited English proficiency or lack of available TA positions may be appointed as GSRs for their first one or two semesters by mutual agreement of the student and the research advisor. The conditions of appointment will be the same as in #3 and #4 below. Normally all students will be required to TA for at least one semester as long as a suitable TA position is available. TA experience at other institutions could satisfy this requirement.
3. Graduate students serving as GSRs during the academic year will be appointed at 49.9% at the step for which the monthly stipend is most nearly equal to that for a first year TA in the Natural Sciences. There will be no additional or reduced pay during break periods.
4. Graduate students serving as GSRs during the summer will be appointed at the step determined in #3 above. The appointment will be 60% for students who have not yet been advanced to candidacy for the Ph.D. degree, and 70% for those who have been advanced to candidacy. Students are expected to spend the remainder of their time pursuing independent study toward the degree. GSRs do not accrue paid vacation time.
5. These policies should be revisited and revised as necessary on an annual basis.
6. Exceptions to these policies may be made at the recommendation of the student's research advisor, the graduate group chair, and the graduate dean.